THURSDAY, APRIL 26, 1906.

THE NEW ORGANIC CHEMISTRY.

Chemie der alicyklischen Verbindungen. By Prof. Ossian Aschan. Pp. xlv+1163. (Brunswick: Vieweg und Sohn, 1905.) Price 40 marks.

FEW reflections are more curious than those which contrast the manifold complexity of the organic chemistry of the present day with the crude simplicity of the fundamental conceptions upon which it has been built up. Broadly speaking, these conceptions are but two in number—first, the almost repulsively mechanical atomic theory of Dalton, which we still retain in practically its original form, and second, the irritatingly mysterious doctrine of valency introduced by Frankland and Kekulé, also still preserved much as it was enunciated, but which eludes our grasp and sets us chasing shadows so soon as we attempt to translate it into definite mechanical conceptions. Yet, on the ground-work afforded by these two conceptions, so irreconcilable in their nature and so hopelessly crude in the eyes of the physicist, the organic chemist has built up a purely experimental science which embraces hundreds of thousands of different substances within a scheme as perfect as any known to science, which classifies with similar perfection the reactions by means of which those substances are produced and the behaviour which they exhibit, and has led to the synthetic preparation of hosts of compounds the production of which our immediate predecessors regarded as amongst the most intimate secrets of animal and vegetable life.

This result has been attained by the systematic development of experimental methods, and by applying those methods, as they became sufficiently powerful, to the consecutive study of the diverse classes of compounds occurring in organic chemistry. Long ago, experimental methods were sufficiently strong to permit of their successful application to large numbers of aromatic compounds. To-day, the rough methods of the older chemists have become largely superseded by far more delicate ones, by methods which render possible the building up, piece by piece, of the fragile molecular structures numbered amongst the alicyclic compounds. The organic chemist has probably always realised the filamentary character of his hypotheses, and, knowing that he has no prophetic or far-reaching mathematical theory with which to eke out his own cunning, has been led to rely very largely upon his own manipulative skill. For this reason, and more especially is this the case in the branch of the subject now under consideration, organic chemistry partakes of the nature of an art as much as of that of a science, and, to be successful, the organic chemist must be endowed with a sort of intuition which education cannot impart and instruction cannot destroy.

The systematic study of the alicyclic compounds dates back only some twenty-five years. At that time the wonderful successes achieved amongst the aromatic compounds by Kekulé and his followers seem almost to have suggested that all complex organic substances might be benzene derivatives. One of the most important alicyclic compounds known to us, namely, camphor, was formulated by Kekulé as an aromatic substance, and for long the Kekulé constitution for camphor held its own, in spite of objections raised by Armstrong and others. Gradually, however, as the early work of Freund, and especially of W. H. Perkin, jun., was developed, it became clear that benzene derivatives are not the only possible closed chain carbon complexes, and derivatives of 3, 4, 5, and 6 membered closed carbon chains were prepared synthetically; it was thus demonstrated that there exist in nature many important closed ring compounds which belong to a class totally different from that of the aromatic compounds, and which may be termed, as Bamberger first suggested, the alicyclic compounds.

A work like the present, which aims at giving a full and complete account of all that has been done in a subject which has grown so rapidly, and is even yet but in its childhood, is greatly needed, and probably no one is better equipped for successfully carrying out the colossal task involved in its production than Prof. Aschan, of Helsingfors. For the worker in this subject, such a book as Aschan has produced is invaluable, if only as an aid to the mnemonic arrangement of his knowledge, and for the student, face to face with the task of studying hundreds of lengthy memoirs, such a classified digest of the whole subject as is here provided offers invaluable indications as to what must be read and what may be safely disregarded.

The classification adopted in the work consists primarily of a division into a general and a special part; further, each division of the subject is ushered in by an historical introduction, which is both interesting and of considerable educational value as leading up, tersely and plainly, to the main theme. The general part includes an introductory chapter defining the scope of the subject dealt with, a theoretical discussion relating to the development of the subject, a discussion as to the influence of ring formation upon the chemical and physical properties of ring compounds, and an exposition of the stereochemistry of alicyclic substances. The special part comprises a systematic description of the methods of formation and preparation of alicyclic compounds, followed by a detailed and equally systematic presentation of our present knowledge of monocyclic, bicyclic, tricyclic, and polycyclic carbon compounds.

The variety of types and the complexity of detail involved in the study of the alicyclic compounds possibly make essential the primary division of the work into a general and a special part; the instances which can be quoted in which some repetition results from the introduction of a general summary as a preliminary to the detailed section are therefore, perhaps, unavoidable in a work of this kind. At the same time, any duplication of matter in the general summary and the detailed description has some drawbacks, because it increases the actual number of pages to be got through without essentially affecting the

amount of information which is imparted: and the stream of literature incessantly poured upon the unfortunate chemist is now so voluminous that few can attempt to read even the most interesting work in detail; the pages have to be merely skimmed through, and the task of forming and storing an adequate visualisation of the whole is possible only to the highly trained memory.

The general arrangement of the book, although highly systematic, sometimes leads to difficulties in finding any desired subject. Thus, the dihydrophthalic acids are dealt with on p. 827, the tetrahydrophthalic acids on p. 771, and the hexahydrophthalic acids on p. 702; yet all these substances were prepared by v. Baeyer at the same time and described in the same paper. The difficulty of finding one's way about the book would, however, be far greater were it not for the excellent index and detailed table of contents.

