THURSDAY, APRIL 16, 1914.

"THE GOLDEN BOUGH" COMPLETED.

The Golden Bough. Third Edition. Part vii., "Balder the Beautiful." By Prof. J. G. Frazer. Vol. i. Pp. xx+346. Vol. ii. Pp. xi+389. (London: Macmillan and Co., Ltd., 1913.) Price 20*s.* net.

THE concluding instalment of Prof. Frazer's famous book may be regarded as demonstrating in a vivid manner and at an appropriate juncture the qualities both of itself and of its author. As has been the case with the other editions, this, which, it seems, is final and definitive, contains more than one change of view. It is characteristic of the author's mind that it is receptive of fresh ideas, and grows, instead of hardening into dogmatic attitudes. Prof. Frazer now, for instance, regards the Aryan god, Zeus-Jupiter, as being primarily a god of the sky, as the orthodox view has it, and only secondarily a personification of the oak. The interesting fact, amply proved by statistics, that the oak is more frequently struck by lightning than any other tree is the chief mediating influence between two sets of data. In a similar connection the revised account of the lore of the mistletoe shows cause for supposing that the parasite was believed to be the embodied result of the lightning-flash, "a sort of smouldering thunderbolt," containing within itself the seed of celestial fire.

But it is with a point of extreme importance for history and modern sociology that the most significant change of view is concerned. Prof. Frazer had accepted the explanation of the fire-festivals of Europe, which W. Mannhardt had suggested—namely, that they were in original intention charms to expedite the course and ensure the life-giving operations of the sun. But Dr. Westermarck's researches among the Moors have convinced the author that the fire-festivals are in intention purificatory. This is no mere academic or curious conclusion, as by necessity much of the substance of "The Golden Bough" must be. For "the grand evil which the festivals aimed at combating was witchcraft, and . . . they were conceived to attain their end by actually burning the witches, whether visible or invisible, in the flames." "The wide prevalence and the immense popularity of the fire-festivals provides us with a measure for estimating the extent of the hold which the belief in witchcraft had on the European mind before the rise of Christianity or rather of rationalism; for Christianity, both Catholic and Protestant, accepted the old belief, and enforced it in the old way by the faggot and the stake. It was not until human reason at last awoke after the long slumber of the Middle Ages that this dreadful obsession gradually passed away like a dark cloud from the intellectual horizon of Europe." Here we have the defect of the author's quality, though we gratefully note how well the new theory fits in with modern history, and brings, as few other episodes do, "The Golden Bough" into touch with living humanity. For the fact is that witch-burning and heretic-burning (they are essentially the same thing, as Westermarck has shown) did not become a form of social emotionalism until after the Middle Ages. Nor is the belief in witchcraft dead yet, anywhere in Europe; while its more cultured form, resentment against social abnormality, is one of the strongest forces in modern life.

It is a pleasure to see that Prof. Frazer, as he lays down his pen, promises us yet other works. No man in history has done more for the reasonable soul of the human race and its salvation by sense. Perhaps he may develop "Psyche's Task" into a treatise which shall give us the sociological meaning of religion. In that treatise the study of the modern crowd should be an essential foundation. A. E. CRAWLEY.

ASSAY OF PRECIOUS METALS.

The Sampling and Assay of the Precious Metals: comprising Gold, Silver, Platinum, and the Platinum Group Metals in Ores, Bullion, and Products. By E. A. Smith. Pp. xv+460. (London: C. Griffin and Co., Ltd., 1913.) Price 15*s.* net.

THE advances in the assay of the precious metals of late years have been directed mainly towards improvement in detail, and have not resulted in any great change in method or in the discovery of new principles. Nevertheless, the minor changes have been numerous, great numbers of useful observations have been made, and it was high time that a new and complete account should be prepared, setting forth the present varied practice, with the considerations on which it is based. The author of this volume is well equipped for such a task, and has produced a valuable treatise which may be taken as authoritative.

Besides gold and silver, Mr. Smith has included the assay of platinum, a course which will be convenient to assayers, on account both of the importance now attached to the ores of platinum and of the increasing use of the metal in jewelry. Moreover, platinum is often associated with gold, and the methods of assaying gold and platinum are so closely allied that they cannot be separately treated. Special attention is devoted to sampling, a subject which is of great interest to

assayers, although sometimes neglected by them. Sampling operations being common ground, and by no means peculiar to the treatment of the ores or alloys of any one particular metal, all reference to them is frequently omitted, both in works on metallurgy and in text-books on assaying. There is also a chapter on the laboratory work in a cyanide mill, and a short but adequate account of ore and bullion valuation and sale.

The book compares favourably with its forerunners, both in respect of completeness and accuracy of statement, and the patient care displayed by Mr. Smith in collecting and arranging all the available data might well be envied by his colleagues. There are few changes which can be suggested as desirable in the next edition. It would perhaps be of interest to add to the historical section something as to the evolution of the assay furnaces, balances, and implements generally, say, from the fifteenth century onwards. Another more important addition would be some further discussion on the effects of borax when mixed with a crucible charge. According to many assayers, this influence is always malign, giving low results. Mr. Smith is not precise in his directions as to the proportion of borax to be reserved for a cover to the charge in various cases.

There is also more to be said as to cupel absorption and the use of proofs or checks. Bullion assayers have long recognised that the determination of the absorption of gold and silver by a particular brand or batch of cupels is not enough, and that the variations in the temperature, amount of draught, etc., appreciably affect the loss. Accordingly, they use check assays for every determination. Ore assayers are often too easily satisfied on this head, or in the alternative subject themselves unnecessarily to the inconvenient course of fusing the cupels. If cupel loss were determined by the use of checks for each cupellation or batch of assays, the extra work would, in the opinion of the reviewer, be more than repaid by the increase of accuracy. In any case, the matter should be faced and fully discussed. Lastly, exception may be taken to the statement on p. 201 that it is necessary to remove the cupels immediately after the button has brightened (what exactly does Mr. Smith mean by "brightened"?). Experience generally, and especially the work of Mr. Wilkes (*J. Chem. Met. and Min. Soc.*, 1905, vol. v., p. 237) is not in favour of this contention.

There is, however, little to criticise in this handsome volume. It may safely be placed in the hands of students, and will be of the greatest value to assayers as a book of reference.

T. K. R.

SEISMOLOGICAL PHYSICS.

Modern Seismology. By G. W. Walker, F.R.S. Pp. xii + 88 + 10 plates. (London: Longmans, Green and Co., 1913.) Price 5*s.* net.

THE first thing to strike one, on glancing through this book, is the absence of an index; the second is the absence of footnote references; and the third is an introduction which, purporting to be a history of the progress of modern seismology, contains about as many errors, of misstatement and omission, as can be crowded into five pages of print. But, once the book proper is begun, these unfavourable impressions disappear, and we find an excellent introduction to the study of that modern seismology which is very remote from earthquakes.

The author's qualification to deal with the subject is said to be his experience in having set up at Eskdale Muir, and for a short time taken charge of, a set of modern seismographs of various types, and the book exhibits at once the drawbacks and the advantages of this limited justification. On one hand, the author's acquaintance with the literature of the subject is evidently limited; for instance, he makes several references to Lord Rayleigh's investigation of surface waves in solids, but ignores Prof. Lamb's later and more apposite work, and in more purely seismological work the reader might well leave the book with the entirely erroneous impression that only three names—Wiechert, Zöppritz, and Galitzin—count as really important, and that their importance is in the order of mention. On the other hand, the recentness and brevity of the author's acquaintance with the subject leaves him in close touch with the difficulties and doubts which beset the beginner, and, being a practised observer in other branches of physics, and writing from a first-hand and current experience, he has produced a lucid and sufficient introduction to the subject.

Beginning with the general dynamical theory and principles of construction of modern seismographs, which is a clearly put, concise, but withal sufficient, account of the subject, he goes on to deal with the character of wave motion recorded by them and the interpretation of seismograms, traversing practically the whole of the ground covered by what is known as the modern seismology, and forming an excellent introduction to that branch of the science. The book deserves, and will doubtless run to, a second edition, when the author will be able to revise the references to earlier work on earthquakes proper, which are almost uniformly erroneous in the present issue. In spite of this it may confidently be recommended, not merely to those who approach the

subject for the first time, but to the attention of practised workers, who will find both interest and advantage from being brought into contact with those elemental principles and difficulties, which are apt to be lost sight of as they advance along their special lines of research.

PURE MATHEMATICS.

(1) *Plane Geometry.* By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix+213+xxxi. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 3*s.* 6*d.* net.

(2) *Higher Algebra.* By Dr. W. P. Milne. Pp. xii+586. (London: Edward Arnold, 1913.) Price 7*s.* 6*d.* net.

(3) *The Twisted Cubic: with Some Account of the Metrical Properties of the Cubical Hyperbola.* By P. W. Wood. Pp. x+78. (Cambridge: University Press, 1913.) Price 2*s.* 6*d.* net.

(4) *Graphical Methods.* By Prof. Carl Runge. Pp. viii+148. (London: Oxford University Press; New York: Columbia University Press, 1912.) Price 6*s.* 6*d.* net.

(5) *Einführung in die Mathematik für Biologen und Chemiker.* By Prof. L. Michaelis. Pp. vii +253. (Berlin: Julius Springer, 1912.) Price 7.80 marks.

(6) *Théorie des Nombres.* By E. Cahen. Tome Premier. Le Premier Degré. Pp. xii+408. (Paris: A. Hermann et Fils, 1914.)

(1) THIS text-book, written by two American professors, is arranged on lines similar to those of modern English text-books. Fewer theorems, more experimental geometry, and numerous practical applications are its chief characteristics. In placing properties of areas after those of circles and similar figures, the authors have adopted a change of order, which we believe will eventually become general. The idea of similarity is so fundamental and at the same time presents comparatively so little difficulty, that it is in our view regrettable that in many examination syllabuses, and consequently in most school courses, it should be postponed to a late period. In fact, it is probably true to say that many boys leave school without any knowledge of what is one of the most valuable, practical, and important branches of geometry.

(2) There are in this volume distinct merits and a certain originality of treatment such as will appeal to many teachers of the modern school. No attempt has been made to develop the subject in a rigorous and logical fashion from the fundamental axioms of number, and we agree with Dr. Milne's opinion that students at this period of their training are ill-fitted for what is almost a philosophical discussion. But at the same time it is becoming generally recognised that the harm done by inculcating incorrect notions of limits, convergence, etc., is so serious and so difficult to remedy that many teachers have, with little assistance from current text-books, been taking their scholarship candidates through a course of serious analysis. They will undoubtedly welcome the publication of this treatise, which with admirable clearness and with an abundance of detailed explanations and illustrations, sets out the lines upon which accurate investigations of the existence of limits and the convergence of single and double series must proceed. More than half the book is occupied with work of this character.

The scope of treatment is best indicated by an enumeration of the headings of the chapters:—Rational numbers; irrational numbers; summation; binomial theorem; permutations and combinations; exponential and logarithmic series; continued fractions; theory of equations; determinants; miscellaneous theorems. In his selection and arrangement of material, the author has, therefore, departed considerably from the customary plan. What little "Theory of Numbers" there is, comes in the first chapter; the usual account of probability has been considerably curtailed; diophantine problems and inequalities receive very brief treatment; and the chapter on permutations follows, instead of precedes, the binomial theorem. There is a good collection of examples at the end of each chapter; we regard, however, as unfortunate the omission of any intermediate sets. Clearly it is undesirable for a student to read the whole of a chapter before doing any examples, and the result of grouping them at the end is to saddle the teacher with the burden of selection.

The final collection of four hundred miscellaneous problems and a number of questions of an essay type call for special notice. Teachers and pupils alike will probably feel the need of an index. Dr. Milne has produced an essentially scholarly work, and we have no hesitation in classing it with those books which are exercising a wholesome and valuable influence on mathematical teaching.

(3) It is curious that no systematic account should have been hitherto published of the properties of the space curve of the third order, although many mathematicians have given their attention to the subject, the fruit of which is to be found in a number of isolated memoirs and, incidentally, in a few treatises, as, for example,

in Grace and Young's "Algebra of Invariants," where the invariants and covariants of a binary cubic are interpreted in terms of the geometry of the skew cubic. This is now remedied by Mr. Wood's tract, which discusses the subject *ab initio*. The first section deals with the projective properties of the curve, developed analytically with the use of homogeneous coordinates, and the second is specially concerned with the cubical hyperbola (the case in which the curve has three real and distinct points at infinity), and discusses the properties of asymptotes, diameters, vertices, centre, axis, inscribed and circumscribing quadrics, the rectangular cubical hyperbola, etc. No one who is interested in geometry can fail to appreciate the collection of properties which Mr. Wood has made, and many will, no doubt, be encouraged by the way in which the initial stages have been simplified, to pursue the subject beyond the limits which space has here rendered necessary.

(4) The purpose of this book is to supply the theoretical basis upon which graphical methods rest, and to discuss in general terms the manner in which applications may be made to shorten the labour involved in the heavy computation with which the physicist and engineer are so often faced. In many cases special graphical methods have been invented to cope with a particular kind of problem, and in view of the fact that there is little inter-communication between those working in different spheres, the opportunity of making use in one department of a device that has been of value in another is often missed, on account of the failure to recognise the generality of the principle which has been employed. The subject-matter is divided into three sections: the first deals with graphical arithmetic, the evaluation of integral functions, and the treatment of complex quantities; the second with the representation of functions of one or more variables, the principle of the slide rule, and the idea of conformal representation; and the last with the calculus and the solution of differential equations.

(5) This course of pure mathematics is most distinctly a lower limit of the equipment every scientific student should possess. The ideas of the calculus are at last beginning to find their way into the ordinary curriculum, more rapidly on the Continent than in England, and the time cannot be far distant when it will be impossible for boys who specialise in chemistry or physics to leave school ignorant of infinitesimal methods. The book deals with revision of arithmetic, algebra, geometry, and trigonometry; graphs of functions; differential and integral calculus, with special reference to expansion in series; and differential equations. The sections of the calculus make rather dull reading, little indication being given of the nature of the applications that it permits. The systematic treatment of what may be called the grammar of the subject should, however, enable the reader to acquire some degree of facility in performing ordinary operations.

(6) What is the criterion that distinguishes the theory of numbers from other branches of analysis? To this question, M. Cahen makes the following reply:—"The Theory of Numbers is a science in which division is *possible* only in special cases, whereas elsewhere division is *impossible* only in special cases." And this statement gives in brief the limits he has set himself in this treatise. The first eight chapters deal with addition, multiplication, subtraction, and divisions of integers, H.C.F. and L.C.M., and fractions; the next four with systems of diophantine equations of the first degree; then follow chapters on linear substitution and groups, linear and bilinear forms, congruences, matrices, prime numbers.

The treatment is thorough in character, and the work is set out so clearly that no student, however small his previous knowledge may be of the theory of arithmetic, should find it difficult to follow the argument; and if he reads through this volume carefully and tests his progress by working out some of the examples provided, he should obtain a firm grasp of this important modern subject. Text-books such as these form an admirable preparation for the student who wishes to make a more specialised study of the subject, for, by giving him a sound groundwork, they make it possible for him to consult intelligently the original memoirs which mark the growth of the theory, and which no text-book, however comprehensive, can in reality replace.

OUR BOOKSHELF.

Dental Diseases in Relation to Public Health. By Dr. J. Sim Wallace. Pp. viii+90. (London: Office of *The Dental Record*, 1914.) Price 3*s.* net.

THIS book consists of three chapters. They are addresses given by the author in "response to requests." Chap. i. sets forth in detail the prevalence of dental diseases, the serious effects they exercise on general health—especially during childhood—and the methods by which such diseases may be prevented. There are, however, within its pages statements based on loose figures, which are calculated to mar the effect the writer has in view by causing an impression of exaggeration of unverified inference. On the strength of the statement—itself too wide a generalisation—that 75 per cent. of the total population have irregularities of the teeth, we have presented to us the wild statement that "the number of teeth

which are pouring pus into the buccal cavity may be estimated, at least has been estimated, at 200,000.000."

Chap. ii. contains a fairly wide description of the function of mastication, and of the effects of saliva on various foods. Chap. iii., on "Children and Dental Disease," is to a large extent a repetition of parts of chap. i., but clothed in different language.

