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PROGRESS OF THE STEAM TURBINE.

Steam Turbine Design. With especial reference to the Reaction Type, including chapters on Condensers and Propeller Design. By Dr. J. Morrow. Pp. viii + 471 + chart. (London: Edward Arnold, 1911.) Price 16*s.* net.

Marine Steam Turbines. (Forming the Supplementary Volume to "Marine Engines and Boilers.") By Dr. G. Bauer and O. Lasche; assisted by E. Ludwig and H. Vogel. Translated from the German and edited by M. G. S. Swallow. Pp. xvi + 214 + entropy chart. (London: Crosby Lockwood and Son, 1911.) Price 10*s.* 6*d.* net.

The Steam Turbine. The Rede Lecture, 1911. By Sir Charles A. Parsons, K.C.B. Pp. iii + 57. (Cambridge: University Press, 1911.) Price 1*s.* 6*d.* net.

THE literature of steam turbines grows apace. This growth is seen to be natural enough when one considers the immense developments which have taken place in prime movers of the type during recent years, as well as their varied applications for land and marine purposes. On land, steam turbines are now almost universally preferred to reciprocating engines for electric generating stations; while low-pressure turbines are largely utilised—as auxiliaries to reciprocating engines—in iron works, factories, and engineering establishments. One of the most notable developments in modern mechanical engineering consists in the adoption of methods for utilising heat which had previously been wasted in carrying on manufacturing processes. In this endeavour to secure increased economy the steam turbine has played a great part, although its successful applications have unquestionably been greatly assisted by the work of electrical engineers. The fundamental principle of this increased economy is found in the capability of steam turbines, especially those of the "reaction" type, to carry the expansion of steam much further than is practically possible with reciprocating engines. Superheating, higher vacuums and greatly improved arrangements for condensing steam have necessarily had to be devised in order that the full efficiency of turbines might be realised; and it is worth noting that these advances have not only produced beneficial results in association with the use of steam turbines. Their range of usefulness has been much wider, and has affected the economical use of earlier types of reciprocating engines, both afloat and ashore.

Marine engineering has benefited quite as much as, if not more than, mechanical engineering on land from the introduction of steam turbines. It is indeed a simple statement of fact to assert that steam navigation could not have reached its present position had not steam turbines been introduced. This statement applies to the largest and swiftest ocean passenger steamers, to the latest battle-ships and battle-cruisers, to fast cross-channel and coasting steamers, and to the wonderful little craft classed as the "torpedo flotillas" of modern war-fleets. When such a revolution has been effected, and further advances are in progress, it is, as was said above, quite natural that text-books and treatises on steam turbines should be multiplied in number, and multiplication has been attended by greater specialisation of treatment in successive publications.

The first and second of the three volumes now under notice have been issued with the distinct intention of serving as text-books for men actually engaged in the design of steam turbines. In both these books is contained a clear, yet brief, statement of thermo-dynamical principles underlying designs of turbine machinery; but the authors have assumed that readers desiring to master these principles will turn to existing text-books in which the subject has been treated thoroughly, and in a fashion adapted to the needs of students.

Dr. Morrow is lecturer in engineering at the Armstrong College, Newcastle-on-Tyne; and, as everyone knows, the Tyne was the birthplace of the Parsons type of turbine. In the hands of Sir Charles Parsons and his licensees in the Tyne district, this type of machinery has been manufactured on a gigantic scale; but it is right to add that the Tyne district in no sense stands alone in its acceptance and use of steam turbines. In the circumstances it is natural to find the author devoting by far the greater portion of his book to the "reaction" type of steam turbines, and to the Parsons type in particular. "Impulse" turbines are also dealt with briefly, but students must turn to other works for full details of their designs. The characteristic features of Dr. Morrow's book are clearness of description, excellence of illustration, a wealth of examples of methods and details of design, and a strict regard for fundamental principles. Dr. Morrow concludes his preface with the remark that "in a work containing so much original matter, the author cannot but feel that errors of judgment and mistakes in details will be found"; and he invites readers to favour him with corrections and suggestions. This is the attitude which an author ought to assume in such

a case; and later editions will benefit therefrom. Taking the book as it stands, it will undoubtedly prove of much use to men who are engaged in the design of steam turbines. For that reason it will be likely to find a large circulation, although it is probable that its interest will not be limited to engineering draughtsmen and students.

The second volume in our list is a translation of a German book on "Marine Steam Turbines," issued as a supplement to a treatise on "Marine Engines and Boilers," which one of the authors published a few years ago, and which has also appeared in an English translation. The author of this earlier work (Dr. Bauer) is the director of the great marine engineering works at Stettin. Mr. Lasche, who is joint-author with Dr. Bauer, is a director of the Allgemeine Electricitäts Gesellschaft (better known as the A.E.G.) works in Berlin. Both these gentlemen have had large experience in the design and construction of steam turbines of various types, and they have been interested in the application of the A.E.G. turbine and the American Curtis turbine to the generation of electricity and the propulsion of ships. The present book, however, relates entirely to marine steam turbines, and the greatest prominence is naturally given to that class of turbine with which the authors have been mostly concerned. They very properly point out that only these two types of marine steam turbines and the Parsons type have as yet been practically tried on a large scale. As a matter of fact, the Parsons type has been used in by far the greater number of turbine-driven ships yet constructed. The Curtis type has been hitherto its only real competitor in the United States, and in Germany the A.E.G. type is being steadily developed for marine purposes. Proof of the relative progress of the Parsons type up to date is found in the circumstance that in the two huge Atlantic steamers now building in Germany for the Hamburg-American Steamship Company, and in all the largest and swiftest armoured cruisers built or building for the German fleet, that type is still preferred.

The general line of treatment followed by Dr. Bauer and Mr. Lasche closely resembles that adopted by Dr. Morrow. The book is of a very practical character, giving methods of calculations and examples of the application of those methods to the design of details of steam turbines of various types, the settlement of the dimensions of shafting and propellers, and the arrangements of condensing apparatus. It will have special interest for English readers as coming from a German source, and containing a considerable amount of information in regard to German practice. In size, the book is only about half as large as that noticed above. It is exceedingly well produced, and very tersely expressed, the authors stating their own conclusions on many points where differences of opinion prevail, without entering into elaborate arguments in support of those opinions. No objection need be taken to this method of treatment; in fact, it has distinct advantages for the men who are expected to be the principal users of the volume; but it is necessary to note that in many points, especially in those where comparisons are made between British and German or American types of turbines, the opinions expressed by the writers are not shared by no less competent authorities. In some cases the endeavour to compress statements within narrow limits has been accompanied by what, no doubt, is an unintentional omission of important facts. These, however, may be regarded as minor blemishes on what is, on the whole, a good performance; and there can be no doubt that such a book will naturally find a place on the shelves of all who are interested in the design of steam turbines, representing as it does the experience of two leading German engineers.

The third book in our list is a slender volume of less than sixty pages, in which the Rede Lecture for 1911 by Sir Charles Parsons is reproduced. The authorities of Cambridge were fortunate enough to secure, on this occasion, a lecturer who is one of the most distinguished living graduates of the University, and to find him ready to describe the principal features of his own great invention, as well as those of competing types of steam turbines.

This little book contains a wealth of illustrations, an epitome of the history of the progress of steam turbines, and a summary of the matured opinions of the man who knows most about that class of prime movers. Sir Charles Parsons has set down in modest and simple fashion his main conclusions on a subject of which he is the acknowledged master. The utterance is itself but a brief summary of facts and opinions; consequently, it is impossible even to mention its main points in this review. All who are interested in the subject should read the book itself, and its low price ought to ensure for it a large circulation.

One characteristic feature of the book, however, deserves mention. Throughout his references to types of turbines which have been originated by other inventors, the author displays great fairness of judgment and a generous appreciation of merits possessed by machines which are in competition with turbines designed by himself. Sir Charles Parsons has thus taken a course differing from

that which many inventors have followed when dealing with the work of rivals; in doing so, he has added—if that be possible—to the high reputation which he had previously acquired as an engineer. W. H. W.

INFERIOR RACES.

The Mind of Primitive Man. By Franz Boas. A Course of Lectures delivered before the Lowell Institute, Boston, Mass., and the National University of Mexico, 1910–11. Pp. xi + 294. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* 6*d.* net.

A FAMOUS psychological novelist has asserted that racial differences are irreducible, and that even when love unites two members of distinct races their life, however harmonious, is lived over a slumbering volcano of hate. There is a popular fallacy that racial antipathy is based on physiological foundations. But in so far as such antipathy is real, there is nothing physiological in its causation; and its emotional strength depends on the law that the more automatic and unconscious a habit is, the greater is the displeasure felt and the disgust aroused by infractions of the habit. The most plausible form of this racial habit is one which even scientifically trained minds find it difficult to transcend. This is the attitude of superiority consciously or unconsciously adopted by civilised men towards the semi-civilised, and among the civilised by the so-called Caucasian race. As Prof. Boas puts it, "Proud of his wonderful achievements civilised man looks down upon the humbler members of mankind." The European looks down on the civilised Oriental. The point of interest, however, is that he claims to be of a higher type, possibly physical, but certainly psychical, on the assumption that achievement depends solely upon aptitude for achievement.

In these lectures, delivered before the Lowell Institute and the National University of Mexico, the main thread of Prof. Boas's argument is that this assumption and this claim of superiority of type are unproven. In support of his argument he employs data from the whole field both of physical and of social anthropology, and the resulting exposition of the salient features of difference between the civilised and the primitive types of man has the advantage of the author's first-hand experience and personal investigation.

He notes that the ancient civilisation of the Old World, not essentially superior to that of the New, reached its height 3000 years earlier for accidental reasons. He explains the European aptness for civilisation as not necessarily due to superior faculty. Due regard is had to heredity and environment, and several confusions of thought on the subject are cleared up. In reference to environment, his own remarkable observations are introduced, namely, that the American-born children of European immigrants (European-born) respond at once in a curious way. The short, dark-haired, and longheaded Sicilian loses in stature; the head increases in width and loses in length, becoming brachycephalic. The medium-sized, short-headed native of Central Europe gains in stature and in narrowness of head. The tall, long-headed European of the north-west grows taller.

The observation made by Fritsch on the Bushman is applied generally to man. Europeans, for instance, are to savages as domesticated animals are to wild. Their bones, that is, become, though heavier, less solid and less slender; their structure is more open. The mental change in domesticated animals is undoubted. Modifications of type, physical and mental, he concludes, are largely due to the progressive domestication of man incidental to the advance of civilisation.

The author's discussion and explanation of the causes and results of variation within a race, brief though they are, supply the most convincing theory that has yet appeared. The whole question of permanence and variation of type, in fact, is treated in a masterly way.

The ordinary view of the mental deficiencies of the "inferior races" is remorselessly criticised. The lowest savage *does* possess self-control. He is not improvident, but rather optimistic. He *can* concentrate his mind. He possesses originality. Savages who do not count beyond three or ten easily adapt their language and intellect to civilised methods of reckoning. The same is the case with abstract and general ideas, as Prof. Boas has himself proved by experiment. The point is that these civilised methods are not needed in the primitive state, where each man on a war-expedition is known by name, though the number of the troop may not be reckoned.

Both in mind and in body there is little to choose between the ordinary barbarian and civilised man. The thesis is applied to a practical purpose in the last lecture, the question of the influence of the negro and of the European immigrant upon the type of the American citizen. No one interested in this or in other racial questions can afford to pass over this most sane and scientific critique. The whole volume is conspicuous both for balanced reasoning and for brilliance, and as a practical application of anthropology is of the first importance.

A. E. Crawley.

APPLIED CHEMISTRY.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, C.B., F.R.S. Assisted by Eminent Contributors. In five volumes. Vol. i. Revised and enlarged edition. Pp. viii+758. (London: Longmans, Green and Co., 1912.) Price 45*s.* net.

IT will be remembered that the first edition of Thorpe's "Dictionary of Applied Chemistry" appeared in 1890, when the great "Watts" was at the same time abridged and edited by Dr. Foster Morley and Mr. Pattison Muir. Since that time it has served as a standard reference book, and has had a most useful life. But in a subject so progressive as applied chemistry, twenty-two years are a very long period, and the call for this new edition has been imperative. It is very characteristic of Sir Edward Thorpe's inexhaustible energy and enterprise, that on the eve of his retirement from his official position—a time when most men would be looking for some leisurely occupation—he should undertake a task which might daunt the most vigorous of his juniors. We have reason to know that his editorship has been of the most active and real kind. We have heard from many sides of an almost inexhaustible flow of autograph letters of courteous but insistent character, addressed to gentlemen who, in some cases, were looking with unstable resolutions on approaching holidays; and we have seen on proof-sheets the track of the same pen constraining the exuberance of a contributor's verbosity. We feel sure that all chemists will unite in their admiration of Sir Edward Thorpe's achievement, and in acknowledgment of the latest of many great services which he has rendered to his time and generation. We may be permitted to anticipate that on his retirement he will return to the field of scientific biography, where he has accustomed us to look to him for work of such rare excellence.

The new edition of the dictionary is both revised and enlarged, and the five volumes, which are to replace the original four, will evidently constitute, as the editor says, practically a new book. The scope of the work has also been extended so as to include articles on important topics that are not strictly those of applied chemistry.

The list of contributors to the first volume fully justifies the satisfaction which the editor expresses in regard to the collaboration he has secured, and certainly the chief value of a dictionary of applied science must arise from the cooperation of genuine experts who are able and are at liberty to speak from personal knowledge and experience. In the present volume we have this very notably before us. Dr. G. H. Bailey writes on aluminium, Mr. Bertram Blount on cement, Dr. Colman on ammonia, Dr. Hübner on bleaching, Prof. Lewes on acetylene, and Dr. T. K. Rose on assaying. Mr. L. J. Spencer deals with a number of minerals.

Among the organic subjects we have various series of colouring matters dealt with by Prof. W. H. Perkin, Mr. A. G. Perkin, and Dr. Cain. Mr. A. D. Hall writes on cereals, Dr. E. F. Armstrong on bread and carbohydrates, Mr. C. F. Cross on cellulose, Mr. John Heron on brewing, Dr. Lewkowitsch on various oils and fats, and Mr. Stubbs on butter. Prof. Senier treats of a number of drugs, and there are also articles on topics of chemical physiology by Prof. Halliburton, and of agricultural chemistry by Mr. Herbert Ingle.

Germany is represented by Dr. O. N. Witt, who has an article on azines. Miss Beatrice Thomas and Dr. M. A. Whiteley are important lady contributors. Among articles lying a little outside the main current is an admirable one on chemical affinity by Dr. J. C. Philip, whilst the old and valuable article on the balance by the late Prof. Dittmar is reprinted.

Special mention must be made of an article on analysis by Dr. G. T. Morgan, with a supplementary one on electrochemical analysis by Dr. F. M. Perkin. These occupy a hundred pages, and constitute, indeed, an excellent, compact treatise. The only fear is that it may be rather lost in a dictionary, and this is the only important case where the present writer has been struck with any disproportion in the allotment of space.

It is, of course, not to a general dictionary that anyone engaged in a branch of applied chemistry will go for detailed information on his own subject, but it is of great service to have concise and authentic summaries of other people's subjects, and this requirement is admirably met in the work under review. A comparison of the new articles with those of the original edition has convinced the reviewer, in those cases where he is at all competent to form an opinion, that the revision has been thoroughly carried out. Such a comparison gives a vivid impression of the great advances which have been made in chemical industry; see, for example, the manufacture of aluminium and acetylene.

In concluding this notice with renewed congratulations to the editor on his success in producing a most serviceable dictionary, we must allow a word of acknowledgment to the rank and file of workers, who have contributed a vast amount of indispensable information on minor

topics. The binding of the book is strong, plain, and apparently durable; the edges of the leaves are coloured with the lurid pigment usually indicative of specially pious literature. Perhaps, however, it will mellow rapidly in chemical surroundings. S.

AGRICULTURE IN THE SCHOOL AND AFTERWARDS.

Beginnings in Agriculture. By Albert R. Mann. Pp. xii+341. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

Dairy Cattle and Milk Production. Prepared for the use of Agricultural College Students and Dairy Farmers. By Prof. Clarence H. Eckles. Pp. xii+342. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7*s.* net.

