THURSDAY, APRIL 29, 1909.

CENTRAL-AMERICAN ORTHOPTERA.

Biologia Centrali-Americana. Insecta. Orthoptera, Vol. I., by Dr. Henri de Saussure, assisted by Dr. Leo Zehntner and A. Pictet. The Forficulidæ, by Count de Bormans (1893–1899). Vol. II., the Acridiidæ, by Prof. Lawrence Bruner [the Tettiginæ, by Albert P. Morse], and the Phasmidæ, by Robert Shelford (1900–1909). (London: Dulau and Co.)

THE Orthoptera have been sadly neglected by British entomologists, and the sound systems of classification of the component families, which we now possess, are due almost entirely to the researches of Continental naturalists. It is therefore not surprising, though perhaps a little galling to one's sense of patriotism, to find that the study of Central American Orthoptera in the Godman-Salvin collection was entrusted to French, Swiss, Austrian, and American entomologists. The result of their combined labours is a magnificent memoir on a most interesting order of insects from one of the most interesting regions of the world; it is, in fact, the only complete memoir on a tropical orthopterous fauna that has been published, and we venture to prophesy that this position will long remain unchallenged. The faunistic memoirs of Grandidier's "Histoire de Madagascar," which alone can compare with the "Biologia Centrali-Americana," appear to have come to a premature end; whilst naturalists like Dr. Godman and the late Mr. Salvin, with the energy, public spirit, and sufficient pecuniary resources to institute zoological surveys of other tropical lands, are unfortunately seldom found.

The first volume of the memoir under notice began to appear in 1893, and it was completed in 1899; it treats of the Forficulidæ, Blattidæ, Mantidæ, Gryllidæ, and Locustidæ. The Forficulidæ were worked out by de Bormans, and are referred to forty-one species, of which eight are new to science; the author merely enumerates the species with descriptions of the new forms, but adds nothing to what was previously known on the taxonomy of the group. De Saussure and Zehntner, on the other hand, in their work on the Blattidæ and Mantidæ, publish valuable keys to the genera and species, and, in order to make the keys as complete as possible, have included a number of extra-Central-American forms; consequently these treatises have been since their publication standard works of reference. The largest cockroach known, *Megaloblatta rufipes*, occurs in Central America, and is fully described and well illustrated in this memoir. The authors remark on its resemblance in details of structure to the genus Blabera of a totally different subfamily, and they appear to regard the resemblance as mimetic. This interpretation is obviously erroneous; mimicry implies the superficial resemblance of structurally different animals, but Megaloblatta is superficially very different from Blabera, especially in colouring, and the structural resemblances of the two forms must be due either to convergence in development or to genetic relationship; for our own part we are inclined to favour the latter view, and to believe that the systematic position of Megaloblatta has been wrongly determined.

Since Brunner von Wattenwyl once exclaimed enthusiastically that the system of classification of the Gryllidæ evolved by de Saussure was not the system of M. de Saussure, "mais bien celui du Créateur Lui-même," it is only fitting that to the Swiss naturalist should have been entrusted the study of the Central American species, and entomologists may be congratulated on now possessing a most illuminating monograph of a difficult but fascinating group of insects. De Saussure was a systematist who delighted in discovering the relation of structure to function, and his entomological writings are full of references to the bionomics of the insects he studied, and of ingenious suggestions as to the use of the structures that they present. When discussing, in the memoir now reviewed, the presence of four cerci in the genus Tridactylus, a character unique amongst the Orthoptera, he alludes to the amphibious habits of these little crickets, and suggests that the appendages serve to hold an air-bubble when the insects dive and swim under the surface of the water. The various modifications of elytral structure and venation to form stridulating organs in the Gryllidæ and Locustidæ are admirably explained and clearly figured; the fact is mentioned that many of the apterous Stenopelmatinæ are endowed with auditory organs on the front tibiæ, and that stridulation is produced, as in the Acridiidæ, by the friction of the hind femora, which are roughened on their inner aspect, against an apposed surface—in this case the sides of the abdomen.

The second volume, containing a monograph on the Acridiidæ by L. Bruner and A. Morse, and a list of Phasmidæ compiled by R. Shelford from the recent monograph on the family by Brunner von Wattenwyl and Redtenbacher, bears the dates 1900–1909. The considerable period of time elapsing between the commencement and the completion of this volume is partly to be accounted for by the difficulty of working out the large collections of the difficult family of Acridiidæ, and partly by the conditions imposed by the Austrian entomologists when they undertook the determination of the Godman-Salvin collection of Phasmidæ. They were unwilling to anticipate by preliminary memoirs their exhaustive monograph of the Phasmidæ of the world, and would only undertake to describe the new genera and species from Central America in the monograph itself; consequently it was impossible to publish anything on these insects in the "Biologia Centrali-Americana" until the monograph appeared in 1906–1908. The plates illustrating the Central American species were prepared some years ago, but since, in some cases, the views on nomenclature of Brunner von Wattenwyl and Redtenbacher were subsequently modified, the legends on the plates do not always correspond with the names of the species as published in their monograph; such discrepancies as exist have, however, been explained in the references to the plates. The memoir on the Acridiidæ is a valuable piece of work, and adds largely to our knowledge of them; some of the keys to the genera in the different subfamilies are, however, of most portentous length, occupying ten or twelve quarto

pages; it would have been advisable to split up the subfamilies into sections, and so to subdivide the keys into more handy form. A word of special praise must be accorded to the general editing and indexing of these two volumes, a task that has been most efficiently and conscientiously carried out. R. S.

COAL MINING.

Practical Coal Mining. By Leading Experts in Mining and Engineering, under the Editorship of Prof. W. S. Boulton. Divisional Vol. VI. Pp. viii+177–449. (London: The Gresham Publishing Company, n.d.)

THIS volume forms the final instalment of the above-named book, and brings to a conclusion this somewhat heterogeneous collection of articles relating to coal mining. The fifth volume was noticed in NATURE of October 1, 1908, and it concluded in the midst of an article by Mr. A. H. Cooke on mine surveying, the entire article consisting of five chapters; for reasons best known to themselves the publishers have here again given an example of their irritating practice of concluding a volume in the midst of a paragraph.

Mr. Cooke's contribution maintains throughout a high standard, and in the absence of any modern British text-book on the subject is more especially welcome. He quite rightly lays stress upon the importance of triangulation for the purpose of surveying the surface of mining royalties, and his description of the field work of triangulation is very good and complete; the only omissions that we have noted, and these are not very important, are those of the use of such modern alloys as "invar" for bands for base-line measurements, and some reference to the employment of satellite stations, when trigonometrical stations, otherwise highly suitable, are not accessible for setting up the theodolite. It would have been well to have devoted some space to the office work and calculations required, especially to the methods for calculating the coordinates of the triangulated points direct by the use of traverse tables alone.

It might also be pointed out that whereas a chapter has been devoted to the correlation of underground and surface surveys, there is no mention made of the important portion of the mine surveyor's duties that is comprised under the general head of "setting out," *e.g.* the laying out of surface and underground roadways, curves, &c.; yet the latter is almost a daily part of the surveyor's routine work, whilst the former, important though it certainly is, constitutes an exceptional operation that has only to be performed at long intervals.

The second article, by Mr. S. W. Price, deals with the preparation of coal for the market. It is a great pity that more space was not devoted to this subject, in view of its great and daily increasing importance, and of the fact that the literature on the subject is so scanty. This latter reflection justifies the expression of some surprise that the author has not made use of the best—almost the only—contribution to his subject in modern British literature, namely, the report of the committee of the Mining Institute of Scotland on coal cleaning, which he might have consulted with much advantage. The present article contains three chapters, the first on the handling and tipping of coal-tubs, the second on screening and picking coal, and the third on washing coal. The first two are entirely satisfactory, but the third is too short and sketchy, and is decidedly weak, especially in the theoretical portion. Thus the author seems to rely almost wholly on the principle of equal falling in order to explain the action of the jig or bash, without making it at all clear that in these appliances the *régime* of equal falling (when the particles are falling with practically uniform velocity) is never really reached; it is, moreover, not quite correct to say with Pernolet that a particle reaches this ultimate velocity in the first second of its fall, because the time required to reach this condition depends upon the size and density of the particle, and may be much more than a second or only a fraction of that time. The author quotes Maurice and Bring with equal approval, or, if anything, lays more stress on the conclusions of the former, although Bring reaches his as the result of a vast amount of experimental work, whilst those of Maurice are mainly deduced from mathematical reasoning, which is, moreover, vitiated by the fact that it is all based on the assumption that the resistance offered by the water (or viscosity, as Maurice wrongly calls it) varies always as the square of the velocity of motion of the particle, whereas this relation is only approximately correct when a certain velocity has been attained, and is therefore not true in the initial stages of falling.

Prof. W. Galloway contributes an excellent article on coke ovens, dealing exclusively, however, with retort and by-product ovens. He has gone almost exclusively to Germany for his data, and has succeeded in condensing a large amount of very valuable and not generally accessible information into his article.

The last article is on the economics of coal, by Messrs. H. S. Jevons and David Evans. This difficult subject is dealt with here far too briefly, and the writers do not seem to have the intimate technical knowledge that is required to discuss this subject thoroughly, though it is only right to say that in dealing with a subject like this, on which every writer has views of his own, wide differences of opinion are naturally to be expected. Thus to many it would seem that the authors' classification of the demand for coal is not satisfactory, and that a sharp line should be drawn between the demand for furnaces, factories, and the like, and the demand for transport purposes, by railways, and, above all, by steamships, the economic effects of these two requirements being quite different. The authors have included the requirements for manufacturing and for transport under one head, and thus obscure the results of certain conditions that are economically of distinct importance, as, for example, the effect that the annual closing of the Baltic Sea to navigation in winter has upon the price of coal. Further, it might be objected that the question of the life of a colliery and the necessity of the corresponding amortisation of the capital invested in the shafts and other permanent works has not received the consideration which this very important subject deserves. HENRY LOUIS.

A COMPREHENSIVE WORK ON DIPHTHERIA.

The Bacteriology of Diphtheria. Edited by Dr. G. H. F. Nuttall, F.R.S., and Dr. G. S. Graham-Smith. Pp. xx+718. (Cambridge: University Press, 1908.) Price 25*s.* net.

THIS important work aims at a much more comprehensive account of the essential facts underlying the pathology of diphtheria than its title suggests. It is by far the most complete record of our present knowledge of this disease hitherto written in the English language. Not only is the bacteriology of diphtheria dealt with very fully, but chapters are included which cover the history of the disease, its epidemiology, its mortality, and an account of its toxins and antitoxins. Seeing that we have come to regard the antitoxin treatment as the only rational method of therapeusis in this disease, the reader has here before him practically all he may need to know about diphtheria, except certain clinical facts which he can easily find in any text-book of medicine. The inclusion of a short chapter embodying these facts, indeed, would have completed the whole subject from beginning to end.

Of all the infective diseases which trouble mankind, diphtheria stands foremost as the one concerning which our knowledge seems most complete. It may be mere vanity to say so, but this knowledge appears to contain few, if any, gaps of vital consequence to the human race. The nature of the causal micro-organism is known, the methods of detecting this in afflicted persons are matters of everyday practice, and, most important of all, the specific remedy is in universal use. It is quite doubtful if all this can be said of any other infective disease. Were there room for boasting in the sphere of medical science, this array of brilliant discoveries connected with diphtheria might be quoted with pride as conquests for humanity, won by much toil in the face of great difficulties. These discoveries, of the utmost practical value in the treatment of the disease, constitute one of the greatest arguments against the statement oft-times made, that the results of animal experimentation prove this method of research to be devoid of useful results. Not only the discovery of the cause of the disease, but the very manufacture of the only remedy known to cure it, has depended almost solely upon animal experiments.

The book opens with a short series of biographical sketches of the men whose names figure most prominently in connection with these discoveries: Bretonneau, who first recognised the clinical picture presented by the disease; Loeffler, who discovered the specific microbe; Behring, who first enunciated the principles of toxin and antitoxin; and Roux, to whose studies we owe the preparation of anti-diphtherial serum. Excellent photographs accompany these sketches.

The subject-matter proper of the book is contributed by well-chosen authors. To Prof. Loeffler is given the task of writing the history of the disease, resulting in fifty pages of most fascinating reading. Dr. Newsholme treats of the epidemiology and Prof. Mallory of the pathology of diphtheria. The causal bacillus and its various congeners, with the modes of infection and methods of diagnosis, are dealt with by Dr. Graham-Smith. Matters of immunity, including the difficult subject of toxin and antitoxin, are discussed by Dr. Dean, and a most carefully written chapter on mortality comes from the pens of Drs. Park and Bolduan. The last-named writers also contribute a section upon serum sickness. A very full bibliography, including all the papers extant upon the subject, and a useful index, complete the work. Sixteen plates are inserted, and the photomicrographs in these are excellently reproduced.

Despite a most thorough acquaintance with the work, we have failed to find anything at which to carp. There is nothing to say except praise for the editors, who have produced a magnificent exposition of modern knowledge on this important disease—an exposition which must certainly take its place as the classical authority upon the subject. T. J. H.

ALLOYS.

Alloys and their Industrial Applications. By E. F. Law. Pp. xvi+269; with numerous illustrations and plates. (London: C. Griffin and Co., Ltd., 1909.) Price 12*s.* 6*d.* net.

IT is not easy to realise the unimportance or even insignificance of metals, as such, in the workaday world. Generally speaking, it is only when they are mixed together that they are converted from chemical curiosities into useful materials. The improvements in the properties of metals usually brought about by alloying them are a reduction in melting point so that they can be more easily melted and cast, and an increase in hardness, which confers greater strength and durability. The only general deterioration caused by alloying is a reduction in malleability and ductility, which can be put up with if it is not allowed to get out of hand. It is typical of the extent to which the essential and fundamental may be lost sight of amid the wealth of detail in modern study that the comparative lowness of the melting points of alloys is never once alluded to in the volume under review.

It must not be concluded, however, that Mr. Law's book is lacking in clearness of thought or in balance. It is the most important summary of the state of knowledge on the subject that has appeared for many years. More than this, it is a well-considered attempt to make the results of the recent scientific investigations on alloys available to manufacturers and engineers. How far the attempt will be successful cannot yet be said. It is not the author's fault that English manufacturers are wary birds, and that it is difficult to put the salt of research on their tails. It is not even his fault that much recent research has been somewhat beside the mark.

Besides, efforts have not been spared to apply investigations to the problems that most need solution. As soon as trustworthy pyrometers made their appearance, there was a rush to determine the melting points of alloys and then to ascertain the nature and extent of

their pasty stages. The hardness of alloys was found to be due in many cases to the formation of intermetallic compounds, and straightway the conditions of formation of numbers of these were investigated. The toughness and ductility of alloys were seen to be connected with their structure, and the effects of annealing, quenching, and the like on the structure were accordingly subjected to careful scrutiny. It is natural for scientific observers to lose sight of the practical bearing of their work, and to wander, in the author's words, "in the intricacies of solid solutions, hypereutectics, solidus curves and phases," whither the manufacturer refuses to follow them. It has been Mr. Law's business to show that there is another side to research, and that something has been done besides the manufacture of a set of new labels.

On the whole the result of his labours is promising. The book is written in an easy conversational manner, which encourages the reader to continue seeing what the author has to say. About 100 pages are devoted to the general properties of alloys and the methods of investigating them, and the remainder to special descriptions of particular alloys. Only those employed in the industries are dealt with, and though at first sight this seems to leave many gaps, we are reconciled to the method as we realise how much space is saved for useful and practical remarks.

Both sections have been carefully prepared, and mistakes are far from numerous. Among those noticed is the statement on p. 219, and again on p. 221, that 5 per cent. of cadmium is added to standard silver in America as a deoxidant. This should, of course, be 5 per 1000. Then the definition of "isomorphous" in the glossary, "a term applied to crystals exhibiting similarity in form," leaves much to be desired. The "glossary of terms" generally is weak, alike in respect of omissions and of inexactness. The author is happier when dealing with photomicrography. Both the colour photographs reproduced in the frontispiece and the series of plates at the end of the book are really handsome illustrations of the structure of metals, and are far in advance of the smudgy photographs or diagrammatic drawings usually associated with such work.

T. K. R.

ASTRONOMICAL DETERMINATION OF POSITION FROM BALLOON.

Astronomische Ortsbestimmung im Ballon. By Prof. Adolf Marcuse. Pp. 67. (Berlin: Georg Reimer, 1909.)

THE great advances made in aërial transit, by which long-distance voyages are rendered possible by ordinary spherical balloons, while hundreds of miles may be travelled by dirigibles, and the prospect of long-distance voyages in the rapidly improving aëroplanes, suggest at once the important problem of the determination of the astronomical position of these craft at any moment.

During the daytime, while the earth is in view and not rendered invisible by cloud strata below, the experienced aëronaut can easily locate his position by means of the many excellent large-scale charts at his disposal. On clear nights, by means of the light of the moon, he is also able to follow his course, and, failing the moon, he can pick up his whereabouts by closely observing the lighted-up cities and towns as he approaches them.

With, however, no glimpse of the earth below him, the only two facts which he has in his possession are his height from the ground and the magnetic cardinal points.

In a spherical balloon this knowledge does not inform him whether he is travelling in a northerly, southerly, easterly, or westerly direction. In a dirigible he may head his craft in the direction of any of the points of the compass, but then his leeway will be an unknown, probably a very considerable, quantity, and he will soon find that his position in relation to the earth's surface is unknown.

For navigating purposes it is as important to know exactly where one is when travelling in the air as it is to a sailor when his ship is ploughing the ocean.

The volume before us is therefore very welcome, for Prof. Marcuse brings together, in a very concise and simple manner, methods which can and have been employed on actual voyages. It must be understood, in the first instance, that very rigid determination of position cannot at present be attempted. In the first place, the basket of a balloon is seldom steady, and is nearly always in a slow state of rotation. Again, the envelope above the observer cuts off a considerable portion of the sky that would be available under land or sea conditions, but against this he is in an elevated position and his horizon is clearer. Possibly better observations can be made from the platforms of dirigibles than from the baskets of spherical balloons.

The instruments necessary for the determination of the latitude and longitude, to which reference is made in this book, are the level-quadrant for the observation of altitude, a chronometer for recording Greenwich time, and a fluid compass with an alignment addition for azimuth observations. The first portion of the book, parts i. to iii., deals with the instruments, their use, and the general nature of the problems to be solved. Part iv. is devoted to the formulæ, forms for working them out quickly, and numerous worked-out examples; this portion is divided into two parts, treating of day and night observations. In part v. the use of the tables given at the end is explained in detail, and a description is also given of the charts which conclude the book. These maps include a chart of the northern hemisphere, showing the brighter stars which are best available for use, and following this are two magnetic maps, showing by isogonic lines the deviation of the compass from the true meridians for the year 1909 for (*a*) the whole of Germany and (*b*) for Europe.

This brief summary of the main features of this book shows that it is well adapted for the purpose it has in view. British aëronauts should therefore make themselves acquainted with some of the methods here expounded, for the subject will increase in importance as years go by.

W. J. S. LOCKYER.

SOCIAL AND EXPERIMENTAL PSYCHOLOGY.

(1) *An Introduction to Social Psychology.* By William McDougall. Pp. xv+355. (London: Methuen and Co., n.d.) Price 5*s.* net.

(2) *Lectures on the Elementary Psychology of Feeling and Attention.* By Prof. E. B. Titchener. Pp. ix+404. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 6*s.* net.

(1) THE general nature and scope of Mr. McDougall's book is admirably expressed, in the words of his preface, as "an attempt to deal with a difficult branch of psychology in a way that shall make it intelligible and interesting to any cultivated reader, and that shall imply no previous familiarity with psychological treatises on his part; . . . a book that may be of service to students of all the social sciences, by providing them with the minimum of psychological doctrine that is an indispensable part of the equipment for work in any of these sciences." After an introductory chapter pointing out the grave need in the sciences of ethics, economics, history, and politics for a more accurate and thoroughgoing psychological analysis than that employed at the present time, the author proceeds to give a description and classification of the emotional constituents of the mind, which he vindicates as of paramount importance for social life.

The principle of classification adopted is new, in that it involves an identification of emotion and instinct as the psychical and physical aspects, respectively, of the same process. On this assumption the list of primary emotions receives support and confirmation from the list of principal instincts of specific tendency with which they are individually correlated. These principal instincts and emotions are as follows:—the instinct of flight and the emotion of fear, the instinct of repulsion and the emotion of disgust, the instinct of curiosity and the emotion of wonder, the instinct of pugnacity and the emotion of anger, the instincts of self-abasement (or subjection) and of self-assertion (or self-display), and the emotions of subjection and elation (or negative and positive self-feeling), the parental instinct and the tender emotion. The more complex emotions are shown to admit of complete description as combinations of two or more of these primary emotions, either by themselves or within a "sentiment." Moreover, this conception of "sentiment," due originally to Mr. A. F. Shand, is given a physiological interpretation by the author. The difficult task of displaying the course of development of the moral sentiments is remarkably well done, and in a subsequent chapter on volition Mr. McDougall comes to closer quarters with the question of free-will than any other modern psychologist, giving, *inter alia*, a good psychological solution of Prof. James's difficulty of "action in the line of greatest resistance."

The last hundred pages of the book are devoted to the more strictly sociological question of the working of the primary mental tendencies in social life.

In bringing together emotion and instinct, Mr. McDougall has made an original contribution to psychological science of the highest value and importance, and even if he does not succeed in carrying his fellow-psychologists all the way with him in his identification of the two, he will have set the problem of their relation in a form which is itself at least half the solution. Before the theory can be accepted as it stands, reason must be given for the occasional occurrence of well-marked instinctive activities unaccompanied by any clearly defined emotion. Again, the absence of joy and sorrow from the list of primary emotions, although necessitated by the theory, is not easy to justify on purely psychological grounds; the account given of them in the text, viz., that they are qualifications of other emotions, is not quite convincing.

The book is full of close reasoning, but is written in so lucid a style that it makes very pleasant reading. Its importance is more than academic; there are political theorists at the present day who would do well to take some of its teachings to heart.