We do not consider these chapters are a serious contribution to the literature of public health. Careful perusal of them impresses upon us the conclusion that, while condemning physiologists and medical men for their shortcomings in dental hygiene, the author is unduly confident in his own exaggerated and unbalanced opinions. He recommends prevention of dental disease by methods of dieting, which "show beyond all doubt that dental caries is not only preventable, but that it is easily and surely preventable."

The enormous benefit bestowed by early treatment as a method of prevention is not admitted by the author, who asserts that, "compared with modern methods of prevention, however, treatment must be regarded as a failure." He is equally clear that sugar should not be regarded as a wholesome and cheap food for children, but as a large and important factor in the production of dental caries. In these opinions we doubt if many physiologists will join him.

Savants du Jour: Albin Haller, Biographie, Bibliographie Analytique des Ecrits. By Ernest Lebon. Pp. 120. (Paris: Gauthier-Villars; Masson et Cie., 1913.) Price 7 francs.

THERE is something to be said for the publication of a man's biography during his lifetime. He is at least able to participate in the pleasant things that are said of him. Mr. Ernest Lebon has undertaken the task of writing the lives of the "Savants du Jour," and so far he has completed seven, the latest of the series being the life of Prof. Albin Haller. Son of a joiner and cabinet-maker, of Thaun-St.-Amarin, in the Vosges, Haller was apprenticed to a local apothecary until the outbreak of the Franco-German War, when he served as hospital assistant. At its conclusion in 1871, he left his native town to follow the fortunes of his teacher, M. Gault. When the staff of the Strasburg University was transferred to Nancy, Haller entered as a student of pharmacy, and in 1873 became lecture assistant in chemistry. He quitted the school of pharmacy in 1884 in order to fill the chair of chemistry. He was elected corresponding member of the Academy of Sciences, in 1891, and in 1899 was asked to take the chair vacated by the death of Prof. Friedel as professor of organic chemistry at the Sorbonne. In 1911 he was made commander of the Legion of Honour, and since then he has received widespread recognition by native and foreign scientific bodies.

His principal researches are mainly in the domain of organic chemistry.

In connection with his studies in the camphor group, he not only obtained a great variety of new and interesting derivatives of camphor and borneol, but among them the homologue of camphoric (homocamphoric) acid, which on distillation of its lead salt gives camphor, and in this way he succeeded in effecting a partial synthesis of camphor. The long list of researches which have emanated from his laboratory, in addition to his numerous literary contributions on scientific subjects, give evidence of an unusually active and fruitful career. J. B. C.

A Course of Practical Work in the Chemistry of the Garden. By D. R. Edwardes-Ker. Pp. 40. (London: John Murray, 1914.) Price 1*s.* 6*d.* net.

ONE of the results of the foundation of a diploma in horticulture by the Horticultural Society is certain to be an improvement in the method of education of horticultural experts. The number of appointments in this direction tends constantly to increase, and now that the Board of Agriculture has established a horticultural branch, the competent expert finds the possibility before him of a highly successful career. In order to meet the demand for text-books that is certain to arise, Mr. Edwardes-Ker has collected a set of experimental lessons to be carried out in a chemical laboratory, and requiring only such limited knowledge of chemistry and of manipulation processes as will be available in the circumstances.

The book is divided into four chapters, headed respectively, "The Chemistry of Plants," "The Chemistry of Soils," "The Chemistry of Manures and Fertilisers," and "The Chemistry of Sprays and Washes." The experiments are simple and well chosen, and should prove of distinct value both to the student and the teacher. They will, of course, require to be supplemented by a suitable series of lectures setting forth the bearing of the facts thus ascertained on the growth of plants, and, in order to bring this out more clearly, we should like to see some pot experiments added. Pot experiments can be made quite simple enough for the purpose, and satisfactorily demonstrate many important phenomena that laboratory exercises alone can never bring out.

A Practical Manual of Autogenous Welding (Oxy-Acetylene). With a chapter on the Cutting of Metals with a Blowpipe. By R. Granjon and P. Rosemberg. Translated by D. Richardson, Pp. xxii+234. (London: C. Griffin and Co., Ltd., 1913.) Price 5*s.* net.

AUTOGENOUS welding consists in uniting metals by fusion without the intervention of solder. Ordinary welds may be effected by heating in a forge, but the local application of heat by an electric current or by the heat of an intense flame is more properly called autogenous welding in contradistinction to the junction of metals made by solder. The work before us treats of welding as done by the oxy-hydrogen and oxy-acetylene blowpipe, the introductory matter on soldering and electric welding being outside the main purpose of the work. The oxy-hydrogen weld was used before oxy-acetylene, but the latter is now the most

common. Acetylene burnt with an equal volume of oxygen gives a temperature which is 1000° C. higher than the oxy-hydrogen flame. For successful welding minute attention to the details of construction of the blowpipes is necessary, and the author describes the forms of blowpipes used and the generators for producing acetylene economically.

The enormous extent to which this form of welding is employed in the arts may be gathered from the descriptions of iron and mild steel welds that can be done *in situ* on large pieces of structures and machinery. From repairing a large rudder of a steamer to the delicate junction of rose-petals in ornamental wrought iron work, the usefulness of the oxy-acetylene blowpipe extends, but perhaps the most important application of the blowpipe is in the cutting of metals and removing rivets. The weakest part of the work is in the translation, which in places leaves much to be desired.

Ambidexterity and Mental Culture. By Dr. H. Macnaughton-Jones. Pp. 102. (London: William Heinemann, 1914.) Price 2*s.* 6*d.* net.

THE author's object in this little volume has been to state briefly the conclusions that may be drawn from the authoritative opinions of physiologists, psychologists, and teachers in different parts of the world as to the advantages of ambidexterity and the desirability of teaching it. Recent experience is drawn upon, and accounts of "Eurythmics" and the Montessori system are included.

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.*]

Cellular Structure of Emulsions.

WHILE preparing emulsions of radio-active minerals in alcohol for α ray examination, my assistant, Mr. E. K. Denton, directed my attention to the mottled appearance of the surface of the emulsion. Closer examination with a lens or low-power microscope shows that the surface is divided into numerous polygonal cells. At the centre of each cell the liquid is flowing vertically upwards, on the surface horizontally outwards, then downwards at the edges of the cell and horizontally inwards along the bottom; such a circulation, in fact, as would be produced by a vertical doublet at the centre of the cell. The hydrodynamical action of these doublets is no doubt responsible for the cellular structure, and the flow is maintained by the evaporation of the alcohol at these centres.

The effect may be obtained with an emulsion of an insoluble powder in any volatile liquid. I have found it, *e.g.* with carborundum, graphite, and lycopodium in ether, alcohol, or molten paraffin. (Certain powders, such as rouge, fail to show it.) The accompanying photograph (graphite in methylated spirits) shows the general appearance of the surface, but does not give an adequate idea of the sharply rectilinear character of the boundaries of the cells.

It seems possible that this effect is related to the formation of flocculi in the solar photosphere, and even to terrestrial cloud formations of flocculent type. I have not been able to find previous reference to it,

and should be obliged to any of your readers who can supply me with such or otherwise comment upon it.

KERR GRANT.

The University of Adelaide, March 1.

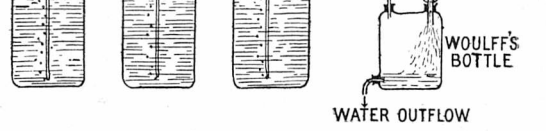
A Simple Method of Aerating Marine and other Aquaria.

THE following method is adapted for aerating aquaria, especially those which contain microscopic organisms, such as Amœba, Vorticella, Hydra, Desmids, Diatoms, and delicate Algæ. Further, the method is admirably suited for marine aquaria, and when once set up the sea-water does not require to be renewed but only maintained at its original level in the aquarium by the addition of distilled water.

The apparatus required is readily obtained and fitted up; and as the cost is only a few shillings, it should appeal to all teachers of nature-study. Apart from the fascination of having several fresh-water and marine aquaria maintained in perfect condition, there is the educational value to be considered.

All that is required is a water pump, a Woulff's bottle, some glass tubing, a short length of rubber tubing, and one or two screw clips.

The apparatus is fitted up as shown in the accompanying sketch.



The pump is connected with the water supply tap, and when the water is turned on it passes through the pump, dragging air with it into the Woulff's bottle; here the air and water separate, and since the water outflow is checked, the air fills the upper part of the bottle, and becomes compressed. The air being under pressure may either blow the water out of the bottle or bubble through the aquaria; the latter being the path of least resistance, produces the desired result, namely, complete aeration of the aquaria.

ELLIS W. GILDERSLEEVES.

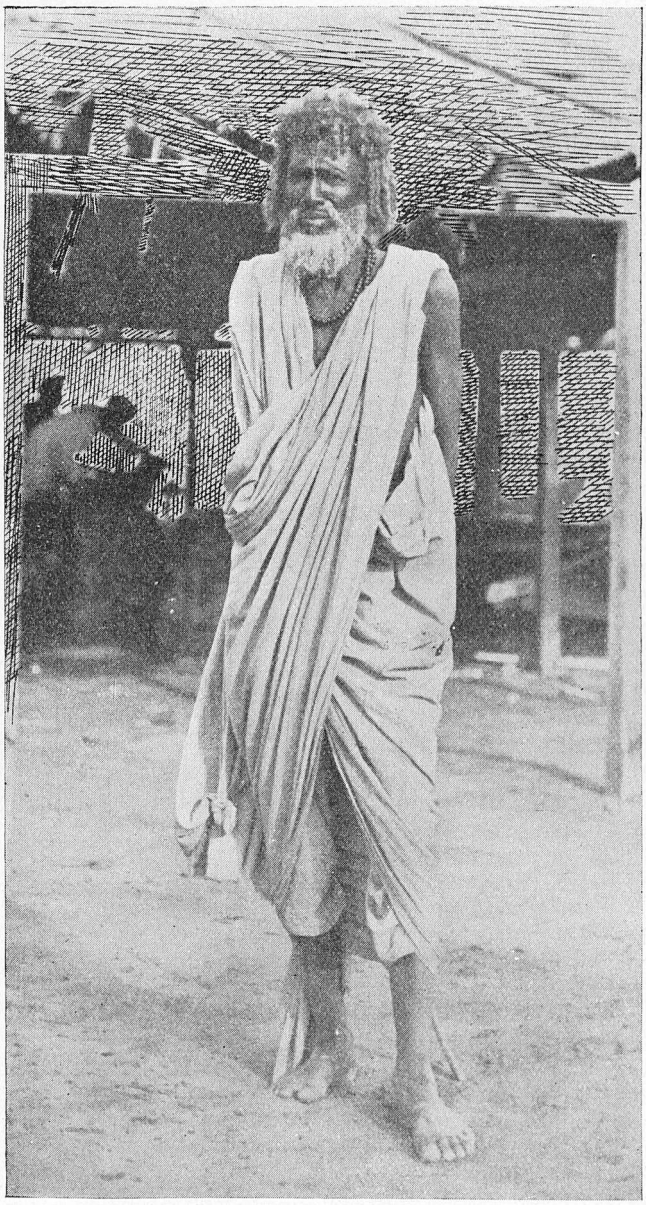
Physiological Laboratory, Bedford College, Regent's Park, N.W.

THE RED SEA COAST.[1]

MR. CROSSLAND, as marine biologist to the Sudan Government, has been resident for some years in the neighbourhood of Suakin, and has had ample opportunities to become intimately acquainted, not only with this portion of the Red Sea coast, but also with the inhabitants of this interesting part of Africa. Living in the course of his work in close acquaintance with some fifty or sixty employees, among whom were Arabs from Sinai and Yemen, Negroes from the Upper Nile, and especially Hamites, the descendants of the original inhabitants of north-eastern Africa, he finds that they range in intelligence between much the same limits as the uneducated class of European lands. The social and religious conditions of these three nationalities are well described and illustrated by numerous instances which came under the author's notice, and his descriptions of them provide a valuable addition to our knowledge of these peoples. In the arid region which they inhabit, the life of the Hamitic nomad tribes is a hard one, and the extremely local character of the scanty rainfall and the consequent scarcity of forage for their camels and flocks impose on them the necessity for constantly shifting their encampment. While the Hamites are the camel-owners of the district, the Arabs and their Negro slaves hold almost a monopoly of the sea traffic in their coasting vessels, "Sambuks," in which they cruise up and down the Red Sea, and it is on the coast-belt that they come into contact.

A short chapter on corals introduces us to an account of the building of the reefs. Here a good account is given of the growth of the shore-reefs, with examples from the Red Sea and from other places, and of the erosion and deposition which is going on at various points by the tidal currents where these are sufficiently developed. At Port Sudan the tidal range is extremely small, being rarely more than 30 cm., but at other parts of the Red Sea this is greatly exceeded. The book concludes with a very instructive chapter on the tectonic structure of the Red Sea, which is a welcome addition to Suess's general discussion of it, and to the more detailed work of Hume, Ball, and Blanckenhorn in the northern portion.

Mr. Crossland considers that the sandstone hills of the coastal plain were deposited previous to the extensive faulting of the Red Sea area, which eventually resulted in three parallel fault-blocks. Of these the first and nearest to the Red Sea hill-ranges once formed a barrier reef near the foot of the mountain, and a coastal plain was formed behind it. Further movements produced an outer barrier reef on another fault block, and within this now a coastal plain has been built up. The present barrier itself is being formed on a third and outlying fault-block, and the deep lagoons so typical of this coast lie within it. These descriptions, which have largely appeared in the *Journal of the Linnean Society*, show what an interesting field awaits the physiographer and the geologist along these shores of the Red Sea. The descriptions both of the people and of the country are excellently true to life, and furnish an interesting and accurate account of a little-known region, though the discomforts of residence there during the hot season



An elderly Bishari. From "Deserts and Water Gardens of the Red Sea."

[1] "Desert and Water Gardens of the Red Sea." Being an Account of the Natives and the Shore Formations of the Coast. By Cyril Crossland. Pp. xv+158+xl plates. (Cambridge University Press, 1913.) Price 10s. 6d. net.

of the year are made light of, and the difficulties which the arid climate offers to the detailed examination of an extensive tract of such country have to be experienced in order that they may be fully appreciated. H. G. L.

THE LAWES AND GILBERT CENTENARY FUND.

JUST a hundred years ago was born John Bennett Lawes, followed three years later by his life-long collaborator, John Henry Gilbert; together they carried on their scientific work until the end of the nineteenth century, and now preparations are being made to commemorate the year of Lawes' birth by rebuilding the laboratory in which so much of the pioneer work in agricultural science was done. The issue of the Annual Report on the Rothamsted Experiments reminds us of the historic claims of that institution to all the assistance the public can give it.

Lawes began his agricultural experiments so far back as 1838, but though those early essays led to the invention of superphosphate and so incidentally to the fortune from which he so liberally endowed the Rothamsted Station, the experiments, properly speaking, did not begin until 1842, when Gilbert became associated with them. From that time some of the famous fields began to take shape, and by 1852 had settled down to that scheme of manuring which has never since been changed; in consequence, the plots now supply data as to the effect of fertilisers both upon the crop and upon the soil which are not merely unrivalled in their trustworthiness, but are constantly being re-interpreted as the science of the nutrition of the plant develops. In 1855 the laboratory was built from subscriptions raised as a testimonial to the value of Lawes' work, and it is this laboratory, now out of date and becoming structurally unsound, that the Rothamsted Committee seeks to replace.

Lawes died in 1900, Gilbert in 1901, and that first long and honourable chapter in the history of Rothamsted was closed. With the appointment of a new Director, Mr. A. D. Hall, in 1902, came the desire for a fresh outlook upon the old experiments; new points of view had arisen, particularly the physical and biological aspects of the soil had become important. The first necessity was to get together a body of workers, for one man could no longer cover so complex a field, and to find adequate accommodation for them, because the arrangements of the old laboratory, though equal to the routine determinations which Gilbert needed, were extremely primitive. Unfortunately, the endowment of the Lawes' Trust provided no margin for extension; still the laboratory was reformed, a few voluntary assistants were secured and new ground broken. After a time Mr. J. F. Mason built a new wing for bacteriology and enabled Dr. H. B. Hutchinson to join the staff, and a little later the Goldsmiths' Company added to the endowment so that the services of Dr. E. J. Russell could be secured.