IT is universally agreed by all who have considered the subject that the education of the child ought to have some relation to the surroundings among which its life will be passed, and that, in consequence, the education of the country school should be directly connected with country life and the great rural industry. In America this principle has long since been translated into practice—how completely is best seen by the flood of agricultural books issuing each year from the publishing houses—and we have in the first of these volumes an illustration of how it was done in a particular case.

Wherever reformers have tried to make rural education fit country life, the question has sooner or later cropped up: Ought agriculture to be taught in schools? and this speedily raises another: Can agriculture be taught in schools? Mr. Mann's little book is a serious attempt to show that a great deal can be done to educate the American child through the experience that it has, or can easily get, of farm life, and, further, that the thing can be done without doing any violence to the exigencies of village school conditions or assuming too much from the teacher. That he has achieved a certain measure of success is undeniable; how much can only be ascertained by actual use in a school.

Setting out with the assumption, probable enough throughout wide areas of the western States, that the child is a member of a new community the older members of which broke up the prairie, the author begins with a history of a typical community and shows the interdependence of the various sections. But of all the members the farmer is the most important, because he is the producer of food and of clothing material. Hence farming is an honourable occupation; it has, besides, many collateral advantages over other professions. But if it is to be done properly it must be well organised. The farm should be laid out so that the farmer will lose little time in getting to his work, and can take full advantage of natural features specially adapted to any particular treatment. Further, the farm should be attractive and beautiful, with a "neat and picked-up appearance," to use the author's expressive Western phrase. So much for generalities; the author then passes on to deal with the special factors in agriculture, the farm plants, the soil, and the animals. Liberal use is made of photographs, and at the end of each chapter a number of problems are set for the scholars to work out, some arithmetical, some observational, and some experimental. Thus the child is taught to observe and to think—in other words, he is educated—and at the same time he learns to think in terms of country things and acquires a stock of knowledge that cannot fail to be helpful to him afterwards. He is shown that country life and country work are interesting, and he has their other attractive features put before him in a very pleasing way.

The book will prove interesting to educationists in this country who are seriously studying our rural educational problems, and it will be appreciated most by those who have some knowledge of the American child, with its strangely serious outlook on life and its premature realisation of its responsibilities.

Prof. Eckles's book on dairy cattle deals with a specialised branch of agriculture in a manner well suited to the requirements of the advanced student. The animals described in detail are Holsteins, Jerseys and Guernseys, Ayrshires, and Brown Swiss as pure dairy cows, and Shorthorns as dual-purpose cows. A short but sufficient history of the breed is followed by an account of its chief characteristics and typical requirements. Photographs of good pedigree animals are given, and finally a score card is set out showing the number of marks to be allotted to each of the various points in estimating relative values. This feature is specially useful. The score card is a well-recognised method of instruction in the States, where it has repeatedly justified itself by its results; one or two teachers of agriculture have adopted it in this country also, and wherever it has been tried it has been found advantageous. Anything, therefore, that popularises so useful an instrument is to be commended.

A good deal of attention is devoted to feeding. The author considers it safe to say that "the yearly average milk production per cow could be increased one-half or three-fourths by following

better methods of feeding." The importance of sufficient food is emphasised, but the author might have dealt even more fully with this point. As the dairy industry advances, cowkeepers increase their rations, until, in districts where the industry is very highly developed, as in many parts of the home counties, they tend to give too much food for *profitable* milk production.

It has been shown by experiment that an increase in the quantity of the ration leads to an increased production of milk, but the return obtained per unit of food becomes less and less, and finally is not worth as much as the food costs.

The great difficulty about dairy farming in the States seems to be the labour supply. "The special objections raised to the labour on the dairy farm are the long hours, the steady, regular work, and the nature of the work." The same difficulty is felt in British agriculture, and to meet it machinery is being invented. Strenuous efforts are being made to perfect the cow-milking machine, which will considerably ease matters.

E. J. RUSSELL.

ALGEBRAIC NUMBERS.

The Elements of the Theory of Algebraic Numbers. By Prof. L. W. Reid. With an introduction by Prof. D. Hilbert. Pp. xix+454. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 15*s.* net.

IT is almost a misfortune that Gauss and Smith were such consummate masters of mathematical style. Nearly everyone who writes on an arithmetical topic is tempted to imitate them, at least in their brevity and severe deductive method, and the result is that many are frightened away from a delightful study because of its dry, and, so to speak, inaccessible aspect.

Prof. Reid's book ought to do much to remove this misapprehension; he has assumed no previous knowledge of the subject beyond elementary arithmetic, and he has been careful to give a very large number of special examples, as well as discussions of special fields. Thus the reader is able to see, much more than is usually possible, the really inductive character of arithmetical research, and is provided with material on which he may make experiments of his own.

As an introduction to the general theory of algebraic numbers, the work follows mainly the treatment of Hilbert and Dedekind; the principal difference from the latter being that, for instance in a quadratic field, an ideal (α, β) is (ultimately) defined as the aggregate of integers $\lambda\alpha+\mu\beta$, where λ, μ are any two integers in the field, and α, β are given integers therein. This saves a good deal of rather delicate reasoning, necessary if Dedekind's own definition of an ideal is adopted, and detracts little, if anything, from the naturalness of the sequence of theorems.

After four chapters dealing with the ordinary rational theory (including the law of quadratic reciprocity), we have four others, each devoted to a special quadratic field, namely, those derived from $\sqrt{-1}$, $\sqrt{-3}$, $\sqrt{2}$, $\sqrt{-5}$ respectively. In the last of these it is made perfectly clear how the law of resolution into prime factors appears to break down, and how it is restored by the introduction of ideals. Moreover, examples are given to show the distinction, in this field, between principal and non-principal ideals.

The next four chapters give general theorems on algebraic numbers, a discussion of the general quadratic field, its discriminant and ideals, and the theory of congruences with respect to ideal moduli in such a field.

Finally, there are two chapters, of a rather more advanced kind, on the units of the general quadratic field, and on the number of its ideal classes. In the latter use is made of Minkowski's remarkable theorem that every ideal class contains an element whose norm does not exceed $|\sqrt{d}|$, where d is the discriminant of the field. Prof. Reid has elsewhere published a list of classes of cubic fields calculated on the same principle; but the work is tentative and laborious, and it is still a desideratum, even for cubic fields, to determine, by some simple method, the fundamental units and representatives of each ideal class. Fortunately, however, in working with an ideal, any one of its forms will do in using it as a modulus, finding its prime factors, and so on: just as (6, 9) or (6, 9, 27) define 3 (as a greatest common measure) just as well as 3 itself for purposes of this kind.

It is very gratifying to see that the higher arithmetic is attracting more and more attention, and it is certain that books like Prof. Reid's will greatly help to popularise "the queen of the sciences," as Gauss so affectionately called it.

G. B. M.

A HISTORY OF EUROPEAN CULTIVATED PLANTS AND DOMESTIC ANIMALS.

Kulturpflanzen und Haustiere in ihrem Uebergang aus Asien nach Griechenland und Italien sowie in das übrige Europa. Historisch-linguistische Skizzen von Victor Hehn. Achte Auflage. Neu herausgegeben von O. Schrader. Mit botanischen Beiträgen von A. Engler und F. Pax. Pp. xxviii+665. (Berlin: Gebrüder Borntraeger, 1911.) Price 17 marks.

VICTOR HEHN'S book, the result of years of labour, first appeared in 1870. A second edition was called for in 1874, to which the essay

on the horse was added, and in which replies to critics fill most of the preface. A third edition was issued in 1877, a fourth in 1883, and a fifth in 1887. Hehn died on March 21, 1890, leaving his book in the hands of Prof. O. Schrader, editor-in-chief of the three editions which have appeared since that date.

The work opens with a long extract from the preface to the sixth edition, from which the above particulars have been taken. In nearly a quarter of a century (1870–94) knowledge had increased greatly, and many additions and corrections were necessary. Herr Schrader addressed himself to his task on the lines laid down by De Candolle. To cope with the botanical work became the duty of Prof. Engler, assisted later by Prof. Pax, of Breslau. With regard to the sections treating of domestic animals, the editor called in the help of Prof. A. Nehrings. The general revision and philology were Prof. Schrader's special care; but he is very ready to acknowledge help received from Dr. Kurt Muller, Dr. Hugo Prinz, and others.

All additions and corrections are placed, in small type, at the end of each essay. The adoption of this plan was no doubt due to respect for Hehn's work. Even then the method is a bad one, and the present writer cannot see anything in Hehn's original text to warrant such respect. To a reader coming fresh to the book it is somewhat irritating, and causes waste of time. The writer of this notice worked carefully through the essay on the horse, making critical notes, only to find that the editors had made all necessary corrections in their notes placed at the end of the section. Articles dealing with domestic animals are scattered about among those dealing with cultivated plants. No fewer than ninety-nine pages are occupied by original "notes"—pp. 531–629. This adds another drawback to the work. Either the reader must turn away from the page to the "note" at once, breaking the thread of attention, or the "notes" must be left to be read later, when it may easily happen that the point referred to is not clearly remembered. The book contains a good table of contents and a satisfactory index.

In the introduction we get a record of the good and harm that man may work upon virgin soil. The early Aryan invasion found Greece thickly forested and with a fruitful soil. Much harm was subsequently done by exhaustive cultivation and destruction of forest. Such ruined areas recovered partly when deserted, often to pass through similar stages as is recorded by Fraas, in 1847, of parts of the peninsula. About one hundred cultivated plants are dealt with, the most important being the vine, olive, fig, citrons, plums, almonds, flax, hemp, maize, rice, and tobacco. Of the domestic animals—a more limited class—an almost complete account is given. In the original text, and in all subsequent additions, the authority for borrowed statements is given with scrupulous care. If genius is taking pains—a definition ascribed to Sir Isaac Newton—Victor Hehn was a genius. That his work needed correction as the years went by is to be expected. The work has been well done, and the line quoted by Prof. Schrader is well applied:—

"Was fruchtbar ist, allein ist wahr."—GOETHE."

J. H. T. W.

GENERAL SCIENCE.

Introduction to General Science, with Experiments. By Percy E. Rowell. Pp. xxix+302. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

THE author of this book has a great belief in what he calls general science, which apparently amounts to a slight knowledge of many sciences. A pupil who knows a little about a great many subjects will, he considers, be able to obtain a bird's-eye view of the whole ground of knowledge, and to reason from many points of view on the phenomenon of nature. Further, a general course of this kind should reach every pupil somewhere and stimulate his ambition to learn more of at least one subject. Thus in the three hundred or so pages of this little volume we find sections devoted to almost all known sciences, illustrated by 100 experiments, with cross references to a large number of text-books and bulletins.

To say that the book is sketchy, incomplete, and not infrequently inaccurate is to make an obvious criticism applicable to any book of this kind. At the same time one must feel sympathy with the object of the author and admiration for his courage in tackling so formidable a list of subjects and writing about them. He usually confines himself to applications of science to the common things of daily life, and does not concern himself with great generalisations. A few experiments on combustion thus lead to oxygen, then to fuels, and so by easy transitions to blasting, animal heat, flames, first aid to the burnt, sterilisation, disinfectants, &c., throughout the book. Indeed, as the author says with some

pride, the course may be commenced anywhere, and it will always lead to a study of all science. The only danger the author sees is that the teacher may specialise in some particular part that he likes and knows something about; unless this temptation is resisted the course ceases to be general. In order that the pupil should be kept up-to-date, he must be urged to get the "bulletin habit," and to obtain as fast as they appear the very numerous publications of the Department of Agriculture.

Reaction was bound to set in sooner or later against the specialisation that has of late years characterised science teaching in many schools, and the book before us is one of the fruits of this reaction. Whilst we do not think that the author has found the final solution of the difficulties connected with the problem, we distinctly like his plan of utilising the experience of the child for all it is worth in the science course.

OUR BOOKSHELF.

South African Zoology. A Text Book for the use of Students, Teachers, and Others in South Africa. By Prof. J. D. F. Gilchrist. Pp. xi+323. (Cape Town and Pretoria: T. Maskew Miller. Pietermaritzburg and Durban: P. Davis & Sons, n.d.) Price 10*s.* 6*d.* net

THE object of this book, as stated in the preface, is "to give illustrations of the South African fauna with special reference to the more familiar forms, for the benefit of students of nature study, as well as the agriculturalist." Dr. Gilchrist, therefore, has a fine opportunity of replacing the hackneyed examples that have done duty so long in zoological teaching by Ethiopian types. In this, however, the book is disappointing. The European *Rana temporaria, Hydra, Bougainvillea, Aurelia,* the liver-fluke, the beef tapeworm, the common *Lumbricus terrestris,* the cockroach, the snail *Helix aspersa,* the dogfish, rabbit, and pigeon are once again employed for descriptive purposes.

It is a more pleasing task to point out the share devoted to African animals in this work. The section upon insects is in this respect the best in the book, the accounts of the locusts, termites, and ants being particularly interesting. The ticks are briefly considered, but the spiders are summarily dismissed. An African crawfish, Palinurus, is described as an introduction to the Crustacea. The life-histories of certain African parasitic Protozoa are also given. The African vertebrates, however, are only briefly referred to; the antelopes, for example, are not described, though their distribution is given. Incidentally, a number of interesting points are mentioned, *e.g.*, the use of the ascidian Polycarpa as a bait in seafishing, the habits of the rain-frog in burrowing into the nests of ants and termites, and the almost entire absence of eels from the westerly-flowing rivers.

More bionomical information would have been valuable. For example, we are not told anything about the habits of African Annelids, whereas the introduced forms are referred to at some length. Dr. Gilchrist's experience as an officer of the South African Fisheries investigations must have made the marine fauna of the Cape very familiar to him, but we are unable to form any picture of the common objects of the Cape shores. The book has been carefully revised, but the irritating forms "Rhodent" and "Rhodentia" are surely an oversight. An excellent index has been compiled for this work, which is illustrated throughout.

Physiology. By Prof. W. D. Halliburton, F.R.S. (Dent's Scientific Primers. Edited by Dr. J. Reynolds Green, F.R.S.) Pp. xi+176. (London: J. M. Dent and Sons, Ltd., n.d.) Price 1*s.* net.

IN this volume Prof. W. D. Halliburton "aims at presenting the main facts of modern physiology in an elementary way and in language as free from technical terms as possible." In a sense, he has succeeded in this aim. The facts are nearly all there, crowded into 167 pages of excellent and not very small type, with many illustrations, and the language is not obtrusively technical but has an appearance of simplicity. Technical language, however, is a species of shorthand, and in compressing into so small a space without its aid all that Prof. Halliburton considers main facts, there is an inevitable loss of real intelligibility. Without some rigorous selection a book of this size tends to become a succession of statements hardly assimilable by a mind not previously acquainted with the subject, and so of little educational value. Yet the work is obviously intended for students extremely junior, not so much in age as in knowledge. It is not, indeed, quite obvious what public the author seeks to reach, but perhaps we may be guided by such remarks as those on the "need for diligent use of the tooth-brush, . . . tooth-powders are not to be recommended," and "it is hardly necessary for me to preach to readers the necessity for temperance in the use of alcohol." The complete absence of any reference to the reproductive system of either sex—a remarkable omission in a scientific primer on physiology—may perhaps be also taken as an indication that here we have "popular" science of a familiar kind.

Colour-Music. The Art of Mobile Colour. By Prof. A. Wallace Rimington. Prefatory Notes by Sir Hubert von Herkomer, M.V.O., and Dr. W. Brown. Pp. xx+185. (London: Hutchinson and Co., 1911.) Price 6*s.*

IT is difficult to give a fair impression of the value of this book. Its author obviously lacks scientific training (hence the inclusion of a chapter "on some scientific opinions") and adequate knowledge of the "laws" of colour mixture; he fails to

describe the apparatus and the methods he employs with sufficient detail; his acquaintance with the psychology of æsthetics is defective; the analogies which he presses between tones and colours are unsound. Yet, despite these manifest shortcomings, the book is to be welcomed as the sincere attempt of an enthusiast, who has spent much time and money on his hobby, to give the world some idea of its interest and of its value. No doubt, seeing is here verily believing; but it is easily imaginable, as Sir Hubert von Herkomer states, that to sit at the author's "instrument and improvise for half an hour whilst watching the ever-varying combinations of colour on the screen produced by the playing is not only an unspeakable delight, but of real health-giving effect on the sense of colour." Apart from his absurd division of spectral colours on the basis of our musical scale, "the main advantages of colour-music as an art" would, as the author rightly says, "remain unaffected, and the force of the chief arguments, which can be advanced in support of it as a separate and distinct art, would not be weakened in the least." It is, as we have said, impossible to describe such æsthetic enjoyment; one must experience it. C. S. M.