(2) Prof. Titchener's book is a publication of lectures delivered at Columbia University last spring. The lectures deal with the problems of feeling and attention from the experimental standpoint, and are profusely annotated with quotations from and references to all the most recent experimental work. This fact, together with a clearness of statement, should make the book very popular. The one and only weakness of the book is its slight bias towards sensationalism, which makes the author very unfair in his treatment of such a theory as that of Prof. H. R. Marshall, and perhaps explains his tendency to quote Prof. Külpe as final. The development of a theory of attention as sensory clearness is admirably done, and should go far towards converting psychologists (old style) to the experimental method.

WILLIAM BROWN.

OUR BOOK SHELF.

Die Termiten oder weissen Ameisen. Eine Biologische Studie. By K. Escherich. Pp. xii+198; coloured frontispiece, and 51 figures in the text. (Leipzig: D. W. Klinkhardt, 1909.) Price 6 marks.

ALTHOUGH the termites, or white ants as they are frequently called, belong to the order Neuroptera, and not to the Hymenoptera like the three other great classes of social insects, the ants, bees, and wasps, yet they closely resemble the ants in their habits and domestic arrangements, as well as in their economic importance, in the countries which they inhabit. As a rule they shun the light, and always work in darkness in their underground nests and galleries, and in most places in the tropics they are extremely destructive to all kinds of woodwork. The raised nests of some species are even more gigantic above ground than those of the ants, those of one Australian species being built in the form of a solid wall twenty feet high. In South Africa, as shown in an illustration on p. 158 of the book before us, the hollowed-out nests of termites are frequently used by natives and colonists as ovens.

Prof. Escherich has given us an extremely useful treatise on these insects, which he regards as far superior to the ants; though in his preface he discusses the difference between human reason and the collective and inherited "instinct" of social insects.

In his introductory chapter he discusses the zoological position of termites, and compares them with the ants. He follows Handlirsch in regarding the termites as forming a separate order, Isoptera, allied to the Blattidæ, and including three subfamilies and about 350 species.

In later chapters the foundation of a colony, the structure of their nests, and their form and habits are dealt with. Like ants, they sometimes defoliate trees in order to form mushroom-beds. Next, their relations, hostile and otherwise, with bees, wasps, and especially ants, are discussed, and also the various animals (beetles, reptiles, &c.) which inhabit their nests, either as guests or intruders. In the sixth chapter their relations to man, and the good and harm which they work, are dealt with. The book concludes with a useful synopsis of families and genera, after Desneux, supplementary notes on the sexes, soldiers, recognition of friends and foes, &c., and a bibliography and index. Naturalists will be grateful to Prof. Escherich for having brought together in this handy form a useful compendium of widely scattered information relative to a very interesting and important, though somewhat neglected, group of insects.

W. F. K.

Oil Motors: their Development, Construction, and Management. By G. Lieckfeld. Pp. xv+272. (London: C. Griffin and Co., Ltd., 1908.) Price 15*s.* net.

THIS work is an authorised translation of a German handbook written for German engineers interested in engines using liquid fuel. Although, as is inevitable in a case of this kind, a large part of the work is taken up with catalogues of German machinery, there are about 130 pages of the book which give valuable and well-arranged general information on the subject. The first few chapters give a very readable history of the development of the liquid fuel trade, both of the mineral oils obtained from oil wells and the liquid fuels distilled from coal or from various shales. The chapters on petroleum spirit, on the paraffin oils, on benzol, and on alcohol also give valuable information in a condensed form.

The development of the modern internal combustion engines worked by petroleum spirit and by paraffin and the heavier oils is given partly in historical and partly in descriptive form, and the remainder of the book, with the exception of the last thirty pages, is a descriptive list of machinery almost entirely German, although a few engines of English construction are mentioned.

There are several important omissions in the book. The name of one of the leading workers on this subject, Dugald Clerk, is never mentioned, although he was undoubtedly one of the first in the field, and has taken a leading part in the development of the internal combustion motor using liquid fuels. Again, in giving the history of the adaptation of the petrol engine to the automobile movement, the author assumes that all the work previously done with steam engines may be ignored, whereas it is well known that as regards the heavier class of motor vehicles steam-driven vehicles still predominate.

There are several places where the work suffers from careless translation, notably in one of the notices on the De Dion Bouton engine, at the foot of p. 84, which is quite unintelligible as it stands.

Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew, 1908. Pp. iv+477+116; with appendices. (London: His Majesty's Stationery Office, 1908.) Price 4*s.* 6*d.*

THE volume of the Kew Bulletin for 1908 well merits its title as a compendium of miscellaneous information. The systematic work emanating from the herbarium includes six decades of African plants, two of new orchids, and seven of new plants generally. The African plants appear to have come in small collections and from all parts of the continent. China supplies a considerable quota to the Decades Kewenses. A notable contribution to a knowledge of Transvaal trees and shrubs is provided by Mr. J. Burtt Davy, and no less valuable is the list of southern Nigerian trees furnishing timber, prepared by Mr. H. W. Thompson. Generic revisions are provided by the director for the gentianaceous genus Chironia, and by Mr. A. W. Hill for two genera of the Exaceæ. In connection with the rubber industry, information is supplied regarding the West African asclepiad *Raphionacme utilis,* that stores the latex in its tuberous root, *Bleekrodea tonkinensis* (Moraceæ), and the sources of Manicoba rubber. Other economic articles deal with patchouli and cascara sagrada. It is interesting to note the inclusion of articles by outside contributors, such as the account of the Southern Islands expedition by Captain Dorrien Smith, and the continuation of the policy of sending members of the staff to visit establishments of interest.

The Genitalia of the Group Noctuidae of the Lepidoptera of the British Islands. An Account of the Morphology of the Male Clasping Organs. By F. M. Pierce. Illustrated by F. M. Pierce and H. Butler. Pp. xii+88; 32 plates. (Liverpool: A. W. Duncan, 1909.) Price 7*s.* 6*d.* net.

IN this unpretentious volume we have the results of twenty years' investigations by an ardent microscopist into a group of anatomical characters which have hitherto been less frequently, and also less successfully, employed in the Lepidoptera than in some other orders of insects, especially the Neuroptera and Trichoptera. Mr. Pierce's work is naturally too technical for detailed notice, but we may note that he gives careful directions for the preparation and examination of specimens, and a general description and nomenclature of the organs, one section only of which, the clasping organs of the males, is figured, and described in more or less detail, in a large number of species of British Noctuidæ. Mr. Pierce takes as his motto a quotation which expresses a truth which should encourage all honest workers, and should never be overlooked by critics, "He who never makes a mistake, never makes anything."

W. F. K.

Palaeolithic Vessels of Egypt, or the Earliest Handiwork of Man. By Robert de Rustafjaell. Pp. iii+22; 13 plates. (London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

IN this pamphlet of some twenty-two pages and thirteen plates, Mr. de Rustafjaell advances a new theory as to the origin of pottery. He directs attention to certain flint nodules with hollow cavities which he found in the Western Desert of Egypt, and suggests that they were used by primitive man as waterholders, that these hollow flint "nodules were copied during the Palæolithic age in limestone, from which again evolved other stone, and finally the clay vessels of the predynastic period" (p. 21). This is a theory which will have few, if any, adherents, and the author seems to be unaware that the lines on the earliest examples of pottery abundantly show its evolution from basket-work (by way of a burnt clay lining), and not from any form of rigid material. The forms of early stone vessels clearly show that they were copied from pottery types.

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.]*

Australian Kinship.

IN a note which appeared in NATURE of April 1 *à propos* of my paper on terms for human relationships (British Academy), the writer suggested that our knowledge of Australian society was still very incomplete. Even as to Arunta rules and customs, he said, our informants differed greatly in their reports. There is now reason to suppose, however, that our informants, Messrs. Spencer and Gillen, and, later, the Rev. Mr. Strehlow, are not really at odds. The impression that they disagreed was caused by some letters of Mr. Strehlow in *Globus* and elsewhere; but now that he has published two parts of his "Die Arunta und Loritja-Stämme" (Frankfurt: Baer and Co., 1907, 1908), it becomes clear that he has merely studied branches of the Arunta "nation" not within the range of the work of Messrs. Spencer and Gillen, and that his natives differ, not only in customs and beliefs, but more or less in language, from those of the English explorers.

The differences are matters of detail; the broad outlines of custom and myth are identical. I ventured to express this opinion in *Man*, and was confirmed in my view by finding that it is held by Mr. N. W. Thomas ("Folk-Lore," March 30, 1909). He writes that Mr. Strehlow's second volume "confirms the belief that local differences of considerable magnitude exist, not only in belief, but also in social organisation."

In all probability both Messrs. Spencer and Gillen and Mr. Strehlow are right as regards the natives whom they have studied. Mr. Strehlow's full knowledge of the languages or dialects makes his book "masterly," as Mr. Thomas says, but the book does not invalidate the results of the English inquirers. An English translation would save trouble to readers in this country who are not too familiar with German. A. LANG.

Forms, Markings, and Attitudes in Animal and Plant Life.

THE object of this letter is to suggest what I may call a collateral theory of mimicry, and not in any sense a complete theory. It is based upon facts or groups of facts, many of which are very well known, but all of which have passed under my own observation.

Notwithstanding the great variety of form in leaves, there is general agreement as to the primary character of a simple ovate leaf, and the bi-facial form of the leaf is in obvious correlation with the great functions of transpiration and assimilation. The bi-facial leaf-like form of the leaf-insect (Phyllium) is not in correlation with any such essential metabolic functions, but it is correlated with the mode of life of the insect. The expression "mode of life" is sufficiently vague; it represents the combination of physiological reactions which make up the outward life of the animal. What these reactions are cannot always be stated in precise language, and until they can be so stated our knowledge has not advanced very much in regard to a particular case.

The cryptozoic habit of so many animals is the expression of reactions which may be conveniently classified together under the term cryptotaxis. Thus the concealment afforded by protective resemblance is one example of this general tendency; living under logs, or bark, or below the surface of the ground is another. Prof. Loeb, as I understand him, has attempted to throw discredit on this tendency in so far as he reduces it to a manifestation of stereotropism ("The Dynamics of Living Matter," 1906, p. 157); but stereotropism may, and obviously does, coexist with cryptotaxis, as may be verified any day in the behaviour of snakes, land-leeches, and land-planarians.

The leaf-butterfly (Kallima) also admirably lives up to its name, but in a different sense; for, whereas Phyllium has a dorsoventrally flattened body, Kallima has a normal body, and resembles a leaf only when at rest with closed wings. The pupa of another butterfly, *Troides darsius*, resembles a crumpled yellow leaf; but it is not only amongst insects that we find leaf resemblances. It occurs also amongst fishes. Besides the extraordinary case of Phyllopteryx, the young sea-bat (*Platax vespertilio*) resembles a simple yellow leaf, the dorsal, ventral, and anal fins assisting to form the contour line, while the caudal fin is glass-clear (*Spolia Zeylanica*, ii., 1905, p. 51). Drifting yellow leaves which have fallen from mangroves and other maritime trees are common enough in the sea and backwaters.

Animals which resemble the same thing resemble one another; but whereas the resemblance of a leaf-fish (Platax) to a leaf is a real resemblance, advantageous to the fish, its resemblance to a leaf-butterfly is accidental, and of no value to either. The important fact is their common possession of a fundamental form, namely, that of a leaf.

Of other forms which are widely distributed amongst different families, orders, and even classes, I may mention the ant-form and the tadpole-form, without going into further particulars.

With equal brevity allusion may be made to familiar markings, widely distributed without reference to mutual resemblances, but conforming to common physiological reactions. Such, for example, are longitudinal stripes or bands, transverse bars or rings, bright spots on a dark ground, dark spots on a pale ground, &c. In all such cases I suggest that the primary fact is the conformity to a fundamental pattern, which is itself the expression of a pigment-reaction, the causes of which have not yet been reduced to a definition. Any advantage which this conformity to a common standard may confer is a secondary factor which may conduce to the preservation of the species by natural selection.

Lastly, with regard to attitudes there is much to be said, but I must be brief. One of the most telling examples of general conformity of attitude is the bi-pedal posture of all birds, some reptiles, and many mammals.

The little palm-squirrels (Funambulus) and tree-lizards (Calotes) are often seen associated together on the same tree, and it is therefore the more noticeable that they have in common a singular habit of remaining in one spot with the fore-body somewhat raised, and then jerking the fore-body up and down several times in rapid succession whilst clinging to the trunk or branch of a tree. I do not know what the precise significance of this bobbing movement may be, but they both practise it.

The only other attitude which I desire to mention is the vertical attitude assumed by some fishes. Some years ago I described and published an ideal picture of the vertical swimming attitude of *Amphisile strigata* (Zoological Results, part vi., 1902, p. 719). More recently the late Mr. W. Saville Kent told me that he had seen the same thing, and had kept the fish in an aquarium, whereas I had only seen it from a boat, swimming in a small shoal in the sea. I was glad of the confirmation of the vertical attitude; but upon showing my figure to Mr. Saville Kent, he pointed out to me that the head is not directed upwards, as there represented, but downwards, as if to feed from the bottom. What I saw were swimming in mid-water, and as the body has a pronounced amphioxine form, it was impossible to be certain which end was uppermost. This uncommon vertical attitude, with head directed downwards, is not without parallel amongst fishes, having been observed by Dr. Abbott in the case of the "mud sunfish" (*Acantharchus pomotis*) in 1884. ARTHUR WILLEY.

Colombo, Ceylon, April 4.

The Simple Equivalent of an Alternating Circuit of Parallel Wires.

IN NATURE of January 30, 1908, some results were quoted by me with reference to the effective inductance of two long parallel wires when the change of current distribution due to frequency is taken into account. These were extended later (*Phil. Mag.*, February, 1909) to meet the case in which the wires are very close together. Pending more detailed publication, the following developments and extensions may be of interest from the practical point of view, as they do not require the construction of special

tables, but may be used as they stand. The system of formulæ determines the simple equivalent of the two wires, copper or iron, when their capacity is sufficiently small to be left out of account. One wire is the return of the other, and they are equal in all respects.

Let (a, μ, σ) be the radius, permeability, and resistivity of a wire in C.G.S. units, f the frequency of alternation, and c the distance between the axes of the wires.

Writing

$$\lambda = 4\pi a(\mu f/\sigma)^{\frac{1}{2}}, \quad \rho = \log_e(\tfrac{2}{3}\pi f a.10^{-10}).$$

Then

(*a*) For copper wires, provided $\lambda > 11$, so that the frequency is high, if (L, R) be the inductance and resistance per unit length of the pair,

$$L = 4\left(1 - \frac{a^2}{\rho c^2}\right)\log_e\frac{c}{a} + \frac{4}{\lambda}\left(1 - \frac{2}{\lambda}\right) - \frac{4a^2}{\lambda c^2\rho^2}\left(\rho - 4\overline{\rho+3}\log_e\frac{c}{a}\right)$$

$$\frac{R}{8\pi f} = \frac{1}{\lambda}\left(1 + \frac{1}{\lambda}\right) - \frac{a^2}{\lambda c^2\rho^2}\left(\rho - 2\overline{\rho-1}\log_e\frac{c}{a}\right) + \frac{a^2}{\lambda^2 c^2\rho^3}\left\{\rho^2 - 2\overline{-3\rho+2\rho^2}\log_e\frac{c}{a}\right\}$$

where λ^{-3}, a^4/c^4, and $a^2/\lambda^3 c^2\rho$ have been neglected.

(*b*) For iron wires, ignoring also $\mu\lambda^{-3}$ and μ^{-3},

$$L = 4\left(\log_e\frac{c}{a} - \frac{a^2}{c^2}\right) + \frac{4}{\lambda}\left(1 - \frac{2}{\lambda}\right) - \frac{2a^2}{\mu c^2}\left(\lambda - 1\right)\left(\rho - 2 + \log_e\frac{c}{a}\right)$$

$$\frac{R}{4\pi f} = \frac{2\mu}{\lambda}\left(1 + \frac{1}{\lambda} + \frac{3}{4\lambda^2}\right) - \frac{a^2\lambda}{\mu c^2}\left(2 - \rho - \log_e\frac{c}{a}\right) + \frac{a^2\lambda^2}{c^2\mu^2}\left(4\rho - 2 - \rho^2 - \rho\log_e\frac{c}{a}\right)$$

(*c*) For copper wires with low frequency,

$$L = 4\log_e\frac{c}{a} + \frac{2\beta}{\alpha z} + \frac{4a^2}{c^2 D}\left(1 - 2\beta\rho z - \frac{\gamma}{z}\right) - \frac{8a^2}{c^2 D}\left(2\alpha\rho z^2 - 2\alpha\rho\gamma z - \beta z + 2\beta\gamma\right)\log_e\frac{c}{a}$$

$$\frac{R}{8\pi f} = \frac{\gamma}{\alpha z} - \frac{2a^2}{zc^2 D}\left(\beta - 2\alpha\rho z + 2\gamma\rho z^2\right) + \frac{4a^2}{c^2 D}\log\frac{c}{a}\left(\gamma^2 - \beta^2 \quad \gamma z + 2\alpha\beta\rho z\right)$$

where

$$D = 1 - 4\beta\rho z + 4\alpha\rho^2 z^2, \quad 2z\surd/2 = \lambda,$$

$$\alpha z^{-2} = 1 - \frac{5}{12}z^4 + \frac{143}{720}z^8 \cdot 2\beta z^{-3} = 1 - \frac{11}{24}z^4 + \frac{473}{2160}z^8$$

$$\gamma z^{-1} = 1 - \frac{1}{3}z^4 + \frac{19}{120}z^8$$

and z^{12}, a^4/c^4 have been ignored.

(*d*) For iron wires under the same conditions, neglecting also μ^{-2} and $a^2 z^8/c^2$,

$$L = 4\log_e\frac{c}{a} - 4\frac{a^2}{c^2} + 1 - \frac{z^4}{24} + \frac{13z^8}{4320} - \frac{4a^2z^4}{\mu c^2}\left(\rho + \log_e\frac{c}{a}\right) + \frac{8a^2}{\mu c^2}\left(1 + \frac{1}{6}z^4\right)$$

$$\frac{R}{4\pi f} = \frac{\mu}{z^2}\left(1 \quad \frac{1}{12}z^4 - \frac{1}{180}z^8\right) - \frac{4a^2z^2}{\mu c^2}\left(1 \quad \frac{z^4}{24}\right) + \frac{4a^2z^2}{\mu c^2}\left(\rho + \log_e\frac{c}{a}\right)\left(1 - \frac{1}{3}z^4\right)$$

The results above appear to be capable of including all important practical cases in which the condition of small capacity is not violated. This condition restricts the length of the wires.

For a four-figure accuracy, the capacity must in general satisfy the two conditions

$$C \dagger (3f^2)^{-1}10^{-3}$$
$$C \ddagger (6Lf^2l^2)^{-1}10^{-4}$$

where C is the capacity per unit length and l is the length of either wire. For a capacity of a microfarad per kilometre $C = 10^{-20}$.

J. W. NICHOLSON.

Trinity College, Cambridge, April 21.

Gigantocypris and the "Challenger."

THE writer of the note on "Some Marine and Freshwater Organisms" (NATURE, April 8) quotes from Herr Lüders (*Zeitschr. wiss. Zool.*, xcii., [1], p. 103, 1909) the statement that the giant Ostracod Gigantocypris was first obtained by the *Challenger* Expedition. It may perhaps be worth while to point out that this statement has no foundation in fact. It was first made in 1895 by Dr. G. W. Müller (Bull. Mus. Comp. Zool. Harvard, xxvii., p. 165), who quotes a passage from the "Challenger-Briefe" of R. v. Willemoes Suhm (*Zeitschr. wiss. Zool.*, xxiv., p. 13, 1874), where it is stated that the *Challenger* dredged between Prince Edward Island and the Crozets a fragmentary specimen of a gigantic Ostracod. Dr. Müller suggests that this may have been a Gigantocypris, and he continues:—"Leider fehlen nähere Angaben über das Thier, und in den Challengerostracoden ist es nicht erwähnt." Herr Lüders, in his recent paper, accepts the identification, and echoes the lament. As a matter of fact, the specimen described by Willemoes Suhm is still safely preserved in the British Museum, but it is not an Ostracod at all! Long before Müller conjectured that it might be a Gigantocypris, Prof. G. O. Sars had described and figured it as one of the two co-types of the remarkable phyllocarid crustacean *Nebaliopsis typica* (Rep. Phyllocarida *Challenger*, p. 22, 1887). Prof. Sars says:—"It is apparently this form that was mentioned by the late Dr. v. Willemoes Suhm in a letter to Prof. v. Siebold as a gigantic Ostracode. This strange mistake may be readily explained by the incompleteness of the first specimen obtained, of which only the carapace and a small fragment of the body was brought up in the dredge." The statement might have been made still more emphatic. The description and the dimensions given by Willemoes Suhm, as well as the locality, put it beyond doubt that he was speaking of the identical specimen which is figured on Plate III., Fig. 5, of Prof. Sars's report.

W. T. CALMAN.

British Museum (Natural History), Cromwell Road, S.W., April 15.

Persistent Trail of a Meteor on March 14.

I RECENTLY sent the Cape Astronomer Royal an account of an unusual meteor which I saw, and he has suggested that I forward an account to you.

On the evening of March 14 I was walking along the sea-shore looking south-west; the sun had set, and the sky was still bright with sunlight. A few clouds were slowly drifting from the south-east, when suddenly, about 7.45 p.m., I saw what looked like a large rocket dart from behind a cloud, rush across the sky from west to east, and disappear over the Table Mountain range in the direction of False Bay. The track of the meteor was shown by a brilliant, apparently glowing, streak of silvery light, which remained stationary in the sky like a long ribbon of fire for fully ten minutes. The "tail" then gradually assumed a wavy form, and slowly faded out of sight. The peculiarity consisted in the persistence of the "tail" or track of the meteor, as I suppose it was. On looking into Sir Robert Ball's book, "The Story of the Heavens," I find an account strangely akin to mine, and I should like to know the reason for the persistence of the luminous track, which must have been very bright to have shown so plainly against the sun-lit sky. Our southern skies are wonderfully brilliant, owing, doubtless, to the clearness of our air; and I have often seen meteors flash across the sky, but never before have I seen such a magnificent display as that described above.