In the sections devoted to the terpenes and the camphor group, we cannot but miss the spirit of selection and criticism which lends such fascination to the account of the same branch of organic chemistry given by Prof. Harries in Meyer and Jacobson's "Handbuch der organischen Chemie." But, after all, Aschan's book is so replete with valuable detail that any serious attempt on his part to exercise the critical faculty might have impaired the usefulness of the whole work. At the same time, the value o the book as a comprehensive digest would certainly be the greater if more stress had always been laid on investigations which really mark an epoch. Thus, the brief mention made on pp. 501 and 563 of Perkin and Thorpe's recent synthesis of α-campholytic and isolauronolic acids appears quite inadequate in view of the way in which this synthesis cleared the field and settled definitely the question of the constitutions of these two important acids.

A similar objection may be raised in connection with the otherwise excellent discussion of the constitution of pinene on pp. 170 to 186, from which it is by no means easy for the casual reader to discern the really essential points in the complicated argument. The whole discussion relating to this problem centred for a long time upon the constitution of isocamphoronic acid, and for this Tiemann and Semmler offered the formula

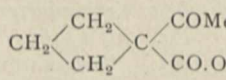
$$HO.OC.CMe_2.CH(CH_2.CO.OH)_2,$$

whilst v. Baeyer suggested

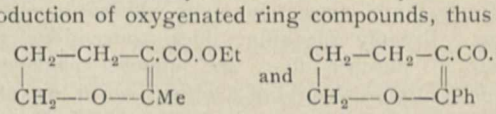
$$\begin{array}{l} CMe_2.CH_2.CO.OH \\ | \\ HO.OC.CH.CH_2.CO.OH \end{array}.$$

The discussion was settled once and for all by Perkin, who prepared both these acids and proved thereby that the Tiemann and Semmler constitution correctly represents isocamphoronic acid. No mention seems, however, to be made in the work of these two syntheses, although they are vital to the argument.

In such a comprehensive work as the one under consideration it is surprising that so few slips and omissions occur. On p. 22, lines 13 to 32, and p. 23, lines 10 to 37, the action of sodioacetacetic ester upon trimethylene bromide is stated, in accordance with the original paper of 1883, as leading to the formation of acetyltetramethylenecarboxylic ester,



but no mention is made of Perkin's subsequent demonstration that this reaction, both in the case of acetacetic and of benzylacetic ester, really leads to the production of oxygenated ring compounds, thus:—



although when sodiomalonic ester is employed a tetramethylene derivative actually results. The reaction is correctly stated in the special part of the work at p. 418.

Further, on p. 38, v. Baeyer's old condensation of three molecules of malonic ester into one of phloroglucintricarboxylic ester is still figured in all that simple symmetry which constitutes one of the glories of our elementary text-books. No mention is made of Moore's proof (*Trans. Chem. Soc.*, 1904, 165) that the product is really the phloroglucindicarboxylic ester of Bally, although v. Baeyer himself refers to the correction in his recently published collected works.

A curious slip occurs on p. 585—probably as the result of confusion with the work of Zelinsky—where Perkin and Haworth are represented as having prepared hexamethylene by the action of sodium on *bromocyclohexane* in boiling *alcoholic* solution, but where an equation is given representing the action of sodium on hexamethylene bromide. The synthesis was actually effected by the action of sodium on hexamethylene bromide in metaxylene solution; the action of sodium in boiling alcoholic solution would obviously have led to the production of normal hexane.

A valuable section is devoted to the discussion of the stereochemical relationships which may exist between isomeric alicyclic compounds, and the elucidation of the isomerism is materially facilitated by the use of carefully designed figures; the somewhat intricate stereochemistry of these substances can hardly be brought home to the reader more clearly than is here done. On p. 354 an erroneous constitution is assigned to isolauronic acid, and the deduction drawn therefrom that this acid can exist in four optically active modifications; isolauronic acid actually contains no asymmetric carbon atom, and, as is clear from the correct constitution assigned to it on p. 698, is incapable of exhibiting optical activity.

The section dealing with irone, ionone, and allied substances possessing the odour of violets forms a particularly lucid exposition of the finest piece of work done by Tiemann. Amongst the copious references given is to be noted one of the first fruits of the system of abstracting chemical patents introduced into the *Chemisches Centralblatt* during the last few years. Now that so much of the pioneer work in organic chemistry appears for the first time in patent specifications, references to the patent literature are

as necessary as references to the ordinary scientific journals.

In reading chemical compilations of German origin we are sometimes struck by the scant attention received by work done in this country, and are often forced thereby to the conclusion that the author's study of English chemistry is limited to the system of abstracts issued by the Berlin Chemical Society. No such fault can be found here; the author is obviously as much at home in the Journal of the Chemical Society as in the Continental journals, and gives full credit to all results, from whatever source they are derived.

For Aschan's new book, as a whole, nothing but praise is possible, and the few points to which objections have been made rank as nothing when regarded as raised from the perusal of a book 1200 pages long, which aims at giving a systematic account of the alicyclic compounds. The study of these substances has been mainly carried out at fever heat during the past quarter of a century, and the necessarily ragged way in which the results have been laid before the world in the current journals must have offered immense difficulties to the compiler.

We cannot close this book, containing as it does a lucid account of one of the most important and intricate sections of organic chemistry, without reflecting with pleasure that the intense but systematic work which has led, during the last twenty years, to the synthetic building up of such complex molecular structures as those of camphor and of the terpenes has been largely carried out in our own country.

W. J. P.

THE SYSTEM OF THE FIXED STARS.