Up to that time no assistance came from Government, but with the creation of the Development Fund in 1910, the Rothamsted Station became recognised as the Institute for the investigation of the soil and the nutrition of the plant, and received an adequate endowment. The first result was that the Committee was able not only to add some experienced workers to the staff, but also to take a long lease of the home farm containing the classic fields and to embark upon the erection of an additional laboratory with all modern conveniences of electric supply, vacuum and air current, etc. At that point Mr. Hall resigned the Directorship, and was succeeded by Dr. Russell, who has no sooner got the new laboratory opened than he has set about the replacement of the old one which, even were it adaptable to modern methods of work, has for years been giving trouble owing to original defects in construction.

Subscriptions have been received from all parts of the world, the farming societies, large and small, in Great Britain, have contributed in a way that shows their increased appreciation of research, but nearly 1000*l.* are still wanted to complete the 6000*l.* that it is necessary to raise from the public. The laboratory is expected to cost 12,000*l.*, towards which there is reason to expect the Development Commissioners will give a sum equal to that raised from other sources, so now is the time for everyone interested in the welfare of this *doyen* of institutions for agricultural research to send along their donations from which the Rothamsted Station will reap a double benefit.

THE LIFE-HISTORY OF THE EEL.[1]

MANY articles in NATURE have dealt, during recent years, with the above subject; but its interest is not exhausted, and we here welcome the appearance of three new contributions to the long-debated question of the eel.

Dr. Grassi's work is the first publication of the Italian Royal Commission on "Thalassography," and in these first-fruits the commission gives promise of a great return from its systematic exploration of the Mediterranean Sea. Mr. Lea's paper is one of the many beautiful and interesting monographs which have already been based on the collections made by Sir John Murray and Dr. Hjort in the deep waters of the Atlantic. Dr. Bowman's paper is a brief but interesting note, based on the work of the Scottish research vessel *Goldseeker*.

In a long and learned introduction Dr. Grassi relates the history of our knowledge of the life-history of the eel; and while this history has been often summarised, it is here told more completely than ever. Dr. Grassi goes back even to Aristotle,

1 "Metamorphose der Murænoiden: Systematische und Oekologische Untersuchungen" (Text Italienisch). By Dr. Battista Grassi. Pp. x+211 +xv plates. (Jena: Gustav Fischer, 1913.) Price 50 marks.

"Murænoid Larvæ from the *Michael Sars* North Atlantic Expedition, 1910." By Einar Lea. In vol. iii. of the Scientific Reports of the Expedition. Pp. 59+6 plates. (Bergen: John Grieg, 1913.)

"The Distribution of the Larvæ of the Eel in Scottish Waters." By Alexander Bowman, D.Sc. Fishery Board for Scotland, Scientific Investigations, 1912, No. II (December, 1913).

and, telling us that the Sicilians still call the larval eels *casentule*, that is, "earthworms," while the philosopher tells us that the eels spring from "earthworms," γῆς ἔντερα, he inclines to the conclusion that Aristotle knew a deal more about the biology and development of the eel than is actually set forth in his brief recorded references. It was Redi, in the seventeenth century, who showed, with the utmost clearness, that the eels breed out in the open sea, after migrating down the rivers "nel rimpunto della luna," "in the dark of the moon."

Another chapter of the story opens, just 150 years ago to a year, when a certain Mr. William Morris sent to Pennant, from Holyhead, the curious little fish which, in our youth, we used to read of in "Yarrell," under the name of the "Anglesey Morris," or *Leptocephalus morrisii*, as Gronovius had called it. Other similar fishes were from time to time described, until in 1856, Kaup, in a British Museum catalogue, described a number of species, including a certain *L. brevirostris*, from the Straits of Messina. A multitude of naturalists dealt, during the early part of the last century, with these little fishes. Cuvier said that their study was "une des plus intéressantes auxquelles les naturalistes voyageurs puissent se livrer." Johannes Müller, with splendid insight, declared that they were closely allied to the Murænoids. Carus, in 1861, suspected that they were larval forms of some other fish, perhaps Cepola or Trichiurus, and in 1864 Dr. Theodore Gill asserted that these little Leptocephali were but larval eels, a fine instance of zoological prescience.

A long controversy followed, in which Günther and others maintained that the Leptocephali were not an ordinary necessary stage in the life-history of the eels, but were abnormal larvæ, distorted by an unnatural habitat. At length it was made clear by Dareste, Moreau, and finally and experimentally by Delage, in 1886, that *Leptocephalus morrisii* was the normal larva of the conger. Here begins the series of researches by Grassi and Calandruccio, who between 1892 and 1905 confirmed Delage's account of the metamorphosis of the conger, showed that Kaup's *L. brevirostris* was the larva of the common eel, studied in detail the life-history and metamorphosis of a whole series of other Leptocephalids, and maintained that these little larval fishes were inhabitants of the deep waters, from which sometimes, as in the Straits of Messina, they were brought up to the surface by currents or by whirlpools; just as Yarrell told, long before, of a specimen cast up in the eruption of Graham's Island in the Mediterranean. As was foreseen by Salvatore Lo Bianco, in 1891, the larvæ of the common eel are inhabitants of the deep sea, and three years later Johan Petersen captured the Leptocephalus of the common eel, *L. brevirostris*, out in the Atlantic, south-west of the Faeroe Islands. From that date onwards, together with Prof. Grassi himself, a band of Scandinavian naturalists—Petersen, Hjort, with his pupil Einar Lea, and last but not least, Dr. Johann Schmidt—have carried on the investigation of the metamorphosis and migrations of the eel.[2] Schmidt, Hjort, and Lea have now shown that the main breeding-place of the eel is not only out in the open Atlantic, but is in all probability in the warm and very salt waters of the southern part of the North Atlantic, south and west of the Azores; and an interesting part of Mr. Lea's paper is one in which he discusses the probable duration of the eel's long voyage to its breeding-place, and of the slow return of the young larvæ home. This point is further elucidated by Dr. Bowman, who is able to trace the Leptocephali of the common eel on their way round the west and north of Scotland from about June to August, while by November or December they appear as "elvers" off the coast, and are ready to ascend the rivers in March or April. The Leptocephali of the conger are found off the east coast from December to May.

But there still remain a few points of doubt, and therefore of controversy, on which the learned Italian naturalist and his Scandinavian brethren do not quite agree. These are questions which we would not lightly judge or prejudge, and we may simply say that Dr. Grassi seems to state his case with great fairness, and with a very open mind. Among the points still at issue we may mention two. First, does the eel breed in the Mediterranean? And secondly, are the Leptocephali (at least those of the common eel) inhabitants of the surface-waters, of the bottom, or of intermediate depths? Dr. Schmidt believes that the eel does not propagate at all in the Mediterranean, "conclusione molto sorprendente," as Grassi calls it. He holds that for the Mediterranean eels, as for all those of western and northern Europe, the Atlantic is the one great breeding-ground, and that inwards, through the Straits of Gibraltar, pass the migrating young; while Dr. Grassi still inclines to his old belief that the deeper parts of the Mediterranean are also breeding-grounds. At considerable length Dr. Grassi discusses the other problem, and holds that it is by no means proved, as Dr. Schmidt would have it, that the Leptocephali are dwellers in the upper layers. He refers to the habit, which many species at least of the Leptocephali have, of burrowing in the sand or hiding under stones; he states that he has seen *L. brevirostris* itself actually doing so; and he tells us that in captivity the little Leptocephali avoid the light, and retreat into dark corners of the aquarium. In short, he is unwilling to budge from his old opinion, set forth twenty years ago, that the Leptocephali come only occasionally towards the surface from the great depths which constitute their natural home.

The question is curiously interlinked with the too little-known habits of the sunfish, *Orthagoriscus mola*. Multitudes of Leptocephali are found within the stomach of that fish, and would even seem to constitute its main, though not exclusive, nutriment. Sometimes, and this in itself would seem rather to tell against Prof. Grassi's view, they are still actually living when the fish is

[2] See Dr. Schmidt's article in NATURE, August 22, 1912; also Dr. Johann Hjort's communication to NATURE of November 24, 1910.

caught and its stomach opened. Now the sunfish is often seen upon the surface, and is harpooned or otherwise captured there; but Prof. Grassi will not admit that this is its normal habitat, but thinks that it only now and then comes up from the greater depths. This is not the usual belief, but it was Lo Bianco's, as Grassi tells us, and Lo Bianco's opinion carries a deal of weight. After all, then, the sunfish may be a denizen of the deep waters, like *Lampris luna*. But, in the few cases where a sunfish has been found to contain other diet than Leptocephali, the stomach was found full of Salpæ, pteropods, and Velellæ, and they had doubtless been fed upon, if not at the surface, at least in the upper layers. If we may at all venture an opinion, Dr. Schmidt seems to have the better of the argument. A minor but curious question is how the sunfish, with its tiny mouth and apparently awkward body, is able to catch, by hundreds and by thousands, these little active, transparent Leptocephali.

D. W. T.

CARTE INTERNATIONALE DU MONDE AU MILLIONIÈME.

THE conference of London, which assembled at the Foreign Office in November, 1909, at the invitation of the British Government, drew up an elaborate code of rules for the construction of an international map on the scale of one in a million. In the four years which have passed since that meeting about a dozen sheets in all have been completed, though not so many have been published. It had soon become evident that a second conference was required for two reasons. Certain of the resolutions of London worked badly in practice, and needed modification; while several of the Governments which would be called upon to undertake a considerable share of the work had not been represented in London, and desired to be heard before committing themselves to the scheme.

The second international conference met in Paris, at the invitation of the French Government, in December last, and thirty-three countries were represented by delegates officially nominated, whose resolutions will be submitted to their respective Governments for formal ratification. This official character of the meeting has much practical importance. The scheme had been discussed at successive meetings of the International Geographical Congress for twenty years; it remained inoperative until the first official conference of 1909.

The first business of the Paris meeting was to decide what parts of the London resolutions should stand unchanged, and what was open to discussion. A prompt decision to leave as much as possible untouched cleared the way for the real business of the meeting, which resolved itself into three parts—the revision of the conventional signs; the improvement of the colour scale for the layers, and other details of the representation of relief; and the distribution of the sheets which covered the territory of several Powers. The three commissions which were nominated to deal with these questions chose as their presidents Prof. Penck, Colonel Thiébaut, of the *Service géographique de l'armée*, and Colonel Close, respectively. General Bourgeois, chief of the *Service géographique*, presided over the full conference with admirable firmness and lucidity.

The work of the first commission involved long meetings and animated discussion on the classification of towns and the spelling of place names, which affect different countries in very different ways. A system of town classification which is good for Europe is hopeless for Africa, while the relative claims of population and administrative importance lead to difficulties on a single sheet. The spelling of place names in Eastern Europe is fiercely contestable; the transliteration of African names into European equivalents produces endless trouble on boundary sheets. On these matters no hard and fast agreement was possible; much must be left to the discretion of the establishment that makes the sheet. Minor difficulties in the classification of railways, navigable rivers, and roads were amicably adjusted, and the resulting conventional signs sheet is in many respects a great improvement on that adopted four years ago.

The work of the second commission was very much simplified by the production of experimental variants of the Istambul sheet, which had been prepared by Colonel Hedley in the Geographical Section of the General Staff. Fine black contours, instead of brown, were accepted without difficulty. The ugly and unsatisfactory upper tones of the London colour scale for layer tints found few defenders, and it was not difficult to substitute a scale running into orange and red in place of the old brown and magenta. Above the snow line the layer tint is to be omitted; glaciers are to be distinguished by blue form lines or hachures, and there is liberty to use shading when the contours are not sufficient to bring up the form of the snow peaks. In principle the contour interval is, as before, 100 metres throughout; but this is not always feasible, while the suppression of contours at discretion leads to unnecessary diversity. The remedy was to declare certain contours obligatory (*courbes maitresses*), the others being discretionary.

The third commission laid down the principle that the right to produce a sheet belonged to the country which owned most territory within its limits, and refused to make any pronouncement as to sheets lying wholly in territories which have no cartographical establishments. The significance of the latter decision was lessened by the announcement of the Chinese delegate that topographical establishments were now in active operation in all the provinces of the Republic. The delegates of the South American States came to an important agreement among themselves in regard to the representation of doubtful boundaries.

In the full sessions the decisions of the com-

missions were ratified without excessive rediscussion, and there was happily no need to settle the awkward question whether delegates of countries which had not produced, and never would produce, a sheet of the map should have an equal voice with others more deeply interested.

In an enterprise needing so much cooperation and exchange of information a central office is necessary. The British delegates had the satisfaction of being authorised by their Government to propose that a central office should be established in England, of which the small expenses should be borne by contributions from the consenting Powers in equal shares. The conference did England the honour of accepting this proposal unanimously, and if the agreement is ratified it is probable that the office will be at the Ordnance Survey, Southampton, with an auxiliary office in London where all information will be available for reference.

It was decided that the official name of the map shall be the French name—"Carte internationale du monde au millionième." A strict adherence to this rule is desirable, especially in indexing and cataloguing the literature which will grow up, in notices, reviews, and lists of published sheets.

The labours of the conference were lightened by the excellent arrangements made for its reception in the Salle d'honneur at the Invalides, and in the rooms of the *Service géographique;* by the cordial attentions of the hosts; and by the splendid hospitality, public and private, extended to the delegates.

The British delegates were Colonel Close (Ordnance Survey), Colonel Hedley and Captain Cox (Geographical Section, General Staff), and Mr. Hinks (Royal Geographical Society), representing Great Britain; Major Tandy (Survey of India) representing India; and Major Richardson, representing New Zealand.

INTERNATIONAL CONVENTION ON PLANT DISEASES.

SHORTLY after the final sitting of the International Phytopathological Conference, which was held at Rome last month, an official statement was issued, and extracts from it were given in our issue for March 26 (p. 90). The text of the draft convention which was prepared at this conference has now been issued by the International Agricultural Institute at Rome, and the Governments which were represented on that occasion will be invited to consider whether they will signify their formal acceptance of the proposed agreement. Their decision will depend on political and administrative reasons with which we are not here concerned, but the suggestions contained in the document mark an advance in public opinion on the subject of plant diseases of great interest to men of science, which cannot be entirely overlooked. The delegates of thirty independent States have decided that it is desirable that a uniform procedure should be adopted to control the spread of those diseases which have in the past done so much injury to agricultural and horticultural crops, and, indeed, are still doing so, and that this procedure should include both the scientific study of the insect and fungus pests at one or more Government phytopathological stations in each country, and the application of remedial measures by administrative order where these pests exist.

The official acceptance of this policy would in any case give a great stimulus to the study of applied biology, and would tend to concentrate the attention of entomologists and mycologists on economic problems. But the scheme contemplated by some of the articles of the convention is likely to be productive of even more important results. It was evidently felt impossible to prepare a list of dangerous diseases applicable to all countries, and while, on one hand, it was decided not to legislate for those diseases which attack agricultural crops, such as seeds, grain, potatoes, and other "articles de grande culture," each Government is invited to prepare a list of those diseases against which it wishes to be protected. The preparation of such a list is bound to be difficult, since many of the diseases which are comparatively harmless in a country where they have been established for many years are apt to assume a virulent character when introduced into a country where they are unknown. The ravages caused by the Brown Tail Moth (*Euproctis chrysorrhoea*) and the Cotton Boll Weevil (*Anthonomus grandis*) in America, by the Vine Louse (*Phylloxera vastatrix*) and the American Gooseberry mildew (*Sphaerotheca mors-Uvae*) in Europe, are familiar examples. The attention of official plant pathologists will have, therefore, to be directed not only to the study of the pests of their own country, but also to those of other countries the character of which is such that they might prove dangerous if introduced.

The field for this kind of research is, of course, very wide; but lest an opening should be given to unreasonable and alarmist measures likely to cause a serious disturbance of trade, it is laid down in a very important article what are the conditions on which the list must be prepared. It is wisely declared that the list must be as restricted as possible, and must not include any of those common pests which are widely distributed in almost every country, and are well established there. (Les espèces banales, dont la dispersion déjà ancienne s'étend à presque tous les pays.) Moreover, the pest must be epidemic in character, and destructive, or at least very injurious, in action, as well as be easily capable of being conveyed on living plants, or parts of plants.

In those cases where the pest is already known to be of such a character in its native home or in some country into which it has already been introduced, its inclusion in the list is a foregone conclusion, and there will be little hesitation about including the San José Scale (*Aspidiotus perniciosus*) or the Mediterranean Fruit Fly (*Ceratitis capitata*), the Black Knot (*Plowrightia morbosa*) or the Chestnut disease (*Endothia parasitica*).