EDWARD J. STEER.

Box 42, Cape Town, March 22.

Lignum Nephriticum.

I MUST thank Mr. Benham for directing attention (April 8) to the early observations of Boyle quoted by Faraday. I have erred in good company; Stokes himself was apparently unaware of Boyle's experiment, and the "Optics" of Basset, Glazebrook, Preston, Tait, and Winkelmann all seem to regard Brewster and Herschel as the first discoverers of fluorescence.

Dr. Stapf's letter in NATURE of April 22 confirms the conclusions of a recent correspondence in the *Gardeners' Chronicle*; letters of March 20 and April 3 give reasons for assigning *Lignum Nephriticum* to a Mexican tree known as Coatli or Tlapalcypatli.

JOHN H. SHAXBY.

University College of South Wales and Monmouthshire, Cardiff, April 23.

THE NANDI.[1]

MR. A. C. HOLLIS, who holds an important post in British East Africa, is favourably known to ethnologists as the author of a valuable book on the language and folk-lore of the Masai, and now ethnologists are indebted to him for a companion work on the Nandi, concerning whom much less was previously known than about their belligerent neighbours. One-half of the new book is taken up with a vocabulary and grammar of the Nandi language. This is a sister language to that of the Masai, and just as there is probably a strain of Galla or Somali blood in the Nandi, Masai, &c., so also there is nothing improbable in the idea that Somali influence may be traceable in their language. They certainly owe to it some of their numerals, and it may be that the use of the articles and the order of words are due to the same cause. But Sir Charles Eliot, who discusses this problem, states that in details he sees no proof of near kinship.

The general account of the Nandi given by Mr. Hollis is written with great care, and is illustrated by a number of clear figures in the text and a wealth of beautiful plates. The Nandi appear to be a mixture of Nilotic Negro and Bantu, with some pygmy element and a Galla strain. Originally they came from further north, and Mr. Hollis is of opinion that they have not occupied their present position on the plateau east of the Victoria Nyanza for more than a few generations. Their country was closed to Arab and Swahili traders, for the Nandi, who were hardy mountaineers and skilful fighters, refused to allow strangers to cross the threshold of their country without special permission. Punitive expeditions against them were made in 1895, 1900, 1903, and 1905. Now they are moved into a reserve, and it is hoped that a difficult native problem has been finally settled.

In the Nandi we have an example of an originally hunting people who became pastoral, and, according to Sir Charles Eliot, have within the last few generations betaken themselves to agriculture, though in a somewhat desultory fashion. Like the Masai, they regarded raiding as the most important business of life, and their social institutions are very similar. They are divided geographically into fifteen districts or divisions, and parishes or subdivisions, and genealogically into clans and families. Each clan has one or more totem or sacred animal, but totemism is on the wane, as marrying into the same clan is permitted, and though it is now considered wrong for a man to kill his sacred animal, to whom an apology is expected, in former times the killing of a sacred animal by the clansman was strictly forbidden. A man of the elephant clan shot an elephant because it had good tusks. When the animal was dead he went up to it and said, "So sorry, old fellow, I thought you were a rhino." He traded the tusks with the Swahili, gave the elders a present, and no notice was taken of his action. The supreme deity is Asista, the sun. He is the creator and giver of all good things; prayers are addressed and offerings made to him. There is also a kindly and a malevolent thunder god. The spirits of departed ancestors and adult relatives are held responsible for sickness and death, and are appealed to and propitiated whenever necessary. There is also a devil who prowls around seeking whom he may devour. The principal medicine man is the supreme chief of the whole race, with a hereditary position, but it seems that the office was borrowed from the Masai; he never prays to Asista, but only to the spirits of his ancestors.

A circumcision festival is held every seven and a half years, when most youths between the ages of, say, ten and twenty undergo the operation, which transforms them from boys into warriors. For about six months they remain isolated from women and children, and wear women's clothes, and for about half this time they also wear a remarkable head-dress (Fig. 1). Before their circumcision festival the girls dress in men's attire, and after it they wear long garments which reach from the neck to the feet, and their heads are enveloped in a complete hood which has only two holes for the eyes. It is customary for the Nandi to distribute their stock amongst their wives during their lifetime, each one being given a certain number to look after, tend, and milk. The sons of each wife inherit the property thus placed in their mother's charge. The boys usually are also given cattle from their earliest youth upwards. The eldest son of the principal wife inherits the lion's share of his father's property. There is a classificatory system of kinship, and the maternal uncle plays an important part in the existence of every Nandi. An understanding exists between a boy and his maternal uncle which is not met with between other relatives, and the maternal uncle is appealed to for intervention when a boy is in disgrace. The most

FIG. 1.—Boy wearing the Nyorkit Garb and the Kimaranguchet Head-dress. From "The Nandi."

[1] "The Nandi: their Language and Folk-lore." By A. C. Hollis. With Introduction by Sir Charles Eliot. Pp. xl+328. (Oxford: Clarendon Press, 1909.) Price 16s. net.

terrible thing that can happen to a Nandi is to displease his maternal uncle. Thus it is evident that the Nandi have not long passed from the stage when mother-right obtained.

Mr. Hollis gives an account, illustrated with good figures, of most of the objects made, worn, or used by the Nandi, and a number of folk-tales and riddles

FIG. 2.—A wife and daughter of Ar-ap-Koilepe, the chief medicine man of the Lumbwa. From "The Nandi."

are given in the original language and in translation. It will thus be seen that Mr. Hollis has made a noteworthy contribution to our knowledge of the ethnology of British East Africa. A. C. H.

THE MICROSCOPE IN ENGINEERING.

DURING the past ten years the young science of metallography has made rapid strides, and in consequence of this development the microscope is steadily assuming an increasingly important position in the testing-laboratories of those who have to deal with metals, either as manufacturers or users. This position has, however, been accorded to it with some reluctance, partly, perhaps, because at the outset too much was claimed for the instrument. Another cause is to be found in the fact that, as is necessarily the case in all young sciences, theoretical development has outstripped practical application, and practical men are too apt to regard anything "theoretical" as practically useless. But even if we leave aside all questions of the promising future applications of these theoretical discoveries, a mass of purely practical results is now available in which the microscope has clearly demonstrated its immediate value.

Perhaps the most fruitful field for the application of the microscope in the present state of our knowledge of metals is the study of the nature and causes of breakages or other failures occurring in practice. That the thorough clearing up of such cases, wherever possible, is eminently desirable, both in the interests of the parties immediately concerned, and also for the sake of the general advancement of our knowledge, is so obvious that it need not be further insisted upon. It is just where our accepted knowledge and our usual practice go wrong that the field for fresh discoveries lies before us. The methods that are available for the *post-mortem* examination of breakages must depend very much upon the nature of each particular case; experiments that are possible with the broken end of a 12-inch shaft are not applicable to a small brass condenser tube. In every case, however, the first, and perhaps the most vital, step is the examination of the micro-structure of the material close to the actual fracture itself, and also of the mass of the material lying away from the fracture. The first of these sections will often show whether there is any special local weakness in the metal at the point of actual fracture, or whether the fracture itself displays any particular characteristic, for it is well known that the path which a fracture takes among the micro-constituents of a metal depends on both the nature of the metal and the manner in which the fracture was produced. In a given material, for instance, the section of a tensile or bending fracture is quite different from one produced by shock or by repeated alternations of stress. The difficulty about these observations lies, however, in preparing an actual section through the fracture, as this is usually either corroded or worn by subsequent friction; when it is clean and fresh, however, the actual fracture may be embedded in a thick deposit of electrolytic copper, and a satisfactory section may be cut through the compound mass thus formed. An example of a section of this kind is shown in Fig. 1.

Apart from the examination of the fracture itself, the general micro-structure of the material will, as a rule, reveal whether it has been subjected to any undue treatment during manufacture or use. Thus excessive heating, whether by exposure to an unduly high temperature or to a more moderate temperature for an unduly long time, leaves its trace in the form of a coarse, angular structure which is readily recognised in such materials as steel, brass, or bronze. Insufficient rolling or forging, or working at either too high or too low a temperature, can also be readily diagnosed. In many cases a useful guide can be obtained by comparing the micro-structure of the object which has failed with that of a similar object which has given good service; but this is only necessary where the material in question is one which has not been thoroughly studied, so that the effects of various forms of treatment on the micro-

structure are not so definitely known as could be desired. Fortunately, the list of such materials is rapidly diminishing, but, owing to the wide range and complexity of industrial alloys, cases of this kind will continue to occur occasionally.

Although the microscopic evidence is, as a rule, quite conclusive, it is eminently desirable to supple-

FIG. 1.—Section through a fracture of mild steel, after embedding in an electro-deposit of copper. The path of the fracture among the constituents of the steel can be clearly traced. Magnification, 100 diameters.

ment it wherever possible by the data of a careful chemical analysis and complete mechanical tests, dynamic as well as "static." Even where these additional data are not needed to confirm the conclusions drawn from the microscopic examination, they are valuable as throwing a light upon the indications of the various forms of test relied upon by engineers in drafting their specifications.

This consideration raises the question how far it would be possible or desirable to include an examination of the micro-structure in the regular tests carried out on engineering materials. Some time ago metal manufacturers, and more particularly steel makers, would have met such a proposal with every means of opposition in their power, but greater familiarity with questions of micro-structure has, it may be supposed, diminished this feeling. If it were simply a question of imposing an additional test, or of placing an additional difficulty in the way of the manufacturer who has to comply with specifications, a hostile attitude would, of course, be readily understood, but the effect of the inclusion of microscopic examination in regular testing would not be at all likely to increase the stringency of the specifications in question. Thus, as regards chemical compositions, specifications are so drafted that, even with unfavourable structure, the material may be strong enough to meet the mechanical requirements of the engineer. Were it possible to rely upon obtaining a favourable structure in the material as used, the necessity for stringency in regard to composition would be materially reduced.

Further, the use of the microscope in this connection should enable the engineer to rely more securely upon both the uniformity of his materials and on their conformity with the test specimens. The reason is that, by the microscopic examination of a number of very small pieces chosen from a variety of different pieces or parts of the material, it would be at once ascertained whether the material was uniform, and whether the test-pieces chosen for mechanical testing or for chemical analysis fairly represented the bulk of the material. This again is an application of the microscope in engineering practice which could not be regarded as operating against the interests of the makers of the material; the rejection of metal on the results of tests carried out on samples which happen to be below the average of the batch would be prevented quite as often as the acceptance of a batch on results obtained from an unduly favourable sample.

In the case of large pieces of metal also, the application of the microscope would prevent the occurrence of failures which sometimes arise as a consequence of want of uniformity in the materials forming different parts of the same forging. Such differences may arise either from segregation, *i.e.* from a non-uniform distribution of the constituents or the impurities in the metal as originally produced, or it may be the result of insufficient or of wrongly applied working. Thus, if rods of ductile metal, such as brass, are drawn down cold too rapidly, or if the reduction at each pass through the dies is incorrectly adjusted, the result is the production of a surface layer of material which has been much more heavily deformed than the core of the rod, and this results in a condition of serious internal stress which may even produce subsequent spontaneous fracture.

In large forgings also, an external layer of fine-grained material is sometimes found superposed on a coarse-grained core as the result of inadequate working. This also is liable to lead to failure in use, while the indications of test-pieces cut from the fine-grained layer are entirely falsified by the real behaviour of the piece as a whole. An example of the diversity of structure to be met with in different parts of the same piece of metal is shown in Fig. 2, the two halves representing, to the same magnification, the structure as seen in the outer and central

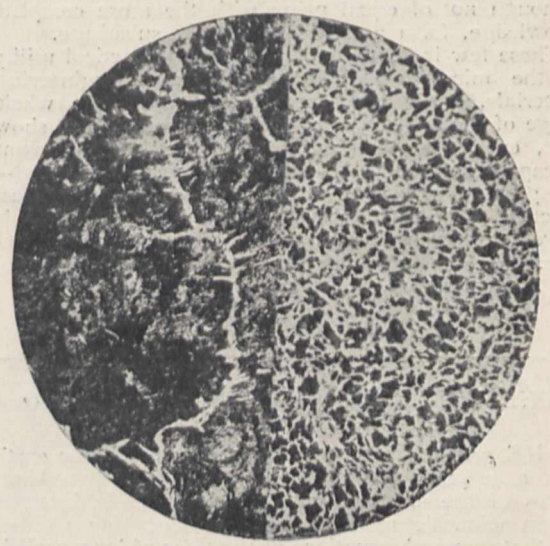


FIG. 2.—Sections from two parts of the same large forging; the right-hand half of the figure represents the fine structure of the external layers, while the left-hand half represents the coarse structure of the interior. The magnification of both is 50 diameters. The dark and light areas in both portions represent pearlite and ferrite respectively.

layers of a large forging. This example is, of course, abnormal, but the intelligent use of the microscope in ordinary testing practice would prevent such a piece from passing into use.

Examples of other uses of the microscope in connection with the materials of engineering could be given in great numbers. Perhaps one of these which

is already most appreciated in practice is the use of the instrument to control the annealing processes in connection with copper and its alloys. The whole history of the constitution and structure of the more important alloys of copper with one added element at a time has been worked out and embodied in what appear at first sight to be highly theoretical "equilibrium diagrams." These diagrams, however, enable us to understand the precise effect produced upon the constitution and structure of any of these alloys by thermal treatment. The structures resulting from exposure to certain temperatures, followed by either slow or rapid cooling, have been determined, as well as the particular properties of the alloys which correspond to these structures. An understanding of these diagrams therefore enables the manufacturer or user to treat his alloys at the proper temperatures, and to control the results with ease and certainty by examining a few specimens of the metal under the microscope and noting the type and the size or scale of the structure.

At the present moment the control of these processes is only satisfactorily available for those groups of alloys the constitution of which has been fully investigated, but this is so far the case only for binary alloys—*i.e.* those consisting of two metals only. The majority of industrial alloys are much more complex, and for these the theoretical guidance is not yet available, principally because the complete study of these complex systems is a matter of much greater difficulty than that of the simpler binary series. The fullest benefit of the microscope will therefore only become available for workers who deal with these complex alloys when the purely scientific investigations have covered this difficult ground; but meanwhile it is quite possible in practice to obtain empirical data as regards the best micro-structure and the treatment required to obtain it. Such data, although not of equal value with the more complete knowledge, form a useful temporary substitute.

These few indications of the present practical utility of the microscope in connection with engineering materials, while very far from covering the whole range of the subject, may perhaps be enough to show that, even with existing knowledge, the instrument is capable of rendering—and is, in fact, rendering—the greatest service to engineering and metallurgical practice. These fruits are already derived from little more than twenty years of metallographic investigation. For the future of this young science, therefore, the highest hopes appear to be well founded.

WALTER ROSENHAIN.

THE YIELDING OF THE EARTH TO DISTURBING FORCES.[1]

THE problem of determining how much the earth as a whole actually yields to the tidal disturbing forces of the sun and moon was definitely brought before scientific men by Lord Kelvin. He pointed out that, from observations of the tides of long period, it ought to be possible to obtain some definite information, and he urged the establishment of gravitational observatories fitted with instruments for detecting the lunar disturbance of gravity. However rigid the body of the earth may be, it necessarily yields a little to the deforming action of the sun and moon. This action produces two kinds of effect. In the first place, it alters the shape of the earth. If the earth were a perfect sphere, it would be drawn out by the attraction of the moon, for instance, into a prolate ellipsoid of revolution. The actual earth, of a shape that is nearly spherical but presents certain inequalities, acquires under the action of the moon a slight additional inequality of figure, of the same type as that which answers to elongation in the direction of the long axis of the ellipsoid and flattening round the parts remote from that axis. As the moon moves relatively to the earth, the long axis of the ellipsoid moves about in the earth, so that a corporeal tide is raised in the earth. Besides raising a corporeal tide, the action of the moon alters the attraction of the earth. If the change of external shape only is taken into account, the alteration of the attraction consists of the added attraction, due to the protuberances at the ends of the long axis of the ellipsoid, coupled with the loss of attraction, due to the flattening round the parts remote from these ends. But, since the material of which the earth is made up is not homogeneous, a similar effect is produced by the elongation and flattening of the surfaces of equal density, and, since the material is not absolutely incompressible, the density must be in some parts increased and in others diminished, owing to the attraction of the moon being different in different parts. The alteration of the earth's attraction by the action of the moon is therefore of a somewhat complex character. The effects produced by the action of the sun are similar to those produced by the action of the moon.

Many attempts have been made to measure the changes of level that are due to the tidal disturbing forces of the sun and moon. In the majority of such attempts, instruments of the horizontal pendulum type have been used. The displacement of a horizontal pendulum that would be produced by the attraction of the moon, or the sun, if the earth were absolutely rigid, is known, for the attractions of the moon and sun are known. In the actual case, owing to the yielding of the earth, all we can hope to determine by observations of the tides or of the displacement of horizontal pendulums is a relative change of level, and to measure this is far from easy. The effect to be measured is extremely minute, and it is liable to be obscured, or even disguised altogether, by the effects of air currents and of changes of temperature. Recently Dr. O. Hecker, of Potsdam, has succeeded in overcoming the experimental difficulties. By setting up two horizontal pendulums in an underground chamber, and observing their behaviour during a protracted period, he was able to show that the effect of the moon, in particular, is perfectly definite, that in phase it follows very closely the motion of the moon, and that in amount it is almost exactly two-thirds of what it would be if the earth were absolutely rigid.

Hecker's result confirms decisively the results which had been found with much less perfect experimental means by previous observers. It leaves no shadow of doubt of the actuality of a corporeal tide produced by the moon. It accords also with those results, deduced from observations of fortnightly tides, which were used by Lord Kelvin in his famous estimate of the rigidity of the earth. This estimate was obtained by working out mathematically the change of shape that would be produced by the attraction of an external body, such as the moon, in a solid elastic globe, of the same size and mass as the earth, if the material of which it is made were homogeneous and absolutely incompressible. When these simplifying assumptions are made, the change of attraction is calculable in terms of the change of shape, and the measurement of the relative change of level leads easily to the determination of the absolute change of

[1] Based on a paper by Prof. A. E. H. Love, F.R.S., read before the Royal Society on January 14.

level. If with these simplifying assumptions there is combined the observed fact that the relative change of level is two-thirds of what it would be if the earth were absolutely rigid, it is found, as Lord Kelvin did in effect find, that the calculated rise and fall of the surface is one-third of what it would be if the earth were made of homogeneous incompressible fluid, and the calculated change of its attraction due to the sun, or moon, is one-half of the tide-generating force of the sun, or moon. The rigidity which the material, supposed homogeneous and incompressible, would need to have in order that the two numbers may have the calculated values, $\frac{1}{3}$ and $\frac{1}{2}$, is about the same as the rigidity of steel. Both the numbers $\frac{1}{3}$ and $\frac{1}{2}$, which are thus calculated are inferred, partly from a result of observation, and partly from the subsidiary hypotheses of homogeneity and incompressibility. If these hypotheses are discarded, all that can be inferred from observations of fortnightly tides and horizontal pendulums is a single equation connecting two numbers. The number which in the special case is $\frac{1}{3}$ is in general conveniently written as $\frac{2}{3}h$, and the number which in the special case is $\frac{1}{2}$ may be called k. The observations in question concur in leading to the equation $h-k=\frac{1}{3}$. (In the special case $\frac{5}{6}-\frac{1}{2}=\frac{1}{3}$.)

It was first suggested by Prof. Simon Newcomb that the length of the earth's free period of nutation, usually called the "Chandler period," may be an independent index of the yielding of the earth to small forces. It has long been known that if the earth were absolutely rigid this period would be about 306 days. A free nutation of the earth would be manifested by periodic changes of latitude of places on its surface. Small variations of latitude have long been known to exist, but all efforts of astronomers to detect a period of 306 days in these variations failed. It was announced by Dr. S. C. Chandler, in 1891, that the variations are roughly periodic, but that the period is really 427 days instead of 306. Newcomb pointed out that the lengthening of the period must be due to a yielding of the earth. At any instant the earth is rotating about an axis which does not quite coincide with a principal axis. A solid globe would be deformed by rotation into an oblate spheroid in the same way as a fluid one, but not so much. The inequality of the so-called "centrifugal force," due to the deviation of the instantaneous axis from a principal axis, produces a slight deformation of the surface, accompanied by a slight alteration of the attraction, and these effects can be specified by means of the same two numbers h and k as are required to express the effects of tidal disturbing forces. Mr. S. S. Hough, H.M.'s Astronomer at the Cape of Good Hope, calculated, in 1896, the lengthening of the period in the case of a solid elastic globe of homogeneous incompressible material. The problem has recently been discussed in a more general way by Prof. G. Herglotz, who was able to dispense with the hypothesis of homogeneity. A review of the theory, as presented by Herglotz, shows that it is possible to dispense with the hypothesis of incompressibility also, and that the lengthening of the period depends upon the number k, and not upon the number h. The number k is found to be expressible in terms of the two periods (306 and 427 days), the ellipticity and mean radius of the surface, the angular velocity of rotation, and the mean value of gravity at the surface. This number is therefore known. Its value is found to be about $\frac{4}{15}$. The result that $k=\frac{4}{15}$ means that the alteration in the attraction of the earth on account of the distortion produced in it by the sun or moon is actually about four-fifteenths of the tide-generating force of the sun or moon. This result does not depend upon any hypothesis as to the homogeneity or incompressibility of the material. The only assumptions that are used in obtaining it are the assumption that an equilibrium theory is applicable to the forces in question, and the assumption, commonly made in the theory of the figure of the earth since the time of Laplace, viz. that the surfaces of equal density within the earth are maintained in ellipsoidal shapes by the rotation. The result does not depend upon the special hypothetical law of density which Laplace introduced. Any law of density which satisfies the ordinary laws of hydrostatics will suffice.[1]

When the result expressed by the equation $k=\frac{4}{15}$ is combined with the result of observations of the tides and horizontal pendulums ($h-k=\frac{1}{3}$), it is found that $h=\frac{9}{15}$. This result means that the surface of the earth actually yields to the tidal deforming influence of the sun and moon by six-twenty-fifths of the amount by which it would yield if the earth were made of homogeneous incompressible fluid. The number $\frac{6}{25}$ takes the place of Lord Kelvin's number $\frac{1}{3}$.