Der Bau des Fixsternsystems mit besonderer Berücksichtigung der photometrischen Resultate. By Prof. Hermann Kobold. Pp. xi+256. (Brunswick: Vieweg und Sohn, 1906.) Price 5.60 marks.

TO prove that the stars form a stable system is a problem that has had attractions for many philosophical minds. The problem has not been solved, possibly may not be capable of solution, but the attractiveness of the speculation remains. Analogy with the solar system has suggested, and given support to, such an idea. The harmony that is to be perceived in the ordered motions of the planets, permitting countless revolutions to be performed without permanent change or irregularity, might well give rise to the hope that the same principle that governs the solar system could be detected in the larger scheme of the stellar universe. Such an idea would naturally have sway at a time when speculation was little fettered by numerical data drawn from rigorous observation. If there was little evidence to support the notion, there was nothing to contradict it. Kant or Lambert could suggest without difficulty that the stability of the system was secured by each star moving in a definite orbit, which ensured the maintenance of the general form and arrangement. The influence that that thought has exercised on modern investigation is of more importance than the thought itself. To suspect the influence of the Milky Way in the scheme of the Cosmos, and to make its investigation the centre of inquiry, was to bequeath us a legacy which is by no means exhausted. Later schemes suggested by improved instrumental appliances have widened the scope and raised fresh issues, but the significance of the Milky Way remains. Similarly with the problem of the sun's motion, which a hundred years ago Herschel solved so satisfactorily, considering the character of his material. Disputed by Bessel and supported by Argelander and a host of later astronomers, the solution has passed through many stages and given rise to novel methods of treatment, involving the application of fresh hypotheses. In these later times we have pressed into the service the results brought to light by the spectroscope, especially difficult of interpretation as they are, and allowing the exercise of much ingenuity. But the essential problem remains the same. The only question is, What advances have we made in solving the riddle which perplexed earlier investigators?

In proportion as the problem becomes more and more complicated, either by repetition of similar processes or the introduction of fresh ones, the greater is the necessity for the examination of the evidence to test its value in combination, and of bringing the whole material to bear in one consecutive argument. This is the task which Dr. Kobold has undertaken, and in which he has acquitted himself with credit. One may not in every case draw the same conclusion, or with the same certainty, that the author does, but the evidence is at least presented with completeness, and we have the opportunity of bringing our critical faculty to bear upon the various lines of argument which are marshalled in review. Such a book is instructive to the tyro and suggestive to the expert. The one may adopt the conclusions which the author has drawn up, as indicating the general position of science towards this problem, the other may see the necessity for pursuing fresh lines of research, or of supporting alternative explanations of the results presented. In any case it is an advantage to see what has been attempted and what has been accomplished.

The author divides his book into three sections. In the first he describes on broad lines how the facts which may aid in solving the problem of the construction of the universe have been collected. The reader who comes fresh to this subject, without any previous acquaintance, gains an intelligent notion of the manner in which the positions of the stars have been ascertained, and can grasp clearly the supreme importance of an accurate determination of the precession constant when the question of proper motion is considered. The brilliancy and the colour of stars are both discussed, though the practical bearing of the latter point on this particular problem is not very clear, and in any case is more conveniently dealt with in discussing the spectroscopic observations, which are also brought under notice. Parallax and stellar distribution are adequately described, and therefore in this section we get a tolerably complete sketch of the main processes of stellar observation, except in

the department of double and variable stars. Into the significance of variable, and especially of "new stars," the author does not enter. Doubtless he is well advised in considering the introduction of such topics premature, but the omission shows that we have a certain class of facts which cannot yet be brought into line with other data. We have not yet succeeded in weaving our information into a consistent whole.

In the second section we have the results of observation mainly as exemplified in the production of star catalogues, whether of place or of spectrum, of brilliancy or of distance, for in these catalogues, applying, as they do, to large areas in the sky, must be contained the information which is to solve the problem of the universe. No inconsiderable portion of this section is occupied with the question of proper motion and the proper method of its treatment. Here we have raised for us, in an acute form, the question of the parallactic as distinguished from the actual motion of the star, and the legitimacy of the assumption as to the absolute lawlessness of direction of the star's own motion. On this and similar points a certain amount of controversy exists, and Dr. Kobold is known to hold very definite views. Fortunately we do not consider it necessary to enter into any of these differences of opinion. We are simply concerned in pointing out the general direction to which the combined information points, and its bearing upon the existence of a stellar system. These conclusions Dr. Kobold collects in his third section, and, greatly daring, has summarised "on half a sheet of note-paper." This statement is so succinctly expressed that it may be reproduced almost literally. Throughout a finite space of spherical form are scattered bodies very different in mass and in physical conditions. With gaseous nebulæ at very low temperature occur other bodies in a condition of glowing heat and advanced condensation. The arrangement of the separate masses is not uniform; they are crowded together in clusters about certain centres of concentration. These groups possess a loose relationship, and are arranged in the form of a spiral having many branches. In the more distant parts of this spiral the hotter and gaseous stars predominate. The sun is comparatively near to the centre of this spiral, and the stars which stand in closest connection with it have also similar physical conditions. On the sun is impressed a motion towards a point in the Milky Way, the principal plane of the whole spiral, and a great number of stars near the sun participate in this same motion. Among the stars there are numerous groups having an apparent motion directed to points in the Milky Way. The stars of each group are in one plane, and their true motion, on the character of which definite information is still wanting, takes place in this plane.

This may seem a very small outcome for so much work, but it will hardly be urged that the author has erred on the side of caution. In any case this "Schlusswort" is valuable, since it expresses the opinion of one who is especially qualified to speak on a subject which possesses in an equal measure both interest and difficulty. W. E. P.