But in other cases a difficulty will arise. Where experience cannot speak with certainty, a scientific reason must be urged, and it will be necessary to formulate a series of deductions from the life-history of the insect or fungus which would justify a presumption that in different surroundings the pest might prove epidemic as well as destructive to plant life, or at least injurious to the crop. No doubt it will be possible, in the course of time, to declare with more accuracy than at present what are the circumstances in which such conditions might arise; but it will require a long and careful study, not only of plant hygiene, but also of the limits of the powers of adaptation to environment possessed by parasitic organisms, under the stimulus of altered climatic and cultural conditions, as well as freedom from injurious influences. This article in the proposed convention will, if adopted, have a marked influence on the trend of economic biology and plant pathology.

NOTES.

A COLLECTION of rock specimens of considerable historic interest has just been presented to the Department of Minerals of the Natural History Museum. The specimens in question were collected in Arctic North America by Sir John Richardson, who accompanied Sir John Franklin's Arctic Expeditions of 1819–1827. They have since that time been kept in the museum of the Royal Naval Hospital at Haslar, but inasmuch as the fossils collected in the same Arctic expeditions are in the National Museum at South Kensington, it was felt to be in the fitness of things that the rocks should be also preserved there. An application was accordingly made to the Lords of the Admiralty to sanction the transfer of the specimens from Haslar to Cromwell Road, with the result that, as we have stated, they are now in the Department of Minerals.

ON Tuesday next, April 21, Dr. Walter Wahl will deliver the first of two lectures at the Royal Institution on problems of physical chemistry: (1) study of matter at high pressures, (2) study of matter at low temperatures; on Thursday, April 30, Dean Inge will begin a course of three lectures on the last chapter of Greek philosophy: Plotinus as philosopher, religious teacher, and mystic; and on Saturday, April 25, Dr. T. E. Stanton will commence a course of two lectures on similarity of motion in fluids: (1) the theory of similarity of motion in fluids and the experimental proof of its existence, (2) the general law of surface friction in fluid motion. The Friday evening discourse on April 24 will be delivered by Dr. F. W. Dyson, the Astronomer Royal, on the stars around the north pole.

PROF. E. HEYN, of Berlin, is this year to deliver the annual May lecture before the Institute of Metals, upon the subject of "Internal Strains in Cold Wrought Metals, and Some Troubles Caused Thereby." The last May lecture, by Sir J. Alfred Ewing, was on the subject of "The Inner Structure of Simple Metals," and previously Dr. G. T. Beilby had lectured on an allied subject, "The Hard and Soft States in Metals." Prof. Heyn's discourse will be given in the building of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W., under the chairmanship of Admiral Sir Henry Oram, president of the Institute of Metals, on Tuesday, May 12, at 8.30 p.m. The secretary of the Institute, Mr. G. Shaw Scott, of Caxton House, Westminster, S.W., will be glad to forward tickets to any readers who may desire to be present at the lecture.

PRINCE GALITZIN will preside over the fifth meeting of the International Seismological Association, to be held early next September, in St. Petersburg. The exact date of the meeting is not yet fixed, but the provisional programme has just been issued. Reports will be presented by the committees on microseisms, on tides in the earth's crust, the bibliography of seismology, the catalogues of earthquakes prepared by the permanent committee, and the uniformity in the arrangement of seismological bulletins. It will be proposed that a new station shall be founded at Bergen, that a reserve supply of seismographs should be kept for occasional or temporary use, and it will be urged that all seismographs should be provided with suitable "damping" arrangements, and that correct time should be supplied by telegraphic signals to all earthquake observatories. Among the papers promised may be mentioned those of the president on the analysis of seismograms, the comparative study of seismograms from different stations, and on observations of the angle of emergence, and of Prof. Omori on the tromometric observations made during the recent eruptions on the flanks of the Asama-yama.

NEWS has just reached us of the death on February 18, in his forty-sixth year, of Dr. J. Huber, director of the Museu Goeldi, Pará, Brazil.

MR. G. H. MARTYN, writing from Biarritz, says that on March 30, at the end of a bright day with light winds, the sun appeared to pass through a clear sky and set in the sea, from which it seemed immediately to start rising again. "The reflecting layer of air was not wide enough to reflect the whole disc of the sun, but a band having a width of a third of the sun's diameter, so that the appearance was of the sun rising and passing behind a bank of invisible clouds."

IN the *Irish Naturalist* for March Mr. N. Colgan contributes an article entitled "Field Notes on the Folk-lore of Irish Plants and Animals." He shows the current traditional knowledge of the transmogrification of species, and that of sexes in plants. Thus, the royal fern is believed to be the wild rannyock or common bracken, and the spargantium or bur-reed the wild shellistring or flagger. The people identify a he- and she-bulkishawn or ragweed, the latter turning out to be the common tansy. On the Irish coasts the common limpet or *patella* is firmly believed to develop out of the acorn-shell or *balanus* which covers the rocks. The grimmest belief about the elder is thus stated by a car-driver: "That's the elder tuff. It's a bad thing to give a man a scelp of that. If you do, his hand 'ill grow out of his grave."

A CONSIDERABLE portion of the second number of vol. v. of the Journal of the Federated Malay States

Museums is devoted to various groups of Malay aboriginal tribes, Mr. C. B. Kloss communicating a number of measurements and photographs of Biduanda (Mantra) of the Ulu Kenaboi, Jelebu, while Mr. J. H. Evans furnishes notes on the same tribe, as well as others relating to the natives of Lenggong, Upper Perak, and yet others on those of the Ulu Langat, Selangor. The Lenggong aborigines, although derived from a Negrito stock, speak a Sakai dialect, like the pure (Negrito) Semang of Grit, from which, however, they differ by their lighter colour. Like many of the other native tribes, they object, however, to be called either Semang or Sakai, the reason for this being that both these names are commonly used by the Malays as terms of reproach. The people of the Ulu Langat and Ulu Kenaboi, who are all of one race, are more or less pure-bred Sakai.

IN the issue of *L'Anthropologie* for November-December, 1913, Mr. O. G. S. Crawford discusses the question of prehistoric trade between England and France. He directs attention to the discovery in southern England of certain stone celts, vases, and bronze palstaves of Continental types. These seem to have reached this country from the Cotentin peninsula, in which prehistoric remains, especially hoards, are abundant. In support of these views he further considers the position of sites in this country sacred to the worship of St. Catherine. These lie in the western half of our south coast, but are wanting in the eastern half. He suggests that her wheel is a symbol of light connected with a Gaulish divinity, known as Lhud in Britain, and Nuada in Ireland. The cult of St. Catherine, not known in England before the Norman Conquest, is believed to have arisen in sites sacred to her predecessor, the olden Gaulish deity.

AT a recent meeting of the Prehistoric Society of East Anglia, Mr. J. Reid Moir announced the discovery of a flint workshop floor in Ivry Street, St. Albans. An excavation for building purposes disclosed one foot of surface soil and two feet of fine stoneless sand. Then came the prehistoric stratum, containing flint cores and flakes, calcined flints, fragments of pottery, quartzite pebbles used as hammer-stones, and animal bones, some of which had been cut through, and, for some purpose, incised. Under this stratum lay fine sand to an unknown depth. Most of the flints were in the form of long flakes, patinated of a light blue colour. One had been trimmed for use as a scraper, and though it is difficult to attribute these specimens to any particular culture, Mr. Moir, judging from the length of the flakes, is inclined to assign them to the Magdalenian period. The bones found were those of a small sheep, teeth of an ox, and a tibia, probably that of a red deer. It is curious that another "find" of flints recently discovered at Ipswich is assigned to the Aurignacian period. If this attribution be accepted, we find remains of two Palæolithic periods within the confines of this town.

IN *Meddelelser fra Kommissionen for Havundersogelser, Fiskeri,* Bd. iv., we have two papers dealing with the biology of the plaice. The first of these is by Dr. A. C. Johansen, on the immigration of plaice to the coastal grounds and fiords on the west coast of Jutland, and contains some interesting data on the changes in frequency of young plaice from one year to another in the shore zone. The second paper is by B. Saemundsson, on marking experiments carried out in the neighbourhood of Iceland. These experiments yield some results of interest, though they are not altogether satisfactory on account of the small numbers of fish dealt with. It is interesting to note that by far the largest number of recaptures were made by English trawlers from Grimsby and Hull. In the same volume there is a useful report by P. L. Kramp on fish-eggs and larvæ collected in 1909 in the Langelands Belt.

IN the March number of the *Journal of Economic Biology* (of which we notice that Mr. W. E. Collinge is now sole editor) Mr. A. A. Girault, of the University of Illinois, completes his "Preliminary Studies on the Biology of the Bed-bug (*Cimex lectularius*)," giving details of successive pairings and generations with statistics as to the periods of feeding and the numbers of eggs laid by the females under observation. In summarising the reactions of bed-bugs to various stimuli, Mr. Girault states that the insect's usual behaviour of shunning light may be abandoned under the stronger stimulus of hunger. "Bed-bugs will visit a host in daylight or in bright artificial lights when hungry . . . as soon as the food-stimulus is neutralised by engorgement, however, the negativeness to light becomes dominant again, and the insect runs off to hide itself."

THE February issue of the *Bulletin of Entomological Research* contains, as usual, systematic papers of considerable interest. Mr. F. V. Theobald writes on African Aphididæ, and is able to record "only thirty-five species for the whole African continent, about the number one can collect in a single afternoon in one's own garden in England," and several of these have clearly been introduced with nursery stock from Europe. Prof. R. Newstead describes new Coccidæ, and Mr. E. E. Austen new Tabanidæ, both papers being well illustrated. Of considerable interest is Mr. R. B. Woosnam's report on a search for Glossina (Tsetse-flies) on the Amala River in the southern Masai Reserve, of which he is game-warden. In a definitely restricted area along the river and its tributaries at more than 5000 ft. altitude he found a Western species, *G. fusca,* hitherto unknown in the East African Protectorate. The cattle, sheep, and goats of the Masai suffer very little from tsetse-borne disease, either because the people manage to avoid the fly-belt when moving their stock, or because only a very small proportion of the flies are infective.

BY publishing reports for two successive years in a single cover, the Felsted School Scientific Society is enabled to reproduce some of the prize photographs taken by its members, the report for 1912–13 consequently presenting a more than usually attractive appearance. Particular interest attaches to the photographs of a young cuckoo and its foster-parent, a whitethroat.

IN the newly issued vol. xxxiv. of "Botanisk Tidsskrift," Copenhagen, Ø. Winge gives an account of some new Sagasso Sea investigations. During 1911–13, the Danish Commission for the Study of the Sea organised a collection of plankton samples by Danish Transatlantic vessels. This material is now to be worked up, and Winge, who is studying the distribution and frequency of the Sargasso, finds the Gulf-weed consists chiefly of two species (*S. bacciferum* and *S. vulgare*), besides other less common forms (*Sargassum* species and *Ascophyllum nodosum*). The great quantity of Sargasso was met with between lat. 37° and 23° N., and long. 35° to 60° W., within an oval area about 600 miles broad. As was the case with the earlier "Sargasso-frequencies" of Krümmel and Antze, all the samples show an autumnal simultaneous increase of the quantity of the Sargasso. This suggests that the floating Gulf-weed has a long-lasting drift and a yearly growth-period in the late summer. Sexual reproduction of the drifting Sargasso is still unknown.

P. D. QUENSEL adds very greatly to our knowledge of the geology of western Patagonia in his "Geologisch-petrographische Studien in der patagonischen Cordillera" (Bull. Geol. Inst. Univ. of Upsala, vol. xi., p. 1). The great group of laccolitic intrusions, varying from granite to gabbro, is younger than the Cretaceous period, and even cuts the folded structure of the chain. As the photographs of scenery show, frost-action produces superb crags and pinnacles in these young and well-jointed granitoid rocks.

BRITISH geologists may be both surprised and gratified to find an elaborate paper in English on the geological structure and history of the Falkland Islands, by Thore G. Halle, in the Bulletin of the Geological Institution of the University of Upsala (vol. xi., pp. 115–226), accompanied by numerous illustrations and a coloured map. The feature of cardinal importance is the discovery of Permo-Carboniferous strata, with Glossopteris, and a glacial boulder-bed ("tillite") at the base. For this series the author proposes the local name Lafonian. The Permo-Carboniferous glaciation is thus seen to have a very wide extension, and it is interestingly pointed out that a laminated clay, and the occurrence of annual rings in the Dadoxyla of the local Gondwana flora, indicate a solar control of the climate during cold conditions. The laminated clay is figured, and bears a remarkable resemblance to those associated with the pre-Cambrian glacial beds in Ontario and with post-Pliocene glacial beds in Sweden.

A FULL report of the recent Sakura-jima eruption has been issued in Japanese by the Kagoshima Meteorological Station; it is especially interesting as giving accurate records of the events which preceded and followed the great eruption. The actual eruption commenced on the morning of January 12, but earthquakes, gradually increasing in intensity and frequency, were felt from early morning on January 11. The general features of the eruption have been already described, but we have now further particulars concerning the lava-flow. On January 14, at 7 a.m., a lava-stream was seen issuing from the mountain, but, encountering high ground, it spread out to a width of a mile and a half, with a thickness of "some scores of feet"; the flow of lava was resumed on the following day, several small craters being opened along its course, and on January 16 the lava-current reached the sea, pushing its way out to one of the small islands in the bay. The activity of the volcano gradually diminished from this time, but did not entirely cease until January 27. The earthquake shocks, which became less violent during the eruption, increased in number and intensity as the volcanic action declined, and then gradually died away. The seismometer recorded no fewer than 418 shocks on the day before the eruption, but during the eruption the seismometer having been broken, it was difficult to distinguish between earth-vibrations and the volcanic rumblings.

THE Royal Meteorological Institute of the Netherlands has published the third quarter (December-February) of a new edition of its very laborious work, "Oceanographic and Meteorological Observations in the Indian Ocean." It consists of two parts: (1) tabular results for the years 1856–1910, and (2) charts constructed therefrom. This issue is much more complete than that for the previous quarter, owing to the inclusion (1) of observations for a longer period, and (2) of a large amount of data received from other meteorological services. In this latter respect special thanks are accorded to our own Meteorological Office. These additions, referring partly to routes not usually taken by Dutch vessels, have allowed certain areas to be more fully represented. The charts, twenty-five in number, show the frequency of direction and mean velocity of currents and winds, together with the general circulation of air and water for each of the months in question, isobars, isotherms, etc. On the backs of some of the charts details likely to be of use to seamen, and based upon all available data, have been carefully prepared. Taking into account the possible establishment of a direct service between the Netherlands' East Indies and South Africa routes are laid down for vessels between those parts, in addition to the tracks recommended for other places on either side of the Indian Ocean.

THE shape of a nearly spherical drop falling in a viscous liquid of different density forms the subject of a paper by Shizumi Saito in the Science Reports of the Tokyo Imperial University, vol. ii., No. 5. The solution is obtained by harmonic analysis, though the method could be shortened by employing the ordinary polar equations of motion or Stokes's stream function. The paper leads to the conclusion that the drop may be deformed into a prolate or oblate spheroid, the distinguishing criterion being in the form of a relation connecting the densities and viscosities of the inner and outer liquids.

A VALUABLE report on the effect of ice on the flow of streams in the United States has been drawn up by Mr. W. G. Hoyt, and forms Water Supply Paper 337 of the U.S. Geological Survey. The first report on the subject was issued in 1907, and dealt mainly with the field operations necessary for the estimation of the rate of flow. The present paper

goes much further, owing to the work which has been done in the interval, and includes a discussion of the factors which influence the flow during the low-temperature period, and the calculation of the flow from the observations taken.

THE Journal of the Washington Academy of Sciences for March 19 contains a *résumé* of a paper on the brightness of optical images by Mr. P. G. Nutting, which is to be published *in extenso* elsewhere. The results obtained deal principally with the transmitting power of various types of photographic lenses. The method adopted consists in exposing a white magnesia block to a luminous source of 1500 candle-power enclosed in opal glass, and comparing the brightness of the magnesia when illuminated direct, with the brightness of the image of the source when thrown on the same surface by the lens system under test. The observed transmissions vary from 57 per cent. for a Zeiss-Krauss tessar to 92 per cent. for a Fuess telescope objective. For several process lenses the transmission is 76–78 per cent., showing that for the six glass-air surfaces of which they consist the transmission is quite up to that theoretically obtainable.