The result that the earth actually yields a good deal less than Lord Kelvin supposed it to do suggests that it is decidedly more rigid than he estimated it to be. There are, however, many difficulties in the way of a more precise estimate, the chief being the heterogeneity of the material. If this fact is disregarded, and the simplifying assumption of homogeneity is made, it appears to be impossible to satisfy both the equations $h=\frac{9}{15}$ and $k=\frac{4}{15}$. An additional difficulty arises from the compressibility of the material, but, although this cannot be met directly, it is not very serious, because the general effect of compressibility must almost certainly be that any estimate of rigidity based on the simplifying assumption of incompressibility is under the mark. A possible method of procedure is to assume the earth to consist of a central nucleus of incompressible material of one density and rigidity, enclosed in a shell of incompressible material of a smaller density and a different rigidity, in the manner advocated by Prof. E. Wiechert, who regards the earth as made up of an iron core enclosed in a rocky shell. This method was developed by Dr. W. Schweydar, who found that, with the densities proposed by Wiechert, the rigidity of the core would have to be nearly three times that of steel, and the rigidity of the shell about one-eighth of that of steel. The possibility of a comparatively small rigidity in the enclosing shell suggests that there may be within it, or between it and the core, a layer of molten rock, devoid of rigidity, such as has sometimes been invoked in connection with the explanation of seismic and volcanic phenomena. This hypothesis is found, when tested mathematically, to require much too great rigidities both of the core and of the outer part of the shell. It appears, however, to be quite possible that the earth may consist of a very dense and very rigid core enclosed in, and connected by solid matter with, a lighter shell or crust, the greater part of which is solid and of a rigidity comparable with that of granite (about one-third of that of steel), the shell being honeycombed with hollow spaces containing molten matter. But it seems to be impossible that the molten matter should form a continuous layer separating the outer portions of the earth's body from the inner portions.

[1] Since the paper was written and sent in to the Royal Society, Prof. Larmor has shown that the result is independent of the supposed ellipsoidal shape of the surfaces of equal density. It is therefore established, quite generally, for any constitution of the earth which would admit of the application of an equilibrium theory to forces of the type in question. It is practically certain that the actual constitution is such that a theory of this kind can be applied.

THE NATURAL HISTORY MUSEUM.

"An independent government of the Natural History Museum is one of the most pressing scientific needs of the times."—*Michael Foster in* 1906.

THE government of the Natural History Museum, to which forcible attention was directed in a letter to the Press on April 19, published in last week's NATURE, stands in urgent need of reform. This has long been recognised by men of science, and, as the writers show in the historical appendix to their letter, the attention of the Government and of the trustees has been directed to it on several occasions in the last forty-three years. Almost every man of science of importance during that period has taken part in one attempt or another to obtain a reform of some of the more serious of the administrative defects. We notice the names of W. B. Carpenter, Charles Darwin, M. Foster, Francis Galton, Hooker, Huxley, Kelvin, Lubbock, Newton, Ramsay, Sclater, Sharpey, Henry Smith, Spottiswoode, Stokes, Turner, Wallace, and all the present professors of zoology and natural history in the universities and principal colleges of the United Kingdom. Further, two Royal Commissions have reported in the same sense, that of 1850 appointed to inquire into the conduct of the museum, and that of 1870 on "Scientific Education and the Advancement of Science."

It would thus appear that for some forty-three years the whole body of scientific opinion has been the same, and has from time to time urged, speaking generally, the same measures of reform, but nothing has been done, and recently the existing arrangements have given rise to grave dissatisfaction. At the outset we desire to point out that, if we understand the letter aright, the signatories, in directing attention to this dissatisfaction, impute no shortcomings to the present working staff of the museum, but they make it clear that the present administrative methods, if persisted in, must lead to failures in the general working of the museum. At present the museum stands at the head of the natural history museums of the world, but, as the *Times* remarks, "if the present system continues it will not only be overtaken, but rapidly put in the background."

The question is a complicated one, and in our opinion cannot be properly dealt with until a full inquiry into the working of the present method of government of the museum has been made. We agree with the deputation to the Prime Minister of last July and with the present writers to the Press in thinking that a Royal Commission is demanded, partly because that is the only means by which the information required can be obtained, and partly because of the dignity and importance of the matter to be inquired into. But if a Commission is appointed we hope that the high social position and importance of the existing board of trustees will not be used to render nugatory its conclusions, as seems to have been the case with the two Royal Commissions which have already dealt with the problem. The first point that comes up for settlement is the nature and functions of the controlling body. If the trustees are retained, as we think it desirable that they should be, and in this we are again in agreement with the deputation of last July, it will clearly be necessary that their number should be reduced, and that those of them who are responsible for the Natural History Museum should be separate from those who are responsible for Bloomsbury. The magnitude and diversities of the interests involved render this reform necessary.

We are further of opinion that the trustees should be, as is largely the case at present, men of the world skilled in affairs, able to attend regularly, and anxious to do their best for the museum, and that the scientific element, whether professional or other, should not be represented as such. This may seem a hard saying, but the reason for it becomes apparent when we consider the function of the trustees. Their powers should be defined and limited. They should not attempt to interfere in the management, because they have neither the time nor the knowledge to do so effectively. Nor should orders be given in their name, but in that of the director. It may be, and has been, replied to this that they should be reinforced and made a competent body from the "expert" point of view; but a little reflection will show that this cannot be done effectively, because it is practically impossible to find men with the requisite knowledge who can without payment give the time necessary for the proper performance of such work. If it is attempted it can only result in the establishment of an inefficient committee of management irregular in attendance (see Panizzi's evidence before the Royal Commission of 1850 on this point), and will almost certainly result in dissatisfaction among those schools of naturalists who are not represented in the management. We think it clear that the management of the museum should be carried on by the director, acting in cooperation with the senior members of his staff, and that the trustees should exercise general supervision and financial control, and act as a final court of appeal. If the trustees require expert advice other than that given by their director, it should come from a board of visitors such as exists in the case of Greenwich Observatory, and was recommended in the fourth report of the Commission on "Scientific Education and of the Advancement of Science" in 1874.

The next fundamental point which comes up for consideration is the relation between the two museums. This has been fully dealt with in the letter referred to, and we are in complete agreement with what is there said. The present arrangement, by which the director of the Natural History Museum is the official subordinate of the principal librarian at Bloomsbury, is, of course, historically intelligible, but from all other points of view is not only unintelligible but absurd. If our suggestion as to the division of the trustees into two bodies is carried out, this anomaly will naturally disappear. It is perhaps unnecessary to labour the point, but we should like to ask the Astronomer Royal or the director of the National Physical Laboratory how they would like to have to submit to the direction of a man of letters or of an antiquarian, however eminent.

A third point of great importance relates to the method of appointment of the officers and servants of the museum. The present method, by which the principal trustees appoint, the subsequent control being in the hands of the general body of trustees, stands condemned, not only by the Commission of 1874 to which we have already referred, but also by the recent lamentable occurrences as a result of which the museum has lost the services of one of the most distinguished naturalists of Europe. In our opinion it is necessary, in the interest of justice and historical accuracy, as well as of the museum, that these occurrences should be inquired into. The Prime Minister, in his reply to the deputation last July, said that he was "still unable to grasp in what way the museum failed to perform its functions." The deputation had carefully, and in our opinion rightly, avoided referring to this point and others similar to it. We admire them for their restraint, but had they done so they would have had no difficulty in convincing the Prime Minister of the radical defectiveness of the present method of government.

However, it is unnecessary for us to deal further with the anomalies of the present system. Enough has been said to show that we are in full general agreement with the views expressed in the letter to the Press of April 19, and by the deputation of last July (see NATURE, July 30 and August 6, 1908). We do not pin our faith to any particular treatment of the problem. That can only be done after a full inquiry by a Royal Commission, which we sincerely hope will be granted. The suggestions we have offered have been made more with the view of bringing out the most important of the points at issue than with that of laying down the law as to their treatment.

In saying what we have said we are deeply impressed with the great importance of the Natural History Museum to science and to education. Not only is it a most important means of scientific organisation and of research into problems which have an intimate bearing on human welfare and happiness, but, to quote the words of Sir Michael Foster in his admirable article on the museum in the *Quarterly Review* for 1906, p. 496:—

"It has other uses as well. The museum belongs to the people; it is supported by the people's money; and it is only right that some benefit to the people more direct than that yielded by abstract science should come from it. And great direct benefit can, with some little administrative care, be got from it for the people. In this dull life of ours, above all in this dull city of ours, with its murky surroundings, it is no small thing that an easy stroll, without fee, should bring the dweller in slum alley and unlovely street face to face with the countless beauties of the animal creation; and much of the animal world is beautiful even in death. It is perhaps even a greater thing that, as is clearly shown by what has been done in the past few years, the collections may be so arranged and displayed as to bring to even the careless stroller lessons not only of beauty, but also of wisdom, opening his eyes to some of the great truths of the world of life."

What nobler aims, for which to work and to sink all minor differences, than these, *the welfare of man and the happiness of the people?* Let these be our watchwords, and the evils born of misrule and ignorance shall not prevail.

NOTES.

PROF. R. MELDOLA, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

LIEUT. E. H. SHACKLETON will describe his recent Antarctic achievements at a meeting of the Royal Geographical Society to be held in the Albert Hall on June 24.

IN reply to a question asked by Sir Philip Magnus in the House of Commons on Monday with respect to the administration of the natural history collections of the British Museum, the Prime Minister said he is in communication with the trustees of the British Museum upon the subjects.

ON Tuesday next, May 4, Prof. Svante Arrhenius will begin a course of two lectures at the Royal Institution on "Cosmogonical Questions." These are the Tyndall lectures. The Friday evening discourse on May 7 will be delivered by Major Ronald Ross, on "The Campaign against Malaria," and on May 14 by Prof. George E. Hale, on "Solar Vortices and Magnetic Fields."

LORD AVEBURY will take the chair at the annual conversazione of the Selborne Society, which will be held on May 7 at the offices of the Civil Service Commission (Old London University). Two lectures will be given, the first on "How Birds Fly," by Mr. F. W. Headley, and the second on "How Men Fly," by Mr. T. W. K. Clarke. Mr. James Buckland, the original promoter of the Plumage Bill, will exhibit a number of lantern-slides illustrating the birds that are in danger of extermination in various parts of the world. There will also be a display of microscopes and natural-history exhibits.

THE Home Secretary has appointed a departmental committee to investigate and report on the best means of standardising with greater accuracy than at present the apparatus and materials employed in the Abel heat test for explosives, and to examine and report on any supplementary test or tests that may be submitted. The committee is constituted as follows:—Major Aston Cooper-Key, Sir Frederic L. Nathan, Captain A. P. H. Desborough, Mr. F. W. Jones, Captain M. B. Lloyd, Mr. C. O. Lundholm, and Major J. H. Mansell, R.A. The secretary of the committee is Major H. Coningham, R.A., to whom correspondence may be addressed at the Home Office.

THE Lisbon correspondent of the *Times* reports that a severe earthquake occurred in Portugal on April 23 about 5 p.m. Reports from up the Tagus show that serious damage has been done in the neighbourhood of Salvaterra, Benavente, and Samora, midway between Lisbon and Santarem. The shocks, which in Benavente extended over three hours, lasted at Lisbon from three to fifteen seconds. A Reuter message from Madrid states that earthquake shocks were registered there on April 23, and also at the towns of Valladolid, Huelva, Val de Peñas, Jerez, Villamanrique, Malaga, and other neighbouring places. The movement registered at the Ebro Observatory lasted 5h. 49m.

THE committee for the forthcoming International Aëronautical Exhibition at Frankfort-on-Main is making great efforts to ensure the success and attractiveness of the undertaking. By the middle of April the amount of the guarantee fund, 50,000*l.*, was over-subscribed, and the sum of 6500*l.* had already been promised for prize competitions. Prizes of 500*l.* each are offered (1) by Count Zeppelin for the smallest dirigible balloon which shall make at least five journeys of not less than half an hour's duration, returning to the starting point without intermediate landing, and carrying at least two men; (2) by Dr. Gans Fabrice to anyone who has made the greatest number of flights of more than five minutes' duration; (3) by Baron Krupp von Bohlen-Halbach, the conditions to be arranged by the committee. An ornithological exhibition for the representation of natural flight is being prepared by the Senckenberg Philosophical Society, with the assistance of Prof. Schillings.

AN investigating party sent out by the Government at Manila has obtained further particulars of the death of Dr. William Jones, reported in our issue of April 15. It appears that, in returning to the head-waters of the River Cagayan in order to obtain boats, he unwittingly crossed a "dead line" that had been established by a hostile tribe. He was met by a party of warriors, who offered him a dish of fish as a token of defiance, in accordance with tribal custom. Not suspecting that he was thereby accepting their challenge, he ate the fish, and was immediately attacked. He managed to fight off his assailants with his revolver until he could reach a boat, in which he escaped, but he died five hours later from his wounds. His body

was rescued by friendly natives. The investigating party has recovered the valuable ethnological collection made by Dr. Jones during his two years' stay in the hills, and it will be sent to the Field Columbian Museum in Chicago.

THE Berlin correspondent of the *Westminster Gazette* gives in the issue of April 22 a *résumé* of an article published by Prof. O. Lehmann in the *Berliner Tageblatt*, in which is described the principal conclusions arrived at as the result of his long series of investigations of the properties of liquid crystals and the observations upon which they are based. The subject has already been discussed in NATURE for January 7, and attention was directed to the part that liquid crystals appear to play in the growth of living organisms. Prof. Lehmann is so fully alive to the far-reaching importance of his discoveries that he endeavours to arouse popular as well as scientific interest in them. To the general public without knowledge of the phenomenon of double refraction and of the crystalline symmetry which it portends, the fact that a substance possessing the mobility of a liquid should at the same time display polarisation effects which were supposed to be peculiar to rigid structures would seem of little importance, but, when it appears that these curious liquids may in some way be connected with the origin of life, the question ceases to be merely academic.

CAPTAIN HENRY TOYNBEE, whose death was recorded in the *Times* of April 22, was born on October 22, 1819. He entered the mercantile marine at the age of fourteen, and followed the sea until 1866. In the following year he accepted the appointment of superintendent of the marine branch of the Meteorological Office. It was in this capacity that most of his scientific work was done, though he had published a number of papers on meteorological, astronomical, or geographical subjects before his retirement from active service. The office had been founded in 1854 for the express purpose of dealing with marine meteorology, and at the time when Toynbee joined it, sufficient data had accumulated to enable a commencement to be made with the publication of average values for the various elements. Among the best-known publications with which his name is associated is a very detailed discussion of the meteorological data for "Square 3" (lat. 0° to 10° N., long. 20° to 30° W.), issued in 1874. This area, lying in the region where the two trade winds meet, is one of special meteorological interest, and the discussion is probably the most detailed that has been attempted hitherto for any oceanic area of equal size. Two years later a somewhat similar, but less detailed, survey of the area between lat. 20° N. and 10° S., and long. 10° W. and 40° W., was issued. This work marked an epoch in the application of meteorology to practical life, for it gives in concise form much information necessary for determining the routes to be followed by sailing ships crossing the equator if they wish to take full advantage of the most favourable winds and to avoid, so far as possible, the equatorial belt of calms. Toynbee retired from the Meteorological Office in 1888, on attaining his seventieth year.

THE death of Dr. Simeon Snell, president of the British Medical Association, during his tenure of this important office, and at the early age of fifty-seven, has created a painful impression. Widely known for many years as an assiduous contributor to societies and journals of ophthalmology, his observations have been recognised as of quite exceptional value and importance. A man of wide sympathies, he wielded a great influence in the intellectual life of the city of Sheffield, wherein his ophthalmic practice was conducted, and established many friendships with men of science who visited Sheffield to deliver lectures under the auspices of its Literary and Philosophical Society. His endeavours, both as quondam president and long as secretary of this society, served to maintain the usefulness and reputation of one of those active local associations such as formed the origin of the British Association for the Advancement of Science. In Sheffield he was also recognised as one of the most indefatigable workers in the development of the city university. Outside his own locality, thoroughly practical man as he was, he was well known for contributions to practice and to knowledge arising from work conducted within it. This great centre for the manufacture and manipulation of steel afforded unlimited opportunities for the treatment of eye injuries produced by splinters of metal, and Dr. Snell was the first to elaborate the use of the electromagnet for their removal. Placed in the centre of a large colliery district, his attention was early directed to those peculiarly embarrassing rotations of the eyeball which characterise the disease known as "miners' nystagmus." Whatever may be the cause of this disease, Dr. Snell's monograph on the subject, and the carefully observed conditions described by him as modifying the frequency of its occurrence, will remain as the basis of suggestions and as testimony to the true scientific spirit of medical practice.

AN excerpt from the *Harvard Graduates' Magazine*, December, 1908, gives particulars of the expedition which the Harvard Observatory is sending to the elevated plateau of South Africa in charge of Prof. S. I. Bailey. The primary object is the determination of the character of the climate, with the view of finding an ideal site for an astronomical observatory. The first requisite for an astronomical station is a clear sky, free from cloud, haze, smoke, and dust. Since no locality is entirely free from clouds, it is very desirable that those clouds which do occur should be distributed fairly evenly throughout the year, rather than condensed into one decidedly "cloudy season," a condition which prevails in many countries. An ideal station would have freedom from strong winds, a small annual, and especially a small diurnal, range of temperature, low humidity, a reasonable altitude, accessibility, together with the necessaries and some of the comforts of modern life. For the present purpose, also, a station not much less than 30° south of the equator is desired, in order that the entire southern sky may be studied to the best advantage. Such meteorological reports as have been published, together with the accounts of various observers, indicate that excellent conditions for astronomical work exist on the tableland of South Africa. The altitude, which varies from 4000 feet to 6000 feet, is sufficient for the purpose. The records which have been published, however, give only a portion of the data which are needed. The problem can be settled only by a careful study, lasting through one year at least. The present expedition will endeavour to carry out this investigation. In addition to the study of climate, various astronomical investigations will be undertaken. A 10-inch visual telescope, provided with a Rumford photometer, will be used for the measurement of the magnitudes of a large number of stars, among which are sequences of standard stars in selected areas, sequences of comparison stars for southern variables, and so on. A pair of small photographic lenses will also be provided, carried on a single mounting. These are of different focal lengths, and of wide angle. They will be used in certain pieces of routine work, but especially to photograph the faint extensions of the Milky Way and other nebulous regions of the southern sky.

A LEADING New England paper, the *Springfield Republican*, recently devoted an editorial article to the subject of the popularising of scientific knowledge, as suggested by a speech of Mr. Balfour's a few weeks ago. According to the American writer, the supply is not equal to the demand. "Magazine editors who try to offer their readers first-rate work are in despair for lack of qualified writers. Newspaper editors who glean instructive notes for their columns find a deluge of the hasty, the superficial, the inaccurate, but seldom come upon really competent and well-written work." As to men of science themselves, their habits of intense and concentrated application make them impatient of popular writing. "They are experts, and when they write they write for experts. They think habitually in technical terms, and when it comes to explaining matters to an outsider they do not know where to begin." The *Springfield Republican* offers a practical suggestion to meet the difficulty. There should be established in some university a post-graduate "department of scientific interpretation," open to young men with a literary gift and an interest in science, but too versatile and active minded to make good specialists—men who had already passed through scientific and mechanical courses in their undergraduate years. "The head of their department, if only his services were available, would be Prof. Thomas H. Huxley." The purposes to be especially kept in view in their training would be "the acquirement of method, a clear comprehension of scientific principles, a broad survey of current scientific work, comprehension of the scientific type of mind, the ability to understand men who cannot explain themselves, the technique of simplifying, elucidating, illuminating by simile and analogy." The *Republican* is confident that a training of this kind would be an excellent preparation for all kinds of writers for the Press. "They would be ground between scientific accuracy and the demand for intelligibility as between the upper and the nether millstone, and if they did not emerge a finished product it would not be the fault of the process."

MR. E. THURSTON'S paper on "Native Man in Southern India," delivered before the Royal Society of Arts on March 25, is a popular and anecdotal *résumé* of a subject already dealt with by him in his "Ethnographic Notes from South India," and the Bulletins of the Madras Museum, of which he is curator. He points out that while the population of the Tamil country and Malabar is dolichocephalic, that of the more northern districts is mesaticephalic or sub-brachycephalic. He declines to enter into a discussion of the causes which may have led to this variance of race type, and he thus tacitly rejects the theory of Sir H. Risley, that the short-headed people of the southern Deccan represent a Scythian immigration from northern India. Mr. Thurston gives interesting details of some curious customs—the dilation of the ear lobes among Shánan women; the rule which forbids women to drape the breast; the use of leaf garments; and the gradual rise in status of the primitive jungle man, who nowadays makes a caste mark on his forehead with ashes or anilin dyes, and uses lucifer matches in lieu of the old method of obtaining fire by friction. It is shown that it is a popular misconception to suppose any of the non-Aryan tribes to be woolly-haired, and the puzzling appearance of the cross-bow as a weapon among the Ulladans of Travancore is proved to be the result of Portuguese influence.

WE have received cuttings of several articles from the *Melbourne Argus*, in which Mr. J. W. Barrett describes the experiences of a party of tourists interested in natural history who made a new year's trip to some of the small islands in Bass Strait. One of the features of the excursion was a visit to the seal-rocks at Westernport, where the seals which formerly frequented several of the islands alone survive. It has been suggested that the numbers of these animals should be reduced, on account of supposed future injury to the fisheries, but, apart from the fact that they do not usually eat fish, the writer points out that their numbers have probably not altered appreciably for centuries, and that the "balance of nature" is almost certain to be maintained in the future. The trip also included an inspection of the wonderful breeding-colony of gannets on Cat Island, where some 4000 of these birds were nesting at the time of the visit.