A PHYSIOLOGICAL STUDY OF THE BRITISH FLORA.

British Flowering Plants. By the Right Hon. Lord Avebury. Pp. xxiii+450. (London: Macmillan and Co., Ltd., 1905.) Price 15*s.* net.

LORD AVEBURY has given us in the past several delightful books on botanical subjects, dealing more especially with the forms and functions of leaves, flowers, and fruits. At the time when the earlier of these books were published there was a tendency to reduce botanical morphology to a cut-and-dried series of shapes and forms, each designated by a Latin name the correctness of which received more attention than the purpose served by the various modifications. In "Flowers, Fruits, and Leaves," and "British Wild Flowers in Relation to Insects," Sir John Lubbock adopted the more natural treatment of studying form in the light of function, with the result that on account of their broad conceptions and the appeal they made to the reasoning faculty, these books obtained a wide circulation, and even now they maintain their position among the foremost contributions to the subject. In the circumstances the author has drawn freely from his previous works in writing this volume, which is restricted to British plants, and contains shorter or longer references to all our flowering plants. It provides, therefore, a running commentary to British floras in general and to Bentham's "British Flora" in particular.

On the details of buds and stipules, a subject that Lord Avebury has studied very carefully, much information is provided. In the genus Lathyrus the shape of the stipules varies from the large foliaceous type of *Lathyrus maritimus* through the narrow sagittate stipules of *Lathyrus pratensis* to the minute, slender stipules that occur in *Lathyrus nissolia*. These and other forms found in the genus are collated, and it is pointed out how the shape fits in with the attachment of the leaf to the stem. The complex nature of the stipules of the hawthorn also receives elucidation. A full account is given of the winter buds of the beech, the pine, and the spruce. It will be seen from these that the examination and dissection of the winter buds of trees and shrubs provide a capital exercise for a nature-study class. Considerable attention has been paid to the dichogamous and diclinous conditions of flowers. The ordinary strawberry furnishes a good instance. Darwin distinguished female flowers producing plenty of fruit, complete flowers less fertile, and male flowers naturally bearing no fruit. Schulz observed for the same plant gynomonœcious, andromonœcious, gynodiœcious, and androdiœcious forms. This is only one of several types of variation in the flower that too frequently pass unnoticed. A certain amount of work has been published on floral variation, more recently by students of biometric problems, but there is plenty of opportunity for observations continued over a series of generations to obtain more definite conclusions on the subject of small variations.

An introductory chapter deals with categories and types, as for instance, flowers of water plants,

methods of protection of the flower against rain, &c. The table on p. 18 collating the modes of dispersal of the fruits of our trees and shrubs brings out the facts very distinctly, and similar tabulations will readily suggest themselves. With regard to the individual descriptions, it seems a pity that many are so short and that the vegetative parts have not received more consideration, but obviously in the limits of a single volume this could not be managed. The absence of technical terms, except for the few that are defined in the glossary, renders the book available to all interested in botany. The book is confined mainly to elementary topics, but students of advanced botany will find that they also can learn much from the information supplied, and can obtain not a few references to questions awaiting explanation or requiring more evidence to verify the explanations that have been offered. The illustrations are numerous, well produced, and appropriate.

OUR BOOK SHELF.

Rowing and Track Athletics. Pp. ix+449. The American Sportsman's Library. Edited by Caspar Whitney. Rowing, by Samuel Crowther. Track Athletics, by Arthur Ruhl. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1905.) Price 8*s.* 6*d.* net.

IN this book the history and progress of rowing and track athletics in America are described in a very interesting manner. From the British sportsman's point of view the book will be read with very great pleasure, for it shows how eagerly the Americans have strived, and not in vain, to excel the prowess of the athletes this side of the Atlantic. From the scientific point of view this history is also of value, for it shows the evolution of ideas which have culminated in the present methods.

The old order changeth for the new, and a race cannot now be won as in the old days, when it was customary "to have your friends out in boats on the course and to impede the other crew as much as possible; the race was not always to the swift—if the home man happened to be the slower," as the author here narrates.

At the present day the successful oarsman or track athlete is he who is able to combine with the greatest efficiency a number of variables. In the case of the former, some of these variables include personal fitness, easiness of style, length of oar and width of blade to suit his particular capability, length and weight of boat, and alertness of brain to take advantage of prevailing conditions and possibly unforeseen eventualities.

In this book we see how hard the struggle has been in America to acquire efficiency, and possibly the reason why. In many national characteristics climate plays a very important part, and, in the case of rowing or track athletics, the influence of climate can be clearly detected. The British style of rowing, for instance, has been evolved by Britishers under British weather conditions. The lines on which this efficiency has been secured need not, and should not necessarily, be identical with those evolved in America, since the climate of the latter country is so different from that of the British Isles.

In track athletics the same principle holds, and this is borne out by the fact that, on the average, the American is the fastest sprinter, while the Britisher is best at long distances. In fact, as the author states, "There is, undoubtedly, something magnetic in our American air, at least in the sort of atmosphere that is found in the north-eastern Atlantic States. . . . What the English climate lacks in this stimulating effect it seems to make up in its general soothing and nourishing influence, and if the athlete who has been bred in it is deficient in snap and nervous spring he is strong in endurance and vitality."

Without going into further detail, the reader must be left to read the book for himself. The illustrations, though not very numerous, are typical, and a capital index concludes the volume.

Économie Forestière. By G. Huffel. Tome Premier. Pp. ix+422. (Paris: Lucien Laveur, 1904.) Price 10 francs.