Annals of the Royal Botanic Garden, Calcutta. Vol. xii., Part i.:—"Asiatic Palms—Lepidocaryeæ." By Dr. Odoardo Beccari. Part ii.:—"The Species of Dæmonorops." Vol. i., Letterpress. Pp. vii+237. Price Rs. 8 or 12*s.* Vol. ii., Plates. Pp. vii+109 plates. Price Rs. 39 or 2*l.* 18*s.* (Calcutta: Printed at the Bengal Secretariat Press, 1911.)

THE appearance of the first portion of Dr. Beccari's monographic account of the Asiatic Lepidocaryeæ, devoted to the genus Calamus, was recorded in NATURE of August 12, 1909. It affords us pleasure to announce now the appearance of a second instalment of this great work, dealing with the genus Dæmonorops, which, like Calamus itself, consists of "Rotangs," and, among the genera of Palmeæ, is only less important than Calamus because it includes a smaller number of recognisable forms.

The methods and the style adopted in the treatment of the previous genus have been followed in the case of Dæmonorops. These have already been noticed in detail, and, therefore, do not require further discussion. The ample descriptions and excellent illustrations are equal in merit to those in the earlier contribution, and this further instalment of the author's monograph places systematic students once more under a great obligation to him and to the Calcutta Botanic Garden, of the "Annals" of which it forms part. All who are interested in palms will look forward with interest to the conclusion of the task on which Dr. Beccari is engaged, and to which, as the two contributions already at our disposal testify, he has devoted himself with such patient enthusiasm and so great a fund of accurate knowledge.

LETTERS TO THE EDITOR.

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

The Principle of Reflection in Spectroscopes.

THE application of a reflector to pass light back through a prism, or prisms, is usually ascribed to Littrow. Thus Kayser writes ("Handbuch der Spectroscopie," Bd. I., p. 513), "Der Erste, der Rückkehr der Strahlen zur Steigerung der Dispersion verwandte, war Littrow" (O. v. Littrow, *Wien Ber.*, 47, ii., pp. 26–32, 1863). But this was certainly not the first use of the method. I learned it myself from Maxwell (Phil. Trans., vol. 150, p. 78, 1860), who says, "The principle of reflecting light, so as to pass twice through the same prism, was employed by me in an instrument for combining colours made in 1856, and a reflecting instrument for observing the spectrum has been constructed by M. Porro."

I have not been able to find the reference to Porro; but it would seem that both Maxwell and Porro antedated Littrow. As to the advantages of the method there can be no doubt. RAYLEIGH.

Acquired Characters and Stimuli.

IN my letter in NATURE of March 21, I pointed out the fact that Dr. Archdall Reid does harm by declaring that the term "acquired characters" as ordinarily used by biologists is not intelligible (is, in fact, nonsensical), giving as his reason that all characters are acquired. That is a "quibble," because the term used by Lamarck (which has been translated as "acquired characters") is "changements acquis," and it is abundantly clear that the *change* spoken of by Lamarck is a change from the normal characters of a wild species. Such normal characters may be, of course, described as "acquired" when considered in comparison with those of the germ from which an individual develops. But that is not the comparison made by Lamarck or by anyone else who uses his term or the English modification of it, and it is a perversion of fact to pretend that it is. It is the plain fact that the *acquired changes* indicated by Lamarck are *changes* as compared with the *normal characters* of the species. There was no allusion in my letter to the terms "innate characters" or "congenital characters." They, of course (as Dr. Reid says), do not mean the same thing as "congenital variation." Dr. Reid in condemning them is beating a mannikin dragged in by himself, diverting attention from the matter in hand. The "acquired changes" or "acquired characters" of Lamarck are properly contrasted with normal characters and not with Dr. Reid's imaginary congenital characters. Considerations as to whether the blacksmith's arm or that of an ordinary man is "normal" are not to the point, since Lamarck was concerned with wild species of plants and animals, of which the "normal specific form" and the "normal specific environment" are understood and known in some detail.

Nor is Dr. Reid justified in attempting to limit the influences under which "acquired changes" or departures from normal specific form are developed to "use and injury." A variety of factors of the en-

vironment, not to be described as use or injury, but broadly classed as excess or defect of heat, light, strain, moisture, chemical constituents of food, may set up in an organism changes of growth, structure, and function of the most striking and obvious character, greatly in excess of the apparent magnitude of the responsible factor. Take, for instance, such cases as that of the rest-harrow grown in dry upland as contrasted with that grown in moist meadowland.

I also objected (and do so again) to the loose use of the word "stimulus" in this connection by Dr. Reid. A particular, definite, measurable agent setting up by its action on living matter a reaction is, in biological terminology, said to stimulate that living matter, and both it and its immediate action are called "a stimulus." The exact nature of the stimulating activity, whether set up by this or that chemical substance, by this or that fluctuation of light, heat, or by electrical conditions, is stated with precision, and its amount and duration compared with the effect on the living matter. To call the nutrition—the normal, persistent nutrition of a growing seed or young plant—"a stimulus" is inadequate and misleading. A good deal of analysis is omitted by so doing. When nutrition, the necessary normal supply of chemical materials in the presence of which a seedling grows and unfolds or develops its specific qualities, is described baldly as "a stimulus," whilst a slicing cut, removing a man's ear and leaving a growth of scar tissue in its place, is also dismissed as "a stimulus," it is obvious that two things profoundly different in character and importance are confused under a common heading. The first is the absolutely essential and widely distributed condition for the continued existence of a living thing; the second is exceptional—an abrupt change with correspondingly exceptional result. Neither is correctly described as "a stimulus," though many stimuli of different nature occur in connection with both.

Dr. Reid says he will admit that he is quibbling about the meaning of the term "acquired characters" if I will indicate how an inborn trait is more inborn and less acquired than an acquirement. The term "inborn trait" has nothing to do with the matter, as I have explained above. The words "change" and "acquire" imply an existing standard *from* which there is change or *to* which there is addition. The fact that the standard is itself an acquirement when viewed in relation to another phenomenon, namely, a reproductive germ, is irrelevant.

Dr. Reid quotes passages from Wallace, Weismann, and Romanes which do not treat of the matter under discussion, and suggests that he "sins with them," and that they agree with his forced interpretation of the term "acquired characters." The suggestion seems to me to be devoid of justification.

Chiefly, however, I object to Dr. Reid's stating that I have called this "a historical discussion," implying that I attach historical importance to it. I have used no such words. This statement by Dr. Reid is erroneous, as is also his attribution to me of certain opinions about the muscular development of an ordinary individual and of a blacksmith. He says, "Sir Ray Lankester regards the former as normal and *therefore* inborn and inheritable, and the latter as abnormal and *therefore* acquired and non-inheritable." This is entirely imaginary. I never wrote a word on the subject of muscular development, nor have I stated that abnormal qualities are necessarily acquired and non-inheritable, or anything of the kind. I do not desire to continue a discussion in which fictitious words and opinions are attributed to me. Nor do I desire to obtain any "admission" from Dr. Reid. I am content to leave the matter to the judgment of your readers.

April 5. E. RAY LANKESTER.

Clouds and Shadows.

ON the evening of Easter Monday I noticed in the western sky an effect which was unlike anything I had ever seen before. The sun was just setting behind a great bank of cloud, the rest of the sky being fairly clear, except for a thin veil of alto-stratus (it was not very high), which was moving at a good rate from the north-west, and stretched across the whole sky. This stratus was scarcely noticeable at first, as the sun's rays shining through it produced a milky kind of light in the sky. In startling contrast to this there appeared about halfway between the horizon and the zenith, to the south-west, what looked like an extraordinary "cloud," which compelled attention. It was obvious, however, that this was no cloud, as it remained quite stationary, while the stratus (which I now observed) and also a few small lower clouds were driven quickly across the sky.

I became greatly interested in the phenomenon, and watched it closely for half an hour or more, and the impression I got was that the apparent cloud was really a heavy shadow, cast upon the otherwise brightly illumined stratus by some unseen object away in the west, which was intercepting the sun's rays. The "dark patch" varied in shape and size, expanding and contracting, but preserving on the whole a shape somewhat like a fan, and keeping the same position in the sky.

After a time I noticed an exactly similar effect growing into shape, halfway between the first one and the point where the sun had set, so that a line drawn through them from the sun would be at an angle of about 45° with the horizon.

I made notes and rough sketches at the time, and could give more complete details as to the conditions existing, and the varying shapes and positions of the dark "shadows." It may be that this effect is not uncommon, and is easily accounted for; but although I have studied the skies for many years I have never before seen anything like it, and I feel confident that it must have been, at any rate, unusual.

While freely confessing ignorance of any scientific knowledge on such matters, I should be very glad to be enlightened as to the explanation of the phenomenon, and also to hear whether anyone else noticed the occurrence.

CHAS. TILDEN SMITH.

"Chisbury," Little Bedwyn, Wilts, April 15.

Winter in India.

I NOTICE that in NATURE of February 15 your reviewer quotes without comment a passage from "Freshwater Sponges, Hydroids and Polyzoa" (Fauna of British India Series) which implies that winter in India is the *driest time* of the year as well as the coolest. This must be a slip on the part of the author. Not only is there a considerable quantity of water in rivers, tanks, and pools in winter compared with the spring and early summer, but the relative humidity is very much higher. In cases where I have collected figures the mean relative humidity is at about the average of the whole year in December and January, and then drops continually up to the first half of May, but it would doubtless vary in different parts of the country. H. H. H.

Camp, Central Provinces.

RECENT RESEARCHES ON CAST IRON.[1]

THE volume before us is an able work, containing much original matter, in which an attempt is made with considerable success to reconcile the theory of the physical chemist with the practice of the scientific metallurgist. The author is obviously impressed with the broad reality of the iron-carbon equilibrium diagram. No doubt this has some value, but its teachings are very limited from a practical point of view. For instance, the area usually marked in such diagrams "martensite," instead of "hardenite," gives no indication that steel quenched at the

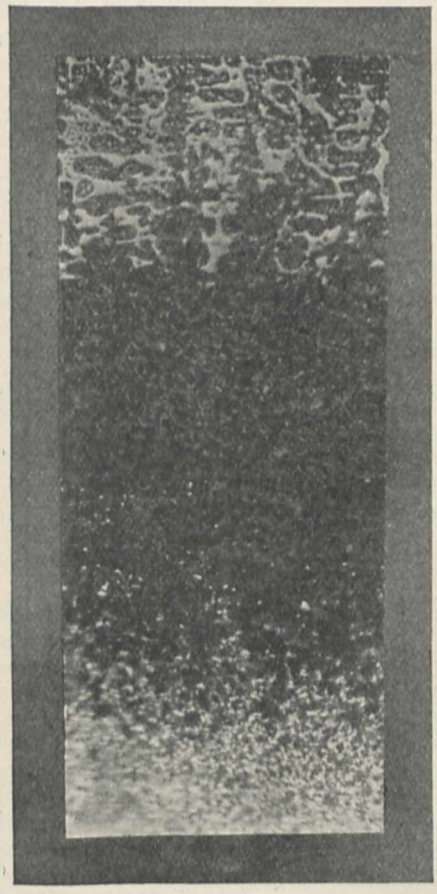

FIG. 1.—Stages of decarburisation of white iron by iron ore. Magnified 150 diameters. Etched HNO_3.

lower end of the range is good, and at the upper end worthless, a matter of some little importance to the steel maker.

The influences of various ordinary elements on cast iron, viz., silicon, manganese, sulphur, and phosphorus, are very well dealt with. The influence of more rarely present elements, such as vanadium, chromium, titanium, is also considered.

In his treatment of malleable cast iron, the author, as one of our ablest authorities on the subject, is naturally at home, and publishes many original and interesting photo-micrographs. It is clear that the author's experiments in the higher ranges of the iron-carbon diagram have led him to the conclusion, long held by many steel metallurgists, that the carbon at high temperatures is in solution as carbide, and not in the free state. A section is devoted to a consideration of the "growth" of cast iron.

The appendices contain a well-expressed series of definitions and a useful set of typical analyses of cast and malleable cast irons. All makers of such products should study this excellent book.

A figure showing micrographically the stages of decarburisation of white iron is here reproduced (Fig. 1). Another figure (Fig. 2) reproduces an excellent photo-micrograph (lent to the author by Wüst) of a 1·76 per cent. carbon steel quenched from 1130° C.

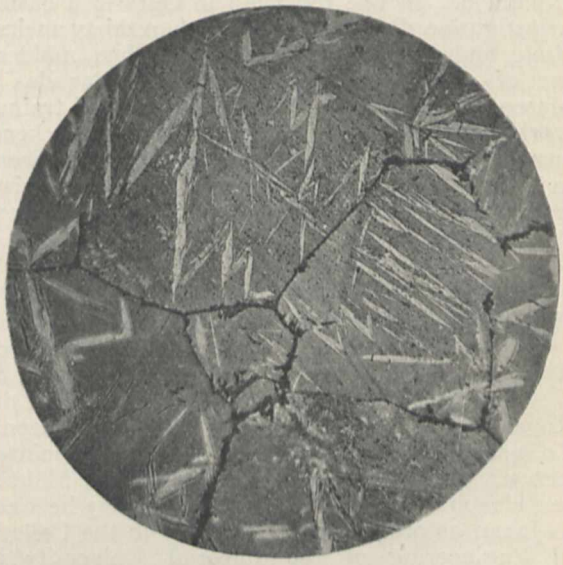

FIG. 2.—1·76 per cent. carbon steel quenched from 1130° C. Etched. Magnified 200 diameters.

In view of the experimental facts contained in the advance copy of a paper to be read at the Iron and Steel Institute in May, 1912, the author's views on the influence of allotropy on the hardening of steel will require revision in any future edition. J. O. ARNOLD.

[1] "Cast Iron in the Light of Recent Research." By W. H. Hatfield. Pp. xiii+249. (London: Charles Griffin and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

THE INTERNATIONAL CONGRESS OF AMERICANISTS.

THE eighteenth session of the International Congress of Americanists will be held in London, with Sir C. R. Markham as President, from May 27 to June 1 of the present year, at the Imperial Institute, South Kensington. The object of the Congress is to promote scientific inquiry into the history of both Americas and of their inhabitants. It will be divided into six sections—Palæoanthropology, Physical Anthropology, Linguistics, Ethnology and Archæology, General Ethnology, and Colonial History. This meeting, which has been organised under the invitation of the Royal Anthropological Institute,

has already received the patronage of the universities and leading scientific societies both at home and abroad, which will be represented by delegates. The programme of papers already contains contributions from the best known authorities on the history and ethnology of the vast region over which its operations extend. It may be hoped that the many persons interested in prehistoric America will assist in the work of the Congress, and that collectors will contribute specimens of antiquities to the exhibition which will be organised in connection with it.

In view of the approaching Congress, Mr. Harlan J. Smith, superintendent of the Archæological and Ethnological branch of the Geological Survey of Canada, appeals for the aid of trained field-workers in the exploration of the vast number of prehistoric sites in various parts of the Dominion. In one township in Ontario a casual investigation disclosed no fewer than thirty ancient sites, and on the seacoast the kitchen middens are of great extent and interest. Canada at present cannot supply a sufficient staff of trained workers to carry on this survey, and the scheme suggests a promise of interesting scientific work in which some of the younger anthropologists trained in our university schools may be inclined to cooperate.

PROF. EDWARD DIVERS, F.R.S.

WE regret having to record the death of Prof. Edward Divers, F.R.S., which occurred on April 8. Born in London on November 27, 1837, he was educated at the City of London School, at the Royal College of Chemistry, and at Queen's College, Galway. In 1870 he was appointed lecturer on medical jurisprudence at the Middlesex Hospital Medical School, and in 1873 he went to Japan as professor of chemistry in the College of Engineering of the Imperial University at Tokyo, of which he became principal in 1882. He remained in Japan until 1899, when he was made emeritus professor and received the Order of the Sacred Treasure, in addition to that of the Rising Sun, which had been previously conferred upon him.