THE heredity of the colour of hair in man is discussed at considerable length by Gertrude and Charles Davenport in the April number of the *American Naturalist*. As regards the nature of the colouring, the authors consider that there are probably two main types of pigment in human hair, one a reddish-yellow, which finds its highest development in bright red, and the other a sepia-brown, the intensity of which ranges from light yellow to dark brown and black. As the result of a combined study of both eye-colour and hair-colour, the writers finally arrive at the conclusion "that two parents with clear blue eyes and yellow or flaxen straight hair can have children only of the same type, no matter what the grandparental characteristics were; that dark-eyed and haired, curly-haired parents may have children like themselves, but also of the less developed condition. In the latter case what the proportions of each type will be is, for a fairly large family, predictable by a study of the immediate ancestry."

WE have received from the Bureau of Entomology of the United States Department of Agriculture a paper by Mr. J. J. Davis containing biological studies of three species of Aphididæ, the corn-root aphis (*Aphis maidi-radicis*, Forbes), the corn-leaf aphis (*Aphis maidis*, Fitch), and the sorghum aphis (*Sipha* [*chaitophorus*] *flava*, Forbes). The life-cycle of the aphis is very curious, no fewer than five forms being recorded for the corn-root aphis, viz. winged viviparous females, wingless viviparous females, oviparous females, males, and eggs. From the eggs some ten to twenty-two generations of viviparous females follow, but the last generation of the season consists of oviparous wingless females and males, which pair, and the females produce eggs. Evidence is adduced to show that external conditions of temperature, &c., determine whether a particular generation is to be viviparous or oviparous; it is considered that aphides could reproduce parthenogenetically for an indefinite period if the environment was favourable. The biological problems involved are of great importance. Bulletin No. 66, by F. H. Chittenden and H. M. Russell, deals with the semi-tropical army worm (*Prodenia eridania*, Cram.), a hairless caterpillar doing much damage to market-garden crops. Arsenical sprays were found to be effective against it.

MR. C. BAKER, of 244 High Holborn, London, W.C., has issued his quarterly classified list of second-hand scientific instruments for sale or hire. He offers a very large stock of microscopes and microscopic apparatus which, as in the case of all instruments catalogued, have been inspected and where necessary repaired. The list also contains a varied selection of surveying instruments and other apparatus classified under eight sections.

THE report of the commission for the flora of Germany regarding new localities for plants recorded during the years 1902 to 1905 has been published as a supplement to last year's volume of the *Berichte der deutschen botanischen Gesellschaft* (vol. xxvi., A). It is a continuation of the reports issued as part of the supplements to the twentieth and earlier volumes of the *Berichte*, but is confined to phanerogams. The arduous task of compilation has been undertaken by Prof. K. W. von Dalla Torre. As in previous reports, the systematic list of records is arranged according to the floras of Koch and Garcke, and is preceded by a bibliography of publications consulted.

THE notes contributed by Mr. J. E. C. Turner to the *Indian Forester* (February) on the germination of myrabolan seedlings, *Terminalia chebula*, are of interest, as the conditions must be somewhat similar in the case of not a few drupaceous fruits yielded by trees. Some myrabolan fruits are plump and round, others are strongly ridged; the latter are preferred commercially, but the former are recommended for propagation. The ridges are due to the shrinking of the mesocarp, which causes also the tighter and more solid encasement of the seed. The fruits are sometimes penetrated by a fungus which reduces the mesocarp to powder; in this case, or when for other reasons the mesocarp does not shrink, the fruits remain round, and at germination the embryo has little difficulty in emerging.

AN important contribution to the classification of the Geoglossaceæ, a family of ascomycetous fungi, has been furnished by Dr. E. J. Durand, who has published in the *Annales Mycologici* (vol. vi., No. 5) a systematic account of North American species. It is based on the examination of many type-specimens and duplicates in American and European herbaria, and is fully illustrated with outline drawings and photomicrographs. Two groups are distinguished, the Geoglosseæ, mostly clavate, like a simple type of Clavaria, and the Cudonieæ, mostly pileate. Under Geoglosseæ seven genera are identified, including Microglossum and Corynetes for the hyaline-spored species, and a genus, Glœoglossum, for species of a viscid, gelatinous consistency. The Cudonieæ are arranged under the four genera Leotia, Vibrissea, Apostemidium, and Cudonia. Confirmation is given to the researches of Dittrich that the young hymenium of many species is covered by a veil, comparable to the "volva" of the agarics; it is best seen in *Cudonia lutea* and *Spathularia velutipes*.

THE report of the East Kent Scientific and Natural History Society for the year ending September, 1908, contains the presidential address delivered by Mr. S. Harvey at the commemoration of the jubilee of the society. Among the notes there is reference to the discovery of *Salvia verticillata* near Dover, where, according to the Rev. J. Taylor, it appeared to be well established; this plant is not listed in Hooker's "Student's Flora" or in the "London Catalogue," but is given in Dun's "Alien Flora of Britain." Another interesting find, made by Mr. W. R. Jeffery on Westwell Down, was an apparent hybrid between *Verbascum Lychnitis* and *Verbascum Thapsus*. The hybrids were much taller than the species, produced inflorescences similar to *Lychnitis*, but bore yellow flowers like *Thapsus*.

DR. L. RITTER VON SAWICKI publishes a discussion of the vexed problem of the Rhine-Rhone water-parting in the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde. The main conclusions at which he arrives are four in number:—(1) the present Rhine-Rhone water-parting was formed during the Quaternary period, and destroyed the unity of the former system which flowed to the Rhine; (2) it was formed by a displacement of the old divide caused by lowering of the Geneva basin. This lowering (3) can be correlated with the levels of inter-Glacial times; (4) the "Bühl" period is an important epoch in the glacial time, and on the Lake of Geneva it can be divided into at least three phases, of which the second is the most important.

THE International Council for the Exploration of the Sea has issued a supplementary part of the "Bulletin Trimestriel" for 1906–7, containing a *résumé* of the observations made and the results obtained in the areas under investigation. The region is divided into eight sections:—the Gulf of Bothnia, the Baltic (including the Gulf of Finland, the waters between Rügen and Scania, and the Baltic proper), the Belts and the Kattegat, the Skagerak, North Sea and English Channel, the Irish Sea, the Atlantic, the Norwegian Sea, and the Arctic Sea, and in each case a short description is given of the general distribution of temperature and salinity. Twenty-three plates giving mean values from August, 1902, to May, 1906, accompany the memoir, which is invaluable as marking a stage in the discussion of the vast quantity of material acquired by the council. It is obviously impossible to give, in the space at our disposal, even a short abstract of the results stated; suffice it to say that in each subdivision marked progress has been made in the elucidation of the difficult problems of surface and under-surface circulation.

THE Bulletin of the Imperial Society of Naturalists of Moscow (vol. xxi., No. 4) contains a detailed and valuable discussion, by Dr. E. Leyst, of the meteorological observations made in 1907 at the observatory in connection with the university of that place. Observations are made thrice daily, and these are used as standards for checking the hourly tabulations from the self-recording instruments, of which the observatory possesses a very complete set. The year 1907 was about 2°·2 F. below the normal; the mean was 36°·9; January 4°·6, July 65°·5. The extreme readings were 85°·3 and −27°·2; the absolute extremes during the last fifteen years were 96°·3 and −34°·6. Only 198 days in the year 1907 were quite free from frost. The rainfall, &c., amounted to 20·87 inches, the number of days being 209; the amount was normal, but the average number of days of precipitation is 171. The hours of bright sunshine numbered nearly 1300—about the average for the north-east of England. Although the results are not published in this summary, the observatory records earthquake phenomena, observations of atmospheric electricity, and terrestrial magnetism. The investigation of the upper air has been temporarily suspended for want of funds.

WHEN carbon, metals, or metallic oxides are heated in a vacuum they give out negative electrons, and expressions for the number of electrons emitted in a second, the electric charge they carry, and the energy with which they leave the surface from which they are emitted, have been given by Profs. O. W. Richardson and H. A. Wilson. Part iv. of the *Verhandlungen der deutschen physikalischen Gesellschaft* contains an abstract, and part iii. of vol. xxviii. of the *Annalen der Physik* a complete account, of the measurement of the energy of these electrons recently made by Drs. A. Wehnelt and F. Jentzsch, of the University of Berlin. They measure the energy necessary to keep the temperature of a platinum wire covered with calcium oxide constant, first when electrons are, secondly when

they are not, emitted by the surface. They find the agreement between theory and experiment altogether unsatisfactory, and conclude that the present theory is not a correct representation of the phenomena of emission of electrons from glowing bodies.

THE March number of *Terrestrial Magnetism and Atmospheric Electricity* contains an abstract by the author, Dr. L. A. Bauer, of the report recently issued by the United States Coast and Geodetic Survey, dealing with the results of the magnetic survey work in the country up to 1906. This report is the most complete summary published up to the present, and supersedes previous reports. The stations used in the survey are on the average thirty-one miles apart, and the charts cover a considerable area of the surrounding ocean. All values relate to 1905 January 1, and are corrected for diurnal variation. The secular changes in the United States appear to be much more complicated than has been supposed hitherto, and if cyclic must have subperiods as well as a principal period. Dr. Bauer is already examining the data with the view of determining what part of the magnetic field is referable to a potential, and hopes to base other investigations on the material the report supplies.

THE *Journal of Physical Chemistry* has during recent months been occupied largely by a series of papers by Prof. Bancroft on the electrochemistry of light. In the fourth and fifth papers of the series the "problem of solarisation" is discussed at length, the two papers covering ninety pages of the January and seventy pages of the March issue. Bulky quotations are given from the original literature, and the monograph therefore does for one branch of modern scientific work the same service that Ostwald has performed by reprinting various classics of exact research. The February number will be read with interest, as it contains Kahlenberg's reply to the criticisms of Cohen and Commelin of his work on the osmotic pressure of solutions in pyridine with a rubber membrane. It will be remembered that Kahlenberg obtained pressures for inferior to those deduced by means of the gas-equation; Cohen and Commelin, with an improved apparatus, also failed to reach the calculated pressures, but attributed their failure to experimental imperfections. In the present communication the validity of the original experiments is maintained, but no new evidence of importance is brought forward.

ONE of the principal machines to which the requirements of a modern boiler-house have given birth is the automatic recorder of carbon dioxide. Such recorders are devised to take samples of the flue gases at intervals of, say, two or four minutes, analyse them for the percentages of CO_2, and record the results on a chart driven by a clock. A continuous record is thus obtained throughout the whole period at which the boilers are at work, and is of value in showing whether proper conditions for maintaining complete combustion have been preserved. As the record is visible at all times, stokers rapidly learn to preserve economical conditions. Some tests on the Simmance-Abady combustion recorder have been made recently by Mr. Rosenhain at the National Physical Laboratory, and are commented on in *Engineering* for April 16. Samples giving 4·99 per cent. of CO_2 by the Sodeau hand analysis apparatus were recorded by the automatic instrument as 4·91 per cent., the draught being 0·75 inch of water. This result corresponds to an avoidable loss in fuel of 32 per cent. Another sample, showing 9·09 per cent. by hand test, was automatically recorded as 8·98 per cent., the avoidable loss of fuel in this case being 10 per cent. Another sample, showing 15·88 per cent. by hand test, was recorded as 15·39 per cent.; this percentage represents the highest possible under economical working with bituminous coal. Taking the mean of all the tests, the recorder was less than half of 1 per cent. low. As the charts are graduated to read to 1 per cent. only under ordinary conditions, the results of the trials must be regarded as extremely satisfactory for this recorder.

A PAPER on problems connected with the construction of the *New York Times* building was read by Mr. C. T. Purdy before the Institution of Civil Engineers on April 20. The Underground Railway passes through the basement of the building, and the paper describes the special features of the steel construction due to the existence and operation of the railway. The height of the building from the pavement to the twenty-third storey is 329 feet, and above this is an observatory and lantern, the roof of which is 30 feet higher; the basement storeys extend 48 feet below the level of the sidewalk. The total dead weight of the building is 33,611,000 lb. (15,000 tons). The problem of vibration arising out of the Underground Railway needed special treatment. In addition to making the structure of the subway independent of the building, it was arranged to found the supporting columns of the former on cushions of sand, and thus still further to insulate the building. The results at first were quite satisfactory, and no vibration was felt from passing trains; but later distinct vibration was detected, and at last this became very pronounced. Seismograph observations were taken, and a thorough examination of the two structures was made. The trouble disappeared when the railway company re-laid the tracks through the building, all perceptible vibration then ceasing. The author considers, nevertheless, that the insulation of the two structures and the provision of the sand-cushions for the subway columns have a material effect in producing this result. Under many conditions such insulation of structural members would be the most effective and economical method of preventing vibration. It is stated that it was certainly efficient in the new building, which has four railway tracks through it, and often three or four trains in the building at the same time, some stopping and others passing through at high speeds.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY:—

May 1. 12h. Jupiter stationary.
5. 9h. 43m. Satellite III. occulted by Jupiter, reappearance 13h. 12m.
5. Red spot visible on Jupiter's disc between 8h. and 9h.
7. Red spot visible on Jupiter between 10h. and 11h.
13. 3h. Mars at quadrature to the Sun.
16. 3h. 33m. Satellite III. transits Jupiter's disc, egress 7h. 3m.
19. 11h. 34m. Venus in conjunction with the Moon (Venus 1° 6′ N.).
20. 4h. Mercury at greatest elongation E. of the Sun (22° 22′).
23. 7h. 28m. Satellite III. transits Jupiter, egress 10h. 57m.
26. 11h. 5m. Jupiter in conjunction with the Moon (Jupiter 4° 13′ S.).
26. 23h. Jupiter at quadrature to the Sun.
30. 11h. 27m. Satellite III. transits Jupiter, egress 14h. 56m.

THE METEORIC SHOWER OF HALLEY'S COMET.—Mr. W. F. Denning writes:—

"The stream of meteors radiating from near η Aquarii in the mornings between May 1 and 6 should be looked

for with special attention this year, as the shower is supposed to owe its parentage to Halley's comet. The latter is approaching the sun rapidly, and will probably be discovered next September.

"Should the meteors prove to be unusually abundant this year and in 1910, the fact may be accepted as conclusive evidence that they are directly associated with Halley's comet. Experience has proved that meteors may swarm in front of a parent comet as well as behind it. Prof. Newton pointed out that the Andromedid meteors precede Biela's comet to a distance of 300 millions of miles along the orbit.

"At Greenwich the radiant of the Aquarids does not rise until about 1.30 a.m., so that observations will be useless before that time, and there is only a short interval left for effective watching, for daylight has so far advanced at 3 a.m. that only really conspicuous meteors can be observed. This year the moon will be full, and her strong light will obliterate the fainter meteors, but the Aquarids are generally pretty bright, with long flights of 40 or 50 degrees, so that should the shower abundantly return this year it may be expected to present a striking aspect, notwithstanding the presence of our satellite."

COMET MOREHOUSE, 1908*c*.—This comet was observed by Prof. F. Ristenpart at Santiago de Chile on March 28 and 30, and the observations show that, on these dates, the ephemeris published by Herr Ebell in No. 4296 of the *Astronomische Nachrichten* required corrections of +2m. 2s., −1·0′, and +1m. 43s., −2·2′, respectively (*Astronomische Nachrichten*, No. 4318).

THE "ORIGINAL" CANALS OF THE MARTIAN DOUBLES.—Usually the twin lines forming the double canals on Mars are equally intense, but on occasions one line appears to be more conspicuous than its fellow. The reduction of Prof. Lowell's 1907 observations shows that, with one or two exceptions, it is always the same canal of any pair that becomes weakened, sometimes to extinction.

A table given in Bulletin No. 37 of the Lowell Observatory shows that, of twenty-two double canals observed during the opposition of 1907, eighteen definitely presented the phenomenon of unequal intensities. Of these, sixteen always showed the one line of the pair, the "original" canal as Prof. Lowell names it, stronger than the other; the period of observation covered the epoch of minimum visibility of the doubles.

The two exceptional canals were the Gihon and the Is, and in both cases there is a possible explanation of their apparently anomalous behaviour. For the former this depends upon the fact that when the eastern line was the stronger the canal was still being fed from the north polar cap, whilst when the western line preponderated the canal was sharing in the general southern darkening of the canals of the southern hemisphere. A similar explanation holds in the case of Is. Comparisons with Schiaparelli's observations confirm the phenomenon.

CHROMOSPHERIC CALCIUM LINES IN FURNACE SPECTRA.—In No. 32 of Contributions from the Mount Wilson Solar Observatory Dr. A. S. King discusses the behaviour of the calcium lines H, K, and λ 4227 in the spectrum obtained by heating calcium to various temperatures, and under varying conditions of density, in the electric furnace.

His experiments at the Pasadena laboratory show that whilst the line 4227 appears at a low temperature, and is not sensitive to increases of temperature, it is enormously strengthened by increasing the amount of calcium vapour present. On the other hand, H and K do not appear until the temperature approaches 2500° C., and are very sensitive to temperature variation, whilst but little affected by increasing the quantity of calcium vapour.

Dr. King points out that although these results do not throw much light on the study of sun-spot spectra, they are in strict accordance with eclipse observations of the chromosphere. H and K appear alone in the higher regions of prominences, but 4227 does not appear until the chromospheric vapours reach a considerable density.

MOUNT WILSON SOLAR OBSERVATORY REPORT.—Prof. Hale's report of the work done at the Mount Wilson Observatory during 1908 is too compendious to notice in detail, and many of the results mentioned have already been abstracted in these columns, but there are one or two points which may be mentioned. Prof. Hale states that the electric-furnace experiments have confirmed the conclusion that the temperature of the vapours of Fe, Ti, &c., in sun-spots is lower than that in the "reversing layer" outside spots.

Mr. Abbot, of the Smithsonian Institution, is still engaged in the studies of the solar constant, and arrangements have been made by the institution to construct a permanent station on Mount Wilson, where such studies will be regularly maintained. The total number of spectroheliograms taken with the 5-feet spectroheliograph amounted to 5196 on September 30, 1908.

An investigation dealing with the absorption and scattering of light in the solar atmosphere has just been completed by Prof. E. F. Nichols, of Columbia University, and the observations are in course of reduction.

A spectrocomparator has been added to the laboratory equipment, and is being used for the comparison of the intensities of spectrum lines. The definite reduction of the photographic sun-spot spectra is being carried out, and some idea of the magnitude of the task is afforded by the statement that between λ 5000 and λ 5500 there are more than 1500 lines for which wave-lengths and laboratory identifications have to be determined.

THE ELECTRIFICATION OF RAILWAYS.

THE presidential address delivered by Mr. John A. F. Aspinall in the lecture hall of the Institution of Mechanical Engineers on Friday, April 23, proved to be a most agreeable surprise to those members who were fortunate enough to be present. Addresses on such occasions are apt to take a historical or academical form, and many experiences of this character served to emphasise the interest taken by the audience in Mr. Aspinall's clear account of the electrification and experiences gained in the working of the Liverpool and Southport branch of the Lancashire and Yorkshire Railway, of which the author is the distinguished head, since its inception in October, 1902.

It is too often stated that a general electrification of our railways would be of very great advantage. In certain instances this work can be undertaken with great commercial success, but each case has to be considered with great care, not only on account of the costly character of the work, but also because the conditions upon which success or failure depend vary in almost every place or district. To warrant the electric equipment of a main line of railway, dealing in present circumstances with long steam-hauled trains at high speed for long distances without a stop, some great commercial advantage must be shown. Business men can easily arrange their journeys at present between Liverpool or Manchester and London so as to have five hours in town. Even supposing a speed of 120 miles per hour to be attained by electric traction, the gain to the traveller would be small, while the increased cost to the railway would be enormous. Again, such fast trains would practically prohibit the use of the same tracks for the running of slower local trains, and would necessitate separate tracks for these. The earning capacity of the express tracks would thus be diminished.

On the other hand, in the case of many suburban lines from our great cities, electrification will at once double the train-carrying capacity of the tracks, while in others it will allow a greater time space between trains, which may be utilised for the passage of steam-worked express trains coming in from the more distant parts of the line. In a district where a railway has had its tracks paralleled by tramways, the creation of an electric railway service will have the immediate effect of bringing back large numbers of passengers who have used the trams in the early stages of their construction, but who find that they cannot tolerate the great waste of time which results from the very slow speed and the many stops due to the crowded streets through which the trams have to run. Some of the advantages of electrification for local services are:—

(*a*) High schedule journey speed.

(*b*) Much more frequent service when required.

(*c*) Increased acceleration and deceleration.

(*d*) Greater possible mileage per train per day, increasing the earning capacity of any given quantity of rolling stock, and increasing the loading and unloading capacity of existing platforms.

The Southport branch of the Lancashire and Yorkshire Railway has proved to be a commercial success under electric working. It consists of a coast line of 18½ miles, having fifteen stations. The total length of electrified line in the district amounts to four miles of four tracks and twenty-five miles of double tracks, making a total of seventy miles of single track, including sidings. It has been found possible to run all the passenger traffic on the double track on the section having four tracks, leaving the other double track free for goods traffic, thus enabling several stations on the goods track to be closed. The line is considered to provide the fastest service of this character in existence. Stopping trains run 18½ miles, stop fourteen times, and do the journey in thirty-seven minutes. Express trains run the same distance in twenty-five minutes.

During the transition stage from steam to electrical working there came a period when it was necessary to run steam trains in between the electrical trains at the same speed in order to keep them out of the way of the latter. An opportunity was thus afforded of comparing the coal consumption of the locomotives and the power house, and it was found that the six-wheeled coupled tank engines which did the work in 1904 consumed 80 lb. of coal per train mile with express trains, and 100 lb. with stopping trains. The consumption of coal at the power station in 1908 works out at 49 lb. per train mile for the electrical trains.

The time necessary for the conversion from steam haulage to electric traction is of importance. In the case of the line under discussion, the order for commencing the work of electrification was given on October 22, 1902, and the work was finished and the steam trains entirely withdrawn on May 13, 1904.