FRANCE has always taken a leading part in sylvicultural science, and the above volume is a good indication of the thorough manner in which this nationally important subject is practised in that country. The French Government has learned by past experience the disastrous results which the injudicious destruction of the forest inevitably brings, but at the same time France can furnish unrivalled examples of the benefits of proper forest management and administration.

The present work is divided into four parts. The first part deals with the use of the forest, both as regards the production of materials applicable to the needs of man and the beneficial influence it has upon the climate. A very interesting historical summary is given of the uses to which the forest was formerly put. This was pretty much the same in all countries, viz. the chase and pasturage. Then came the time when the forest was principally of value in regard to its wood production, especially in France, for firewood, until this was to some extent superseded by coal and other substitutes. A most interesting table is included giving the variations in the price of timber during the nineteenth century in France and Austria. The author also goes into the numerous uses to which timber may be put, and the different substances which are to be got from it by chemical means, from the crude products of distillation to the finest silk. The author further gives a survey of the colonial forests and their products. Then follow two or three chapters dealing with the very important but formerly too frequently disregarded aspect of sylviculture, namely, the influence of the forest on the climate. Very interesting statistics regarding the daily, monthly, and yearly variations of temperature inside and adjacent to the forest are given. Further, the forest influences the humidity of the air. It increases the rainfall. It regulates and preserves the soil-moisture and controls the "flow off" in such a way that disastrous floods and equally pernicious droughts are prevented. The protection forest, and the necessity for its preservation in the high collecting ground, is dealt with in a masterly manner. The forest regions of France, the hygienic influence and æsthetic aspects of the forest, each receives its due share of attention.

In parts ii. and iii. we have a historical account of the forests of France from the very earliest time. Forest administration in all its branches, together with the equipment and training for the State forest service, are fully treated. Part iv., which concludes this volume, contains a vast amount of statistics concerning the present forests and forest regions of France.

The author has evidently spared no pains to make this volume as complete as possible in every way, and it cannot fail to be of great service to those for whom it is written.

Physiologie des Menschen. By Dr. L. Luciani. German Edition by Dr. S. Baglioni and Dr. H. Winterstein. Part v. Pp. 161–320. (Jena: G. Fischer.) Price 4 marks.

THE fifth part of Dr. Luciani's text-book of physiology deals with the mechanical and chemical phenomena of digestion in the alimentary canal, with the absorption and storage of the food-stuffs, and with the excretory functions of the intestinal tract.

The first chapter gives an excellent account of the gastric movements, and of the nerve mechanism controlling them. The second chapter deals with the digestion of the various food materials by means of the pancreatic and intestinal juices, and of the bile. An exceptionally full *résumé* is given of the results following upon removal of extensive portions of the small intestine in animals and in man. The products and probable significance of bacterial digestion are also fully described and discussed.

The account of the peristaltic movements of the intestines and of the nerve mechanism controlling them is well brought up to date, giving briefly the results of the most recent researches in this field.

The final chapter treats of absorption in the stomach and intestines. The channels and mechanism of absorption of different food-stuffs—carbohydrates, fats, and proteids—are fully described. A very interesting epitome is given of the synthesis of the products of proteolysis and lipolysis by means of the intestinal epithelium. The theories with regard to the formation and fate of glycogen in the liver and muscles are critically reviewed. A brief account is also given of the various forms of pathological and experimental diabetes.

The fifth part of the work well maintains the high standard for accuracy and clearness set by its predecessors. J. A. MILROY.

Seta Artificiale. By G. B. Baccioni. Pp. 231. (Milan: Ulrico Hoepli, 1906.) Price L3.50.

THIS is an interesting account of "artificial silk" or "lustra cellulose," an industry which has now assumed serious proportions; in fact, the present production of these new textile threads may be estimated at not less than six tons per day, chiefly manufactured in France, Germany, and Belgium. In the preface it is stated that a Società Italiana della Seta Artificiale in Pavia is the first organisation to undertake developments in Italy. The technology of the industry is briefly outlined in six chapters (pp. 230), attention being chiefly directed to the systems based upon the spinning of collodion (nitrocellulose). The alternative systems, based upon the Cuprammonium and "Viscose" solutions of cellulose, are also described.

The work is a compilation from various sources in the technical literature of cellulose, and makes no claim to an original treatment of the subject-matter. Its appeal will be chiefly to specialists.

The book is original as to binding, for which a silk fabric is employed—as a covering to the humble "board"—the weft of which is a lustra-cellulose yarn.

Zwölf Vorlesungen über die Natur des Lichtes. By Dr. J. Classen. Pp. x+249; diagrams. (Leipzig: G. J. Göschen, 1905.) Price 4 marks.

THESE lectures consist in a series delivered in the winter of 1904–5 in Hamburg to a popular audience. The theme of the lectures is the development of the wave-theory, culminating in the special form of this theory which postulates the essential identity of luminous and electromagnetic waves. The lectures were illustrated experimentally, and a special feature in connection with them is the care taken in devising experiments of a simple and attractive kind. Although they were delivered to a lay public, it must not be supposed that they are popular in the bad sense. They are infused throughout with the scientific spirit; there is no sacrifice of accuracy on the altar of simplicity. The subject is dealt with in a way which must have proved very welcome to the non-professional listener who had some very elementary knowledge of it and desired to have the fundamental experimental facts brought before him in a consecutive way. Geometric propagation, dispersion of colour, interference and diffraction phenomena, double refraction and polarisation, electric oscillations and their quasi-optical properties, the explanation of the demonstrated relations between electrical conductivity and the optical properties of metals—these, in brief outline, are some of the chief phenomena which are expounded. Each experiment is described with the help of a diagram.