During the whole period of his active professorship, Dr. Divers alone and in collaboration with a succession of his Japanese students, Shimosé, Shimidzu, Haga, Kawakita, Nakamura, Ogawa, and Hada, was a prolific contributor to chemical science—hyponitrites, the constitution of fulminates, the quantitative separation of tellurium and selenium, the production of hydrosulphides, the constitution of sulphazotised salts, the red sulphur of Japan, hydrocarbon from Japanese petroleum, the composition of Japanese birdlime, the economical preparation of hydroxylamine sulphate, and many other subjects were dealt with in papers published in the Journal of the Chemical Society and the Philosophical Transactions. In 1893 he was elected a Fellow of the Royal Society.

On his return to England, Professor Divers did not cease his activity. He was a Vice-President of the Chemical Society and of the Institute of Chemistry, President of the Chemical section of the British Association, President of the Society of Chemical Industry, and at the time of his death was still serving as the representative of the last-named society on the governing body of the Imperial College of Science and Technology, whilst as late as last year he contributed to the Society of Chemical Industry a lengthy paper on "A modification of Raschig's theory of the Lead-Chamber process."

Prof. Divers married in 1865 Margaret Theresa Fitzgerald, daughter of D. G. Fitzgerald, of Mayfield, Co. Cork, by whom he had one son and two daughters. His son died in early life, and he lost his wife in 1897, shortly before his return from Japan, but his two daughters survive him. A man of fine physique, and, until within the last few months, of splendid health, he appeared to suffer only from defective sight, largely the result of a laboratory explosion, which practically destroyed the sight of his right eye. This accident happened in 1885, but he did not allow it seriously to interfere with his work, though it was painful to others to watch him read or write with the book or paper held within a few inches of his eyes. In public he always felt the disability of being unable to recognise acquaintances that were more than a few feet distant, and this naturally gave him an appearance of reserve. But in small gatherings and among intimate friends he was a delightful companion, genial and humorous, especially pleased to talk about Japan and the Japanese, for everything connected with which he was always most enthusiastically appreciative, ever ready to discuss a chemical problem, and, to the last, keenly interested in chemical progress.

Prof. Divers leaves behind him in England and Japan a host of friends who will long mourn the loss of a very sterling character. He was buried at Brookwood on Thursday last, April 11, and though, in consequence of the Easter holidays, many of his friends were away from home, the Royal Society, the Chemical Society, the Society of Chemical Industry, the Institute of Chemical Industry, and the Institute of Brewing were all represented at his funeral and the memorial service. In addition to the members of his family, the following were present, viz.:—Sir Wm. Tilden, Prof. Emerson Reynolds, Prof. Gowland, Prof. Mondy, Prof. Hodgkinson, Dr. Rudolph Messel, Messrs. Tyrer, Reid, Hemingway, Grant Hooper, Coste, Baker, Cresswell, Pilcher, Carr, and others.

NOTES.

THE appalling disaster to the *Titanic* on Monday morning, by which more than 1300 of the passengers and crew have lost their lives, has brought several scientific subjects into prominence. Such subjects are: the dynamic effects of a mass of 50,000 tons moving at a speed of about 15 knots, the conditions of stability of a vessel built upon the watertight bulkhead system when an extensive injury has been

isolated by closing the watertight doors, the beneficent use of wireless telegraphy in summoning assistance to a vessel in distress, and the means of detecting the presence of icebergs at a distance. The *Titanic*, which was making her maiden voyage from Southampton to New York, was the largest vessel in the world, and the most luxuriously equipped. She was installed with Marconi wireless telegraphy instruments having a sphere of influence with a radius of about 500 miles by day and treble this distance by night. The first news was the appeal for help which went throbbing through the æther and was detected by the wireless telegraphy operators on several vessels. The message was: "Have struck an iceberg 41·46 north, 50·14 west. Are badly damaged. Rush aid." This was at 10.25 p.m. on Sunday, New York time (3.25 a.m. Monday, Greenwich time). Several vessels hastened to the place of the disaster, but the nearest ship appears to have been 170 miles distant from the *Titanic* when the message of distress was received, and none of them was able to reach her before she foundered at 2.20 a.m. (New York time) on Monday morning—four hours after the collision with the iceberg. The *Carpathia* reached the *Titanic's* position at daybreak, and found boats and wreckage only. In the boats were 868 survivors of the crew and passengers—mostly women and children—the remainder of the human freight of 2200 souls having found a grave with the vessel in the Atlantic.

No more terrible disaster at sea than this has ever occurred; and that a vessel which was said to have been designed with all the precautions which engineering science can provide should meet with such a calamity on her first voyage is almost unbelievable. It was claimed that the vessel was practically unsinkable, yet she was only able to keep afloat a few hours after crushing against the iceberg. The existence of immense fields of ice and great icebergs, the visible parts of which are only about one-eighth the mass of the portions submerged, constitutes a danger in the North Atlantic against which no satisfactory safeguard has yet been devised. A vessel which represented the best work of science applied to marine engineering has disappeared with its burden of human lives beneath the waters of the Atlantic as the result of a catastrophe which could only have been avoided by following a course south of the danger zone caused by ice. Until science has suggested a practical means of detecting masses of floating ice at a distance sufficiently great to enable vessels to avoid them, and thus prevent calamities such as that which the nation now mourns, it is to be hoped that the steamship track across the Atlantic will be more southerly than that hitherto recognised.

THE Memorandum on Naval and Military Aviation issued on April 12 provides for seven aëroplane squadrons of twelve machines each, one airship and kite squadron of two airships and two flights of kites, and one line of communication flying corps workshops —the total number of flyers required being 182 officers and 182 non-commissioned officers. It sounds the death-knell of the airship, in that it specifically states that the only advantage that this type of aircraft possesses over that of heavier-than-air lies in its ability to receive and transmit wireless messages over a large area. "It is hoped, however," says the memorandum, "that means will be found for overcoming difficulties in this respect, and experiments in this direction are now being conducted which give prospects of success." The other scientific aspect of this scheme is the desire to subsidise flying grounds or aërodromes, where safe landing places are available, all over the kingdom in order that cross-country flying—an essential for practice in military work—may be carried out in comfortable circumstances. This practically amounts to mapping out the whole country into air-ways, and from the meteorological point of view is of the greatest importance. From a settled system of cross-country flying, most valuable data will be obtained as to general wind direction and to the existence of "remous," or eddies, and what are now termed "holes in the air." No coordinated information is at present available as to where such aërial phenomena may be expected or as to their actual cause. The whole science in this respect is lamentably deficient, and the *hiati* may be filled up by the system of cross-country flying proposed. It is to be hoped that ample funds will be allotted to this new and important branch of both services, not only for the defences of the country but also on account of increased knowledge of meteorology.

WE regret to learn of the death of Mr. A. Lawrence Rotch, director of the Blue Hill Meteorological Observatory, Mass., U.S.A.

THE sixth annual meeting of the British Science Guild will be held at 4 p.m. on Friday, May 17, at the Institution of Electrical Engineers, Victoria Embankment, W.C. The dinner will be held on the evening of the same day at Prince's Hall, Piccadilly.

A REUTER message from Mobile, Alabama, U.S.A., states that the captain of a steamer which arrived there on April 10 reports the destruction of thousands of people and a number of Indian villages by an eruption of Chiriqui Peak, near Bocas del Toro, Panama, on April 5.

A COURSE of four lectures on some mathematical subjects will be delivered at the University of London, South Kensington, on May 3, 4, 10, and 11, by Prof. Henri Poincaré, professor of mathematical astronomy in the University of Paris. Two of the lectures will deal with the philosophical aspects of mathematics, one with a subject in pure mathematics, and one with a subject in applied mathematics. Further information and tickets of admission may be obtained on application to the Academic Registrar, University of London, South Kensington, S.W.

THE Board of Agriculture and Fisheries has been informed that the Lords Commissioners of his Majesty's Treasury, on the recommendation of the Development Commissioners, have sanctioned the payment from the Development Fund of a sum of 2,500*l.* per annum for three years to be distributed by the Board as grants to certain institutions in England and Wales to enable them to supply tech-

nical advice to landowners and others interested in forestry. Owing to inadequate resources, institutions possessing forestry departments have hitherto restricted their attention for the most part to imparting instruction to students. It is now proposed to attach an experienced forest expert to the forestry departments of two universities and three colleges, whose chief duty will be to supply to landowners and others advice as to the general and detailed working of their woods. Each institution will, therefore, become for a given district a centre for information, to which application may be made on all questions relating to the formation, treatment, utilisation, and protection of woods.

THE annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Westminster, on May 9 and 10, commencing each day at 10.30 a.m. At the morning meeting on the first day, the retiring president, the Duke of Devonshire, will induct into the chair the president-elect, Mr. Arthur Cooper; the Bessemer gold medal for 1912 will be presented to Mr. J. H. Darby; and the president will deliver his inaugural address. On the morning of May 10, the Andrew Carnegie gold medal for 1911 will be presented to Dr. P. Goerens, of Aachen, and the award of research scholarships for the current year will be announced. Among the papers to be read and discussed during the meeting the following may be mentioned:—Dr. J. O. Arnold will deal with the chemical and mechanical relations of iron, vanadium, and carbon; Sir Hugh Bell, Bart., will described a bloom of Roman iron from Corstopitum (Corbridge); Mr. C. Chappell will discuss the influence of carbon on corrosion; and Dr. J. N. Friend, J. L. Bentley, and W. West the corrosion of nickel, chromium, and nickel-chromium steels and the mechanism of corrosion. Sir Robert A. Hadfield, F.R.S., will describe Sinhalese iron and steel of ancient origin, and Dr. H. Nathusius, of Friedenshütte, Upper Silesia, the improvements in electric steel furnaces and their application in the manufacture of steel.

IN the House of Commons on April 10 Mr. Lewis Harcourt, Colonial Secretary, announced that the terms of reference to the Royal Commission on the Trade Resources of the Empire are as follows:—To inquire into and report upon the natural resources of the Dominion of Canada, the Commonwealth of Australia, the Dominion of New Zealand, the Union of South Africa, and the Colony of Newfoundland; and, further, to report upon the development of such resources, whether attained or attainable; upon the facilities which exist or may be created for the production, manufacture, and distribution of all articles of commerce in those parts of the Empire; upon the requirements of each such part and of the United Kingdom in the matter of food and raw materials, and the available sources of such; upon the trade of each such part of the Empire with the other parts, with the United Kingdom, and with the rest of the world; upon the extent, if any, to which the mutual trade of the several parts of the Empire has been or is being affected beneficially or otherwise by the laws now in force, other than fiscal laws, and, generally, to suggest any methods, consistent always with the existing fiscal policy of each part of the Empire, by which the trade of each part with the others and with the United Kingdom might be improved and extended.

WE record with regret the death on April 12 of Dr. William Ogle, a distinguished statistician and physician, in his eighty-fifth year. He held the office of superintendent of statistics in the department of the Registrar-General of Births, Deaths, and Marriages for England and Wales from 1880 to 1903, in succession to Dr. William Farr. In that capacity he continued the practice of his predecessor by contributing to every annual report of the Registrar-General a memoir on some subject of interest arising out of his researches. He became a member of the Statistical Society in 1885, served on its council, and contributed papers on the alleged depopulation of the rural districts of England, on marriage rates and marriage ages with reference to the growth of population, and on the trustworthiness of the old bills of mortality. In 1891 the well-deserved compliment was paid to him of election to the Athenæum under rule 2 of that club, as distinguished in science and for his public services. He was also a member of the Institut International de Statistique. His services to medical science as secretary of the Royal Medical and Chirurgical Society, lecturer and physician at St. George's Hospital, medical officer of health, and in other positions, were conspicuous, and he contributed to medical literature translations of Aristotle and other works. He belonged to a medical family, being a son of the Regius professor of medicine at Oxford. There he took the degree of M.D. He became a fellow of the Royal College of Physicians in 1806. In official, scientific, and academic circles he was highly esteemed, and many friends will mourn his loss.

IN the January-February issue of *L'Anthropologie* MM. Breuil and Obermaier contribute an account of the operations of L'Institut de Paléontologie Humaine, recently founded by that enthusiastic student of the sciences, Prince Albert I. of Monaco. Its work is at present largely devoted to an exploration of those caves in the Spanish peninsula which were occupied by primitive man. That at Valle, in the province of Santander, has produced some harpoons of the Azilian and Magdalenian periods, and a bone engraved with a group of horses. From the Hornos de la Peña cave we have a frontal bone of a horse, with a drawing of that animal. The newly discovered cave containing frescoes at La Pasiéga supplies drawings of a stag and a chamois. Of special interest are the sketches of primitive hunters pursuing stags with their bows and arrows, and some rudely conventional representations of human beings from caves in Almeria, Andalusia, and Murcia. The Institute founded by Prince Albert has thus undertaken a wide scheme of exploration which is sure to supply material of the highest importance to students of primitive man.

M. J. DECHELETTE, in *L'Anthropologie* for January-February, suggests a new interpretation of the origin of the spiral carvings at the grave-mounds of New Grange and Gavr Inis, which Mr. G. Coffey and

other British authorities recognise to be an extension of the great Ægean spiral motive which passed through a large part of Europe in the early Bronze age. M. Dechelette now endeavours to trace the pattern through seven types: tattooed images of the Mother goddess of the Ægean area, and figurines from the second stratum at Hissarlik; anthropomorphic pillars from Fivizzano in Italy; Sardinian menhirs; plaques from the Iberian peninsula; menhirs and cave sculptures, with fragments of vases, from France; cylinders from Folkton Wold in Yorkshire; and Scandinavian vases. This essay, which is well provided with figured representations of the assumed transitional types, is sure to furnish material for discussion. The art student will probably desire more evidence of the approximation of these motives in their original home, the Ægean area, whence, whatever the exact source may be, the type was certainly derived.

IN the April issue of *Man* Mr. Harold Peake describes an elaborate scheme for an anthropological survey of the British Isles. It is intended to include not only the physical types from which the existing population has been derived, but extends to all forms of human activity, both in the past and at the present day. It is proposed, as part of the project, to compile a series of maps showing the course of distribution of trade articles in prehistoric times—bronze celts, amber, pigs of lead, and the like—with the position of the mines of gold, copper, and tin known to the ancients. In order to afford facilities for comparing the culture of the past with that of the present, he suggests the preparation of maps showing soil and vegetation, the distribution of woodland and marsh, the mineral supply, the distribution of the Neolithic people, the early centres of metallurgy, and the movements of invading tribes. As regards existing facts, we need surveys of the density of the present population and its economic conditions, such as the prevalence of lunacy, poverty, and crime. He proposes to initiate this elaborate scheme through a central bureau working in cooperation with field clubs, county museums, and the like. There can be no question that such material, if collected in a scientific way, would be of great service; but it needs an amount of cooperation between the unorganised body of workers which, for the present at least, is not within the range of practical politics.

MR. H. HABENICHT of Gotha, in a pamphlet on "Die antediluvianischen Oasen bei Taubach und Tonna," attributes the occurrence of northern erratics in the Thüringian loess to catastrophic flooding, which took place at the close of the steppe-epoch that followed on the first extension of the continental ice. A picturesque detail is drawn from the fossil birds' eggs in the Taubach tufa; the flood broke across Thüringia "on a fine day of early summer." This overflow, however, was general, owing to a sudden subsidence, and the mammoth—its hairy covering notwithstanding—is said to have been thus transported northwards. The damp atmosphere, checking the sun's rays, is held responsible for the second extension of the ice. The author, however, does not hope for general sympathy in his revival of the belief in a universal deluge.

LAST year the Marine Biological Station at St. Diego celebrated the twentieth anniversary of the movement that led to its foundation, and advantage was taken of the occasion to publish an account of its rise, progress, and future. This has been drawn up by Mr. W. E. Ritter, and issued as No. 4 of vol. ix. of the University of California Publications in Zoology. The scope of this report is very wide, taking into consideration the larger meaning of science in general, and of biology in particular. Reference is made to the present condition of the station, to the work already accomplished, and to projects for the future. In the concluding section it is urged that every scientific institution ought to do something towards diffusing an accurate knowledge of modern scientific work among the general public. This should be done—largely through the public press—by persons who have themselves been engaged in scientific work, and should by no means be left to those who merely read up science.