After considering the questions of the wear in third and fourth rails, Mr. Aspinall dealt with the important matter of the excessive wear of track rails in electrical working. In his opinion, the special rails introduced by Sandberg were not the real cure. The real fault is one of construction. The more or less modern motor truck has all the defects of the older-fashioned locomotives on account of the low position of the centre of gravity. The modern steam locomotive with a high centre of gravity is a very easy riding machine. A motor-car, with its four axles, has a total weight of 12 tons, which is not carried by the springs. Raising the centre of gravity so as to enable this weight to be spring-borne would introduce additional mechanism, and would also block up the passages from car to car. The great advantages of direct drive would be lost, and as the present gears run extremely well it may be a more commercial method to wear out the cheap rail instead of expensive mechanism.

The cars on the Southport line are 60 feet long, and have large side doors at each end. These doors are opened or closed by the public themselves, who, by a bye-law sanctioned by the Board of Trade, are required to enter the car by the rear door and leave by the front door. This system requires a smaller platform staff, but as the larger number of electric trains requires more guards, the total number of men employed remains the same. During the rush hours the cars are emptied in fifty seconds at terminal stations, while intermediate stops consume fifteen seconds only.

Mr. Aspinall favours overhead conductors wherever possible. In the particular case of the high-tension line connecting Aintree with Seaforth, the cost per mile of the overhead equipment was 1300*l*., while the cost per mile of the cable line was 2030*l*.

It was decided in 1905 to install battery plants; the general idea was to provide for running the whole railway for one hour in the event of any serious accident at the central generating station. The battery substations are placed at points intermediate to the rotary substations, and have had the effects of reducing the momentary peaks in the load from a maximum of 7000 kw. to 4500 kw., and the hourly peak during the rush hours from 3800 kw. to 3100 kw., enabling the load to be carried during the winter with 4500 kw. of plant, and during the summer with 3750 kw. of plant.

The total over-all efficiency was found in July, 1906, to be 81 per cent. from the alternating current bus bars to the circuit breakers on the trains. The coal burned at the power house per unit of direct current delivered to the third rail, including all conversion losses, amounted to 3·28 lb. for the twelve months ending December 15, 1908.

In 1907 the Aintree line was electrified, and has led to the recovery of much of the traffic which had been taken away by the Municipal Tramways, which run parallel to the railway. On Grand National Day the race traffic on this section amounts to 13,000 people in about 2¾ hours.

Mr. Aspinall estimates that any railway company having facilities for putting its own plant down in the country, with opportunities of getting cheap coal and water, should be able to produce current at the generating stations at a "works cost" of 0·25 penny per B.T.U. A high-speed service could then be worked at a cost of 9·5*d*. per train mile. No amount for depreciation, other than battery depreciation, is included in this, or for interest on outlay. The figure does not include the maintenance of running track and stations, costs of platform staff, or other items common to both steam and electric lines. The great economy to be hoped for in the future for electrical railways, where no water power is available, is in the production of electricity in very large quantities; the total current-producing charges amount to the large proportion of 4·52*d*. out of the above-mentioned 9·5*d*. Other possible economies are in the direction of such improved design in the motors as will lead to less repairs and a very careful consideration of the whole design of the motor truck. Items which may be put down as giving no trouble whatever are controllers, commutators, steel spur-gearing, and the third rail.

Mr. Aspinall looks forward to the opportunity which he hopes to afford members of the institution during the summer meeting at Liverpool of seeing the Liverpool and Southport line at work. The proceedings terminated with a hearty vote of thanks to the president for his interesting and valuable address, moved by Sir Wm. White, K.C.B., and supported by Mr. W. H. Maw.

There are ten appendices, with curves and photographs, giving minute information regarding the working of this line of railway.

SOME RECENT PALÆONTOLOGICAL PAPERS.

THE description of the fossil flora of Tegelen-sur-Meuse, near Venloo, in Holland, by Clement Reid, F.R.S., and Eleanor M. Reid (*Verhandel. d. kon. Akad. van Wetenschappen te Amsterdam*, September, 1907), is remarkable as showing how skilfully devised methods of observation will reap a rich harvest from "a box of clay easily carried by a man." The specimens of seeds washed or floated out of this Pliocene clay were temporarily preserved in formalin or salicylic acid; they were then washed in water, and each was placed, still wet, on a film of paraffin wax on a glass slide. The plate was immediately warmed from below, and the paraffin rose to take the place of the water evaporated from the seed. The surface could be cleaned with benzine, and the seed was now so tough that it could be easily handled. The Tegelen flora indicates a stage just earlier than that of the Cromer Forest bed.

An illustrated paper on historic fossil cycads, by G. R. Wieland (*American Journal of Science*, vol. xxv., 1908, p. 93), directs attention to new points in some of the great cycad stems and casts in the museums of Europe. The type *Cycadeoidea etrusca* in Bologna is a silicified stem that was used as a sharpening stone in an Etruscan city some 4000 years ago, and it is claimed as "the most anciently collected of all geological specimens."

From Japan come two papers on fossil plants (Journal of the College of Science, Tokyo, vol. xxiii., 1908, articles 8 and 9). In the former, M. Yokoyama describes spoils of war, in the form of Upper Carboniferous plants collected during the recent campaign in Manchuria. In the latter, H. Yabe, whose work on Fusulina has been previously noticed in NATURE, shows how the occurrence of *Giganto-*

pteris nicotiaenifolia in the Mungyong beds of Korea marks these strata as of Triassic age.

In the Proceedings of the United States National Museum, vol. xxxiv. (1908), p. 281, G. H. Girty describes an interesting series of sponges from the Carboniferous of Kansas, for which he is obliged to erect three new genera, Heterocœlia, Mæandrostia, and Cœlocladia. The specimens are now calcareous, and the first two were probably calcispongiæ, while Cœlocladia was a lithistid.

Mr. Girty goes on (p. 293) to describe several new Carboniferous brachiopods. The brachiopods of the Cambrian are added to by C. D. Walcott (Smithsonian Miscellaneous Collections, vol. liii., No. 1810, October, 1908). In a subsequent paper (*ibid.*, No. 1811) the same author gives a useful classification and terminology of the Cambrian Brachiopoda, in which attention is given to the structure of the shell and to the terms applied to its numerous details. A plate illustrates the microscopic structure.

Prof. A. P. Pavlow devotes a finely illustrated folio memoir to the relationships of the lamellibranch Aucella, with a review of all known species. An appendix deals with the Aucellinæ from the Russian Cretaceous strata (*Nouv. Mém. Soc. imp. des Nat. de Moscou*, tome xvii., 1907, p. 1).

Dr. L. Waagen, as an addition and a tribute to Bittner's work on the lamellibranchs of the Alpine Trias, has described "Die Lamellibranchiaten der Pachycardientuffe der Seiser Alm" (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xviii., 1907, Heft 2, folio, price 30 kronen). Material gathered by Bittner before his death has been utilised and compared with a series of specimens in the collections of the University of Vienna. The memoir is no mere record of species, but contains philosophic criticisms of the position of several genera, such as Neumayr's Heminajas (p. 140), Sowerby's Myoconcha, and King's Pleurophorus (p. 154).

"Die Acanthicus-Schichten im Randgebirge der Wiener Bucht," by Franz Toula (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xvi., Heft 2, 1907), forms yet another handsome folio, and is mainly devoted to ammonites. The author in 1905 found to his surprise, south-west of Vienna, a highly fossiliferous exposure of Upper Jurassic limestone. Quarrying operations allowed of the collection of a large amount of good material, including a new species, *Phylloceras giganteum*, measuring 44 cm. in diameter. Eight new species of Perisphinctes alone come from this limited locality. The author modestly explains that he has dealt with these fossils personally, since they came direct into his hands, and he felt a sort of devotion to them which it might have been hard to arouse in another worker. Nineteen exceptionally fine photographic plates place the features of the actual specimens before the critics whose comment is invited by the author.

An important stratigraphical and zonal paper, by N. T. Karakasch, on the Lower Cretaceous of the Crimea, appears in the *Travaux de la Société impériale des Naturalistes de St. Pétersbourg*, vol. xxxii., 1907. Numerous new species of cephalopods, among other fossils, are described and figured. Hoplites, it is noted, disappears in the Crimea before the Aptian epoch, though it occurs in higher series in other parts of Russia and in the Caucasus. The paper is accompanied by an abstract in French.

Dr. Kitchin's memoir on the invertebrate fauna and palæontological relations of the Uitenhage series (Ann. South African Museum, vol. vii., part ii., 1908) is also mainly concerned with molluscs. Bivalves are here prominent, but the ammonites furnish new species of Holcostephanus, which are shown among the beautiful figures drawn by Mr. T. A. Brock. The author strongly confirms the opinion, which has been gradually spreading, that these interesting beds in Cape Colony are of Lower Cretaceous and not of Jurassic age.

In "New Cretaceous and Tertiary Fossils from the Santa Cruz Mountains, California," by R. Arnold, of the U.S. Geological Survey (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 345), a number of new molluscan species are figured from strata ranging from the Cretaceous to the Pliocene. Dr. Otto Wilckens issues a paper of faunistic importance on "Die Lamellibranchiaten, Gastropoden, &c., der oberen Kreide Südpatagoniens" (*Ber. d. naturforsch. Gesell. zu Freiburg-im-Breisgau*, Bd. xv., 1907, p. 97). The material collected by Prof. Hauthal and sent to Prof. Steinmann was not in a good state of preservation, owing to earth-pressures and weathering processes, but a great deal that is new among molluscan species has come to light. Dr. Paulcke follows (p. 167) with an account of the cephalopods from the same strata, including several new species of Hoplites. On p. 83 Dr. Wilckens, in a sketch of the geology of south Patagonia, places these fossiliferous beds as Upper Senonian.

Almost simultaneously, the seventh volume of the Anales *del Museo Nacional* appeared in Buenos Aires, consisting of H. von Ihering's memoir of 600 pages on "Les Mollusques fossiles du Tertiaire et du Crétacé supérieur de l'Argentine." Dr. von Ihering places himself in accord with Dr. Florentino Ameghino and against Dr. Wilckens on the question of the "Pan-Patagonian" system, which he consequently regards as Eocene. With some justice, he claims that the Tertiary beds of South America are to be judged by their own inter-relations, and not by the sequence in North America or Europe. He believes that a continental barrier, required also on zoological grounds, united southern Brazil and Africa in Eocene times. The characters of the Eocene fauna of Argentina are thus Antarctic and Indo-European rather than North American. The author, in determining his systems, relies on the principles of Lyell and Deshayes, laying great stress on the proportion of the molluscan species that are to be found in existing seas (pp. 95, 113, and 419). The Pan-Patagonian system is thus regarded as Eocene, the Entrerian as Miocene, and the gap between these as filled by the Magellanian or Oligocene. Ameghino, however, has placed the Entrerian as Oligocene. The pebble-beds that extend along the Patagonian coastlands from Tierra del Fuego to the Rio Negro are now known to contain molluscan bands, and Darwin's belief that they were marine is thus confirmed (p. 391). This "Araucanian" formation is classed as Pliocene. Von Ihering thinks that the lower part of the much-discussed Pampas system may be Pliocene, while the higher marine beds proclaim the upper part as Pleistocene. In southern Brazil and on the Buenos Aires coast there are still younger Pleistocene deposits, representing a considerable incursion of the sea (p. 431). The section of the memoir (p. 482) which traces the history of the successive marine faunas raises many questions that affect palæontology, zoological distribution, and general geology. On p. 545, for instance, examples are given of the influence of oceanic climate in sending the littoral species of temperate zones into deeper waters near the tropics, and in allowing of a "bipolar" distribution of other forms, since they can live at great depths over all the oceanic area intervening between the poles. The criticism of so extensive a memoir must be left to specialists, but it is clear that its conclusions will interest geologists of very different lines of study.

In the Proceedings of the Cotteswold Naturalists' Field Club, vol. xvi. (1908), p. 143, Mr. E. Talbot Paris describes echinoids from the Lias of Worcestershire, and, with Mr. L. Richardson (p. 151), writes on the stratigraphical and geographical distribution of the Inferior-Oolite echinoids of the west of England. The latter paper, while relying in part on Wright's work, makes useful additions to it, new species being introduced and figured.

Mr. A. W. Slocom describes several new crinoids, belonging to genera already known, from the Niagara Limestone of Chicago (Field Columbian Museum, Geol. Series, vol. ii., 1907, p. 273). Two new species of the aberrant genus Zophocrinus are included. Mr. R. Arnold, whose molluscan work is above referred to, describes a new species of the ophiurid Amphiura from the Upper Miocene of California (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 403).

Mr. C. D. Walcott, having completed his work on brachiopods, promptly enters on an investigation of Cambrian trilobites (Smithsonian Miscell. Collections, vol. liii., 1908, p. 13). The present instalment describes the new genera Burlingia, Albertella, and Oryctocara. The first-named, from the Middle Cambrian, is placed with Moberg's Schmalenseeia in a special family, the Burlingidæ.

The Geological Survey of Great Britain issued in October, 1908, a welcome quarto memoir on "The Higher Crustacea of the Carboniferous Rocks of Scotland," by B. N. Peach, F.R.S. (price 4s.). Four new genera, one being appropriately styled Tealliocaris, and twenty-three new species, are described. The forms are all transferred from the macrurous decapods to the schizopods, following an opinion early formed by the author, and confirmed by Sars's report in the *Challenger* series in 1885. Palæocaris is interestingly placed in G. M. Thomson's Anaspidæ (p. 53), a family erected in 1894 to include a less specialised fresh-water form still living isolated in lakes among the mountains of Tasmania. The illustrations to the memoir show the excellent preservation of much of the material, and it is pleasant to learn that the work was undertaken by Dr. Peach on his retirement from the Survey directly he was free from pressing official duties.

Passing to vertebrates, Messrs. F. R. von Huene and R. S. Lull are engaged in a re-consideration of the affinities of Hallopus, a reptile described by Marsh from Wyoming, and now known to be of Upper Triassic age (Am. Journ. Science, vol. xxv., 1908, p. 113).

Mr. G. E. Pilgrim gives us a new genus of Suidæ, Telmatodon, from Lower Miocene beds in Baluchistan (Records Geol. Surv. India, vol. xxxvi., 1907, p. 45). Mr. F. B. Loomis shows how the rhinoceros Diceratherium was comparatively common in the Lower Miocene of North America in beds where few vertebrates were known until some three years ago ("Rhinocerotidæ of the Lower Miocene," Am. Journ. Sci., vol. xxvi., 1908, p. 51). Two species of Acerotherium, a genus abundant in the American Oligocene, lived on amid a rich variety of Diceratheria. By the close of the Miocene, the latter forms had also run their course.

Herr Wilhelm Freudenberg introduces the Pleistocene *Rhinoceros Mercki*, var. *Hundsheimensis*, Toula, in his account of the fauna of the Hundsheim cave in Lower Austria (*Jahrb. d. k.k. geol. Reichsanstalt*, Bd. lviii., 1908, p. 220). The animals of this cave, including Machairodus, which may have preyed on rhinoceroses and elephants, are held to have lived in the district at first under cold conditions, and then during a warm interglacial interval. The striped hyæna occurs (p. 212), a species that goes back far into the Pliocene. The absence of the horse and man also gives the deposit an early aspect. G. A. J. C.

PAPERS ON MOLLUSCS AND INSECTS.

THE molluscs of the family Pyramidellidæ inhabiting the coasts of New England and the adjacent region form the subject of an illustrated monograph, by Mr. P. Bartsch, published in the Proceedings of the Boston Society of Natural History, vol. xxxiv., parts lxvii.–cxiii. Attention is chiefly concentrated on the characters of the shell, although mention is made of some of the soft parts in diagnosing the genera. The new genus Couthonella is proposed for the species hitherto known as *Pyramis striatula*.

To the proceedings of the Academy of Natural Sciences of Philadelphia for December, 1908, Prof. H. A. Pilsbry contributes the twelfth instalment of his account of the clausilias of the Japanese Empire, in which a number of new species and subspecies of various sections, or subgenera, of Clausilia are described and figured. Especial interest attaches to certain species belonging to the section Euphædusa, such as *Clausilia echo*, on account of their exhibiting stages in a degeneration-series leading on to the section Reinia. In the same issue Prof. Pilsbry and Mr. Y. Hirase describe a number of new land-molluscs from the Japanese Empire, including forms from the main island of Japan, the Benin Island, the Ryukyu (Liu-Kiu) Islands, and Formosa. Particular interest attaches to the clausilias and operculated shells from the small volcanic isles of the Tokara group.

The pteropods and heteropods of the Irish coasts form the subject of a paper, by Miss A. L. Massy, published as No. 2 of Irish Fisheries Scientific Investigations for 1907 (1909). The list includes seventeen species of pteropods, among which is a new species of Clio (*C. gracilis*) and seven other species not previously recorded from British waters. Heteropods, on the other hand, are represented, according to present information, in Irish waters only by a few occurrences of *Carinaria lamarcki*.

The habits of the British carnivorous slugs of the genus Testacella form the subject of an illustrated note by the editor in the April number of the *Selborne Magazine*. Special interest attaches to the figure of one of these slugs seizing a worm with its protruded "radula."

Turning to insects, we have first to notice the first three "leaflets" on injurious insects issued by the Indian Forest Department. Of these, No. 1 is devoted to the sal bark-boring beetle (*Sphaerotrypes siwalikiensis*); No. 2 treats of the moth known as the teak-defoliator (*Hyblaea puera*); and No. 3 describes the teak-leaf skeletoniser (*Pyrausta machaeralis*), which, in its adult condition, is also a moth. As two at least of these insects have been noticed in NATURE in connection with other publications of the Forest Department, it will suffice to add that the three leaflets have been drawn up by Mr. E. P. Stebbing. In vol. ii., No. 7, of the entomological series of the Memoirs of the Department of Agriculture in India, Mr. Maxwell-Lefroy discusses the scale-insects, or Coccidæ, of the country, the life-history of three species being illustrated by coloured plates. None of the Indian species of the group inflicts much harm on crops.

Brazilian grasshoppers of the subfamilies Pyrgomorphinæ and Locustinæ (or Acridinæ) form the subject of No. 1661 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 109–163). Fifty-three species are discussed in this paper, among which the author, Mr. J. A. G. Rehn, describes seventeen as new, four new genera being also named and defined. The greater portion of the collection came from Matto Grosso and Rio de Janeiro, and the remainder from the neighbourhood of Pernambuco and Bahia. In the February issue of the Proceedings of the Academy of Sciences of Philadelphia, Messrs. Rehn and Hebard continue their survey of the Orthoptera of the south-western United States, dealing in this instance with those of New Mexico and Texas.

On a previous occasion reference was made in our columns to a paper in the Proceedings of the Philadelphia Academy of Sciences, by Dr. F. Creighton Wellman and Mr. W. Horn, on the tiger-beetles of Angola. In the same serial for December, 1908, the first-named author gives an account of Angolan oil-beetles (Meloidæ), in which special attention is directed to interesting features connected with the habits of these insects. Throughout the driest district of Angola various species of these beetles may be seen in thousands on a roseaceous plant of the genus Tribulus, which occurs in enormous masses, and forms almost the sole food-supply of the adult Meloidæ of the district. This plant produces large masses of yellow flowers, upon which the beetles cluster. It is remarked as a curious fact that the young of these oil-beetles should feed on the eggs, and later on the larvæ, of orthopterous and other insects, while the adults have such an intimate relation to certain plants, the appearance of the full-grown Meloidæ being synchronous with the flowering of the Tribulus, which lasts only for a few weeks.

An important contribution to morphology is formed by a paper on the so-called sclerites of insects, by Dr. G. C. Crampton, published in the Proceedings of the Academy of Sciences of Philadelphia for January. According to the author, there exists a most confusing want of uniformity in regard to the homology of these small chitinous elements and the names applied to them, this being, apparently, in great degree due to the fact that each investigator has been content to confine his studies to one or two groups of insects. Many important points have been brought to light by such investigations on the different orders, but they stand, for the most part, as isolated facts. The object of the investigations undertaken by the author has been to bring these isolated facts into harmony, and to construct a nomenclature for these structures which shall be applicable to the Hexapoda as a whole. With this object in view, Dr. Crampton first reviews the various theories of his predecessors on this subject, and then furnishes a revised and general system of nomenclature. A further communication on the subject is promised.

Publications by the Entomological Bureau of the U.S.

Department of Agriculture include a Bulletin on the peach-tree bark-beetle (*Phlaeotribus liminaris*), by Mr. H. F. Wilson, a paper on the orange-thrips (*Euthrips citri*), named for the first time, by Mr. D. Moulton, and a leaflet on fleas.

Starting with the fact that no sensible difference between the variability of the sexes in the human species can be found, if accurate measures be taken to determine that variability, it is of considerable interest to ascertain whether there is differentiated variability in the castes of the social insects. In a memoir published in *Biometrika*, vol. v., it was shown that the worker-wasp was more variable than the drone, and the drone than the queen. In vol. vi., part iv., of the same serial, Dr. Ernest Warren investigates the variability of the six castes of South African white-ants, or termites. The author finds that the sexual are less variable than the asexual castes, and considers that the difference of variability between the inhabitants of different nests cannot be accounted for by heredity, but must be due to post-embryonic environmental influences. It is also held that the relative variability of the whole population as compared with that of a single nest cannot be attributed to heredity, but must be due to the influence of environment on a plastic organism. Dr. Warren finds a high correlation between the mean sizes of the different castes in the same nest, and little correlation between the variability of different castes in the same nest, thus indicating that a similar environment does not affect the different castes in the same way.

In the April number of the *Zoologist* Mr. A. H. Swinton continues his account of the vocal and instrumental music of insects.

TRANSATLANTIC WIRELESS TELEGRAPHY.[1]

II.

IN the spring of 1903 the transmission of news messages from America to the London *Times* was attempted, in order to demonstrate that messages could be sent from America by means of the new method, and for a time these messages were correctly received and published in that newspaper.

By reference to the files of the *Times* I find that 267 words of news, transmitted across the Atlantic by wireless, were published in the London *Times* during the latter part of March and the early part of April of that year. A breakdown in the insulation of the apparatus at Glace Bay made it necessary, however, to suspend the service, and, unfortunately, further accidents made the transmission of messages uncertain and untrustworthy. In consequence of this it was decided not to attempt, for the time being, the transmission of any more public messages until such time as a trustworthy service could be maintained in both directions under all ordinary conditions.