IT is interesting to read in the *Revue Générale des Sciences* (March 15) an elementary discussion of the principle of relativity by Prof. H. A. Lorentz, to whom, more than to any other, the hypothesis owes its origin. After a very clear exposition of some simple ideal experiments which illustrate the relative nature of the measures of space and time, he dismisses in a single paragraph what is to most physicists the greatest objection to the principle, the apparent denial of the existence of the æther as they had come to think of it. "That is, as it seems to me, a question towards which each physicist may take the attitude which best agrees with the way of thinking to which he is best accustomed." ". . . he must recognise that it is impossible for him to know the direction and the velocity of the æther (relative to his apparatus), and, if he feels the need of not concerning himself with his ignorance, he will take the side of M. Einstein." It is interesting to speculate how far it is possible to use these words and at the same time to feel convinced of the objective existence of a unique æther, which is something more than a convenient way of correlating phenomena, but may be described in Prof. Lorentz's own words as "always remaining at rest," and "endowed with a certain degree of substantiality."

IN the *Monist* (vol. xxiv., No 1) Mr. Leonard T. Troland, under the title "The Chemical Origin and Regulation of Life," combats recent views on vitalism, that "cult of incompetence" in biology. The position taken up is that "a single physico-chemical conception may be employed in the rational explanation of the very life phenomena which the neo-vitalists regard as inexplicable on any but mystical grounds. This conception is that of the enzyme or organic catalyst." The thesis is developed along five distinct lines, the author maintaining that this conception will ultimately prove adequate to resolve such fundamental mysteries as the origin of living matter, the origin of organic variation, the problems of heredity, the mechanism of individual development, and the nature of physiological regulation in the mature organism.

AN important method for the rapid estimation of zinc in coinage bronze and similar alloys is described by Dr. T. K. Rose, Assayer to the Mint, in a paper read before the Society of Chemical Industry (vol. xxxiii., No. 4). In this method the zinc is volatilised away by heating one gram of the alloy in a carbon crucible for two hours at a temperature of about 1375° C. Strictly speaking, this is not an entirely new method in principle, having been described many years back, but it is a process that has never come into general use. Dr. Rose has now made the method a perfectly practical one by accurately defining the conditions which are necessary for success. The main advantage of the method lies in the great saving of time and the avoidance of troublesome chemical manipulations.

THE use of catalysis in organic syntheses has come into increasing use in recent years. In the current number of the *Comptes rendus* (No. 14, April 6) additional details are given by MM. Paul Sabatier and A. Mailhe on the advantages of manganous oxide as a catalytic agent in the synthesis of aldehydes and ketones. A fatty acid mixed with an excess of formic acid passed over a column of manganous oxide at a temperature of 300° C. to 360° C. gives the aldehyde corresponding to the acid, the yields being from 50–70 per cent. of the theoretical. The authors describe the preparation by this method of six aldehydes. With the same reagent adipic acid gives *cyclo*pentanone in 80 per cent. yield, and β-methyladipic acid gives β-methyl*cyclo*pentanone. Manganous oxide is cheap, and preserves its catalytic properties over a long period.

OIL-SEEDS, oils, fats, and waxes are the subjects dealt with in a recently issued collection of "Selected Reports" from the Scientific and Technical Department of the Imperial Institute (No. 88, Colonial Reports—Miscellaneous, Cd. 7260). The publication includes all the more important reports on the above-mentioned products made to the Colonial, Indian, and other Governments during the years 1903 to 1912. A large number of seeds and oils have been analysed and otherwise tested by the department, the object in view being to give information as to the yield and nature of the oil obtainable from the seeds, and the possibility of utilising the products commercially. The reports proper are preceded by a short introduction explaining the classification of the oils into groups, and the meaning of the analytical terms employed in the descriptions. Among the more interesting memoirs is one on the utilisation of para rubber seed, which contains a drying oil possessing properties very similar to those of linseed oil; it is concluded that the kernel is a valuable economic product. One of the longest reports treats of the palm-oil industry in British West Africa. Large areas of oil-palm forest still exist almost untouched, and though the native processes for extracting the oil are crude and waste-

ful, it is considered that no failure of supply is likely to occur in the immediate future.

THE April issue of Mr. C. Baker's list of "Second-hand Instruments for Sale or Hire" is now available, and can be obtained post free on application to 244 High Holborn, London. The catalogue contains descriptions of nearly 2000 pieces of scientific apparatus, amongst which modern microscopes and objectives, telescopes and spectroscopes, take a prominent place. The preface to the catalogue points out that every instrument is guaranteed to be in adjustment, and that customers may in certain circumstances have instruments for three days on approval.

MESSRS. DULAU AND CO., LTD., 37 Soho Square, London, W., have just issued their Catalogue 65 dealing with works on recent and fossil ichthyology which they are offering for sale. The list contains 1740 entries, and includes periodicals as well as books on every branch of the science concerned.

OUR ASTRONOMICAL COLUMN.

APRIL SHOOTING STARS.—Mr. W. F. Denning writes:—On Tuesday night, April 21, there may occur a rich return of the April meteoric shower. It is uncertain, however, what this year's aspect of the display will be, as the periodic time is not known. There were brilliant returns in 1803 and 1851, and there is indication that the brighter and more abundant exhibitions of this stream occur at intervals of sixteen years. If so, it ought to be well seen in 1915, but in view of the doubts remaining, the phenomenon should be watched every year, for negative evidence is sometimes useful. The Lyrids probably form a moving radiant like the Perseids, the motion being to the eastward one degree a day. This feature should be attentively looked for, but the shower is usually a very brief one, and meteors directed from it are rarely seen before April 19 or after April 22. This year the moonlight will be almost absent from the sky at the time of the maximum, so that with a clear atmosphere the circumstances will be highly favourable for its observation.

NOVA GEMINORUM NO. 2.—A number of observations has recently come to enrich the general store of data regarding this nova, and some of these later contributions possess a high degree of importance. This applies especially to a memoir appearing in Bulletin No. 3 of the Imperial Academy of Sciences, St. Petersburg, communicated by M. N. V. Vojtkevič-Poliakova, of the Pulkova Observatory. Unfortunately for English students this memoir is printed in Russian, but it contains an excellent plate giving reproductions of eight spectrograms of the new star. It is at once apparent that evidence has been obtained regarding the transient proemial phase during which the nova exhibited a dark-line spectrum showing characteristics resembling that of Procyon. Although the Harvard spectrograms had established beyond any possibility of doubt that this nova had indeed passed through this so much questioned stage, the value of independent confirmatory evidence need not be insisted on. The series of thirty-six spectrograms discussed in the paper extends from March 15, 1912, to October 8, 1913, and includes two excellent plates taken on the first date, and others for March 16, 17, and 18. The wholly dark-line stage so happily caught at the Harvard College Observatory was missed at Pulkova, but the leading Procyonian features are still predominant in the first two spectra, although the bright-line spectrum is making its appearance, and on March 16 predominates, but the H and K lines may still be seen quite plainly.

Another spectroscopic paper comes from the Catania Observatory, and is the work of Dr. Vittorio Fontana. It appeared in the Memoirs of the Società Spettroscopisti Italiani, vol. ii., series 2, pp. 201–10.

Additional observations of the light changes of this nova are given in two papers published in No. 4720, *Astronomische Nachrichten*. In the first of these von J. Kasansky, Moscow Observatory, presents fifty-seven determinations, ranging from the time of the discovery (March 14, 1912) to March 27, 1913. The observed magnitudes range from 3·58 (H.R.) on the former to 8·76 on the latter date. By March 16 the brightness of the nova had fallen nearly two magnitudes to 5·54. The magnitudes for the greater part of the series are also stated in terms of the Potsdam scale, and can thus be at once compared with the values given in the other paper, which is by Sig. Eugeni Guerrieri, Capodimento Observatory. This series includes 139 determinations of magnitude between March 28, 1912, and April 29, 1913. The light curve exhibits the typical characteristics of nova variability. For the few common dates the two series show good agreement.

DIURNAL VARIATIONS OF LATITUDE.—During last year M. Jean Boccardi, in discussing the results of his observations for latitude made by the method of Struve, drew the conclusion that an effect of lunar attraction was suggested by displacements from the vertical. As these displacements were considerably greater than those which he could calculate by theory he was led to conclude that these latitude variations were caused by geological conditions special to the place of observation. Having subsequently become acquainted with M. Schumann's researches on latitude variations in which he could trace undulatory curves showing diurnal variations of latitude, M. Boccardi has completed some diagrams showing the march of the latitude values. These diagrams are not published in the communication which he sends to the *Comptes rendus* of the Paris Academy of Sciences (February 9, 1914, No. 6); tables only are given, but he states that the maxima and minima values of the latitude obtained with the four stars which he has observed follow one another at intervals which correspond to the movement made by the moon in right ascension during the corresponding intervals of right ascensions between the stars. Thus the action of the moon seems to be demonstrated.

A PERPETUAL CALENDAR.—We have received a neat perpetual calendar, "Alle Jahreskalender auf einem Blatt," by "Dr. Doliarius," of Leipzig (B. G. Teubner). It is of postcard size, and seems well adapted to the requirements of clergymen and others. Three tables are given: (1) the dates of Easter according to the Gregorian calendar, 1582–2000; (2) the corresponding Julian dates, 1470–2004; and (3) a double enumeration of the days of the year arranged in thirteen columns in such a way that any seven consecutive columns are complete in themselves. A separate card frame is supplied having a slit which fits over the width of seven columns, and as the top of the slit is marked with the seven days of the week an annual calendar is displayed when the frame is placed over table (3). The correct position of the frame is determined by a marked space which is adjusted to the date of Easter for the year required according to the indication of table (1) or (2). The manipulation of the calendar is quite simple, and furnishes the dates of the principal church festivals very readily.

PRIMARY EDUCATION AND BEYOND.

THE national system of education adumbrated by Lord Haldane and other responsible authorities about a year ago has not yet taken shape, but meanwhile a measure embodying some of the prospective reforms in the domain of elementary education has passed its second reading in the House of Commons. We refer to the Children (Employment and School Attendance) Bill introduced by the Hon. R. D. Denman, member for Carlisle. The principal changes in the law proposed by this Bill are the grant of optional powers to local education authorities to extend the age of leaving school from fourteen years to fifteen; no exception from school attendance to be allowed for children under thirteen years; the abolition of the existing half-time system; the grant to local education authorities of power to require attendance at continuation classes; and the prohibition of street trading by boys under fifteen and girls under eighteen.

While we await the complete scheme of national education promised by the Government, it may be worth while to state the present position as regards those points of primary education for which provision is made in Mr. Denman's Bill, particularly in the matter of continuation classes, which is likely to be given much attention in the near future. Mr. Pease, the President of the Board of Education, has recently made a personal examination of the continuation-school systems in France and Germany; and we may expect to hear something of his impressions and conclusions when he makes his next statement to Parliament upon the work and outlook of his Board.

As the law stands in England at present, a child can leave school immediately it reaches the age of fourteen years, whatever its position in the school may be. Partial exemption from school in order to enter employment during certain hours of the day can be obtained at the age of twelve years, or at eleven in agricultural districts, if the standard of exemption fixed by the local education authority has been passed. This is the "half-time system"; and since the year 1907–8 there has been a continued decrease in the number of children who have taken advantage of it; or rather of whom parents and employers have taken advantage by exploiting their labour. The latest report of the Board of Education (Cd. 6707) shows that there are about 70,000 half-timers, and that nearly 59,000 of these belong to the districts of Lancashire and Yorkshire engaged in textile industries. As about half a million children normally leave the elementary school every year, it is surely not much to insist that the seventy thousand partial exemption pupils should be compelled to remain like the rest until they have reached at least the age of thirteen years. If the age of compulsory attendance at school of all children were raised to fourteen years, the nation would benefit by the enaction of such a law.

But whatever may be the leaving age of the elementary-school career, the work and influence of the school are rendered largely nugatory unless the pupil passes at once into a system of continuation classes. In the "unguarded years" which follow elementary-school life, almost all that has been learnt is forgotten, and when later the thoughtful youth awakes to a sense of his deficiencies, he has to pick up in evening classes the threads carelessly thrown down a few years before. The voluntary attendance at evening classes in technical and other schools is a measure of the desire for further education among youths and girls who are arriving at years of discretion. The adult who, after a day's work in the workshop or office, devotes several hours a week to classes and preparation throughout a session shows by this very act that he has the spirit of perseverance and industry which leads to success. The number of such students is large—about 700,000—but when it is critically examined and compared with what it might be, the result is disappointing. After the first month or so of a session, when the novelty has worn off, there is a steady fall in the attendance at evening classes; and about 18 per cent. of the 700,000 students at the beginning fail to complete the small minimum of attendances—not more than fourteen hours—required in order to enable State grants to be paid toward their instruction. The average number of hours of instruction received by all enrolled evening students in the English county boroughs (including London) is fifty-eight, this number being about the same as that of the working periods in two weeks of ordinary school life. It is evident, therefore, that very many of the students who enter evening classes are not likely to receive instruction of any substantial value.

The great bulk of the work done in evening classes is of the continuation-school type; and it is with the juvenile students attending such classes that we are now particularly concerned. Nearly one-half of the students are under seventeen years of age, and this number—roughly 300,000—represents the position of continuation classes in England. The Board of Education estimates that the juvenile students attending evening classes do not make up more than 13 per cent. of the population between the ages of fourteen and seventeen, after making allowance for those still at elementary and secondary schools. The failure of the classes to attract anything like a sufficient proportion of the possible students is regretfully recognised by the Board as "one of the weakest links in the educational system of the country."

The voluntary system of continuation classes breaks down just when it is most needed. It is essential that children should attend such classes immediately upon leaving the day school, and not after several years' interval, as is usually the case at present. On account of this break of continuity, many evening classes are for adults who have forgotten their early schooling, and have to begin again with elementary subjects at a time when they want to take up technical studies with the view of advancement or of increased efficiency in their respective vocations. If most of the 223,000 students above twenty-one years of age attending evening classes had received suitable continuation education after leaving the elementary school, they would be capable of much higher work than is possible at present. The commonest complaint of teachers in technical institutes is that the students lack the basis of elementary knowledge upon which advanced technical instruction can be built; and the defect is largely due to the absence of a system of compulsory attendance at continuation classes. A few years ago the City and Guilds of London Institute, in conjunction with the Board of Education, took active steps to encourage the attendance of young persons engaged in different trades at evening continuation classes, with the view of their acquiring a competent knowledge of English, arithmetic, drawing, and elementary science before entering upon their first year's course of training in technology. Notwithstanding the establishment of group courses, and an increased grant for the attendance of students at evening continuation classes, it has not been found possible to insist upon evidence of attendance at such classes prior to the admission of students to a technical school. We have well-equipped technical institutes and colleges with teachers capable of giving instruction in the highest branches of specialised education, but most of the adult evening students, though familiar with the practice of their particular trades, are unable to take advantage of the instruction offered because they have forgotten what they learnt at school.

Advance in technical education properly so called is thus connected very closely with the problem of continuation classes; and the only satisfactory way of solving the problem is by a system of compulsory attendance at such classes from the time a boy or girl leaves the elementary school up to seventeen or eighteen years of age. The main difficulties are to decide when the classes should be attended, and to devise the means of enforcing attendance. Ought the hours of attendance to be in the day and within the number of hours of employment of young persons, or ought they to be taken out of the juvenile's own leisure time after the day's work is done? Some large firms make it a condition of employment of their apprentices that continuation classes should be attended for a specified number of hours weekly, but unless facilities are given for such attendance the objection can be made that the firms are increasing the number of working hours sanctioned by Acts of Parliament. It is not surprising, therefore, that trades unions have come into conflict with this system. Assembled representatives of labour, and of teachers, have on several occasions expressed their conviction that attendance at continuation classes should be counted as working hours under the Acts of Parliament limiting the hours of juvenile labour weekly. Only the most enlightened employers will be prepared to accept these conditions of continuation classes for the young persons in their employ, so that even when the principle of compulsory attendance is accepted the actual establishment of it in practice presents real difficulties.

Probably the most adaptable plan will be found in a modification of the system which has worked successfully in H.M. Dockyard Schools for many years. Apprentices in the dockyards have to attend school for twelve hours a week (two afternoons and three evenings). The Admiralty gives the apprentices seven and a half of these hours, and pays for this time as if it were spent in the workshop; the remaining periods have to be taken from the boys' own free time. Both employer and apprentice have thus to make some sacrifice; and the plan may well be taken as a model upon which a compulsory continuation-school system could be constructed.