We have little but praise for this somewhat unpretentious volume. We note only that the devices attributed here (as usual) to Lecher and Blondlot are essentially the same as that employed previously by Sir O. Lodge in the investigation in which he was engaged when Hertz published his demonstration of the possibility of producing electromagnetic waves.

A la Poursuite d'une Ombre. By Prof. Moye. Pp. 98. (Montpelier: G. Firmin, 1905.)

IN the seven chapters contained in this volume Prof. Moye gives a popular account of the observations made by the Société astronomique Flammarion de Montpelier, at Alcalà de Chisbert, during the total eclipse of the sun on August 30, 1905. The eclipse party consisted of eleven persons, who made a series of valuable observations of the corona and the chromosphere with portable telescopes, spectroscopes, and cameras, and with the naked eye.

In addition to the account of the actual observations, the author discusses eclipse phenomena in general at some length, and gives the results obtained by previous observers since the commencement of detailed eclipse work. A number of drawings and photographs illustrate his remarks.

To anyone unfamiliar with solar eclipse work who desires to make a general survey of all the associated phenomena, and the methods employed in observing them, the book will afford a useful introduction to the subject, and will give him just an insight into the present theories concerning the different portions of our luminary.

Ueber Vererbungsgesetze. By C. Correns. Pp. 43 (Berlin: Gebrüder Borntraeger, 1905.) Price 1.50 marks.

ALTHOUGH only six years have elapsed since De Vries re-discovered the laws of heredity originally propounded by Gregor Mendel, Abbot of Brünn, in 1866, the subject has received so much attention—and in this country especially valuable work has been carried out—that many accounts of the general principles have been written. Prof. Correns, one of the foremost workers on the subject, publishes in this brochure the substance of a lecture delivered at Meran, dealing almost entirely with the botanical side. The account does not go far beyond Mendel's propositions, but the subject of *cryptomeric* is explained with the help of an excellent coloured plate of flowers of Mirabilis, and the writer refers to Galton's theory and the extent to which characters *mendelise, i.e.* develop according to Mendel's laws.

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.*]

Diurnal Variation of Ionisation in Closed Vessels.

THE connection between the periodicity in the ionisation in closed vessels and the variation in the intensity of the electric field near the earth's surface suggested by Messrs. Campbell and Wood in NATURE of April 19 (p. 583) may readily be explained on the theory of conduction through gases if we assume that the ionisation is caused by radiation from extra-terrestrial sources.

The view of the origin of the earth's field which appears to be in closest agreement with the facts is that it arises in rainy regions on account of the negatively charged rain conveying its charge to the earth, which thus becomes negatively charged. This leaves a high positive potential in the atmosphere immediately above the rainy region which very rapidly distributes itself over the earth's surface by means of discharges in the upper regions of the atmosphere where the pressure is low enough for ionisation by collisions to occur. Owing to the high conductivity of the upper regions of the atmosphere, therefore, the potential will differ only to a relatively slight extent over different regions of the earth's surface; most of the fall of potential between the positive charge over the rainy region and any point of the earth's surface will occur in the badly conducting layer of air at a high pressure, which is comparatively close to the earth's surface.

The above theory is due to Mr. C. T. R. Wilson, with whom I have recently discussed the matter. The explanation of the connection between the earth's field and the ionisation in closed vessels which follows might be made to fit other views of the nature of the earth's field, but I have selected Mr. Wilson's, as it appears to be the most probable.

The distribution of the earth's field, then, reduces itself to a case very similar to that between two plane electrodes immersed in a gas and maintained at a constant difference of potential. Consider what happens if we increase the ionisation near one electrode to a greater extent than that near the other. The potential gradient will become smaller where the ionisation is greatest, and conversely. In the case of the earth the ionising rays presumably come from extra-terrestrial sources, and will be absorbed to some extent by the earth's atmosphere. They will therefore be more intense further away from the earth's surface, and when for some reason or another they increase in intensity they will increase the ionisation at a point some distance from the earth's surface to a greater extent than at a point near to it. From what has been said above, an increase in the ionising rays should therefore produce an increase in the electric intensity close to the surface, and *vice versâ*.

This corresponds exactly with what Messrs. Campbell and Wood have found to be the case; the maxima and minima in the earth's electric field are simultaneous respectively with the maxima and minima in the ionisation in a closed vessel.

It may be of interest to add that Borgmann (*Jurn. Russk. Fisik. Chimičesk. Obščestva* [physical part], xxxvii., No. 4, pp. 77–98, 1905) has also recorded a minimum at about 3 p.m. in the ionisation in a closed vessel. The fact that the time is nearly the same at Cambridge and St. Petersburg seems to indicate that the ionisation is caused by radiation coming from the sun. The fact that the daily variations in the earth's field are conditioned by the sun has already been remarked by meteorologists (*cf.* Arrhenius, "Kosmische Physik," ii., p. 890).

I wish to point out finally that the above explanation of the changes in the earth's field does not depend essentially on radiation coming from extra-terrestrial sources. Any cause which simultaneously increased the penetrating radiation near the earth and the ionisation further away from it would work in the same way.

O. W. RICHARDSON.

Trinity College, Cambridge, April 22.

The New Spot on Jupiter.