As I found that many improvements evolved during the course of the numerous tests and experiments could not be readily applied to the plants at Poldhu and Cape Breton, it was decided to erect a completely new long-distance station in Ireland, and to transport the one at Glace Bay to a different site in the vicinity, where sufficient land was available for experimenting with aërials of much larger dimensions than had been hitherto employed.

Experiments were, however, continued with Poldhu, and in October, 1903, it became possible to supply the Cunard steamship *Lucania*, during her entire crossing from New York to Liverpool, with news transmitted direct from the shore.

In November of the same year tests similar to those carried out with the Italian cruiser took place on behalf of the British Admiralty between Poldhu and H.M.S. *Duncan*.

Communication with Poldhu was maintained during the entire cruise of this battleship from Portsmouth to Gibraltar, and further communication was established between Poldhu and the Admiralty station situated on the Rock of Gibraltar. It should be noted that the distance between Cornwall and Gibraltar is 1000 miles—500 over land and 500 over water.

[1] From a discourse delivered at the Royal Institution on Friday, March 13, 1908, by Commendatore G. Marconi. Continued from p. 237.

The aërial at Poldhu was shortly afterwards extended by the addition of wires sloping downwards, umbrella-fashion, as shown in Fig. 10. This increased the capacity of the aërial, and some further tests were carried out with a station at Fraserburgh, in the north of Scotland. From these tests considerable advantage appeared to be derived, at least for communication over land, by the adoption of much longer waves than had been hitherto employed, and with a wave-length of 14,000 feet it was found possible to telegraph over a distance of 550 miles with an expenditure of energy of about 1 kilowatt.

The operation of the long-distance stations in England and America made it possible to transmit messages to ships, whatever their position, between Europe and North

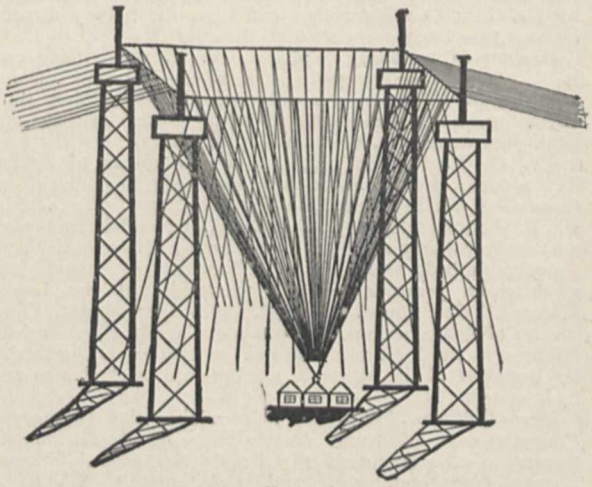


FIG. 10.

America; and to the Cunard Company belongs the credit of having greatly encouraged the long-distance tests, a circumstance which enabled them to commence, in June, 1904, the regular publication on their principal vessels of a daily newspaper, containing telegraphic messages of the latest news from Europe and America.

This daily newspaper has now been adopted by nearly all the large liners plying to New York and the Mediterranean, and it obviously owes its entire existence to long-distance wireless telegraphy. Therefore the tranquility and isolation from the outside world, which it is still possible to enjoy on board of some ships, is rapidly becoming a thing of the past; but, however much travellers may sigh over the innovations which have lately been brought about,

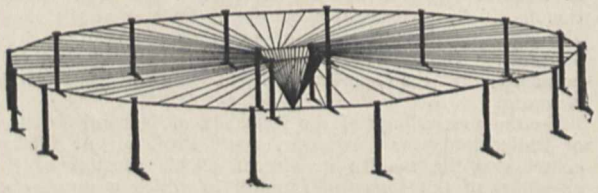


FIG. 11.

they seem anxious enough to avail themselves of the new method of communication on all possible occasions.

Early in 1905 the construction of the new station at Glace Bay was sufficiently advanced to allow of preliminary tests being carried out. The aërial was very large, and consisted of a vertical portion in the middle 220 feet long supported by four towers and attached to horizontal wires, 200 in number, each 1000 feet long, extending radially all round, and supported at a height of 180 feet from the ground by an inner circle of eight and an outer circle of sixteen masts (Fig. 11). The natural period of oscillation of this aërial gave a wave-length of 12,000 feet. The capacity employed was 1·8 microfarads, and the spark-length ¾-inch.

Signals and messages from this station were received at

Poldhu by day as well as by night, but no commercial use of the station was made at that time, in consequence of the fact that, although the signals came through by day as well as by night, they were exceedingly weak and faint, and also because the corresponding station on the same plan had not yet been erected in Ireland.

A further step in advance was the adoption at the Transatlantic stations of the directional aërial shown in Fig. 12.[1] The ordinary wireless telegraph aërials, which I have already described, send out electric radiation equally in all directions. This is, however, in many cases a disadvantage. Many suggestions respecting methods for limiting the direction of radiation have been made by various workers, notably by Messrs. Artom, Braun, and Bellini Tosi.

In some of my earliest experiments, in 1896, I used copper mirrors, by the aid of which it was possible to project a beam of electric radiation in a certain direction, but I soon found that this method would only work over short distances.

About three years ago I again took up the subject, and was able to determine that by means of horizontal aërials, disposed in a particular manner, it was possible to confine the effects of electric waves mainly to certain directions as desired. True, the limitation of transmission to one direction is not very sharply defined, but it is nevertheless very useful. The practical result of this method has been, so far, that messages can be sent over considerable distances in the desired directions, while they travel only over a comparatively short distance in other directions, and that, with aërials of moderate height, greater efficiency in a given direction can be obtained than can be obtained all round by means of the ordinary aërials.

When this type of aërial was adopted at Glace Bay a considerable strengthening of the received signals at Poldhu

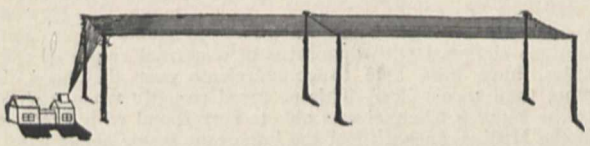


FIG. 12.

was noticed. It was therefore decided to adopt the directional aërial at all long-distance stations.

A further improvement introduced at Clifden and Glace Bay consisted in the adoption of air condensers, composed of insulated metallic plates suspended in air at ordinary pressure. In this manner it is possible to prevent the dissipation of energy due to losses caused by the dielectric hysteresis in the glass dielectric of the condensers previously employed, and a very appreciable economy in working, resulting from the absence of breakages of the dielectric, is effected. These air condensers, which have been in use since May, 1907, have been entirely satisfactory. After very considerable delay and expense, the new station at Clifden was got ready for tests by the end of May, 1907, and experiments were then commenced with Glace Bay.

The wave-length used during these tests was 12,000 feet, the capacity employed 1·6 microfarads, and the potential to which the condenser was charged 80,000 volts.

Good signals were obtained at Cape Breton from the very commencement of the tests, but some difficulty was encountered in consequence of the effects of atmospheric electricity due to the prevalence of thunderstorms in the eastern part of Canada during the first few days of the tests.

Simultaneously with these tests others were carried out from Poldhu to Glace Bay with a new system of transmitting apparatus, by means of which continuous or semi-continuous oscillations could be produced.

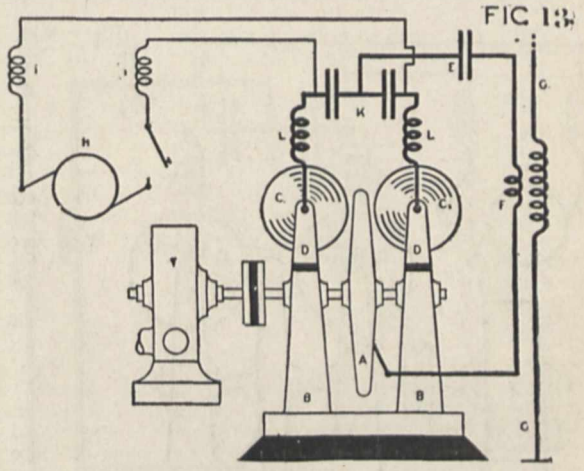
Proportionately to the energy employed the signals from Poldhu were so much better than those from Clifden that I decided at once to adopt this new method of transmission at Glace Bay and Clifden. The apparatus which I have been using for producing continuous or closely adjacent trains of electric oscillations is as follows[2]:—A metal disc A (Fig. 13), insulated from the earth, is caused to rotate at a very high speed by means of a high-speed electric motor or steam turbine. Adjacent to this disc, which I shall call the middle disc, are placed two other discs, C_1, C_2, which may be called polar discs, and which also can be rotated at a high rate of speed. These polar discs should have their peripheries very close to the surface or edges of the middle disc.

If a small amount of energy is used, stationary knobs or points may be used in place of the side discs.

The two polar discs are connected respectively through suitable brushes to the outer ends or terminals of two condensers K, joined in series, and these condensers are also connected through suitable inductive resistances to the terminals of a generator, which should be a high-tension continuous-current dynamo.

On the high-speed or middle disc a suitable brush or rubbing contact is provided, and connected between this contact and the middle point of the two condensers is inserted an oscillating circuit consisting of a condenser E in series with the inductance, which last is connected inductively or conductively to the aërial.

If the necessary conditions are fulfilled, and a sufficient E.M.F. is employed, a discharge will pass between the outer discs and the middle disc, which discharge is neither an oscillatory spark nor an ordinary arc, and powerful



oscillations will be created in the signalling condenser E and oscillatory circuit F.

I have found that in order to obtain good effects a peripheral speed of more than 100 metres per second is desirable; therefore particular precautions have to be taken in the construction of the discs. Electrical oscillations of a frequency as high as 200,000 per second can be obtained.

The apparatus works probably in the following manner:—Let us imagine that the source of electricity is gradually charging the double condenser and increasing the potential at the discs, say C_1 positively and C_2 negatively; at a certain instant the potential will cause the charge to jump across one of the gaps, say between C_2 and A. This will charge the condenser E, which will then commence to oscillate, and the charge in swinging back will jump from A to C_1, which is charged to the opposite potential. The charge of E will again reverse, picking up energy at each reversal from the condensers K. The same process will go on indefinitely, the losses which occur in the oscillating circuit EF being made good by the energy supplied from the generator H. If the disc is not rotated, or rotated slowly, an ordinary arc is at once established across the small gaps, and no oscillations take place. The efficient cooling of the discharge by the rapidly revolving disc seems to be one of the conditions necessary for the production of the phenomena.

By means of this apparatus tests were carried out, but it was found, as was to be expected, that the oscillations were too continuous and of too high a frequency to affect a receiver, such as the magnetic detector, unless an interrupter was inserted in one of the circuits of the receiver.

[1] "On Methods whereby the Radiation of Electric Waves may be mainly Confined," &c. Proc. Roy. Soc., G. Marconi, A. lxxii., 1906.

[2] Patent Application No. 20,119, September 9, 1907.

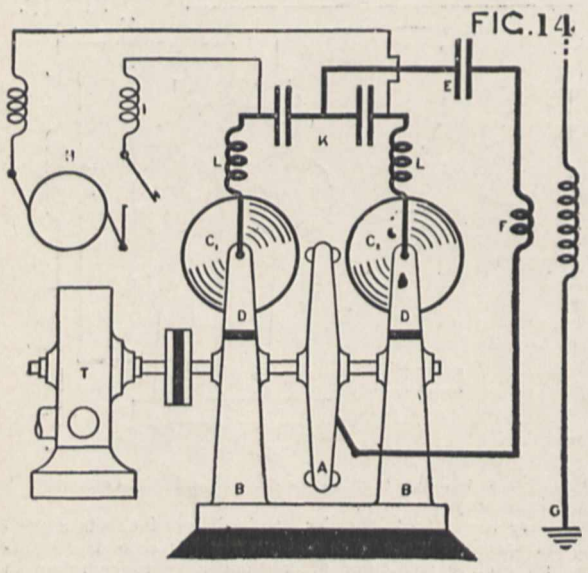
A syntonic coherer receiver would, however, work, in consequence, no doubt, of the considerable rise of potential which occurred at its terminals through the cumulative effect of resonance.

The best results over long distances have, however, been obtained by a disc as shown in Fig. 14, in which the active surface is not smooth, but consists of a number of knobs or pegs, at the end of which the discharges take place at regular intervals. In this case, of course, the oscillations are not continuous, but consist of a regular succession of trains of undamped or slightly damped waves.

In that manner it is possible to cause the groups of oscillations radiated to reproduce a musical note in the receiver, distinguishable in a telephone, and thereby it is easier to differentiate between the signals emanating from the transmitting station and noises caused by atmospheric electrical disturbances. By this method very efficient resonance can, moreover, be obtained in appropriately designed receivers.

A few tests with apparatus based on the principle described were carried out between Glace Bay and Clifden, and on October 17 of the year 1907 a limited service for Press messages was commenced between Great Britain and America. Difficulties were experienced, however, over the question of rates with the telegraph companies working the land-lines between Glace Bay and the principal towns of Canada and the United States, and at present the strange

FIG. 14.



anomaly exists that the rates for Press messages on the American land-lines are much cheaper for messages going from England to New York than in the reverse direction. On February 3, 1908, this service was extended to ordinary messages between London and Montreal.

The stations at Clifden and Glace Bay are not complete, and the necessary duplication of the running machinery has not yet been executed, but nevertheless communication across the Atlantic has never been interrupted for more than a few hours since the commencement of commercial working on October 17, 1907.

There have, however, been several serious interruptions at Clifden, due to the untrustworthiness of the land-lines connecting Clifden to the ordinary telegraph system. On one occasion one of these interruptions lasted from 5.20 p.m. to 10.30 a.m., a duration of seventeen hours, and on another occasion the land telegraph wires were struck by lightning and disabled for twelve hours. There have also been recorded numerous other interruptions of shorter duration, which resulted in delays to private and Press messages. Further delays have also been caused through interruptions on the land-lines connected with the Canadian station.

During the first months, on account of imperfections in the auxiliary apparatus connected principally with the operating keys and switches, only a fraction of the available transmitting power was used. In consequence of this the speed of transmission was slow, and short interruptions somewhat frequent. Many of these difficulties have now been overcome, and in a few more months, when it should be possible to utilise the full power available, a very much greater speed and efficiency is likely to be attained.

Messages can now be transmitted across the Atlantic by day as well as by night, but there still exist certain periods, fortunately of short duration, when transmission across the Atlantic is difficult and at times ineffective, unless an amount of energy greater than that used during what I might call normal conditions is employed.

Thus, in the morning and evening when, due to the difference in longitude, daylight or darkness extends only part of the way across the Atlantic, the received signals are weak and sometimes cease altogether.

It would almost appear as if illuminated space possessed for electric waves a different refractive index from dark space, and that in consequence the electric waves may be refracted and reflected in passing from one medium to the other. It is therefore probable that these difficulties would not be experienced in telegraphing over equal distances from north to south, or *vice versâ*, as in this case the passage from daylight to darkness would occur almost simultaneously in the whole of the medium between the two points.

In the same manner a storm area in the path of the signals often brings about a considerable weakening of the received waves, whilst if stormy conditions prevail all the way across the Atlantic no interference is noticeable. Electric-wave shadows, like sound shadows, may be formed by the interference of reflected waves with the direct waves, whereby signals may be much less effective or imperceptible in the area of such electric-wave shadow.

In the same manner as there exist periods when signals across the Atlantic are unusually weak, there exist other conditions, especially at night, which make the signals abnormally strong. Thus on many occasions ships, and stations equipped with apparatus of a normal range of 200 miles, have been able to communicate over distances of more than 1000 miles. This occurred recently when a ship in the English Channel was able to correspond with another in the Mediterranean. But the important factor about wireless telegraphy is that a service established for a certain distance shall be able to maintain trustworthy communication over that distance.

Long-distance stations are now in course of erection in many parts of the world, the most powerful of all being that of the Italian Government at Coltano, and I have not the slighest doubt but that telegraphy through space will soon be in the position of affording communication between distant countries at cheaper rates than can be obtained by any other means.

As to the practicability of wireless telegraphy working over long distances, such as that separating England from America, there is no longer need for any doubt. Although the stations have been worked for only a few hours daily, 119,945 words of Press and commercial messages had been transmitted across the ocean by this means up to the end of February, 1908, since the service was opened.

The best judges of a service are those who have made use of it, and amongst newspapers, the chief users have been the *New York Times* and the London *Times*, which have already publicly expressed their opinion of this new method of communication.

Whether the new telegraphy will or will not injure or displace the cables is still a matter of conjecture, but in my opinion it rests a good deal on what the cables can do in the way of cheaper rates. It is not, as some appear to imagine, either the business or the wish of those concerned in the development of wireless telegraphy to injure the cable industry. They are endeavouring at present to demonstrate that the new method is not only valuable for shipping, but that it should be also regarded as a new and cheaper method of communicating with far distant countries. Whatever may be the view as to its shortcomings and defects, there can be no doubt but that wireless telegraphy across the Atlantic has come to stay, and will not only stay, but continue to advance.

In seven years the useful range of wireless telegraphy has increased from 200 miles to 2500 miles. In view of

that fact, he will be a bold prophet who will venture to affirm what may not be done in seven years more.

I shall not presume to say that at the present moment the wireless telegraph service between London and New York is as efficient and as rapid as that supplied by the cables. For nearly fifty years the Transatlantic cable organisation has been in existence, and there are now sixteen cables working across the North Atlantic, so that in the case of a breakdown of one cable the traffic is sent by one of the others. Moreover, long experience has served to bring their land-line connections to a high state of perfection. Nevertheless, I am convinced that if there were only one cable and the present wireless service, interruptions would be more frequent and much more serious in the case of the cable than in that of the wireless service.

We have only to look towards those parts of the globe such as India, South Africa, and so forth, where trans-oceanic communication is dependent upon only one or two cables, and the force of my remarks will be more readily appreciated. The cases of delay in regard, not only to commercial messages, but also to Government despatches, are only too frequent, as no doubt you have observed from time to time in the daily Press.

Among many people there seems to be a rooted conviction that wireless telegraphy is not suitable for the handling of code or cipher messages. Whatever gave rise to this idea I do not know, but I wish to emphasise that it is purely fictitious. Code messages can be sent just as well by wireless as by ordinary methods of telegraphy.

I need hardly say that most of the wireless messages passing between warships are now expressed in code, as are likewise the majority of the commercial messages handled by the Clifden and Cape Breton stations.

I do not wish to claim that wireless telegraphy is infallible, and although errors do sometimes occur, it is absolutely certain that, having regard to the London and Montreal service, most of the mistakes can be traced to the land-line telegraph transmission between London and Clifden, and between Glace Bay and Montreal.

I find, however, that probably the greatest ignorance prevails in regard to what is termed "tapping," or intercepting wireless messages. No telegraph system is secret. The contents of every telegram are known to every operator who handles it. It is incorrect to suppose that anyone can at will pick up wireless messages. On the other hand, it is easy for anyone knowing the Morse code to step into many telegraph offices and read off the messages by the click of the instruments.

Further, it is practicable, but illegal in this country, to make arrangements so that messages which pass over a telegraph line can be read by persons who are not operating the line at all. It is also expensive to erect a tall pole or tower and fix up all the instruments which are necessary before wireless messages can be taken in, and, moreover, such proceeding is contrary to the law of the land.

It should be remembered, too, that any ordinary telegraph or telephone wire can be tapped, and the conversation going through it overheard, or its operation interfered with. Results published by Sir William Preece show that it is possible to pick up at a distance, on another circuit, the conversation which may be passing through a telephone or telegraph wire.

At Poldhu, on a telephone connected to a long horizontal wire, the messages passing through a Government telegraph line a quarter of a mile away can be distinctly read. In a paper on his method of magnetic space telegraphy, Sir Oliver Lodge mentions an occasion on which he was able to interfere, from a distance, with the working of the ordinary telephones in the city of Liverpool.

Many instances can be enumerated showing that electric light and tramway power-stations have interfered with cables and land-lines. Nevertheless, there are penalties attached to the tapping of a telegraph wire, and it ought to be as well known that, since the passing of the Wireless Telegraphy Act, there are penalties involved if any wireless stations are erected or worked without the consent of the Postmaster-General. In conclusion, I may say that I am very confident that it is only a question of time, and that not a very long time, before wireless telegraphy over great distances, possibly round the world, will become an indispensable aid to commerce and civilisation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Applications to occupy the University's table in the zoological station at Naples should be addressed to Prof. Langley on or before Thursday, May 20.

Mr. C. L. Boulenger has been appointed assistant to the superintendent of the museum of zoology from March 15 to September 30.

Mr. G. I. Taylor has been appointed assistant demonstrator of experimental physics for five years from January 1, 1909.

The Anthony Wilkin studentship in ethnology and archæology will be available at the end of 1909. Applicants should send their names, qualifications, and a statement of the research which they wish to undertake to the Vice-Chancellor before November 1.

OXFORD.—A new departure was taken in Oxford some time ago by the establishment of a department of forestry. A site for the necessary building was provided by St. John's College on a plot of ground adjoining their own gardens, and the work of the department was placed under the direction of Prof. W. Schlich, F.R.S., formerly of Coopers Hill. Coincidently with this movement, the chair of rural economy, founded by John Sibthorpe, who in 1747 succeeded Dillenius as professor of botany, was re-endowed and put on a new footing by the liberality of the same college. A building for the use of the present occupant of the Sibthorpian chair, Prof. W. Somerville, was also provided by St. John's College, this, together with the new quarters of the forestry department, forming a handsome block nearly opposite the University museum. The combined structure was opened on April 20 by the Vice-Chancellor, the president of Magdalen, in the presence of a large company, which included Sir Thomas Elliott, Sir Charles Crosthwaite, Mr. Rider Haggard, and many resident members of the University. The president of St. John's, who is now in his ninetieth year, was unfortunately prevented from being present by slight indisposition. In his speech at the opening ceremony the Vice-Chancellor dwelt on the traditions associated with the names of Sibthorpe and Dillenius, and referred in appreciative terms to the services rendered by St. John's College to the scientific studies of the University.