This principle is embodied in the recommendations as to continuation schools drawn up by the education committee of the British Science Guild, and adopted at the last annual meeting of the guild. The recommendations represent the most practical scheme with which we are acquainted, and they are, therefore, here given in full:—

(1) Local education authorities should be required to make provision for the attendance up to seventeen years of age at suitably equipped continuation schools of all young persons above the age of fourteen years within their respective areas who are not otherwise receiving suitable education. In these schools, particular attention should be given to the continuance of manual and physical training commenced in the elementary schools, together with instruction having some relation to the occupations of the pupils.

(2) Employers should cooperate with local education authorities with the view of securing the attendance at continuation schools for at least six hours weekly during forty weeks a year of all young persons in their regular employment under seventeen years of age. As a practicable means of ensuring such attendance, it is suggested that the following conditions should be observed:—

(i) It should be illegal to employ any young person under seventeen years of age who is not in regular attendance at continuation classes for at least six hours weekly unless reasonable cause for absence be assigned.

(ii) In order to avoid undue strain upon young persons, after working the usual hours during the day, employers should grant them at least three hours a week out of the ordinary working hours for the purpose of attendance at continuation classes. It would, however, be most desirable where possible for employers to grant the whole six hours during the working day. Many young people would undoubtedly add evening hours of attendance, actuated by the desire for self-improvement.

(iii) The education authority should notify employers of any young persons in their employment who are not attending day or evening continuation classes for at least six hours weekly, in order that the employers may take the necessary steps to ensure attendance at such classes.

This scheme may not satisfy all the demands of extreme advocates of compulsory continuation schools, but it has the merit of reasonableness on its side, and its enforcement is well within the range of practical politics. It approaches the standard of requirement of continuation schools in many parts of Germany, where laws have been passed, and are in active operation, for the compulsory attendance for about 240 hours per annum, or six to eight hours a week, of all children who have left school, and until they are seventeen years of age, chiefly in day continuation schools, and within the hours normally devoted to labour; and its adoption would help to bring us in line with progressive educational movements abroad.

The most complete system of continuation schools on the Continent is at Munich, where every boy not attending a secondary or other day school is compelled to attend continuation classes for eight or nine hours weekly, in the daytime, for three or four years following the termination of the elementary-school course at fourteen years of age. Munich has an average of 330 hours annually for the pupils under instruction in the continuation schools, under a system of compulsory attendance. In the county boroughs of England the average number of hours of instruction in the evening schools is only fifty-eight, and in the administrative counties forty-nine, while, as we have seen, 18 per cent. of the students receive less than fourteen hours' instruction in the year, and not more than 13 per cent. of the young people between the ages of fourteen and seventeen are in attendance at continuation classes. In county boroughs (including London) the attendance at continuation classes is about 18 per cent. of the available juvenile population, and in administrative counties not quite 10 per cent.; but the ratio varies greatly, being only 5 per cent. or less in seventy-one county boroughs and forty-nine county areas.

The success attained at Munich is due to the intimate connection between the teaching and the trade of the pupils; and the provision of workshops and laboratories for practical work as the centre of the entire organisation. The continuation schools are of two types—a highly organised kind for youths between the ages of fourteen and eighteen years during their apprenticeship, at which they receive instruction in specific relation to their trades, and a central school for girls at which three years' attendance is compulsory after the close of the primary-school career. For every trade in which there are thirty apprentices to attend continuation schools, special classes are provided; and there are at present fifty-six of these trade schools, as well as twelve general schools. It is in this direction, namely, that of close relation between the occupation of the pupil and the work of the continuation school, that advocates of compulsory continued education in England may hope to obtain the cooperation of employers. Our trade preparatory schools, which are attended by boys from twelve to

fifteen years of age, who will afterwards be engaged in trade, represent roughly the type of school in which continuation classes can best be carried on.

It is useless to make continued education of primary-school pupils compulsory without the provision and adequate equipment of schools for practical instruction in close relationship with the occupations of the pupils. The schools should thus do something to relieve the monotony and extend the outlook of the young workman who, on account of the minute subdivision of manual labour, may spend his life upon one small detail of some product or process, and learn nothing beyond it. Industrial advance demands the production of intelligent and adaptable types of workmen; and practical continuation classes offer a means of training them which is impossible under modern conditions of manual work. Mr. J. C. Smail, organiser of trades schools for boys under the London County Council Education Committee, has recently studied in Germany the compulsory system of continued education for boys from fourteen to eighteen years of age; and we may appropriately give here a statement of the conclusions arrived at by him with regard to such schools, as they have a direct bearing upon the foregoing remarks, which were written before the report was published :—

(1) There has been, broadly speaking, a difference in ideals between Germany and Britain in the organisation of technical courses. Germany is aiming at benefiting the nation by training properly all the workers through definitely specialised courses. Britain has organised so that individuals may secure what they think best for their own advancement.

(2) The fundamental basis of any course of study for technical students must be their trade or employment. If this is recognised and acted on in the preliminary years from fourteen to eighteen there is little danger of work at more advanced stages, even if irregularly organised, being ineffective.

(3) Germany is aiming at making good citizens and has realised that a good citizen must be a good workman.

(4) Germany has come to believe that workshop training alone is insufficient to make a sound industrial nation; that it must be reinforced by adequate education specialised to trades.

(5) This specialised education must include specialised calculations, technology, drawing, and citizenship. Munich also believes in trade work in the compulsory schools, Berlin does not.

(6) Citizenship must be taught to enable the worker to recognise his individual position in the State, his position with respect to his employer and his fellow-workmen, his family and social duties, the relative position of his trade in his own country, and in the world's commerce and industry.

R. A. GREGORY.

CYTOLOGICAL ASPECTS OF HEREDITY.

THE current number of the *Quarterly Journal of Microscopical Science* (vol. lix., part 4) will be of exceptional interest to students of heredity from the cytological point of view. Dr. L. Doncaster contributes a very useful review of the present state of the evidence with regard to the material basis of hereditary transmission and sex-determination, under the title, "Chromosomes, Heredity and Sex." He concludes that the arguments in favour of the view that Mendelian characters are determined by chromosomes, though very strong indirectly, are lacking in direct evidence. The direct evidence of a relation between chromosomes and sex-determination is much stronger, and various cases are discussed. The phenomena of sex-limited inheritance, now known to occur in various groups of the animal kingdom, taken in conjunction with this relation, afford strong support to the view that the chromosomes play a very important part in the transmission of Mendelian characters, although the part played by the cytoplasm must also be taken into account. With regard to sex-determination difficulties arise in connection with the fact that this has been shown in certain cases to be modifiable by environmental conditions, and it therefore seems probable that the sex chromosome is associated with a particular type of cell-metabolism, which in turn is responsible for sex-determination.

A very important contribution to the discussion is made by Dr. R. R. Gates and Miss Nesta Thomas in "A Cytological Study of Œnothera mut. lata and Œ. mut. semilata in Relation to Mutation." These authors find that in the "mutants" of the evening primrose known as "lata" and "semilata," fifteen chromosomes always occur instead of the normal fourteen. The peculiar characters of these mutants are thus shown to be associated with the presence of an extra chromosome, which they are believed to have acquired by the abnormal distribution of both chromosomes of one pair to the same daughter-nucleus in the reduction division, the actual occurrence of such abnormal distribution having previously been demonstrated by Dr. Gates. The authors maintain that mutations and Mendelian hybrids are not of the same nature but must be contrasted with one another, the former owing their origin to germinal changes (*e.g.* the presence of an extra chromosome), and the latter to recombinations of the parental characters. Dr. Gates adds a useful note on the meaning of the term "mutation," and the difference between "mutations" and "fluctuations."

THE CURRENTS IN BELLE ISLE STRAIT.[1]

THE behaviour of tidal streams and currents in Belle Isle Strait, described by Dr. Dawson, Superintendent of Tidal Surveys to the Canadian Government, in a number of reports, the latest of which are before us, affords an example of the manner in which the various elements in a complex current may be distinguished one from the other. As the same may apply to other straits where the conditions are similar it should, therefore, be of more than local interest. The current in the strait is primarily tidal in character, and under normal conditions it will turn regularly; the flood running westward, and the ebb eastward with equal velocity. When, however, the moon is in high declination the resulting diurnal inequality causes one flood and one ebb in the day to be twice as strong as the other; the difference being much greater than that between ordinary or average springs and neaps.

In addition to the tidal fluctuations, the water has a tendency to make through the strait in one direction more than the other, thus causing a continuous gain to eastward or westward, as the case may be. The overbalance in one direction which is superimposed upon the usual tide elements to which the term element of *dominant flow* is given, introduces complications, because larger in relation to the strength of the tidal streams, especially at neaps when weak. It may, in fact, be so strong as to reverse the ordinary tidal streams or prevent them from turning, although the fluctuation in velocity be well marked.

The dominant flow, it is stated, cannot be attributed to local wind, because wind would produce merely a surface drift, whereas the dominant flow is that of the whole body of the water. It is, however, apparently

[1] The Currents in the Gulf of St. Lawrence. By Dr. W. Bell Dawson. (Ottawa: Government Printing Bureau, 1913.)

due to meteorological causes affecting, it is suggested, changes in the Labrador current or in the volume of water passing into the Gulf of St. Lawrence, occasioned by the distribution of barometrical pressure. The highest tides have been found to occur with winds from between north-east or north-west, and the lowest with winds from west or south-west.

The probable direction of the dominant flow may be inferred from the general weather conditions of the region, and from the presence or absence of floating icebergs in the strait; there being, as a rule, icebergs in the offing of the strait. With a dominant westward flow, bergs afloat in the offing will drift into the strait, whereas with a dominant eastward flow the strait is free from floating bergs; for the icebergs near either shore are certain to be aground and are therefore no guide; they may have been there for weeks. Even in the middle of the strait a berg, if large enough, may ground.

Briefly, the best indications are as follow:—The strait being clear of floating bergs, the barometer moderately high and rising or high and steady, a dominant flow to eastward is probable. There being floating bergs in the strait, and a barometric depression passing southward, indicated by broken weather, a dominant flow to westward is probable; and after a gale from north or north-west certain. The temperature of the water as an indication cannot be relied on.

On the whole the westward flow probably predominates in May and June; and, although less pronounced, the eastward flow is the more frequent in summer; while from September onwards the flow is more to the westward than to the eastward.

As regards the velocity of the current, when the moon is at its maximum declination and there is no dominant flow; at spring tides the strong flood and ebb velocity is 2·27 nautical miles; the weak flood and ebb 0·72 mile. At neaps, strong flood and ebb, 1·04 miles; weak flood and ebb, 0·32 mile. The greatest rates of dominant flow, observed during two seasons, considered separately, were:—Westward average, 1·69 nautical miles running continuously, but fluctuating from 2·65 miles to 0·64 with flood and ebb; eastward average, 1·30 miles to 0·50 mile with ebb and flood.

Under combined conditions the highest velocities observed were:—Westward during flood period, 3·45 nautical miles; eastward during ebb, 2·83 miles.

SUPERSTITIONS RELATING TO WEATHER.

IN an interesting article in the February number of *Himmel und Erde*, Prof. G. Hellmann, director of the Berlin Meteorological Institute, discusses some of the widespread notions generally included in the above heading. At the same time, he points out that some theories long believed in, although afterwards proved to be false, cannot be classed among superstitions.

The subject is divided into three parts, but we can here only refer to a very few typical cases. (1) That relating to the character and causes of meteorological phenomena. This takes us back to mythological times when all the forces of nature were personified; even to-day Jupiter Pluvius is frequently spoken of. Many of the present-day ideas still savour of superstition, *e.g.* the occurrence of thunderbolts, the *return* of a thunderstorm at a later time of the same day, and the belief in equinoctial gales. With regard to the latter, the author refers the idea to Greek and Roman origin, as such storms are prevalent in the Mediterranean regions.

(2) The possibility of predicting weather for any period. Many old sayings have been handed down from father to son; while most of them are based on unsound conclusions, some of them are good, *e.g.* the strengthening cold with lengthening days, the coloration of morning and evening sky, etc. Of modern sayings, that relating to the "ice-saints" (May 11–13) has been attributed both to cosmical and terrestrial sources. Investigations have shown that cold periods in May may occur in any of the three decades (especially the second), but cannot be referred to any special days. The moon's influence is still believed in by millions of people, notwithstanding the proofs given to the contrary.

(3) The possibility of influencing the weather and of making any special kind. This idea extends back to earliest times, and is still prevalent in some parts. One of the principal objects was the warding off of hail- and thunder-storms. Modern hail-shooting has proved to be ineffectual, but it will in all probability return later on in another form. The practice of bell-ringing for the prevention of thunderstorms was at one time much favoured, and is still in vogue in a few alpine districts. The belief in the possibility of making weather is very old, but its origin cannot be exactly fixed. Unsuccessful attempts at rain-making have frequently been made in recent times, but Europe appears to have been practically free from this superstition.

Prof. Hellmann's researches relating to the early history of meteorological questions are always very instructive; in this article he points out that at times it is not easy to draw a sharp boundary line between knowledge, belief, and superstition.

THEORIES OF ORE-GENESIS.[1]

THE subject of ore-genesis is of the greatest importance to the mining engineer, for it is evident that every forecast of the continuity of an ore-body beyond the limits of the ore in sight must, if it is not to be entirely empirical, rest on some hypothesis as to origin. This field of inquiry has since the beginning of this, and during the latter half of the past century, riveted the attention of the best mining geologists in all parts of the world. In a comparatively small interval of time, our knowledge has advanced by leaps and bounds, and many important principles governing ore-deposition have been firmly established.

It was, however, preceded by a long period, which, although fertile in suggestion and hypothesis, was not one of real progress because, contrary to the Baconian principle, "Non fingendum aut cogitandum sed inveniendum quid natura faciat aut ferat," the theories advanced were not founded on ascertained facts.

Prior to the sixteenth century the metallic contents of ore-veins were supposed to have been determined by their orientation in regard to the planets; and Agricola (1494–1555) was the first to formulate a reasonable genetic theory. Reduced to its simplest terms, Agricola's view was that ore-channels (*canales*), formed by erosion, had been filled by metallic minerals deposited from solution. These solutions, or juices (*succi*), as Agricola terms them, were waters of meteoric origin which, under the influence of heat, had taken mineral matter into solution.

From the time of Agricola to the end of the eighteenth century the mines of Saxony produced nearly all the writers on vein-formation. Such were Rösler, Becher, Henckel, Hoffmann, Zimmermann, von Oppel, von Charpentier, and von Treba.

Becher and Henckel, who wrote in the beginning

[1] From the presidential address delivered at the Annual Meeting of the Institution of Mining and Metallurgy, on March 26, by Dr. F. H. Hatch.

of the eighteenth century, supposed the metallic constituents of veins to have been produced by the action on pre-existing stony and earthy matters of subterranean vapours arising from certain processes of "fermentation" in the bowels of the earth.

In 1749 Zimmermann put forward a hypothesis which clearly had in it the germ of the modern theory of metasomatism. He ascribed the origin of veins to a transformation of the rocks into metallic minerals and their accompanying vein-stones, along certain directions now marked by the course of the veins, the solvents that effected the alteration finding a path through innumerable small rents and other openings in the rocks.

But Zimmermann applied his theory indiscriminately to explain the origin of all veins, including those that, by common agreement, are now considered to have been formed by the filling of fissures without replacement. Von Treba, in supporting Zimmermann's view, insisted particularly on the far-reaching changes effected in rocks by circulating waters, especially when aided by heat. "I am persuaded," he wrote in 1785, "that there is constantly going on in our mountains a variety of transformations, compositions, and decompositions, which not only take place at present, but will continue to the end of time."

According to Gerhard, who wrote in 1781, waters circulating through the rocks adjacent to a vein become charged with certain of the metallic and earthy substances contained in them. Passing through the crevices and interstices of the rocks to the larger rents and fractures, they deposit their mineral burden in cavities which, when filled, become veins. It will be seen that Gerhard's hypothesis must be regarded as a precursor of the more modern theory of *lateral secretion*.

To von Oppel belongs the credit of having shown that mineral veins were largely the filling of fault-fissures, a principle which up to that time does not appear to have been clearly recognised.