THE recent outbreak of dark material in the north equatorial belt and north tropical zone of Jupiter has further intensified, and forms a very prominent and striking feature in the region north-following the red spot. The slanting belt, alluded to in my letter published in last week's NATURE (p. 584), appears to be rapidly extending in a longitudinal direction, and the large dark oval spot on its following side has been several times re-observed here. Transits were obtained as under:—

	h. m.	Longitude
April 15	6 8	75·2
20	5 22	77 5
22	7 2	77·7

The rate of motion appears, therefore, to conform very nearly with that of the red spot and of system ii. of Crommelin's ephemerides (9h. 55m. 40·6s.). On April 20 the north tropical spot was very distinctly seen nearly two hours before sunset, and the transit obtained on that date was regarded as accurate.

The preceding side of the slant-belt is moving much faster than the north tropical spot, and it is highly probable that in a few weeks a new and conspicuous belt will have formed and entwined itself completely round the planet. In this phenomenon we have a repetition of that observed in the spring of 1860 (see Monthly Notices R.A.S., April, 1860, and December, 1898, vols. xx., p. 244, and lix., p. 76).

W. F. DENNING.

Bristol, April 23.

Utilisation of Nitrogen in Air by Plants.

YOUR reviewer (p. 531) of the above work has, like others, failed to furnish any proof against my theory of the fixation of free nitrogen by plants. He desiderates direct chemical proof of the increase of nitrogen in the plant, beyond the nitrogen that is provided by the seed and the soil. Those acquainted with agricultural chemistry know the difficulty of directly determining a slight increase in the quantity of nitrogen, in the circumstance of the comparatively large quantity of nitrogen in the soil necessary to produce a vigorous plant, and they will understand how difficult it is to produce such proof; with the greater information now available, however, it may now be forthcoming. But for this difficulty, the fixation of nitrogen would have been found out long ago.

The experiments at Rothamsted conducted by Lawes and Gilbert are identified with the subject of nitrogen. The idea of the inability of plants to fix free nitrogen is largely based on their experiments. As mentioned in a book written by the recently appointed director at Rothamsted—Mr. A. D. Hall—it occupied their minds "from the very beginning of their experiments until the end." It was their "dominant idea." I may therefore refer to experiments carried out there which show that Lawes and Gilbert themselves found (as many others have done) an increase in nitrogen in growing crops, the source of which could only be ascribed to the atmosphere; thus (see p. 10), "As a result of three years' cropping with barley and clover, and then with clover only, an average amount of 319·5 lb. of nitrogen was removed, yet the soil contained, on analysis at the end of the experiment, 2832 lb. of nitrogen per acre in the top 9 inches, or a gain of 175 lb per acre in the three years, making a total, with the crop removed, of nearly 500 lb. of nitrogen per acre to be accounted for." This was a troublesome fact. It was sought to be explained by the tubercles on legumes, but that an increase was got without legumes is shown by another set of experiments (see p. 8):—"the various crops were grown continuously with mineral manures, but without any supply of combined nitrogen; the following average amounts of nitrogen per acre were taken away:—

		lb.
"Wheat	24 years	22·1
Barley	24 ,, ...	22·4
Root Crops ...	30 ,, ...	16·4
Beans	24 ,, of which two fallow	45·5
Clover	22 ,, 6 crops only	39·8"

Here again was an increase, and one which legume tubercles could not be brought in to explain. It was only when Lawes and Gilbert, trying to get chemical evidence, grew feeble, unnatural plants under unnatural conditions that they failed to get a similar increase of nitrogen. On this ground alone they supported the theory of the inability of the plant to draw nitrogen from air, and thus supported themselves in the notorious controversy with Liebig, the distinguished German who has done more for agriculture than any other man of science, and who, by the way, denounced the Rothamsted experiments in no measured terms (see the "Natural Laws of Husbandry," pp. 157 and 298).

Obviously, therefore, to show that plants fix free nitrogen is to undermine the work with which Rothamsted is chiefly identified.

Your readers will understand the value of the critique when they know that the initials under it are those of the director at Rothamsted. THOS. JAMIESON.

Glasterberry, Milltimber, April 10.

I AM glad to see that Mr. Jamieson does recognise the necessity of some proof of his assertion that nitrogen has been fixed by the plants he has been examining; he now says that "it may now be forthcoming." When Mr. Jamieson's "may" has been converted into "is," chemists and botanists may begin to consider his speculations as to how the process is effected. For let us bear clearly in mind that Mr. Jamieson's theories only deal with the question of *how* the nitrogen is fixed; that it is fixed at all he takes for granted.

But what an unlucky series of experiments to enforce his argument has Mr. Jamieson selected from Rothamsted. He quotes three non-leguminous crops, wheat, barley, and roots, which when grown continuously on the same land for a period of twenty-four to thirty years have removed on the average 16 lb. to 22 lb. of nitrogen per acre per annum. But at the beginning of the experiments the soil was estimated to contain about 3000 lb. per acre of combined nitrogen, *i.e.* five times as much as the thirty years' cropping has removed. Furthermore, analyses have been made and published which show that the soil has lost nitrogen during this period; the average loss on the unmanured wheat plot from 1865 to 1893 was 10 lb. per acre, which if added to the 5 lb. per acre of combined nitrogen brought down by the rain pretty well accounts for the 19 lb. per acre removed in the crop. Knowing as we do that there are great reserves of nitrogen in the soil, and that they slowly become available for the plant, there is no reason to suspect that these non-leguminous plants have needed to take any nitrogen from the air to yield the crops that are recorded.