FOR several years past Prof. E. C. Case has been working at the wonderful Permian vertebrate fauna of North America, and some of his latest results are embodied in "A Revision of Amphibia and Fishes" of this formation, published as a quarto memoir by the Carnegie Institution of Washington (1911). The memoir opens with a review of previous work on the subject, this being followed by a table of the classification of the Amphibia as now revised, after which comes a detailed synopsis of the various groups. With the exception of one genus referred to the same group (Urodela) as modern salamanders, the whole of the amphibians are referable to the stegocephalians, or labyrinthodonts, in the classification of which the author follows in the main the lead given by Cope. A discussion of the fishes is given by Mr. L. Hussakof, who concludes with a comparison of the fish-fauna of the Permian of America with that of Bohemia, in which it is pointed out that there is a great similarity between the two, with the exception that the acanthodian sharks are unrepresented in the American formation.

THE Journal of the Royal Society of Arts of March 29 contains the report of a lecture on modern whaling, delivered by Mr. T. E. Salvesen at the sixteenth ordinary meeting of the society. After an historical account of whaling, the lecturer stated that the great recent development of the industry has taken place in the southern hemisphere, where the chief objects of pursuit are rorquals and humpbacks. In South Georgia 7000 whales, yielding some 200,000 barrels of oil, were taken last year; in the South Shetlands the catch was 3500, and in South Africa 4000, the total number of whales taken during the season to the south of the equator being about 17,500, with a yield of some 500,000 barrels of oil, and a gross value of about 1,750,000*l*. For the whole world, the catch was about 22,500 whales, with a yield of some 620,000 barrels of oil. The present year's take is expected to exceed that of 1911 by at least from 10 to 15 per cent. It is a matter for

regret that in the discussion which followed the paper no one pointed out the serious nature of this enormous drain and the urgent necessity of an inquiry to ascertain what effect it is having on the numbers of the whales. On the face of it, no species appears likely to be capable of holding its own against such tremendous slaughter for any length of time.

THE threatened extinction of the sandal tree (*Santalum album*), which occurs over a limited area in India and is practically absent elsewhere, and the great economic value of sandalwood oil, have led to many attempts to extend its area by plantings and sowings, but these have been rarely successful, owing to the fact that, although the sandal is a root parasite, absolutely dependent upon other plants for its nourishment, it has in most cases been treated like other trees in the methods adopted for its propagation. M. Rama Rao has just published (*Indian Forest Records*, ii., 4) an elaborate account of the host-plants of the sandal, in which he describes the relations between the roots of this tree and those of more than 250 species found growing in association with it. Of this number no fewer than 150 species are actually host-plants attacked by the roots of sandal, and the author believes that further investigation will result in additions to this remarkable census. Apparently evergreen plants are better hosts than deciduous species; sandal plants growing on evergreen hosts themselves remain evergreen, while those on deciduous hosts actually become deciduous; and there is a marked tendency for the sandal to become deciduous in very dry localities, where the plants associated with it are few and are deciduous.

A SEVERE earthquake was felt in South Africa on February 20 at 3.4 p.m., especially in the south-western portion of the Orange River Colony. The shock is remarkable for the large area over which it was strong enough to damage buildings. This area, so far as can be judged from the numerous accounts published in *The Cape Times*, is about 150 miles in diameter, and contains more than 17,000 square miles. In Kimberley and Bloemfontein a few houses were injured, but the epicentre of the earthquake lies about 50 miles to the south-east of Kimberley, in the neighbourhood of Koffyfontein, Jagersfontein, and Fauresmith, at which places, also, most of the after-shocks were felt. Although many buildings were demolished and the ground fissured in this district, the earthquake was not one of very great intensity, though unusually strong for the South African colonies. It was felt, however, over a very wide area, from Paarl (480 miles to the south-west of the epicentre) to Mafeking (250 miles to the north), Johannesburg (290 miles), and Durban (360 miles to the east). The disturbed area must therefore have contained about half a million square miles.

THE last Bulletin (vol. iv., No. 3, 1912, Tokyo) of the Imperial Earthquake Investigation Committee consists of Prof. Omori's third paper on the applications of the seismograph to the measurement of the vibrations of railway carriages. The recent experiments were made in a new imperial carriage and a first-class carriage, both six-wheel bogie-cars, and weighing 36 and 27·3 tons respectively. The trains containing these carriages were similarly made up and run along the same course with approximately the same velocities. The records in the two carriages in the same portions of the course were so similar that individual vibrations could be identified, especially in the lateral-vibration curves. The intensity of the vertical vibrations in the imperial carriage was 40 per cent. less, and of the lateral vibrations 26 per cent. less, than in the other. Under ordinary conditions, the maximum acceleration recorded in the imperial carriage amounted to 1100 mm. per second per second for the lateral vibrations and to 2000 mm. per second per second for the vertical vibrations, the latter being nearly as great as that experienced at Nagoya during the great Japanese earthquake of 1891. The vertical vibrations in the same carriage were practically unaffected when the train entered on a curve of from 20 to 60 chains radius, but the lateral vibrations, though unchanged when the velocity ranged from 25 to 30 miles an hour, were nearly double as large as on a straight road when the velocity was as low as 15, or as high as 40, miles an hour.

THE report of the work of the Prussian Meteorological Institute in 1911, issued by Prof. G. Hellmann, states that the existing materials are so great that it was thought advisable to devote as much time as possible to the deduction and publication of results, rather than to take up fresh observations. The report contains several interesting and useful short discussions, to one or two of which we hope to refer later on. The arrears in the discussion of magnetic observations have been brought up to date. A curious incident relating to the uncertainty of the needle-inclinometer is reported. Four needles had been in use, three of which gave concordant results, and the fourth very discordant values, and its use was given up; but some years later it was discovered that the discarded needle was the one which had given correct results. At the end of 1911 the meteorological stations numbered 201, exclusive of a very large number of rainfall and thunderstorm stations. The Potsdam, Brocken, and Schneekoppe observatories are entirely maintained by the institute. It is pleasing to note that his Majesty the Emperor confers from time to time special honours on both officials and observers of long standing.

IN the Trans. Roy. Soc. of Canada (vol. v., sec. iii., 1899) Dr. W. Bell Dawson gave illustrations of some remarkable sea-seiches, or secondary tidal undulations, which occurred in the estuary of the St. Lawrence. He remarked that they seem to be connected with stormy weather. The subject is resumed in a paper jointly by Mr. Kôtarô Honda and Dr. Dawson, published in the Science Reports of the Tôhoku Imperial University, vol. i., No. 1, p. 61 (1912), in which they discuss the periods of the Canadian seiches, showing that they conform to the Japanese theory. The authors are of opinion that the seiches are due to meteorological causes. In the Proceedings of the Tokyo Mathematico-physical Society for February, p. 196, Mr. Honda traces the

connection between the advance of a barometric depression and the sea-seiches observed at eight ports in Japanese waters.

THE new catalogue of physical apparatus issued by Messrs Baird and Tatlock (London), Ltd., is a quarto volume of 650 pages, and is well illustrated. It contains descriptions of several new pieces of apparatus, as, for example, the induction solenoids on p. 536, and Milner's automatic mercury pump. It would be an advantage if British instrument makers would in their new catalogues cease to figure and describe apparatus hopelessly out of date, like Lavoisier and Laplace's ice calorimeter.

THE theory of the universe which was propounded eight years ago by the late Prof. Osborne Reynolds in his "Sub-mechanics of the Universe" has found a popular exponent in the person of Mr. J. Mackenzie, a copy of whose lecture on the subject, delivered before the Minnesota Academy of Sciences and the American Association for the Advancement of Science at Minneapolis, has just reached us. It contains a clear account of a theory which is not by any means easy to follow in the original, and is illustrated by several figures of Prof. Reynolds's experiments, including that of the thin indiarubber bag partly filled with sand which supports 200 lb. on its edge. A good portrait of the late professor serves as a frontispiece.

SPECIAL PUBLICATION No. 9, 1911, of the U.S. Coast and Geodetic Survey contains a magnetic declination chart for the United States for the epoch January 1, 1910. It also gives secular change data—in continuation of similar data in earlier publications—for a number of selected stations. In the east, westerly declination is increasing more rapidly than in 1905. In the North Atlantic States, where the change is most rapid, it is now about 6′ a year. In the western territories easterly declination is increasing, also more rapidly than in 1905. The rise is now as much as 5′ a year in some places a little inland from the Pacific coast. The changes in progress at present throughout the United States are so complicated that it is impossible to predict their course even a few years ahead.

IT has long been known that traces of hydrogen peroxide are found in rain water and in snow, and that during the day the proportion is greater than at night. In 1909 it was shown by Miroslaw Kernbaum that the ultra-violet rays from a quartz mercury-vapour lamp decompose water according to the equation $2H_2O = H_2O_2 + H_2$, a fact which suggests that the hydrogen peroxide in rain water owes its formation to the action of solar ultra-violet rays on water vapour in the upper region of the air. The correctness of this hypothesis has been since verified by M. Kernbaum (*Bull. International Acad. Sci. Cracovie*, 1911, p. 583), who finds that ordinary sunlight even at the earth's surface is capable of demonstrably producing the same result in water enclosed in a quartz flask, both hydrogen and hydrogen peroxide being formed in minute quantities after a few days' exposure to the rays of the sun in July. In such a case the action of the ultra-violet rays is necessarily less than in the upper atmosphere, owing to their absorption in passing through the air.

AN illustrated description of the Ljungström steam turbine appears in *Engineering* for April 12. This machine is of the reaction type, and has been designed by its inventor—a Swedish engineer—so as to avoid some of the defects which are inherent to this kind of turbine. The flow is radial, the steam being admitted between two discs, and in its passage from their centre to their circumference, passing between concentric blading rings carried alternately by the two discs. In the usual design, both the discs revolve, driving their shafts at equal speeds, but in opposite directions, and to each shaft is coupled an electric generator. The relative speed of each set of blades is thus twice as great as in a standard reaction turbine of equal revolutions and diameter, hence for equal efficiency the total number of blade rows is only one-quarter as great. By the disc arrangement distortion troubles are avoided, hence the machine lends itself to the use of steam superheated to the highest degree. The general design makes an astonishingly small turbine for the power developed. Experiments have been made with a 500-kw. machine, and one of 1000-kw. capacity has just been finished and thoroughly tested.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF APRIL 17.—At the moment of going to press, the following telegram has reached us from Dr. Lockyer and Mr. F. Maclean, *viâ* Paris:—"Camp American line on road three-quarters mile north-east Chavenay practically central Bailey's Beads no corona prominences eight and two o'clock duration about two seconds. Weather perfect.—LOCKYER, MACLEAN."

A DAYLIGHT METEOR.—Mr. Hugh Ramage, organiser of higher education, Norwich, sends us some extracts from *The Eastern Daily Press* of April 3, 4, 6, and 8, containing observations of the daylight meteor of March 28, referred to last week (p. 147). Mr. W. F. Bushell, Gresham's School, Holt, states that the meteor was observed at about 2.45 p.m. It was seen by several observers, who agree in stating that "it left behind a yellowish-green track, which faded away almost directly. The meteor appeared in the northern part of the sky, and seemed to be travelling in an easterly direction. The sun was shining at the time."

THE NOVA, OR VARIABLE, IN PERSEUS, 87·1911.—The supposed nova discovered by Mr. D'Esterre is the subject of some further notes in No. 4564 of the *Astronomische Nachrichten*. This object is of especial interest at the present juncture, when so many attempts are being made to explain the appearance of novæ, for it appears to consist of several condensations, of changing aspects, surrounded by nebulosities, or themselves nebulous. Whatever the object itself may be, it is evident that the region is one of considerable interest, which should be carefully examined with more powerful instruments.

A NEW STAR CATALOGUE.—Astronomers are indebted to Mr. Backhouse for a valuable new star catalogue of 9842 stars, containing all stars very conspicuous to the naked eye. The catalogue is intended as a complement to a set of maps designed especially for the use of meteor observers, but should be found very useful by all astronomers. In addition to the various

designations of each star, Mr. Backhouse gives the magnitude as shown in eleven different publications, and then gives a weighted mean, the system of weighting being explained in the preface. Those amateur astronomers who have recently been struggling with the intricacies of various systems, in trying to understand the published magnitudes of Nova Geminorum No. 2, will appreciate the usefulness of such a catalogue. The work contains 186 quarto pages, and is published by Hills and Co., Sunderland.

THE PHOTOGRAPHIC TRANSIT.—The results of further experiments with a photographic transit, carried out by Prof. Hirayama during 1907–08, are published in the second fascicule of vol. v. of the *Annales de l'Observatoire astronomique de Tokyo*. They show that there is no change of the mean error either with the declination or with the photographic magnitude, and that the instrument is capable of producing very valuable results.

PHYSICS AND ASTROPHYSICS.—In No. 12 (1911) of *the Bulletin de la Classe des Sciences, Académie Royale de Belgique*, is published a most interesting lecture by M. J. E. Verschaffelt, in which the author shows how deeply the physical sciences are indebted to the results secured in astronomy for the suggestion, or the confirmation, of many of their fundamental concepts. For examples he quotes, *inter alia*, Newton's and Kepler's work on gravitation, Roemer's determination of the velocity of light reinforced by Bradley's discovery of aberration, and the idea of the pressure of light suggested by the solar repulsion of cometary matter. It is interesting to note that at the earth's surface the pressure of the solar radiation on each square metre of a black body amounts only to two-thirds of a milligram. In conclusion, M. Verschaffelt strongly expresses the hope that astrophysics may be officially included in the programme for the doctorate in the Belgian universities.

THE PARALLAX OF NOVA LACERTÆ, 1910.—From observations made at Yerkes Observatory during December, 1910, and January, 1911, Prof. Slocum finds the relative parallax of Nova Lacertæ to be $+0''.013 \pm 0''.014$. As the average parallax of his comparison stars, according to Kapteyn's table, may be taken as $0''.005$, the absolute parallax obtained for the nova is $+0''.018$. Too great an accuracy cannot be claimed for this result, but if it is correct the outburst producing the nova occurred some 180 years ago. (*Astrophysical Journal*, vol. xxxv., No. 2.)

NOVA GEMINORUM NO. 2.

AN account of the discovery of Nova Geminorum No. 2 is given by Herr Enebo in No. 4564 of the *Astronomische Nachrichten*. After observing the variable SV Tauri, at 8h. 32m. (M.E.T.) on March 12, Herr Enebo's eye, wandering over the neighbouring constellation, was arrested by the appearance of a companion to θ Geminorum which he had not noticed when observing that region four days earlier; the new object was then of magnitude 4·31 on the Potsdam scale. Herr Enebo's subsequent observations indicate that the nova was at its brightest when discovered, or on March 13, when he estimated the magnitude as 4·23, although other observers found it to be about 3·5 on March 14.

Herr Jost publishes a list of comparison stars, ranging from 4·6 to 8·3 in magnitude, and gives the colour of each so that comparisons with the nova may be facilitated. Dr. Wolf publishes a photographic chart of the nova region taken in January, 1909, and gives the magnitudes of surrounding stars down to about 9·5.

Dr. Guthnick reports a brightening of 0·4 mag. on March 22, accompanied by a diminution in the redness of the star. The red colour is quite marked, and makes the nova stand out from the other stars in a field of 1½ degrees; the Rev. T. E. R. Phillips is of the opinion that it is one of the reddest stars he has ever seen.

A communication from Prof. E. C. Pickering, published in No. 4565 of the *Astronomische Nachrichten*, states that Dr. Curtiss found the magnitude on March 13·7 to be 3·9, the spectrum then being like that of Nova Aurigæ. The Harvard photographs of March 13, however, showed only dark lines, and Prof. Pickering suggests that the bright lines seen with a slit spectroscope at the Ann Arbor Observatory may have been too narrow on that date to appear on the Harvard objective-prism spectra. Dr. Curtiss's observations showed a recessional velocity of 5 kms. for the dark reversals of the H and K lines.

Prof. Pickering also states that on March 16 the spectrum was of the normal novæ type, and the nebular lines were first seen. Better weather evidently prevailed in the United States than in England on March 13 and 14, for Prof. Pickering reports that seven good photographs of the spectrum were secured on each of those nights.