At the end of the eighteenth century the mining world was dominated in all matters relating to ore-genesis by the famous Freiberg professor, Abraham Gottlieb Werner, who insisted that all veins, including those that we now term "intrusive dykes," had resulted from the filling of contraction-fissures open above and connected with the primeval universal ocean, which according to the Wernerian doctrine covered the globe and contained in solution all the necessary materials for the formation of its crust. These waters, descending into the fissures from above, deposited the vein minerals by chemical precipitation.

This Neptunist view was in the beginning of the nineteenth century attacked and finally overcome by Hutton and his Plutonist or Vulcanist school. Unfortunately, however, the Plutonists went to the other extreme, and would not allow even ore-veins to have any other than an igneous origin: "The materials," wrote Playfair, "which fill the mineral veins were melted by heat and forcibly injected into the clefts and fissures of the strata."

But Hutton's broad generalisation, even with the important modifications of Elie de Beaumont, Daubrée, and Durocher to the effect that many of the metallic ores had been deposited from vapours and solutions emanating from cooling igneous magmas, was soon discarded in favour of the deposition from waters of meteoric origin; and an animated discussion was maintained for half a century on the respective merits of the *descensionist, ascensionist* and *lateral secretionist* theories; or, in other words, whether the mineral burden of the circulating waters instrumental in vein-formation was derived from superficial rocks, from deep-seated sources, or from the wall-rocks of the veins themselves.

The chief supporters of the modified form of the ascension theory here alluded to, which must, of course, be distinguished from De Beaumont's *ascension by emanation,* were Stelzner and Posepný. They argued that the ground-water (originating by precipitation from the atmosphere) descends by capillarity through the interstices of the rocks to deep-seated regions, and thus acquires a high temperature and pressure, and, consequently, a vastly increased solvent power, whereby in its passage through the rocks it is enabled to take up certain of the mineral substances there disseminated in a minute form. At a certain depth the water moves laterally towards open conduits, on reaching which it ascends towards the surface, depositing its mineral burden in proportion to the decrease of temperature and pressure.

It has been seen that the theory of lateral secretion, or the derivation of the mineral contents of veins by an aqueous leaching of the country rock, was advanced in a crude form as early as 1781 by Gerhard; but it remained a mere hypothesis without the support of ascertained facts until the middle of the nineteenth century, when the chemical work of Bischof, Forchhammer, and Sandberger definitely established two important facts in support of the theory, namely:—(1) That the gangue of ore-veins varies in correspondence with the wall-rock; and (2) that the heavy metals occur in minute traces in certain of the igneous and sedimentary rocks constituting the "country" of ore-veins.

Sandberger's researches were specially directed to prove that the heavy metals (gold, silver, copper, lead, etc.) are contained in the common ferro-magnesian silicates (namely, the micas, hornblendes, and augites) of the igneous rocks; and having satisfied himself on this point he was led to extend his investigations to the sedimentary rocks, with the result that small quantities of the heavy metals were found in the sediments of all ages, and especially in the slates of the older systems. Whether, however, they are there present as constituents of sporadic fragments of ferro-magnesian silicates derived from igneous rocks, or as sulphides that were introduced during the secondary mineralisation connected with ore-deposition, was not satisfactorily settled by Sandberger's researches. The more recent work of Don, carried out on a great variety of material, tends to show that the ferro-magnesian silicates do not carry gold or silver in amounts determinable by chemical analysis. Where the rocks examined by him were found to contain these metals they were present as a constituent of sulphides, such as iron pyrites, pyrrhotite, mispickel, chalcopyrite, and galena, which in most cases are secondary introductions.

But long before this the inapplicability of lateral secretion as Sandberger conceived it had become apparent; and the theory became the subject of vigorous attack on the part of Stelzner and Posepný.

Lateral secretion, in a much more extended sense and in combination with the ascension theory, is advocated by Van Hise. Van Hise's view may be briefly summarised thus: the meteoric waters, after penetrating the surface, are widely scattered through the rocks in innumerable small openings as they travel downward to great depths in the earth's crust. With steadily increasing temperature and pressure they take up mineral matter. The downward movement ultimately develops a lateral component, by which the waters are carried to the larger openings. During this process, also, the waters continue to take material into solution. In the larger openings the waters ascend with decreasing temperature and pressure, and there the ores are deposited.

It will be seen that this view is a combination of the ascension and the lateral secretion theories, and

presupposes the existence of a continuous sheet of water in circulation between the ground-water level and the lower limit of the "zone of fracture," no circulation being admittedly possible in the underlying "zone of flowage." The weak point in Van Hise's assumption of a "sea of underground water" lies in the fact that deep mines are usually found to be dry, the drainage being confined to the upper levels. This, for instance, is the experience in the copper mines of Lake Superior, in the gold mines of the Rand, and in those of Bendigo. Van Hise, in reply to this criticism, attributes this dry zone to the closing of the passages by cementation; but the restriction of the ground-water circulation is equally fatal to the meteoric derivation of deep-seated thermal springs and other phenomena connected with vulcanicity.

In recent years there has been a partial reaction to igneous views. Thus certain classes of ore-deposits are now held to have been formed by a *differentiation of igneous magmas* prior to consolidation. Such, for instance, is the origin ascribed to certain titaniferous iron-ores in basic eruptives, chromite in peridotites, nickeliferous pyrrhotite in norite, and primary platinum in ultra-basic rocks. Similarly pegmatites, and even some quartz-veins, are considered to have originated by the consolidation of the aqueo-siliceous residuum of a slowly cooling granite magma.

But more important in its application to ore-deposition than *magmatic differentiation* is the theory which Vogt has founded on the metalliferous emanation hypothesis, by which Elie de Beaumont and Daubrée sought to explain the origin of tin-ore deposits. According to the *pneumatolytic* theory, certain *agents minéralisateurs*, such as fluorine, chlorine, sulphur, phosphorus, silicon, and boron, have the property of forming with the metals volatile compounds, which escape from the granite-magma as gases with low critical temperatures (the *aura granitica* of Elie de Beaumont). These compounds ascend through already formed fissures in the overlying rocks, or force their own passage by attacking the minerals that compose them. In this manner, for instance, cassiterite, wolfram, tourmaline, fluorspar, topaz, beryl, axinite, datolite, apatite, etc., are deposited either in the granite itself, or in the sediments comprised within its metamorphic aureole.

Closely connected with pneumatolysis in the rôle ascribed in ore-deposition to the so-called *magmatic waters*, a term that has come into use for water not of atmospheric origin, but dissolved or occluded in some way in molten magmas, from which it separates by liquation and distillation on the fall of temperature and pressure. In it are concentrated the substances that (at the existing temperature) are more soluble in water than in the silicate magma.

Suess, in an address on the Karlsbad springs, delivered in 1902, directed attention to the connection existing between thermal springs, vulcanicity, and ore-deposition. He applied the term *hypogene* or *juvenile* to thermal springs (like those of Karlsbad) which, originating in the depths of the earth's crust, bring water to the surface for the first time. Such hot springs are, in fact, the last survivors of vulcanicity, being the relics of a late stage of fumarole activity. Their mineral content comprises readily soluble compounds of the alkalies and alkaline earths, together with, and partly in combination with, sulphur, chlorine, and carbon dioxide, the less soluble metallic compounds having already been deposited as ores at lower depths in the earth's crust. According to Suess the after-products of eruption vary with the temperature; in the earlier (pneumatolytic) *phases of emanation* the gases are dry and their deposits (such as tin-ore and its accompanying boron, fluorine, tungsten, and uranium minerals) are the products of sublimation. At a later period, strongly alkaline magmatic waters are given off, and to these are attributable the *sulphide* and *arsenide phases* of vein-formation, *e.g.* the deposition of iron pyrites, chalcopyrite, primary bornite and chalcocite, enargite, galena, blende, etc.

But although, as we have seen, waters of meteoric origin have been displaced from their pride of place as agents of deposition for what we must term the primary sulphide ores, they are undoubtedly the formative agents for a considerable number of ore-deposits, including the products of oxidation, chlorination, and reduction above the permanent water level, and the secondarily enriched ores usually found immediately below the junction of the zone of oxidation with the zone of primary sulphides. So important are the functions of the vadose waters (to use Posepný's term for the shallow water circulation) in dissolving and redepositing at a lower level the ores of copper in a concentrated form, that it has been confidently stated that the bulk of the copper production of the world, not alone in the past, but also at the present time, is drawn from the zone of secondary enrichment. This view will, perhaps, appear exaggerated in the light of the results recently obtained by Sales at Butte; but for the majority of the great copper deposits of the world it may still pass unchallenged.

In the same way, vast deposits of high-grade iron-ore have been formed as the result of secondary enrichment, but under entirely different conditions from those that determine copper-ore enrichment. Thus the hæmatite ores of Lake Superior are believed by Van Hise to have been derived by the oxidising and concentrating action of vadose waers, from a low-grade cherty iron carbonate originally deposited under water as a chemical sediment; and he draws the important conclusion that "the ore-bodies cannot be expected to extend beyond the depth to which the descending waters may bear oxygen and precipitate iron oxide." He has "no doubt that vastly more high-grade iron-ore will be taken out in the Lake Superior region above the 1000-foot level than below it." If this be true, the iron-ores of that district, with more than 60 per cent. of metallic iron, are not inexhaustible.

The enrichment of gold-ores also takes place in the zone of oxidation; but in their case the action of the vadose waters results in an abstraction of the more soluble and less valuable metals, leaving behind a smaller quantity but a relatively richer material; in other words a diminution of the specific gravity of the whole material raises the gold tenor. Furthermore, there is also an increase in the fineness of the gold, due to the removal of a portion of the silver with which it is alloyed. The Mount Morgan mine in Queensland is a good instance of a gold-ore enrichment brought about by the vadose circulation; here the oxidation of a pyritic copper lode with subordinate gold has, by the removal of the sulphides of iron and copper, led to the formation of an upper zone of cellular quartz, in which the increased ratio of gold to vein-stuff was the *vera causa* of the richness of one of the premier gold mines of the world. But, as with increasing depth the mine-workings are extended below the oxidation-zone, the copper production is becoming more important than the gold yield.

The Witwatersrand Banket is another example. In this case the primary ore is auriferous iron pyrites disseminated in a quartz-conglomerate on which intense silicification during cementation has impressed the character of a quartz vein. The removal of the pyrites from the zone of oxidation, which extends to 200–300 ft. below the surface, left an enriched free-milling ore that gave marvellous returns on the amalgamation plates of the first Rand mills. Since the

exhaustion of this high-grate, free-milling ore early in the history of gold mining on the Rand, the mines have been worked in low-grade unoxidised pyritic ore; and this has shown a gradual but steady impoverishment with increasing depth—a fact which supports the view that the gold of this deposit was precipitated by ascending thermal waters in proportion to their loss of temperature and pressure.

One of the most remarkable advances in the science of ore-genesis during the period under review is the recognition of the important rôle played by metasomatism in the formation of ore-bodies. The fact that the rocks adjacent to vein-fillings often contain small quantities of metallic ores similar to those composing the veins themselves, or are altered for some distance away from them, was observed at an early date; but its significance was very differently interpreted. The lateral secretionists pointed on one hand to ore-disseminations in the wall-rocks as indicating the source of the vein-filling, and on the other, to the

Classification of Ore-Deposits.

Nature of Deposit	Vehicle or Agent of Ore-Deposition					
	a. Molten Magmas	*b.* Gases and Vapours above their critical temperatures	*c.* Deep-seated waters, whether of magmatic or meteoric origin	*d.* Vadose Waters	*e.* Mechanical Agents such as moving water and wind	*f.* Chemical and Bacterial Agents in seas, lakes and swamps
1. IGNEOUS DIFFERENTIATES.	*Certain Massive Iron and Nickel Ores associated with basic igneous intrusions* (*e.g.* those of Sudbury in Ontario).					
2. CAVITY-FILLINGS.	*Injected Tin-Ores* (*e.g.* tin-pegmatites and tin-elvans on the margin of granite intrusions.	*Pneumatolytic Cavity-fillings* (*e.g.* tin quartz veins).	*Hydato-genetic Cavity-fillings* (many fissure veins).	*Superficial Fracture-fillings*, such as gash-veins in limestones and cavity-fillings (*e.g.* the hæmatite-ores of Cumberland).		
3. METASOMATIC REPLACEMENTS.		*Pneumatolytic Replacements* (*e.g.* tin-greisens and many contact-deposits).	*Hydato-genetic Replacements.* (Many veins and massive deposits, also the Rand Banket).	*Some Lead and Zinc Ores* in *limestones. Iron-ores replacing limestones* (*e.g.* Cleveland). Some *lateritic iron* and *manganese deposits. Secondary enrichments of copper ores.*		
4. STRATIFIED DEPOSITS.			*Possibly some Sedimentary Deposits in which the cementing materials are ores of the metals.*	*Some Lead and Copper Ores interstitial in sandstones and shales.*	*Mechanical Concentrates in bedded deposits* (*e.g.* gold and platinum placers, stream-tin, iron-sands, detrital laterites and other metalliferous gravels and sands).	*Chemical and Bacterial Sediments* (*e.g.* lake- and bog-iron ores; clay-ironstone and other sedimentary siderites; bog-manganese-ore and other sedimentary manganese ores).
5. RESIDUAL DEPOSITS.				*Mantle-deposits e.g.* pisolitic and nodular ores of iron (Bilbao and Appalachian hæmatites and limonites of manganese (psilomelane) and of aluminium (bauxite).	*Eluvial Gravels formed near the outcrop of veins* (*e.g.* those of gold, cassiterite and wolfram, galena and zinc-ores).	

alteration of these rocks as a concomitant of the leaching that collected the filling material. But the ascensionists, whether belonging to the school of Elie de Beaumont and Durocher or to that of Stelzner and Posepný, recognised that the solutions from which the materials of the lode were precipitated, whether gaseous or liquid, also penetrated the walls and there caused certain deposits in the rock itself—metallic ores taking the place of some other mineral dissolved, as, for example, when cassiterite forms pseudomorphs after feldspar in the granite country of tin-veins. Much evidence favouring the latter view has since been accumulated. Thus Posepný described in 1873 the replacement of carbonate of calcium by carbonate of zinc in the Raibl deposits; and Pumpelly in the same year attributed the origin of the native copper of the famous Michigan deposits to metasomatic processes.

In 1881 Emmons showed that the Leadville silver-lead deposits had been formed by the replacement of limestone by galena, blende and pyrites, an alteration which, although chemically complete, left untouched the granular texture, joints, and other structural features of the original limestone. He pointed out that the resemblance of the altered rock to limestone was so perfect that, when the faces of the drifts were covered with dust, the observer was often completely deceived until the breaking of a fresh fragment with the hammer revealed the metallic gleam of galena beneath.

In a later paper he showed that many so-called fissure veins were not true cavity-fillings, but owed their origin to the metasomatic replacement of the rock material by substances brought in by solutions circulating along fault-fissures, through crush-zones or in sheeted zones. In such cases a vein may be formed by the replacement of the material enclosed between adjacent parallel fractures, true cavity-filling being only of a restricted character. Owing to the difference in character between replaced sheets of country rock and the filling of the fissures that divide them, deposits formed in this way sometimes possess a banded structure, which, however, is distinguishable from the normal "crustification" of vein-fillings. The whole subject has been admirably reviewed by Lindgren and by J. D. Irving in their well-known papers, in which will be found many illustrations of the potency of metasomatic processes in vein-formation.

Modern views on ore-genesis may be reduced to two principal lines of inquiry, one dealing with the agent or vehicle by which the metals have been collected, conveyed to, and deposited in the places where they are now found, and the other with the nature of the concentrates formed in the course of these processes.

Considering the latter first, ore-deposits are found to be either:—(1) Igneous differentiates; (2) cavity-fillings; (3) metasomatic replacements; (4) stratified or sedimentary deposits; (5) residual deposits. Of these, the sedimentary deposits comprise marine, lacustrine, and fluviatile accumulations, including placers.

Coming now to the agents or vehicles of ore-concentration, these are found to be:—(*a*) Molten magmas; (*b*) gases and vapours above their critical temperature; (*c*) deep-seated waters, whether of magmatic or of meteoric origin; (*d*) vadose waters; (*e*) chemical and bacterial agents in lakes and seas; (*f*) mechanical agents, such as moving water and wind.