UNDER the Irish Universities Act, 1908, a professor of botany will be appointed shortly for the Queen's University of Belfast. Other appointments will include readerships or lectureships in physics, organic chemistry, bio-chemistry, and geology and mineralogy.

IN furtherance of the movement for the establishment of a National Aëronautical College, we learn from the daily papers that the Aërial League has appointed a sub-committee consisting of Dr. Hele Shaw, F.R.S., Mr. Arthur du Cros, M.P., Lord Montagu of Beaulieu, Sir Buchanan Scott, and Mr. Stephen Marples. We are glad to see that the promoters are keenly alive to the importance of placing the movement on a strictly scientific basis, and that the mathematical side of the problem is to receive its due share of attention. This is the more important as the practical experimental side is pretty certain to be efficiently represented. That a serious effort is being made to wake up our country in the present connection may be gathered from the following remarks of Mr. Marples as reported in the *Standard*:—"Our object," he said, "is to prevent Great Britain from being beaten in aëronautics by foreign countries in the same way as we have been in commercial enterprise. France and Germany have had their technical and commercial colleges, which have produced such good results, and now they have their aëronautical colleges in full swing. Unless we have one we shall fall behind in aëronautics too. Aëronautics is a most scientific subject, and goes more deeply into higher mathematics than any other subject connected with engineering. Hence the great necessity for putting the college on a sane, sound, and businesslike footing to meet the needs of the moment. It is no use teaching even the practice of flying unless we have something of the theory. We hope that the Government will help us. We are also appealing to the public for money."

ON July 12, 1908, King Edward VII. and Queen Alexandra visited Sheffield and opened the new University buildings. On the day of the King's visit Mr. Wm. Edgar Allen gave 10,000*l.* to the University on the sole condition that it should be used for the erection of a building for the University library. On Monday, April 26, to the great satisfaction of the University authorities and of the people of Sheffield and district, the Prince and Princess of Wales opened the Edgar Allen Library. At a special Congregation honorary degrees of Litt.D. were conferred on His Royal Highness and on Mr. Wm. Edgar Allen, the donor of the library. During the ceremony the Chancellor, the Duke of Norfolk, announced that Mr. Allen had that morning given donations of 5000*l.* to the Royal Infirmary and 5000*l.* to the Royal Hospital, on condition that a ward or wing in each should be called after the Prince and Princess respectively, a condition their Royal Highnesses were pleased to accept. The educational value of these fresh gifts was aptly referred to by the Chancellor, who pronounced them "a very thoughtful work in connection with this University, because it is undoubtedly a fact that the medical students of this University derive great advantages from what they can learn and see at the great hospitals of this city." The Prince, in the course of an interesting speech, said:—"The great development of the university movement is a remarkable feature in the march of education during the latter part of the nineteenth century. Our important industrial centres recognise that there are problems to be solved differing widely from those dealt with in the more ancient universities. Sheffield was quick to see the necessity of adapting herself to the industrial needs of the people, and to realise that scientific and technical knowledge is indispensable to success in the strenuous commercial struggle among the nations of the west. Thanks to the liberality of Mr. Mark Firth, the college which bore his name was founded in 1879, and incorporated twenty-six years later with those other institutions which constitute the University of Sheffield, including among them schools of engineering and metallurgy which are famous throughout the land. . . ."

THE Lord Mayor will preside at a meeting, to be held at the Mansion House as we go to press, in support of the National League for Physical Education and Improvement. The speakers will include the Bishop of Ripon, the Duke of Argyll (probably), Lord Halsbury, Lord Ashbourne, Sir Henry Craik, M.P., and others. The following report, prepared by a strong and representative committee organised by the league, will be presented and discussed:—(1) That physical education should be compulsory in all schools, subject to the conditions of sections (2) and (3). (2) That medical inspection and report should be compulsory as a preliminary to pedagogical gymnastics and at intervals thereafter; the report to make special reference to the conditions of eyes, ears, teeth, lungs, and heart, and to be drawn up on an authorised form to be supplied to the medical officer. A special report should also be made on the return of a pupil after severe illness. That a local education authority does not adequately carry out its duties in regard to medical inspection unless provision is made for this. (3) That there should be regular pedagogical gymnastics at the schools, the number of lessons, the duration of each, and the nature of the exercises to be adapted to the age and physical condition of the child, the time so allotted not to curtail the play hours, games being an important part of physical education. The committee consider that, when possible, this instruction should be carried out daily, though they recognise that for the present this may be impossible, and that three days a week should be the minimum. They consider that, as far as possible, exercises not demanding apparatus should be carried out in the open air. (4) That in all secondary and intermediate schools specially trained gymnastic specialists should be appointed; in elementary schools, where the physical education is necessarily carried out by ordinary school teachers, such teachers should possess a qualification in physical training. (5) The studies of gymnastic specialists should be carried out on the general lines of the Swedish system, with such modifications as are necessitated by the different conditions of school life in this country; recognition to be made of various grades of qualifications, and corresponding differences in the course of study required. (6) The studies of the gymnastic specialist should embrace anatomy, physiology, hygiene, mechanics, and pedagogics. (7) For the present, certificates of efficiency as teachers will have to be granted or approved by a central body, whether or not in the future these powers can be delegated to universities or other local bodies. (8) The committee have considered the question of a central institute, and are of opinion that, although such an institute is highly desirable, they are not in a position at present to give definite recommendations in regard to its formation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 22.—Sir Archibald Geikie, K.C.B., president, in the chair.—"Dynamic" osmotic pressures: the **Earl of Berkeley** and E. G. J. **Hartley**.—(1) The theory of ancestral contributions in heredity; (2) the ancestral gametic correlations of a Mendelian population mating at random: Prof. Karl **Pearson**. The purpose of these two papers is to place in a somewhat clearer light the relationship of the biometric to the Mendelian standpoint. The law of ancestral heredity, as stated by the present writer in a paper published many years ago in the Proc. Roy. Soc., involved the following three points:—(*a*) the linearity of the regression of offspring on any ancestor; (*b*) the diminution of the ancestral correlations in a geometrical progression; and (*c*) the determination of the probable character of the offspring, when the mating was at random, by the multiple regression formula. It was shown, in a memoir of 1896, that when the ancestral correlations were of the type ρ, ρ^2, ρ^3 . . . then the character of the offspring depended only on the characters of the two parents, and ancestry need not be considered. In a memoir in vol. cciii. of the Phil. Trans. it was shown later that (*a*) and (*b*) held for a generalised Mendelian population, for the *somatic* characters, but that the somatic correlations were not of the type ρ, ρ^2, ρ^3 . . . and accordingly that ancestry, in the biometrician's sense, did matter even in a population following the simplest Mendelian formula, providing the mating was at random. A recent paper in the Proc. Roy. Soc. might be interpreted as meaning that the law of ancestral heredity did not apply to a Mendelian population. In the first of the above papers the writer indicates how, in a population originally consisting of p dominants, s recessives, and q hybrids, mating at random, the percentage of the number of dominants in the offspring increases with the number of dominants in the grandparentage, and this is true in the case of any grade of ancestors, whatever be p, q, and s. In the second paper the writer turns from the somatic to the gametic correlations, which were not discussed in the earlier memoirs, and shows that the gametic correlations form a series of the character ρ, ρ^2, ρ^3 . . .; in other words, a knowledge of the gametic character of the parents makes a knowledge of the gametic character of the ancestry unnecessary. Apart from symbols, this must be a truism, because the offspring arises solely from the gametes of the parents; but a point of some interest is that the Mendelian *gametic* correlations, whatever be the mixture of protogenic, allogenic, and heterogenic elements in the freely mating population, take the same values, *i.e.* 0·5, 0·25, 0·125, &c., diminishing one-half with each ancestral grade. These *gametic* correlations are much nearer to the values obtained by biometric investigations for the *somatic* correlations, the theoretical Mendelian somatic correlations being considerably too small. It would thus appear that the Mendelian gametic correlations accurately obey the fundamental conceptions of the law of ancestral heredity, and the only real outstanding antinomy lies in the principle of absolute dominance. The correlations found biometrically suggest that there is a closer relation between the gametic and somatic constitution—at least for certain characters in the species investigated—than is represented by the first Mendelian principle of absolute dominance.—The intracranial vascular system of Sphenodon: Prof. A. **Dendy**. This memoir contains a detailed description, with illustrations, of the intracranial

blood vessels of the Tuatara, of which no account has hitherto been published. The description is believed to be more complete than any hitherto given for any reptile, and a considerable number of vessels are described which have not hitherto been noted in Lacertilia. This comparative completeness of detail is largely due to the employment of a special method of investigation. By this method the entire contents of the cranial cavity are fixed and hardened *in situ*, and are then in excellent condition either for dissection or for histological purposes. The brain does not occupy nearly the whole of the cranial cavity, there being a very large subdural space (especially above the brain) across which many of the blood vessels run, together with delicate strands of connective tissue which connect the dura mater with the pia. The eyeballs are removed, and an incision is made on each side in the cartilaginous wall which separates the cranial cavity from the orbit. Acetic bichromate of potash (made up according to the formula given by Bolles Lee) is injected into the cranial cavity through these incisions, and the entire animal, after opening the body cavity, is suspended in a large volume of the same fluid for about five days, and then graded up to 70 per cent. alcohol. When the cranial cavity is now opened up the cerebral vessels are seen with extraordinary distinctness, although they have not been artificially injected. Further details were made out by means of serial sections, both transverse and longitudinal, and both of the adult and of advanced embryos (Stage S). In most respects the arrangement of the intracranial blood vessels agrees with that found in the Lacertilia, so far as these have been investigated, but there is an important difference in the fact that the posterior cephalic vein leaves the cranial cavity through the foramen jugulare, and not through the foramen magnum, while a slightly more primitive condition is shown in the less complete union of the right and left halves of the basilar artery. Sphenodon makes some approach to the condition of the Chelonia in this latter respect, but differs conspicuously from this group in the fact that the circle of Willis is not completed anteriorly, as well as in the fact that no branch of the posterior cephalic vein leaves the cranial cavity through the foramen magnum. A very characteristic feature of Sphenodon is the development of large transverse sinuses resembling those of the crocodile, but these communicate with the extracranial vascular system in quite a different manner from that described by Rathke in the latter animal.—The graphical determination of Fresnel's integrals: J. H. **Shaxby.** Fresnel's integrals $\int_0^x \cos \frac{1}{2}\pi x^2$ and $\int_0^x \sin \frac{1}{2}\pi x^2$ can readily be evaluated by applying Simpson's rule to the calculated values of $\cos \frac{1}{2}\pi x^2$ and $\sin \frac{1}{2}\pi x^2$ for a sufficient number of values of x. In the cosine case, the curve $y = \cos \frac{1}{2}\pi x^2$ gives a series of loops, cutting the x-axis at $x = 1$, $\sqrt{3}$, $\sqrt{5}$, &c. The areas of these loops, after the first few, are shown to be proportional to the lengths of the bases upon which they stand; a loop extending from x_1 to x_2 has an area $k(x_2 - x_1)$, where $k = \frac{2}{\pi} = 0{\cdot}6366$. Thus integration to fairly large values of x as upper limit may be simply performed by adding together (*a*) the area for the first few loops (with due attention to + or − sign) obtained by Simpson's rule; (*b*) $k\Sigma d$, where Σd is the quantity obtained by summing (again paying attention to sign) the base lines of the complete loops of higher order than those in (*a*); and (*c*) the area of the part of a loop bounded by the upper limit, viz. from $x_1 = \sqrt{2n-1}$ to the upper limit of integration x_2, where x_1^2 is the greatest odd whole number less than x_2^2. The area (*c*) is given by the expression $\frac{2}{\pi(x_1 + x_2)} (\sin \frac{1}{2}\pi x_2^2 \pm 1)$. Similar methods can be used for the sine integral. Values of the integrals calculated as above are tabulated, and agree with Gilbert's values to within 1 part in 1000.

Linnean Society, April 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Amphipoda Hyperiidea of the *Sealark* Expedition to the Indian Ocean: A. O. **Walker.** The Amphipoda Hyperiidea of the *Sealark* Expedition consist of thirty-five species in twenty-eight genera, none new to science. *Scina borealis*, G. O. Sars, has not previously been found in tropical seas. Most of the specimens were taken in open tow-nets, so the actual depth at which they occurred is uncertain, but an ovigerous female of *Platyscelus armatus* (Claus) was taken "off sounding-lead" at 209 fathoms, which shows that this species deposits its ova on the bottom.—Marine Mollusca of the *Sealark* Expedition: Dr. J. Cosmo **Melvill.** The marine Mollusca obtained during the Stanley Gardiner Expedition of 1905–6 are especially interesting from the standpoint of geographical distribution. Accompanying the catalogue of nearly five hundred species are given tables of comparison with the molluscan faunas of nine or ten selected "areæ" of the Great Indo-Pacific region, one curious result of this investigation being that, whereas many are identical with species found in Polynesia or even Japan, the reverse obtains when comparison is made with the more contiguous fauna of the Persian Gulf and North Arabian Sea. This last has been made the subject of special study during the past fourteen years, and a total of nearly seventeen hundred species chronicled, of which something like five hundred proved new to science. Only one of these new forms (*Peristernia corallina*, Melv.) has been found to occur in the Stanley Gardiner collections made in the more southern portions of the same ocean, and comparatively few of the better-known forms are identical. Indeed, the affinities of this collection are, as might be expected, Mauritian.—Land and fresh-water Mollusca of the Seychelles Archipelago: E. R. **Sykes.** The author gives an account of the land and fresh-water shells collected by Mr. Stanley Gardiner in the Seychelles Islands. Nearly all the known forms are included in the collection, and three species belonging to Ennea (2) and Priodiscus (1) are described as new. A table showing the inter-insular distribution is given, and a list of all known forms. The origin of the fauna is uncertain, but the islands have evidently been for some considerable period separated from the mainland.—A blind prawn from the Sea of Galilee, constituting a new genus and species, *Typhlocaris galilea*: Dr. W. T. **Calman.**

PARIS.

Academy of Sciences, April 19.—M. Bouchard in the chair.—Examination of the upper layers of calcium and hydrogen in the solar atmosphere, and of the same black filaments in the two layers: H. **Deslandres** and L. **d'Azambuja.** The large spectroheliograph at Meudon permits of the examination of the K_3 and K_2 lines, quite pure and free from other light. The black filaments of K_3 have been compared with the image of Hα. It is concluded that in all previous work the lines obtained for hydrogen represent a mixture of different layers. To obtain the upper layer only, it is necessary to isolate the centre of the black line.—The slowness of the spontaneous transformation of the variety unstable at low temperatures of certain dimorphous bodies: D. **Gernez.** An experimental study of the equilibrium of yellow and red mercuric iodide and the corresponding varieties of thallous iodide.—The "sense of direction" in bees: Gaston **Bonnier.** The fact that bees, up to a distance of 3 kilometres, fly in a direct line for the hive, has been explained as due either to the sense of sight or of smell. The author's experiments clearly demonstrate that neither sight nor smell serve for this purpose, and that bees possess a "sense of direction." This sense is not located in the antennæ.—The map of south Imerina: the methods of work employed: E. **Colin.** This map is on the scale of 1/100,000, with contour lines of 50 metres.—Remarks relating to the communication of M. Deslandres: G. E. **Hale.** In the photographs of Hα it has been found that the relative intensity of the black and brilliant flocculi is determined by the position of the slit relative to the line Hα. If the slit only allows the light from the central portion of the line to fall on the plate, the brilliant flocculi are very intense in the image. If, on the contrary, the image is formed exclusively from the light of the edge of the line, the black flocculi are well seen, but the brilliant flocculi are faint or even invisible. The results are not favourable to the theory of anomalous refraction as the cause of the hydrogen flocculi.—Letter from Dr. J. B. **Charcot** describing the voyage of the *Pourquoi-pas?*

(Antarctic expedition).—The determination of the solar parallax from observations of the planet Eros made in several observatories in 1900–1: Arthur R. **Hinks.** The photographic observations lead to $w = 8{\cdot}807'' \pm 0{\cdot}0027''$; the principal micrometric observations give $8{\cdot}803'' \pm 0{\cdot}0039''$. The reduction of the eye observations by the method of passages is not yet completed. The mean value 8·806″ is not consistent with a greater constant of aberration than 20·47″.—The distribution in space of large proper motions: H. H. **Turner.**—Infinitely small deformation of ruled surfaces: J. **Haag.**—Differential systems of isomorphs: E. **Vessiot.**—The analytical function equal to the maximum modulus of an integral function: Arnaud **Denjoy.**—The electrical properties of copper-aluminium alloys: H. **Pécheux.** Alloys containing 3, 5, 6, 7·5, 10, and 94 per cent. of aluminium were examined. The electromotive forces of thermocouples consisting of alloy/copper were measured for temperatures up to 820° C., and the resistances of the same alloys measured for temperatures up to 350° C.—Some consequences of the use of a selective receiver in the measurement of radiant energy: Ch. **Féry.**—The physico-chemical properties of the colloidal particles known as *micelles*: G. **Malfitano.** The author maintains that the experimental data of J. Duclaux are not in contradiction with his own experiments.—The function of contact electrification in the permeability of membranes to electrolytes: Pierre **Girard.**—The determination of added water in decomposed milks: André **Kling** and Paul **Roy.** The total nitrogen corresponding to the albumenoids of the milk is not affected by the fermentative processes, and hence is suggested as more suitable for the detection of added water than the estimation of the non-fatty solids.—The suspension of life in certain seeds: Paul **Becquerel.** Seeds of lucerne, mustard, and wheat were kept at the temperature of liquid air for three weeks, and then further cooled to −253° C. (boiling hydrogen) for seventy-seven hours. All the lucerne and mustard seeds germinated normally, and four out of five of the wheat grains. The seeds had been well dried and placed in a vacuum before cooling.—Remarks on the preceding communication: Armand **Gautier.**—The lowering of the diaphragm: A. **Thooris.**—The diastases of milk: F. **Bordas** and F. **Touplain.** The oxydase reaction given by unboiled milk in presence of hydrogen peroxide and paraphenylene-diamine appear to be due, not to an oxydase, but to the casein, or compound of casein and lime.—The comparative harmlessness of carbonic acid in incubation: M. **Lourdel.**—The inequalities of electric potential at several points of the organism: J. **Audrain** and R. **Demerliac.**—Passive congestion of the liver and arterial hypertension: E. **Doumer** and G. **Lemoine.**—The hydroids of the Lamouroux collection: Armand **Billard.**—A storm at sea: M. **Halluitte.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 29.

ROYAL SOCIETY, at 4.30.—Note on the Results of Cooling certain Hydrated Platin-cyanides in Liquid Air: Prof. J. Emerson Reynolds, F.R.S.—A Phenomenon connected with the Discharge of Electricity from Pointed Conductors (with a Note by Prof. J. Zeleny): Prof. H. T. Barnes and A. N. Shaw.—On the Effect of Temperature on Ionisation: J. A. Crowther.—The Wave-making Resistance of Ships; a Theoretical and Practical Analysis: Dr. T. H. Havelock.—The Ionisation in Various Gases by Secondary γ Rays: R. D. Kleeman.

ROYAL SOCIETY OF ARTS, at 4.30.—The Problem of Indian Labour Supply: S. H. Fremantle.

FRIDAY, APRIL 30.

ROYAL INSTITUTION, at 9.—The Pitfalls of Biography: Dr. Edmund Gosse.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Recent Developments of the Theory of the Colloidal State, and their Bearing on the Dyeing and Cleaning of Textile Fibres: Dr. E. Feilman.

SATURDAY, MAY 1.

ROYAL INSTITUTION, at 3.—The Earth Movements of the Italian Coast and their Effects: R. T. Günther.

MONDAY, MAY 3.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Vulcanisation Tests in Plantation Rubbers: Clayton Beadle and Dr. H. P. Stevens.—The Indian Magnesite Industry: H. H. Dains.—A New Steam Meter: A. Girtler.—A New Refractometer: J. Lewkowitsch.

ROYAL SOCIETY OF ARTS, at 8.—Aërial Flight: F. W. Lanchester.

TUESDAY, MAY 4.

ROYAL INSTITUTION, at 3.—Cosmogonical Questions: Prof. Svante Arrhenius.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—(1) A Note on a Stone on the Rock of Cashel: (2) Some Irish Stone Circles: A. L. Lewis.

WEDNESDAY, MAY 5.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Analysis of Air: W. J. A. Butterfield.—The Estimation of Iron by Permanganate in Presence of Hydrochloric Acid: G. Cecil Jones and J. H. Jeffery.—The Composition of Butter from a Cheshire Herd of Cows: A. Smetham.—A Rapid Method for the Estimation and Separation of Milk Sugar and Cane Sugar in Sweetened Condensed Milk: I. S. Jamieson.

THURSDAY, MAY 6.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: Reciprocal Innervation of Antagonistic Muscles. Note XIV. On Double Reciprocal Innervation: Prof. C. S. Sherrington, F.R.S.—Note on a Curious Property of Neon: Prof. J. Norman Collie, F.R.S.—The Properties of Colloidal Systems. I. The Osmotic Pressure of Congo-red and of Some Other Dyes: Dr. W. M. Bayliss, F.R.S.—The Origin and Destiny of Cholesterol in the Animal Organism. Part V. On the Inhibitory Action of the Sera of Rabbits fed on Diets containing Varying Amounts of Cholesterol on the Hæmolysis of Blood by Saponin: Miss Mary T. Fraser and J. A. Gardner.

LINNEAN SOCIETY, at 8.—On some Zoantheæ from Queensland and the New Hebrides: Mrs. Leonora J. Wilsmore.—The Œcological Relations of the Tiger-Beetles: Dr. V. E. Shelford.

RÖNTGEN SOCIETY, at 8.15.—An Illustrated Description of the Historical Collection of Tubes recently deposited at the Albert and Victoria Museum: Dr. G. H. Rodman.—On X-rays Produced at a Magnetically Deflected Kathode Focus: J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Theory an Application of Motor Converters: H. S. Hallo.

FRIDAY, MAY 7.

ROYAL INSTITUTION, at 9.—The Campaign against Malaria: Majo Ronald Ross, C.B., F.R.S.

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