At the Hamburg Observatory spectrograms were obtained on March 20, 23, and 27, and many broad bright lines, especially the hydrogen series Hβ to Hη, are shown. Prof. Schwassman identifies two of the other bright lines with lines at λλ 4230 and 4176 in Vogel's spectrum of Nova Aurigæ, while a third lies halfway between λλ 4315 and 4288. On March 27 the bright K line was indistinct, but other bright lines were more marked than on the previous dates. Prof. Schwassman identifies three of these, at λλ 4583, 4557, and 4525, with lines of Fe, Ba, and Ti.

Greenwich observations on March 15, reported in *The Observatory* (No. 447, April) showed the visual brightness to be one-quarter of a magnitude, and the photographic one magnitude, fainter than θ Geminorum. The photographic magnitudes were secured by placing a grating, made of zinc strips, with spaces of equal width, in front of the object glass, and are as follows:—March 20, 5·5; 21, 6·0; 26, 6·1; 28, 6·3; 29, 6·5; 31, 6·0, and April 1, 6·5.

At Cambridge, reports Prof. Newall, the nova on March 14 was at least one magnitude brighter than θ Geminorum; as the estimated magnitude on March 15 was 4·2, it would appear that the nova lost 1½ magnitudes in 24 hours. A series of photographs of the spectrum shows interesting changes in the relative brightness of the lines, in the structure of the hydrogen lines, and in the appearance on March 22 of a second pair of broad bright and dark lines on the more refrangible side of each hydrogen line.

According to observations by M. Luizet, published in *L'Astronomie* for April, the nova decreased in brightness to the extent of one magnitude between 10h. on March 15 and 7h. 50m. on March 16.

M. Baume Pluvinel's spectra observations on March 21 show each of the hydrogen lines Hβ to Hε doubled or trebled, and all displaced towards the red.

Dr. Easton reports a second recrudescence of brightness on April 9, when, at 9h. 15m. (G.M.T.), the H.P. magnitude was 6·0, but the brightening probably occurred earlier than this, although bad weather prevented Dr. Easton observing it. A secondary maximum is plainly shown, in Dr. Ebell's series of observations, for March 30 (*Astronomische Nachrichten*, No. 4564). Dr. Strömgren's series shows that on March 24, the previous maximum, the colour became bluish instead of red as previously.

PORTLAND CEMENT.[1]

M. LEDUC has made a notable contribution to the literature of a subject which already possesses *matériel* more remarkable for quantity than merit, and, departing from topical traditions, has given us many useful data with few speculations.

An excellent historical preamble is succeeded by a description of the methods which he employed in his endeavour to throw light on the constitution of cement—a question which is taxing, and will continue to tax, the best efforts of the chemist, equipped as he must be with ample knowledge of physical methods of research. Provision of a suitable apparatus for working at high temperatures with relatively large quantities of material, say a couple of kilogrammes, needed much thought and many trials, and was attained by the device of a furnace heated by three burners fed with gas and air under pressure, these playing below the hearth on which the test pieces are placed and the gases being deflected back above the hearth before reaching the flue, so that as uniform a temperature as could be expected from any contrivance heated by fuel was secured. In many instances of this sort where the experimenter finds himself in a difficulty useful recourse may be had to some industrial apparatus, and M. Leduc, fully alive to this, used one originating with a famous firm of motor manufacturers, and records the result with a touch of sadness:—"Enfin, dans un essai qui, malheureusement, s'est terminé par la fusion complète et le mélange d'un grand nombre d'échantillons, j'ai utilisé le four à porcelaine dure de la maison de Dion-Bouton, que M. Guillet, professeur au Conservatoire des Arts et Métiers, avait bien voulu mettre à ma disposition."

The author prepared the first of the calcium silicates which may occur from the interaction of cement raw materials, that is, wollastonite, $CaOSiO_2$, and notes in passing that the product had a pale-green tint, which he attributes to the presence of a trace of iron. Seeing that the silicate is relatively acid, the reviewer would not care to contest this explanation, but he would point out when white Portland cement, necessarily a far more basic material, is made from the purest materials obtainable in commerce as distinct from strictly laboratory products, it also possesses a pale-green tint, and that this tint is due, not to iron, but to manganese, probably present as calcium manganate. Dicalcium silicate, that is, the orthosilicate, $2CaOSiO_2$, was also made with ease, as other experimenters have established; but, again confirming earlier results, the preparation of that illusive body $3CaOSiO_2$ proved to be impracticable. So far as we know, the only successful attempts have been those of Le Chatelier some twenty-five years ago, in which not pure $3CaOSiO_2$ but a body in which part of the CaO is replaced by $CaCl_2$ was prepared, and the recent work of Shepherd and his collaborators, who have shown that tricalcium silicate has a small range of stability in respect of temperature, and it is in consequence of this that its existence as an individual substance has been so much and so justly doubted.

M. Leduc's conclusions are such that we will quote them without fear of the accusation of laziness properly levelled at commentators on other men's work.

$CaOSiO_2$ has no hydraulic properties; neither has $2CaOSiO_2$, which can only be made in the dry way, and is decomposed by water into the monocalcium silicate and lime. $3CaOSiO_2$ has not been prepared. $CaOAl_2O_3$ and $2CaOAl_2O_3$ are hydraulic and stable in hot water. $3CaOAl_2O_3$ has not been obtained. The calcium-ferrites are not hydraulic, and no silico aluminates or silico-ferrites containing a high percentage of lime could be prepared, the products falling to powder on cooling in the manner characteristic of dicalcium silicate.

Concerning commercial cements, the fact recognised in practice, that the mechanical strength falls off rapidly as the content of clay is increased, is confirmed, and it is also shown that the coarseness of grain of both clayey matter and of sand has at least as large an influence on the "falling" of clinker as has the amount of their constituents. A normal clinkering temperature is set down at 1400–1450° C. Cements in which the alumina is replaced by ferric oxide are mechanically weak, and those containing considerable quantities of magnesia, *e.g.* 25 per cent., went to pieces when exposed to steam. It should be noted that M. Leduc took unusual pains to bring his raw materials to an extremely fine state of division, fully comprehending that in a mass which is almost plastic the occurrence and completion of the reactions concerned in the production of definite silicates, aluminates, and the like are dependent on the intimacy of admixture, as well as on the temperature and the time. Anyone who has prepared Portland cement experimentally knows that particles of sand which may be only 1/10 mm. in diameter will each produce its small centre of "falling," the dicalcium silicate oozing forth from the site of the grain in a very curious lifelike and vermiform manner, whereas the same raw materials, really finely ground, will not "fall" at all.

One more word, and we will close an appreciation of good work well done. M. Leduc has shown, in collaboration with M. Chenu, that Seger cones, useful as they are for many industrial purposes, are far from exact as indicators of temperature. They may well be used side by side with materials of the same class which are to be heated in the same way, but in all cases they must be checked by whatever kind of pyrometer is best adapted for the temperatures to be measured. Failing this the most careful inquiry may be misleading. B. B.

[1] "Sur la constitution et la formation du ciment Portland." By E. Leduc. Bull. Soc. d'Encouragement, Paris, November, 1911.

PLAGUE IN INDIA.

THE sixth report on plague investigations in India, which, like preceding reports, has this year been issued as a supplement to *The Journal of Hygiene*, is in large part made up of a continuation by Dr. M. Greenwood of the statistical examination of plague as it occurs in the Punjab. In the application of statistical methods to a subject-matter so complex it is a considerable advantage to the investigator to have himself personal experience of the methods, particular conditions, and so on affecting the collection of the data with which he has to deal, and adds cogency not so much to the facts elucidated as to the conclusions based upon these facts. It is particularly unfortunate, therefore, that the death of Major Lamb deprived Dr. Greenwood of the assistance which his wide experience and knowledge of local circumstances would have afforded. Major Lamb, of whom a memoir is included in the report, was one of the most brilliant members of the Indian Medical Service, and his untimely death in this country has taken from plague research in India one of the ablest, keenest, and at the same time best-informed of its students.

In the Punjab cases of plague continue to occur, though in reduced numbers, during the off-season, and this persistence is met with chiefly in the larger villages. Dr. Greenwood's first paper is a contribution to the question whether in the smaller villages

the seasonal outbreak should be looked on mainly as a reimportation of the disease from these larger centres or as an independent development of a local focus dormant during the off-season. If the former were the case, we might expect a larger incidence in the villages near the main lines of communication, and taking the Amritsar district as the area for investigation and the railways as the means of communication, Dr. Greenwood finds that in districts containing large centres, villages near a line of railway are, in fact, subject to a higher rate of plague epidemics than villages not so situated, while in districts purely or mainly agricultural, proximity to railways does not increase the liability. The greater liability in the former case is probably due to increased opportunity for personal intercommunication rather than to transport of merchandise, and he concludes that in districts favourably situated for such intercourse the spread of plague can be better explained on the hypothesis of reimportation than on that of recrudescence. The second paper bears on the problem of what circumstances determine the extent of an epidemic when plague has once shown itself, and why the mortality-rates in infected villages are subject to the variations actually observed. Dr. Greenwood is fully alive to the necessity of caution in accepting statistical conclusions based on the material at his disposal, and we give the barest indication of his results in saying that the rate of plague mortality is seen to depend on three factors: the length of exposure to infection, the number of inhabitants, and the situation of the village.

Besides some observations on the breeding of *Mus rattus* in captivity, and a summary of some recent observations on rat fleas, the report includes an interesting account of plague as it occurs in Eastern Bengal and Assam. This province has suffered from the present epidemic to only a limited extent, and the report, which is liberally illustrated by photographs, attributes this freedom chiefly to the scarcity of rats in the Bengali houses, a scarcity due both to the habits of the people and the structure of their houses. Two important papers by Dr. Rowland are sent from the research laboratory of the Advisory Committee, dealing respectively with a possible improvement in the preparation of plague-serum and with some of the problems connected with plague-vaccine. From the second of these it appears that it may prove practicable to obtain a vaccine of low toxicity, but undiminished immunising power, a result which if confirmed has a theoretical as well as practical significance not confined to plague only, but affecting the general question of immunity in infectious disease.

FOUR MAMMAL SURVEYS.

FOUR papers which have recently reached us serve to show the energy and vigour with which the collecting of mammals is being carried on in various parts of the world. If continued at the same rate for a few years longer, such surveys ought to go a long way towards completing our knowledge of the mammalian fauna of the globe, so far at least as external and cranial characters are concerned.

The first of the four papers is a report on the progress of the Indian mammal survey now being carried on under the supervision of the Bombay Natural History Society, in the Journal of which for October, 1911, the report is published. Collecting has been carried on in Kandesh and the Berars, where about 150 skins have been obtained. Apparently none of these represents new forms, thereby bearing testimony to the thorough manner in which collecting (for the most part amateur) has been previously carried on in this part of the country. Interesting results in regard to the geographical distribution of species and the occurrence of local races are, however, expected in the future.

To vol. iv., parts iii. and iv., of the Journal of the Federated Malay States Museums, Mr. C. Boden Kloss communicates an account of the results of a recent visit to the Trengganu Archipelago in search of mammals and other vertebrates. The chain of small islands, of which Great Redang and the Perkentians are the chief, runs at a distance of from seven to twelve miles from the coast of the Malay Peninsula in a nearly parallel direction for about thirty miles. The only previous visit of naturalists to the archipelago appears to have been made by the members of the Skeat expedition in 1899. During an eighteen days' cruise Mr. Kloss obtained thirteen mammals which he regards as representing new forms; all these were named in the *Annals and Magazine of Natural History* for January, 1911.

The penultimate number of the Proceedings of the Zoological Society for 1911 contains the fourteenth report by Mr. Oldfield Thomas on mammals from eastern Asia, collected with the aid of funds furnished by the Duke of Bedford. This particular fasciculus deals with mammals from Shen-si, the most interesting of these being the golden takin (*Budorcas bedfordi*), to which reference has been previously made in these columns, but the whole survey, despite the fact that no strikingly new forms were discovered, has vastly increased our knowledge of the mammal fauna of Eastern and Central Asia. It is, therefore, a matter for regret that it is not to be continued, at all events for the present.

The fourth paper, "Notes on the Mammals of the Lake Maxinkuckee Region," by Messrs. B. W. Evermann and H. W. Clark (Proc. Washington Acad. Sci., vol. xiii., pp. 1–34), is of a totally different type from the above, dealing solely with the habits and environment of the mammals met with during a zoological survey of the region, and is an excellent sample of the best class of American work of this nature. Particular interest attaches to the reappearance of the opossum in the district, from which it had long been absent. R. L.

TREASURY GRANTS TO UNIVERSITIES AND UNIVERSITY COLLEGES.

THE report of the Advisory Committee on the distribution of Exchequer grants to universities and university colleges in England, appointed by the President of the Board of Education last June, has now been published [Cd. 6140]. The committee as then appointed consists of seven members:—Sir W. S. McCormick (chairman), Prof. J. A. Ewing, C.B., F.R.S., Sir William Osler, F.R.S., Miss Emily Penrose, Sir Walter Raleigh, Sir John Rhys, and Sir Arthur Rücker, F.R.S., with Mr. G. M. Young as secretary.

The report states that in framing its recommendations for the distribution of the Exchequer grant, the committee has chiefly had regard to three factors—the needs of the several colleges, the amount of local support received by each, and the volume and quality of their work.

For the purpose of the present report the members of the committee have visited all the colleges coming within their purview except Nottingham, in considering which the committee had before it the report of the recent inspection conducted by the Board of Education. As a result of the visits to the various institutions, the committee says that the colleges gener-

ally are animated with a true university spirit and that the policy of their governing bodies is actuated by true university ideals. The committee does not imply that even among the stronger institutions all are equally efficient or have reached the same stage of development, but it rarely found occasion to think that where weaknesses existed the colleges were unaware of them or would be backward in applying the right remedy when circumstances permitted. The committee assures the Board of Education that in its opinion most of the colleges are fully competent to exercise that "freedom in organising" and "carrying out their important national and international functions" which it is the policy of the Board of Education to secure for them.

The committee recommends that the grant available be distributed in the following proportions :—

	£
University of Birmingham	13,500
University of Bristol	7,000
University of Durham: Armstrong College ...	8,500
University of Leeds	12,500
University of Liverpool	15,500
University of Manchester	17,500
University of Sheffield	7,000
University College, London	16,000
King's College, London 9,500	11,500
King's College for Women 2,000	
Bedford College, London	7,000
London School of Economics	4,500
East London College	5,500
Nottingham University College	5,700
Reading University College	5,500
Hartley University College	2,400
Total	£139,600

These grants have been calculated on a total of 149,000*l.*, and the committee recommends that the balance (940*l.*) of the present grant, together with the balance of 2550*l.* from the previous year's Exchequer grant, be reserved pending consideration of a superannuation scheme to be reported on later and be regarded as applicable to the institution of such a superannuation scheme and to other contingencies.

A number of general recommendations concludes the report. The committee recommends, among other matters, that subject to unforeseen contingencies the grants be fixed for a period of five years as from April 1, 1911, and that the grants be regarded as strictly maintenance grants to meet annual expenditure on teaching and research of a university character and standard.

FIORDS IN RELATION TO EARTH MOVEMENTS.[1]

FIORDS have been a powerful influence on modern life, for the existing facility for intercourse oversea is the difference between modern and mediæval Europe which penetrates most deeply into all departments of life and work. The Roman Empire was held together by its roads, and as its conquerors from the wide plains of the east were neither sailors nor roadmakers, Europe was resettled on national instead of on imperial lines. While Europe thus fell naturally into independent States, the most efficient of all means of international communication was being developed on the shores of Scandinavia; for owing to the fiords travel overland there was even more difficult than through the forest-clad plains of Central Europe. In Norway the fiords were the only practicable highways, and they, with their labyrinth of smooth waterways, their tidal currents, which carried boats to and fro independent of wind or oar, and their unfailing supplies of food, fuel, and skins, attracted men to the sea as much as the barren highlands repelled them from the land.

The poverty of their own country having driven the Norsemen to the sea, the wealth of the more fertile southern coast-lands tempted them to the career of piracy which made the berserkers the terror of the shores of western Europe. These pirates, however, amply repaid their debt by their contributions to modern seamanship, made in consequence of the geographical conditions of the Norwegian fiords. Eva Nansen's song contains a true statement of the influence of the fiords on the Norwegian race :—

> Our mother, weep not! it was thou
> Gave them the wish to wander;
> To leave our coasts and turn their prow
> T'wards night and perils yonder.
> Thou pointed'st to the open sea,
> The long cape was thy finger;
> The white sail wings they got from thee;
> Thou canst not bid them linger!