It is possible, by combining the facts elicited by these two lines of inquiry, to formulate a genetic scheme of classification. For example, cavity-filling may be due to igneous injection, to gases and vapours above their critical temperatures, to deep-seated waters, or to vadose waters; again, metasomatic replacement may be brought about by gases and vapours, by deep-seated waters, or by vadose waters. By arranging these two series of relationships in vertical and horizontal columns respectively, all the various types of ore-deposits are obtained at their intersections; and in this way the classification shown in the table on p. 179 is obtained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced in *Science* that provisions for the creation of a trust fund, said to be approximately 100,000*l*., for the maintenance of male graduates of the Williamsport, Pa., high school at Cornell University are made by the will of Mr. A. D. Hermance. From the same source we learn that Mr. E. Palmer, a Princeton graduate, has offered to build and present to Princeton University a stadium costing 60,000*l*. Mr. Palmer is a son of the late Mr. Stephen S. Palmer, who was for many years a trustee of Princeton University, and gave large sums to the University, including the Palmer Physical Laboratory.

MANY important recommendations are made in the report of the Royal Commission on the Civil Service just issued as a Blue-book (Cd. 7338). It is proposed to abolish the grades known as the Second Division, the Intermediate Class, the Assistant Clerks, and the Boy Clerks, and to substitute for them a new class, to be known as the Junior Clerical Class, to be recruited at the age of sixteen, at which many boys leave the public secondary schools. Another new class recommended is the Senior Clerical Class, to be recruited at the age of eighteen. In both cases the examinations for appointments in these grades are to be brought into close relation with the work of the schools. Other recommendations are:—(1) Greater facilities should be provided, especially in England and Ireland, for the progress from the primary to the secondary schools, and thence to the universities, of pupils capable of benefiting by secondary and university training respectively. (2) There should be closer coordination between the educational systems of the country and the Civil Service Examinations, and to this end the Treasury and the Civil Service Commissioners should consult more freely and systematically than hitherto with the Departments of Education before framing examination schemes. (3) The principle of open competition should be adhered to, and whenever it is applicable, extended. (4) The competitive examinations for recruiting each class of officer, administrative and clerical, should be adjusted in respect of the age of competitors and the subjects of competition to the stages of the educational system actually existing in the country. (5) The examinations should be directed to testing the natural ability of candidates, and the results of their education both with respect to acquirement of knowledge and the formation of mind and character. It should not be directed to testing proficiency in particular subjects which lie outside the normal scope of education.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, April 2.—Dr. A. Smith Woodward, vice-president, in the chair.—W. **Rushton**: Structure of the wood of Himalayan Junipers.—W. B. **Turrill**: A contribution to the flora of Fiji.—Prof. C. **Chilton**: A new Amphipodan genus and species (family Dexaminidæ) from New Zealand.—Prof. E. B. **Poulton**: Mr. W. A. Lambourn's breeding experiments upon *Acraea encedon* (Linn.), Poulton, in the Lagos district of West Africa, 1910–12.

DUBLIN.

Royal Dublin Society, March 24.—Dr. J. H. Pollok in the chair.—Prof. John **Joly**: The local application of radium in therapeutics. The method now very often adopted in treating malignant growths with radium or its emanation is to introduce the radio-active substance, heavily screened with lead, into the tumour. This is a wasteful method, as the lead screen causes a loss by absorption of from 25–30 per cent. of the rays. The use of the screen is, however, necessary in order to cut off the more easily absorbed rays which otherwise would produce injurious effects close to the tube. If tubes containing much smaller quantities are used, screening need not be resorted to. One strongly charged tube may be replaced by a number of small ones, if the latter are in the convenient form of ordinary exploring needles. In conjunction with Dr. W. C. Stevenson the author has worked out a system enabling such needles to be charged with any required quantity of the emanation sealed into capillary glass tubes. By the use of these radio-active needles local injury is avoided, and a more controllable and uniform radiation is attainable. They can be made of any required length to reach more deep-seated tumours. An apparatus was exhibited permitting any desired number of capillary tubes to be sealed off at once, each containing a known charge.

PARIS.

Academy of Sciences, April 6.—M. P. Appell in the chair.—Paul **Sabatier** and A. **Mailhe**: The use of manganous oxide for the catalysis of acids. The preparation of aldehydes and pentamethylene ketones. Formation of the *cyclo*pentylamines (see p. 171).—R. de **Forcrand**: Potassium trioxide and the stability of the alkaline peroxides. Pure potassium trioxide can be obtained by heating the tetroxide to 580° C., the pressure being maintained at about 1 mm. The heats of solution and formation of the trioxide were determined.—G. **Charpy** and S. **Bonnerot**: Iron nitride. Iron in very thin foil, heated in a current of ammonia at 650–700° C., can be completely converted into the nitride Fe_2N. At higher temperatures the nitride dissociates, and it does not appear possible that this nitride could exist in the steel or iron of commerce.—A. **Schaumasse**: Observations of Kritzinger's comet (1914*a*) made at the Observatory of Nice. Positions are given for March 30, 31, and April 4.—Paul **Bruck**: The elements of comet 1914*a* (Kritzinger).—P. **Chofardet**: Observations and calculation of the parabolic elements of Kritzinger's comet (1914*a*) made at the Observatory of Besançon. Positions are given for March 31 and April 4.—J. **Guillaume**: Observations of Kritzinger's comet made at the Observatory of Lyons. Positions given for March 31 and April 4.—M. **Esmiol**: Observations of Kritzinger's comet made at the Observatory of Marseilles. Observation on April 4.—M. **Coggia**: Observations made at the Observatory of Marseilles on the same.—P. **Salet** and M. **Millochau**: The spectra of the chromosphere. The Stark effect due to the possible influence of the solar electric field is either absent or very small in the sun.—B. **Fessenkoff**: The distribution of the cosmic dust in the invariable plane of the solar system.—Arnaud **Denjoy**: Examples of derived functions.—A. **Buhl**: The integral form of the equations of Monge-Ampère.—A. **Hurwitz**: The critical forms of the inverse functions of integral functions.—Paul **Lévy**: The functions of Green and Neumann.—M. **Hadamard**: Remarks on the preceding paper.—G. H. **Hardy**: The zeros of the Riemann function $\zeta(s)$.—M. **Moulin**: The terminal curves of spirals: influence of the terms of the second order.—H. **Bourget**, Ch. **Fabry**, and H. **Buisson**: The atomic weight of nebulium and the temperature of the nebula of Orion. The strong double ultra-violet line λλ 3726, 3729, is attributable to no known gas. From a spectroscopic study by interference methods the atomic weight of the element, named nebulium, is found to be about 3. The temperature of the nebula is of the order of 15,000° C.—Maurice **Drecq**: The determination of the emissive power in the infra-red. Details of the construction of a very sensitive silver-bismuth thermocouple and of a new form of furnace for giving high black-body temperatures are given.—Jean **Bielecki** and Victor **Henri**: Contribution to the study of tautomerism. A quantitative study of the absorption of the ultra-violet rays by fatty diketones. The constitution admitted for the second tautomeric form of acetylacetone, $CH_3.CO.CH:C(OH).CH_3$, is incompatible with the absorption spectra. A more probable constitution is $CH_3.CO.CH_2.C(OH):CH_2$.—A. **Portevin**: The carbon equilibrium of steels in fused mixtures of potassium chloride and cyanide.—R. **Devisé**: The microsporocytes of Larix.—L. **Massol**: The effects of snake poisons on the coagulation of the serum of the horse by heating. Differentiation of the poisons of Viperideæ and Colubrideæ. The effects of cobra poison are consistent with the view that it contains two diastases with contrary actions, one retarding and the other accelerating the coagulation.—Mme. Victor **Henri**: Study of the metabiotic action of the ultra-violet rays. The production of forms of mutation of the anthrax bacillus. The exposure of spore-bearing anthrax bacilli to ultra-violet light causes profound changes in the organism. The surviving bacilli are transformed into new forms distinguished from normal anthrax bacilli by their morphological, biochemical, and biological characters.—Louis and Charles **Fortineau**: The treatment of anthrax by injections of sterilised pyocyanic cultures. An account of the treatment of nine cases of malignant œdema and forty-one of malignant pustule by subcutaneous injection of sterilised pyocyanic cultures: the mortality was reduced to 10 per cent.—Em. **Bourquelot** and Alexandru **Ludwig**: The biochemical synthesis of *β-ortho*methoxybenzylglucoside and of *β-meta*nitrobenzylglucoside. These syntheses were effected with the aid of emulsin in aqueous acetone solutions.—Adrien **Guébhard**: The tectonic in the neighbourhood of Castellane (Basses Alpes).—Sabba **Stefanescu**: The origin of the cuneiform sheets of the molars of elephants.—Henri **Bresson**: Eight hydrographical maps of the Normandy region.

BOOKS RECEIVED.

Australian Fossils. By F. Chapman. Pp. 341+map. (Melbourne and London: G. Robertson and Co. Propy., Ltd.)

Canada. Department of Mines. Mines Branch. Annual Report on the Mineral Production of Canada during the Calendar Year 1912. Pp. 339. By J. McLeish. (Ottawa: Government Printing Bureau.)

Der Geist des Hellenentums in der modernen Physik. Antrittevorlesung gehalten am 17 Januar 1914 in der Aula der Universität Leipzig. By Prof. A. E. Haas. Pp. 32. (Leipzig: Veit and Co.) 1.20 marks.

An Account of the Crustacea of Norway. By G. O. Sars. Vol. vi., Copepoda. Parts 3 and 4, Cyclopidæ (continued.) (Bergen: The Bergen Museum.)

Simple Directions for the Determination of the Common Minerals and Rocks. By Prof. W. H. Hobbs. Pp. 31. (London: Macmillan and Co., Ltd.) 1*s.* net.

Botanische Jahrbücher. Fünfzigster Band. Supplement-Band. Fest-Band für A. Engler. Pp. 672+xi plates. (Leipzig and Berlin: W. Engelmann.) 55 marks.

The South African Institute for Medical Research. Specific Serological Reactions with Pneumococci from

Different Sources. By F. S. Lister. Pp. 14+plate+charts. (Johannesburg.) 2s. 6d.

London County Council. Trade and Technical Education in France and Germany. Pp. 47. (London: P. S. King and Son.) 1s.

Physiological Plant Anatomy. By Prof. G. Haberlandt. Translated from the fourth German edition by M. Drummond. Pp. xv+777. (London: Macmillan and Co., Ltd.) 25s. net.

The Golden Bough. By Prof. J. G. Frazer. Third edition. Part iv. Adonis, Attis, Osiris. Vol. i. Pp. xvii+317. Vol. ii. Pp. x+321. (London: Macmillan and Co., Ltd.) Two vols., 20s. net.

Science and Method. By H. Poincaré. Translated by F. Maitland. Pp. 288. (London: T. Nelson and Sons.) 6s. net.

Board of Agriculture and Fisheries. Agricultural Statistics, 1913. Vol. xlviii. Part 1. Acreage and Live Stock Returns of England and Wales, with Summaries for the United Kingdom. Pp. 119. (London: H.M.S.O.· Wyman and Sons, Ltd.) 6d.

Defensive Ferments of the Animal Organism. By E. Abderhalden. Third enlarged edition. English translation by Dr. J. O. Gavronsky and W. F. Lanchester. Pp. xx+242. (London: J. Bale, Ltd.) 7s. 6d. net.

Ornamental Lathework for Amateurs. By C. H. C. Pp. 121+xxii plates. (London: P. Marshall and Co.) 3s. 6d. net.

Klimatographie von Kärnten. By Prof. V. Conrad. Pp. 139. (Vienna: Gerold and Co.)

Echinoderma of the Indian Museum. Part viii.

DIARY OF SOCIETIES.

THURSDAY, APRIL 16.

CONCRETE INSTITUTE, at 7.30.—The Design of Steel and Reinforced Concrete Pillars with special reference to Secondary and Accidental Stresses; O. Faber.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on Mine Survey Records and Calculations: C. G. Priest and W. Whyte.—Collecting and Handling Flue Dust: E. Huntley.—A Description of a Portion of Equatorial Africa: H. W. Hill.

FRIDAY, APRIL 17.

MALACOLOGICAL SOCIETY, at 8.—Notes on Australian Mactridæ: E. A. Smith.—On the Generic name Martensia, Semper: Some more notes on Polyplacophora. I.: T. Iredale.—Description of a new recent Pholadomya from Tasmania: C. Hedley and W. L. May.—Description of a New Helicoid from South Australia: G. K. Grude.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—A Few Typical Carburetters: R. S. Fox.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Royal College of Science), at 10 a.m.—The Organism of Common Potato Scab. (*Actinomyces scabies.* (Thaxter) Güssow): H. T. Güssow.—Potato Diseases: A. S. Horne.—Insects causing Blotch on Potato Foliage: A. S. Horne and H. M. Lefroy.—Standard Fungicides and Insecticides: A. G. L. Rogers.—Observations on *Aphis rumicis*: J. Davidson.—The Golf Green Fly: A. W. Westrop.—Observation on the Winter Stage of the American Gooseberry Mildew. (*Sphaerotheca mors-Uvae*): E. S. Salmon.—The Darkening of Oak: P. Groom.—The Phytopathological Conference: A. G. L. Rogers.—Apple and Pear Sucker: P. R. Awati.—An Experiment in House Fumigation: H. M. Lefroy.—Life-history and Habits of *Aleurodes vaporariorum*: E. Hargreaves.

SATURDAY, APRIL 18.

ASSOCIATION OF ECONOMIC BIOLOGISTS, at 10 a.m. (*See Papers under April 17.*)

MONDAY, APRIL 20.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Lines of Future Development in High Power Diesel Oil Engines: J. Richardson.

VICTORIA INSTITUTE, at 4.30.—The Latest Discoveries in Babylonia: Dr. T. G. Pinches.

TUESDAY, APRIL 21.

ROYAL INSTITUTION, at 3.—Problems of Physical Chemistry. I. Study of Matter at High Pressures: Dr. W. Wahl.

ROYAL STATISTICAL SOCIETY, at 5.—Rural Population in England and Wales A Study of the Changes of Density, Occupations and Ages: Dr. A. L. Bowley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* The Transportation Problem in Canada, and Montreal Harbour: F. W. Cowie.

ZOOLOGICAL SOCIETY, at 8.30.—Further Contributions to the Anatomy of the Ophidia: Surg. J. C. Thompson.—Crustacea from the Falkland Islands Collected by Mr. Rupert Vallentin. II: Rev. T. R. R. Stebbing.—Report on the Arachnida and Myriopoda Collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: S. Hirst.—The Coloration of the African Hunting Dog (*Lycaon pictus*): Major J. Stevenson Hamilton.—Notes on *Aristeus goldiei*, Macleay, and on some other Fishes from New Guinea: C. Tate Regan.—The Courtship-habits of the Great Crested Grebe (*Podiceps cristatus*); with an Addition to the Theory of Sexual Selection: J. S. Huxley.

WEDNESDAY, APRIL 22.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1913: J. E. Clark and R. H. Hooker.—A Small Anemometer for Tropical Use: A. J. Bamford.

FARADAY SOCIETY, at 8.—Recording Pyrometers: C. R. Darling.—The Embrittling of Iron by Caustic Soda: J. H. Andrew.—Diffusion and Membrane Potentials: Dr. E. B. R. Prideaux.—The Acidic and Colloidal Properties of Aluminium Hydroxide: Dr. R. E. Slade and W. G. Polack.—"Negative" Absorption: A. M. Williams.

THURSDAY, APRIL 23.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The East African Trough: J. Parkinson.

CHILD STUDY SOCIETY, at 7.30.—Raising the Standard of Child Upbringing Rev. J. C. Pringle.

CONCRETE INSTITUTE, at 7.30.—Sand and Coarse Material and Proportioning Concrete: J. A. Davenport and Prof. S. W. Perrott.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrification of Railways as affected by Traffic Considerations: H. W. Firth.

FRIDAY, APRIL 24.

ROYAL INSTITUTION, at 9.—The Stars around the North Pole: Dr. F. W. Dyson.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—A Visit to the Iron Districts of French Alsace: G. Evetts.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Application of Electrical Driving to Existing Rolling Mills: L. Rothera.

SATURDAY, APRIL 25.

ROYAL INSTITUTION, at 3.—Similarity of Motion in Fluids. I. The Theory of Similarity of Motion in Fluids and the Experimental Proof of its Existence: Dr. T. E. Stanton.

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