The white sails of the Norse and Danish Vikings, amongst other things, carried the name fiord far and wide. It is found on the Irish coast, for example, in Wexford, which is said to be derived from the Danish Weis-fiord, and in Waterford from Vadre-fiord; and the name is now accepted as a technical term in general geographical nomenclature.

The word fiord is used in Norwegian for any arm of the sea, including various types of gulfs, bays, and straits. But the name is adopted in international geography for arms of the sea of a special kind. A fiord in this restricted sense is a long inlet which extends far inland between steep parallel walls; it usually consists of long straight reaches, which are bent and receive their tributaries at sharp and regular angles. Its walls are high, as fiords are restricted to mountain regions.

Fiord districts combine the features of mountain and coastal scenery. Many authors have been impressed by a sense of the monotony of fiord scenery, owing to the constant repetition of the same form; it is, however, popular from the easy access to it along smooth waterways, the especial beauty of the cloud forms and the colour effects, which do not pass with the flash of a tropical sunset, but last for hours in the prolonged twilight of most fiord areas. The charm of fiord countries is, moreover, enhanced by the survival, owing to the special geographical environment, of primitive conditions of rural life.

The origin of fiords has given rise to prolonged controversy. The difficulty of the problem is due to the peculiar combination of geographical characters. The fiords are clearly valleys, of which the lower ends have been drowned by the sea. Sea-drowned valleys are of three main kinds.

The most familiar kind is that of ordinary river estuaries, which have been submerged by subsidence of the land. Such estuaries have gentle, rounded slopes and curved shore lines; they are typically funnel-shaped, as they increase seaward, both in width and depth. The Firths of the Tay and Forth, the estuaries of the Thames, Severn, and Humber, and Bantry Bay in south-western Ireland are examples of such drowned valleys. They are well illustrated in north-western Spain, where they are called rias, and this term "ria" has been adopted as the technical name of this kind of drowned valley.

The members of the second group are known as "fiards" from their typical representatives in south-

[1] Abridged from a lecture delivered to the Midland Institute of Birmingham on January 22, by Prof. J. W. Gregory, F.R.S.

western Sweden. They agree with rias by having curved lines, gentle slopes, and indented shores. They differ, however, from rias, as they often include deep basins, separated by rock bars from the outer sea, which may not for some distance reach the depth of the inner basins. Fiards, moreover, usually have no large rivers draining into them, and may receive only insignificant streams and brooks. Fiards are due to a lowland area with an irregular surface of hard rocks having been partially submerged beneath the sea. The essential difference from fiords is that fiards are characteristic of the coast lands which rise to but a slight height above sea-level.

The third group consists of the fiords, which, seen from a steamer or on an ordinary map, have seven chief characters.

(1) They are typically long, straight, narrow channels, and they are usually so crowded and run so far inland that they add greatly to the length of the coast line. Thus, whereas in Norway the length of the coast from headland to headland is 1700 miles, the actual length of the shore line along the fiords is 12,000 miles.

(2) The walls are typically high and steep.

(3) The fiord channels usually have parallel sides, and the fiords bend or branch at sharp angles, and the same angle tends to recur throughout a district. There is accordingly a striking parallelism in the geographical elements of neighbouring fiords.

(4) The fiord valleys are often arranged along intersecting lines like a network of cracks, in contrast to the converging tributaries of a river system.

(5) The fiords are characteristic of dissected plateaus. All the great fiord districts of the world were formerly plateaus.

(6) Owing to the plateau structure the land extends backward from the fiord walls with gentle slopes and shallow valleys. Streams flow gently across these uplands until they reach the fiord wall, and then plunge down it in great waterfalls, which are especially picturesque in spring, when the rivers are flooded by the melting snow. The highest waterfall in the world, the Sutherland Falls of New Zealand, sometimes leaps, it is said, in one jump of 1900 ft. on to the floor of the fiord valley of Milford Sound. The upland valleys which join the fiords have not been cut down to the level of the main valley, but enter abruptly high upon its side. They are therefore "hanging valleys."

(7) Finally, the amount of land beside the fiords suitable for cultivation is usually limited to small tracts at the head of the fiord or on small deltas along its sides. The amount of cultivable land in a fiord district is small, and fiord countries are therefore sparsely populated. One of their main values will be as the playgrounds for more crowded countries. They sometimes have rich mineral deposits, as in Alaska; but many American authorities claim that even there the scenery will prove the most valuable economic asset.

The previous characters can be observed by a tourist from the deck of a steamer, but if we could remove the sea and travel over the fiord floors three fresh geographical features would be revealed.

The walls which rise high above the sea surface would be seen to descend steeply to extraordinary depths. The deepest known fiord is the Messier Channel, in Patagonia, which reaches the depth of 4250 ft. The Sogne Fiord is the deepest in Europe, with the depth of 3780 ft. Some of the lakes which may be regarded as inland extensions of fiords are also surprisingly deep. Thus Lake Morar, in the western Scottish Highlands, of which the surface is 22 ft. above sea-level, is 1017 ft. deep; and this fact is all the more striking as the sea to the west does not reach that depth within the distance of 120 miles.

The deepest part of a fiord basin is usually at some distance from the sea; the floor rises seaward until it is covered only by shallow water, or projects above the surface and the fiord becomes a lake.

Fiords are therefore often separated from the outer sea by submerged thresholds. This fact was first discovered by Captain Cook in Christmas Sound, Patagonia; he found to his danger that on passing up that fiord he lost the anchorage which he had at its mouth. The existence of a threshold is such a frequent feature of fiords that it is regarded by some authorities as an essential character.

The removal of the water from a fiord would show that it has a flat floor. The valley is trough-shaped, whether empty or partially filled with water. The flatness of the floor can be learnt by cross sections from charts, or seen on the floor of the undrowned part of a fiord valley.

The problem presented by fiords is therefore that of the formation of systems of steep trough-valleys, which are arranged in networks so that the land beside them is broken up into rectangular blocks, and usually have deep inner basins separated from the sea by shallow thresholds.

The simplest explanation of valley formation is excavation by rivers; but this process will not explain the origin of fiords. Thus our British fiords, the Scottish sea-lochs, are not on river valleys; of the chief Scottish rivers, the Tay and the Forth enter the sea through rias; the Clyde discharges into a compound basin which is not a fiord; and the Tweed, Dee, Don, and Doon have no long arms of the sea at their mouths. The chief sea-lochs, on the other hand, receive only small streams. The river systems of Scandinavia, North and South America, and New Zealand show the same independence of the fiords. The fiords are not the outlets of the main rivers. In fact, so far from fiords being made by rivers their existence depends on the absence of rivers, which would convert them into ordinary valleys by wearing back their banks and filling the main channel with sediment.

The failure to explain the formation of fiords by rivers of water therefore led to the invocation of rivers of ice, and many features of the fiord valleys are consistent with their formation by glaciers. The essential difference between the action of water and ice as agents of excavation depends on their difference in plasticity. Water, being very plastic, readily adapts itself to the irregular resistance of the adjacent rocks; it glances lightly off opposing hard surfaces and carves for itself sinuous channels.

Glacier ice flows around opposing obstacles, but as it is less plastic than water it is deflected less readily and bears with persistent pressure against the rocks in its path, and if armed with stones and grit it wears away the rocks like a grindstone. Therefore, whereas denudation by water tends to develop rounded surfaces with curved lines, ice, when confined in valleys, tends to produce straight lines, flat slopes, and angular, facetted surfaces.

The difference between the rounding action of water and the facetting action of ice may be illustrated by reference to the typical forms of pebbles in deposits laid down by rivers and by ice. The typical river pebble is rounded, and often egg-shaped. The typical ice-worn rock in a boulder clay has flattened surfaces, which often meet sharply along straight edges, like the facets of a gem. The same differences can be recognised on a larger scale in the topography of a glaciated district.

Further, a river flows around the base of the spurs

from the sides of its valley, and often tends to lengthen them, whereas ice slowly cuts away the toes of these spurs until they end in triangular facets. These facetted ends are well shown on many of the spurs that run down to the Alpine glaciers, and they can be recognised on many Scottish mountains and valleys.

A glacier flowing down a valley presses against the spurs from the two sides and gradually rubs them away. It thus converts a sinuous river valley into a straight canal-like or trough-valley, which is the characteristic form of fiord valleys, of many glacier valleys, and of some of the lower Swiss valleys, such as that of the Rhone—though it is not the usual form of the higher level Alpine valleys from which glaciers have retreated.

There is also an important difference between the powers of ice and water in deepening their valleys. A river, except where it plunges over a waterfall, cannot deepen its valley lower than the outlet. Deep rock basins can only have been made by river action by a combination of three processes: first, the elevation of the country high above sea-level; secondly, the cutting of deep valleys by rivers; and thirdly, the uneven subsidence of the land, so that the mouth of the valley either sank slightly or remained stationary, and was thus left as a raised threshold. The existence of deep fiord basins and their thresholds cannot, however, be thus explained in many and in perhaps the majority of cases.

Ice, however, has greater powers of irregular vertical excavation than water. It moves slowly, and its great weight presses heavily upon its bed. Fragments of the loose material beneath the ice may be frozen into the sole of the glacier and be thus carried away. There is much evidence that the power of a glacier to cut away fresh, undecayed rocks is limited, except where they project into the path of quickly moving ice; but ice acting on weathered, decomposed rock can pick it up and remove it grain by grain. Mining experience shows that the depths to which rocks are weathered varies very irregularly; along the outcrop of a lode there may be a succession of places where decomposition has gone deeply, separated by ridges of fresh and hard rock. A glacier has greater powers than a river in eating out such weathered material, and thus forming rock basins.

The attack of glaciers on the rocks beneath them is aided by a second process. Many geologists hold that rivers owe their main power of cutting down hard bars of rock to pot-hole formation, which beneath a river cannot extend deeply below sea-level; but there is no such limit to the depths to which pot-holes are bored beneath a glacier; a stream of water plunging down a glacier mill may drill pot-holes into hard rocks deep below sea-level, and where many occur together the surface may be lowered into a rock basin. Hence glaciers have some powers of hollowing out basins greater than those of rivers. There are, however, other factors which counteract this process, and cause slowly moving glaciers and sheets of snow and ice to protect their beds, for the rock beneath them is preserved from the wear and tear of wind and water, from shattering by heat and frost, and from atmospheric decomposition.

The distribution of fiords has also been claimed as proof of their glacial formation. There are nine main fiord districts in the world, and of these the most famous are in high latitudes and in districts which were formerly occupied by ice. Thus in Europe they occur in Norway, Scotland, Iceland, and Spitzbergen. In America they are found in Greenland and down the western coast throughout Alaska and Canada. They disappear further south, and reappear again in the far south of South America in areas where glaciers still exist upon the mountains, and there is clear evidence of the former extension of the glaciers to sea-level.

The famous fiords of New Zealand are in the south-western corner of the country, where the glaciers formerly reached sea-level; while the North Island, where, according to many New Zealand geologists, there is no satisfactory evidence of low-level glaciers, has no fiords.

It is therefore claimed that fiords are limited to countries that have been glaciated, and that their restriction to such regions is proof of their glacial origin. Nevertheless, in spite of its attractiveness, the simple theory which explains fiords as due to the action of glaciers appears inadequate. Many fiords were no doubt occupied by ice, and have been moulded to their present form by ice; but they were not necessarily formed by it. Fiords are not limited to formerly glaciated areas, and even in glaciated countries their distribution is inconsistent with their glacial formation. Thus a sheet of ice covered nearly the whole of the British Isles, and, according to most authorities, it extended as far south as the line between the estuaries of the Thames and the Severn. The fiords of Great Britain are, however, almost limited to western Scotland, although the ice covered most of the eastern coasts, and there flowed over rocks of the same character as those beside the western fiords. Some of the glaciated areas in eastern England consist of soft beds, upon which glacial erosion should have been particularly effective. Nevertheless, there are no fiords in Yorkshire, for example, although the hills that reach the coast were buried under deep ice, and are composed of comparatively soft rocks. The best English fiords are in Cornwall, where some of the harbours, like those on the opposite coasts of Brittany, have many characters which show that they were originally true fiords; and Cornwall is one of the few English counties which admittedly were not glaciated.

Moreover, the plan of the fiord systems in each country does not appear to be that which would have developed as the result of glacial erosion. The chief fiord systems in the world have the same essential plan. Each fiord area is long and curved; in most cases a series of channels extend along the coast, and from them other fiords run inland, and are usually connected by others, or by deep valleys, so that the country is divided into angular blocks.

These networks are not the arrangement that would be expected if fiords had been excavated by glaciers, for in that case the main channels should be radial from the chief centres of snow fall. The course of the fiords is inconsistent with the lines of flow of the chief glaciers. The glaciers discharged from the highlands or from great domes of snow which sometimes formed on the lee side of the existing watersheds; the ice flowed by the most direct channels to the nearest low land or the sea. Many of the fiords owing to their directions were quite useless to the outflowing ice; they appear to have been simply filled with stagnant ice, and the main flow of the glaciers was above and across them.

The inconsistency between the direction of the lochs and the lines of flow is well shown in many parts of Scotland, as, for example, by the map of the ice movements in the area around Colonsay in a recent Scottish Survey memoir. It is also well shown in the Shetland Islands, where the main fiords, lochs, and other geographical elements trend north and south; but the ice movement was from east to west at right angles to the fiords.

The final and most convincing argument against the glacial origin of fiords is that they are pre-glacial. They are older than the ice which once

occupied them. They are due to a series of uplifts which happened mainly in Pliocene times after the great Miocene movements which in Europe formed the Alps and the associated mountain chains. In nearly all cases the fiord valleys were formed in Pliocene times; hence the Pleistocene ice used the fiords and did not originate them.

It is therefore necessary to find an explanation of these complex valley systems independent of the ice action, which has given some of them their most conspicuous features. Facetted spurs and long parallel-walled valleys with hanging valleys upon their sides are formed by other than glacial agencies. They may be due directly to earth movements, as in the fiords of Dalmatia. Thus the famous fiord of Cattaro is flanked by facetted spurs, and the formation of the facets is due to recent faulting. The straight Dalmatian trough-valleys with their high walls and hanging valleys are due to recent earth movements, aided by the comparative weakness of the rivers owing to the porosity of the limestone which is the prevalent rock. These fiords are due to the earth movements which formed the Adriatic Sea, and all the fiord systems of the world are related to earth movements. Their networks do not resemble valleys cut by erosion, but intersecting fractures. The most striking features in the distribution of fiords connect them not with ice movements but with earth movements. The fiord systems of all parts of the world are arranged, not in radial lines from the highlands, but as angular networks resembling intersecting cracks in slabs of twisted glass. This fact is apparent from Kjerulf's plan of the fiords of southern Norway, which showed that all the fiords, lakes, and main valleys of that country can be arranged into a number of groups each with a definite direction, and the different series cross at sharp angles. The same arrangement of the fiords on intersecting lines is shown in Alaska, Patagonia, New Zealand, and Scotland.

The Scottish lochs and their valleys may be arranged in four groups. The most conspicuous lines in the coast of Scotland run east and west, as in the Pentland Firth and the southern side of the Moray Firth. Many of the western lochs, such as Loch Hourn, Loch Leven, Loch Eil, Loch Rannoch, and Lower Loch Etive, trend in this direction, which also occurs in the northern coast of Connaught in Ireland, and along the northern coast of Wales.

The second series of lines trend north and south at right angles to the first.

The members of the third group trend north-east and south-west; they include Glen More, the line of the Caledonian Canal, the Kyle of Tongue, the valley of the Spey, Upper Loch Etive, Loch Awe, Loch Fyne, many of the lochs around the Sound of Jura, and the central part of Loch Tay.

The direction of the fourth group is at right angles to part of the Glen More lines, and its series of valleys and lochs extend north-west and south-east, and include Loch Broom on the north-western coast and Lower Loch Fyne and Loch Crinan, and the Sound of Islay; also various inland lakes, such as Loch Shin.

These directions are not those that would be expected in valleys formed by glacial erosion. The largest centre of glacial accumulation in Scotland must have been the Grampians of eastern Aberdeenshire, for though the highest point of the area around Ben Macdhui and Cairngorm is slightly lower than the summit of Ben Nevis, it belongs to the largest area of highlands in Scotland. All this land was unquestionably covered by ice, and in no part of Scotland are glacial phenomena better displayed. Most of the ice probably flowed eastward and north-eastward and reached the North Sea; but nowhere along the eastern coast are there any fiords, and in spite of the great power of the glaciers, even the long narrow fresh-water lochs are confined to western Scotland.

Ben Nevis was also intensely glaciated, and the chief ice movements in that area were from south-west to north-east, for the great centre of accumulation was over the country between Ben Nevis and the coast, owing to the heavy precipitation of snow piling up a huge ice dome. Valley glaciers radiated from Ben Nevis in the last stages of the glaciation, but the chief lochs in this district are not radial from Ben Nevis, but form a circular series around it.

The angular fiord networks also occur in regions where there are no indications of the former existence of glaciers. Thus the colony of Hong Kong, including the adjacent peninsula on the mainland of China, has a fiord-like series of intersecting valleys, and a most beautiful example of the same arrangement occurs in the peninsula of Sinai. The Gulf of Akabah has many of the characters of a fiord, and Prof. Bonney has so called it; and, if Sinai were partially submerged, it would be divided into angular islands and peninsulas, separated by parallel-sided, steep-walled valleys, which would form a typical series of fiords.

The explanation of fiord valleys as due to intersecting fractures explains the chief facts of their distribution. It explains their restriction to plateau countries, as it is only where wide areas have been uplifted that they are shattered by regular intersecting cracks. It also explains their restriction to areas of old rocks, for the younger rocks yield by stretching and not by cracking.

The fiord valleys were not formed by gaping cracks of the full width of the present valleys. The cracks caused narrow clefts along the planes of weakness, which have been widened by denudation. Water and air enter them and cause the decay of the rocks. Streams remove the weakened rock material, and the clefts are gradually widened into river valleys, and if the country be subsequently glaciated the ice enters the valleys and completes their formation.

Uplift alone is, however, inadequate to produce fiords. Subsidence also is necessary to let in the sea. In nearly all fiord countries the last movement has been a fresh elevation. Many fiord thresholds appear to be due to a tilting of the country at the last uplift.

Fiords, therefore, are produced in regions which have undergone repeated earth movements. They mark out areas of the crust which in recent geological times have undergone alternate elevation and depression. These regions are mainly polar and circumpolar, as in the equatorial zone the uplifts have been more local. There are numerous raised coral reefs, but the tropical coasts of Africa, Australia, and America lack the widespread raised sea beaches which are so charactertistic of the chief fiord regions. The restriction of the fiord areas to high northern and southern latitudes gives a clue to the cause of the fiord movements. They may be explained as a deformation of the earth which is more marked in the polar than in the tropical zones. If a flexible circular band be rotated about its axis it becomes oval, and the radial movement is greater on the flattened polar sides than on the raised equatorial zone. The deformation of the earth which produced the fiords caused greater vertical movements in the polar and circumpolar regions than in the tropics, and thus fiords are characteristic of higher latitudes.

I have therefore endeavoured by this rapid survey of a wide subject to show that fiords are not only attractive from their unique scenery and their special

historic interest, but that they give important evidence relating to the structure and mobility of the earth. The spirit of maritime adventure born in the Scandinavian fiords gave the European races the mastery of the sea and a political predominance which is world-wide in its influence. The geological study of fiords leads to geographical problems that are also world-wide in their range, for the view that fiords are due to local superficial agents chiselling out furrows on an impassive earth explains neither their features nor distribution. Fiords teach more significant and far-reaching lessons; they point to deep-seated forces which affect the earth as a whole. However greatly fiords may have been moulded by ice, wind, and water, they are not primarily due to those agencies, which have used the fiords, not made them.

The ultimate cause of fiords is the rupture of certain wide areas of the earth by the pulsation of the crust under the play of titanic forces set at work by the great Miocene disturbances which upheaved the chief existing mountain systems of the world.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, April 11.—Dr. H. F. Baker, president, and temporarily Prof. A. E. H. Love, vice-president, in the chair.—A. **Cunningham**: Mersenne's numbers.—G. N. **Watson**: A modification of Liouville's theorem.—G. H. **Hardy** and J. E. **Littlewood**: Contributions to the arithmetic theory of series.—G. B. **Mathews**: Complex binary arithmetic forms.—H. S. **Carslaw**: An application of the theory of integral equations to the equation $\nabla^2 u + k^2 u = 0$.—H. F. **Baker**: (i) Some transformations of Kummer's surface; (ii) the curves which lie on a cubic surface.

PARIS.

Academy of Sciences, April 9.—M. F. Guyon in the chair.—E. H. **Amagat**: The variations of the pressure coefficient with temperature and on some points which depend on it in the study of the internal pressure of fluids. The pressure coefficients of argon are calculated from experimental data obtained in the laboratory of Prof. Kamerlingh Onnes for temperature ranges, −121·2° to −109·9°, −102·5° to −57·7°, −57·7° to 0·0°, and 0·0° to +20·4°; for hydrogen at temperatures −217·4° to −182·8°, −182·8° to −103·6°, −103·6° to 0·0°, and 0·0° to 100·2°; for helium, at temperatures −258·9° to −182·8°, −182·8° to −103·6°, −103·6° to 0·0°, and 0·0° to 100·3°. All the results point to a small diminution of the pressure coefficient as the temperature increases. The changes observed are much larger than would be expected from the values of the specific heat at constant volume.—E. L. **Bouvier**: The classification of the genus Caridina and the extraordinary variations of a species of this genus, *Caridina brevirostris*. The variations of this species have led the author to reject the existing classification of the Caridinæ based on the rostral structure; suggestions for a new scheme are put forward.—Paul **Sabatier** and M. **Murat**: The direct addition of hydrogen by catalysis to the benzoic esters; the preparation of the hexahydrobenzoic esters. The addition of hydrogen to methyl and ethyl benzoates by the catalytic action of reduced nickel requires the temperature of the reaction to be maintained exactly at 180° C. Good yields of ethyl and methyl hexahydrobenzoates are thus obtained.—Kyrille **Popoff**: The influence of the various methods of photometric measurements on the estimation of stellar magnitudes.—Ch. **Jordan** and R. **Fiedler**: Contribution to the geometry of convex curves and of certain curves which are derived from them.—A. **Cotton** and H. **Mouton**: New substances showing magnetic double refraction. The straight chain carbon-compounds and some of their derivatives remain inactive in a strong magnetic field. Substituted paraffins, however, containing the nitro-group or a halogen exhibit magnetic double refraction.—Albert **Colson**: The singular features of certain proofs in physical chemistry. A reply to a recent note of M. Langevin, dealing especially with the van't Hoff theory of solution.—Ed. **Griffon** and A. **Maublanc**: The microsphœra of the oak.—Paul **Macquaire**: Two combinations formed by iodine and the tyrosine obtained by the trypsic hydrolysis of albuminoid materials. Analyses are given of a definite diiodo-derivative of tyrosine; by the action of boiling water on this substance a new iodine derivative of tyrosine was obtained containing less iodine.—A. **Desgrez** and Mlle. Bl. **Guende**: The influence of an excess of sodium chloride on nutrition and on renal elimination. An excess of common salt in food favours auto-intoxication.—Gabriel **Bertrand** and F. **Medigreceanu**: The normal manganese in the blood. Traces of manganese were found in blood from the sheep and the horse; negative results were obtained with blood from man, rabbit, chicken, and duck. The amount of manganese present in the blood of man and the higher animals is much less than has hitherto been supposed.—Ed. **Bourquelot** and M. **Bridel**: The action of emulsion upon salicin in alcoholic solution. Salicin is hydrolysed by emulsion in solutions containing proportions of alcohol up to 90 per cent. In aqueous solution the hydrolysis is not complete, about 5 per cent. of the salicin remaining unchanged.

BOOKS RECEIVED.

Notes and Answers to Exercises in "A Shorter Geometry." By C. Godfrey and A. W. Siddons. Pp. 16. (Cambridge: University Press.) 6*d*.

Note sur le Vol des Oiseaux. By E. Delsol. Pp. iv+23. (Paris: Gauthier-Villars.) 1 franc.

The Cause of Cancer. Being Part iii. of "Protozoa and Disease." By J. J. Clarke. Pp. xi+112+viii plates. (London: Baillière, Tindall and Cox.) 7*s*. 6*d*. net.

Mikroskopisches Praktikum für systematische Botanik. (I., Angiospermae.) By Prof. M. Möbius. Pp. viii+216. (Berlin: Gebrüder Borntraeger.) 6.80 marks.

Anleitung zur mikroskopischen Untersuchungen von Pflanzenfasern. By Dr. G. Tobler-Wolff and Prof. F. Tobler. Pp. viii+141. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 20 Lief. Band iv. (Jena: G. Fischer.) 5 marks.

British Association for the Advancement of Science. Portsmouth Meeting, 1911—A Catalogue of Destructive Earthquakes, A.D. 7 to A.D. 1899. By Dr. J. Milne. Pp. 92. (London: The British Association.) 5*s*.

The Mafulu Mountain People of British New Guinea. By R. W. Williamson. Pp. xxiii+364+ plates. (London: Macmillan and Co., Ltd.) 14*s*. net.

Oxford Gardens. Based upon Daubeny's Popular Guide to the Physick Garden of Oxford: with Notes on the Gardens of the Colleges and on the University Park. By R. T. Günther. Pp. xv+280. (Oxford: Parker and Son; London: Simpkin, Marshall and Co., Ltd.) 6*s*. net.

Handbook of the Technique of the Teat and Capillary Glass Tube, and its Applications in Medicine and Bacteriology. By Sir A. E. Wright. Pp. xvi+202. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

On the Backwaters of the Nile. Studies of some

Child Races of Central Africa. By the Rev. A. L. Kitching. Pp. xxiv+295. (London: T. Fisher Unwin.) 12s. 6d. net.

The Land of Goshen and the Exodus. By Sir H. Brown. Second edition. Pp. 92+2 maps. (London: E. Stanford.) 3s. net.

Mineralien-Sammlungen. Ein Hand- und Hilfsbuch für Anlage und Instandhaltung mineralogischer Sammlungen. By Dr. W. Brendler. ii. Teil. Pp. viii+700. (Leipzig: W. Engelmann.) 20 marks.

Hevea Brasiliensis, or Para Rubber. By H. Wright. Fourth edition. Pp. xx+542. (London: Maclaren and Sons, Ltd.) 15s. net.

The Fishes of the Indo-Australian Archipelago. I. Index of the Ichthyological Papers of P. Bleeker. By Drs. M. Weber and L. F. de Beaufort. Pp. xi+410. (Leiden: E. J. Brill, Ltd.)

Einführung in die Tier- und Menschenkunde. By Prof. O. Schmeil. Pp. x+260. (Leipzig: Quelle & Meyer.) 2.50 marks.

Lebensfragen aus der heimischen Pflanzenwelt. By Dr. G. Worgitzky. Pp. viii+295. (Leipzig: Quelle & Meyer.) 7.20 marks.

Mitteilungen des Ferdinand von Richthofen-Tages, 1911. Pp. vi+78. (Leipzig and Berlin: B. G. Teubner.)

Feuerungsanlagen und Dampftessel. By J. E. Maner. Pp. vii+147. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die Geschlechtskrankheiten, &c. By Prof. Schumburg. Zweite Auflage. Pp. vi+112. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Australien und Neuseeland: Land, Leute und Wirtschaft. By Dr. R. Schachner. Pp. vii+120. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Naturwissenschaften und Mathematik im classischen Altertum. By J. L. Heiberg. Pp. 102. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Physical Geography for South African Schools. By A. L. Du Toit. Pp. xii+250. (Cambridge: University Press.) 4s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 18.

ROYAL INSTITUTION, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

LINNEAN SOCIETY, at 8.—*Botrychioxylon paradoxum*, a Palæozoic fern with secondary wood: Dr. D. H. Scott, F.R.S.—On *Psygmophyllum majus*, sp. nova, from the Lower Carboniferous rocks of Newfoundland, together with a revision of the genus, and remarks on its affinities: Dr. E. A. Newell Arber.—The Alpine Flora of the Canadian Rocky Mountains: Mrs. Henshaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Valuation of Ores and Minerals and on Metallurgical Calculations: G. T. Holloway.—The Domes of Nova Scotia: T. A. Rickard.—Gels in Relation to Ore Deposition: E. Hatschek and A. L. Simon.—Recent Practice in Diamond Drilling and Borehole Surveying: J. I. Hoffmann.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 9.—Electricity Supply: Past, Present, and Future: A. A. Campbell Swinton.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Tenth Report to the Alloys Research Committee on the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.

INSTITUTION OF CIVIL ENGINEERS, at 9.—"James Forrest" Lecture: Aerial Flight: A. Mallock, F.R.S.

MONDAY, APRIL 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, APRIL 23.

FARADAY SOCIETY, at 8.—Discussion on Magnetic Properties of Alloys, preceded by the following Papers: On the Magnetic Properties of Iron-carbon and Iron-silicon Alloys: Dr E. Gumlich.—The Dependence of Magnetisation on Composition in Chemical Compounds: Prof E. Wedekind.—The Magnetic Properties of a Variety of Special Steels at Low Temperatures, and The Heusler Alloys: Dr. Alexander D. Ross and Dr. J. G. Gray.—(1) The Magnetic Properties of Nickel and Manganese Steels with Reference to their Metallographical Composition; (2) The Magnetic Properties of the Compounds of Manganese with Phosphorous, Arsenic, Antimony, and Bismuth: Dr. S. Hilpert and Dr. E. Colver-Glauert.—The Nature of the Heusler Alloys: The Physical Aspect: Dr. E. Take.—The Chemical Aspect: Dr. F. Heusler.—Variation of Ferromagnetic Properties of the Heusler Alloys with Composition and Heat Treatment: Prof. A. A. Knowlton.—The Relations between the Mechanical Hardness and the Retentivity and Permeability of Ferro-Alloys: Prof. C. F. Burgess and J. Aston.—The Magnetic Properties of the Iron-nickel, Iron-cobalt, and Nickel-cobalt Alloys: Prof. Pierre Weiss.

ROYAL STATISTICAL SOCIETY, at 5.—On the Methods of Measuring Association between Two Attributes: G. Udny Yule.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Pre-Boulder Clay Man: Mr. Moir and Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 8.30.—A First Account of the Courtship of the Redshank (*Totanus calidris*): Julian S. Huxley.—Amphipoda from Bremerhaven: Mrs. E. W. Sexton.—Descriptions of New Fishes of the Family Loricariidæ in the British Museum Collection: C. Tate Regan.—The Circulatory System of the Common Grass Snake (*Tropidonotus natrix*): C. H. O'Donoghue.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Remodelling and Equipment of Madras Harbour: Hon. Sir Francis J. E. Spring, K.C.I.E.—The Alteration in the Form of Madras Harbour: H. H. G. Mitchell.

WEDNESDAY, APRIL 24.

ROYAL SOCIETY OF ARTS, at 8.—Technical Education in Ireland: George Fletcher.

THURSDAY, APRIL 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Diffusion and Mobility of Ions in a Magnetic Field: Prof. J. S. Townsend, F.R.S.—On the Observed Variations in the Temperature Coefficients of a Precision Balance: J. J. Manley.—On the Torque produced by a Beam of Light in Oblique Refraction through a Glass Plate: Dr. Guy Barlow.—Contributions to the Study of Flicker. III: Dr. T. C. Porter.

ROYAL INSTITUTION, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The Central Provinces: Sir John O. Miller, K.C.S.I.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Third Kelvin Lecture: Prof. H. du Bois.

CONCRETE INSTITUTE, at 8.—Discussion on reports presented by the Tests Standing Committee, entitled (1) The Testing of Concrete, Reinforced Concrete, and Materials Employed therein; (2) The Testing of Reinforced Concrete Structures on Completion.

FRIDAY, APRIL 26.

ROYAL INSTITUTION, at 9.—Sir William Herschel: Sir George Darwin, K.C.B., F.R.S.

PHYSICAL SOCIETY, at 5.—*Adjourned Discussion*: The Coefficients of Expansion of Fused Silica and Mercury: H. Donaldson.—The Solution of Net-work Problems by Determinants: R. Appleyard.—A Method of Measuring Small Inductances: S. Butterworth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Principles and Practice of Accountancy in Relation to Engineering Design and Work: T. Frame Thomson.

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