Then Mr. Jamieson quotes the output of nitrogen from two leguminous crops, clover and beans, and it is just about double that of the non-leguminous crops; very much more than double, in fact, if calculated on the number of crops actually obtained, and not spread over an average of years. Yet Mr. Jamieson goes on to say that the "legume tubercles" cannot be brought in to explain this; when the only crops yielding anything like an average amount of nitrogen are the two, beans and clover, which by accepted theories obtain nitrogen from the air by means of the bacteria in the "tubercles" on their roots. Most people regard these experiments as a very sound piece of evidence for the fixation of nitrogen by leguminous crops alone.

Let us consider these results from another point of view: the wheat crop without nitrogen, but with phosphoric acid and potash, at Rothamsted averages about fifteen bushels per acre, barley about twenty bushels per acre, the root-crops (mangels) about 5·4 tons per acre: this is the sort of level that is reached when the crop has to rely upon the air and the original stock of nitrogen in the soil. Is Mr. Jamieson proposing to recommend farmers to grow crops of this size, for that is what they must come to when they have only the air to draw upon for their nitrogenous food?

In his concluding paragraph Mr. Jamieson appears to suggest that Lawes and Gilbert ran the Rothamsted experiments as a sort of conspiracy to disguise the truth in favour of a prepossession of their own, and that after their death the body of scientific men who constitute the committee of management engaged their present director to continue the traditional fraud; this is a "theory" which, like others of Mr. Jamieson's, must require a robust confidence in the credulity of his disciples. A. D. H.

A Horizontal Rainbow

I SHALL be much obliged if a reader of NATURE will kindly give me an explanation of the following:—

I was on Loch Lomond yesterday, a perfectly still, cloudless day, with haze as from east wind over the mountains. There had been hoar-frost in the morning. About 10.15, from the deck on the steamer at Balloch, I observed a broad patch of strong prismatic colours on the absolutely calm surface of the loch about half a mile from the pier, my back being turned to the sun. I watched this patch with interest, and, as the steamer approached it, it gradually lessened and almost disappeared; but in its place a rainbow, faint but distinct, lay horizontally on the surface of the water, one end resting beside the bow of the steamer and the arc curving for perhaps 150 yards ahead, the sun still being behind me. I never saw anything of this kind before, and was much interested. The loch was absolutely calm, reflections of sea-gulls, &c., being perfect.

The only explanation I can think of is that, after the hoar-frost and possible sea-fog of the earlier morning, there was just a film of fog left undisturbed on the calm surface of the water, sufficient to break up the rays of the sun into their component parts. W. R. M. CHURCH.

Western Club, Glasgow, April 12.

THE SAN FRANCISCO EARTHQUAKE OF APRIL 18.

IN the immediate presence of a great catastrophe, in which hundreds of lives have been lost, and San Francisco, the "Queen of the Pacific," has been almost entirely destroyed, it is not to be expected that details of much scientific value should be recorded. All that is here possible is to describe briefly the course of events, to trace in rough outline their connection with former shocks and with the geological history of the district, and to refer to the unfelt earth-waves registered at distant observatories.

NATURE AND EFFECTS OF THE EARTHQUAKE.

Though the coast of California from San Francisco to Los Angeles is one of the chief seismic regions of the globe, the first and greatest shock was heralded by no warning tremors or earth-sounds. It occurred at 5.13 a.m. (that is, 1.13 p.m. Greenwich mean time), perhaps, as the seismographic evidence would imply, a few minutes earlier. As in all tectonic earthquakes of the first magnitude, the duration of the shock was considerable, not less than two or three minutes, and it was in this time that the chief part of the destruction, so far as it was directly due to the earthquake, was accomplished. Five minutes later another and less violent shock was felt, and, in the midst of almost continuous tremors, a third prominent shock took place at 8.15 a.m., and others shortly before 10 a.m., and about 1.30 and 7 p.m. None of these seems to have been registered in European observatories, but they sufficed to throw down walls already damaged. Soon after the first shock fires broke out in several parts of the city, and spread rapidly, the water-mains having been injured. Attempts, on the whole successful, were made to limit their extension by blowing up passages through the crowded parts, with the result that about one-quarter of the city may be ultimately saved.

Like Charleston, which was so seriously damaged by an earthquake twenty years ago, San Francisco is

built upon a peninsula; and the effects of the two shocks, as revealed by the distribution of the damage, were very similar. Although the whole of both cities suffered severely, the chief destruction was confined to houses built on low-lying "made" land. In San Francisco this land is occupied by business houses and warehouses, and, in the southern part, by cheap tenements and poorly-built lodging-houses. At 5 a.m. most persons were in bed, and thus there was little loss of life in the business district, and much in that covered by the tenements. The better-class residential district, situated on the hills, escaped with comparative impunity, so far as the earthquakes were concerned, though the fires afterwards spread to that quarter.

That San Francisco was situated within or close to the epicentral area is shown by the continuous after-shocks, and by the effects of the shock. Observers in the open air state that the streets could be seen to bulge and wave as if about to crack open. Three miles of railway have sunk out of sight between Suisan and Benetia; several railway tracks have been destroyed for scores of miles; and on the harbour-front the earth appears to have sunk from six to eight inches. Great cracks were formed in the streets, and these cracks were twisted into all shapes. The houses, before they were destroyed by fire, were also seen to be out of alignment.

Outside San Francisco many towns are known to have suffered severely, especially San José, Santa Cruz and Santa Rosa; others less seriously, from Mendocino on the north to Monterey on the south. With our present information (and the absence of news from neighbouring places, and especially from the Lick Observatory, is disquieting), the meizoseismal area is a band extending along the coast and parallel to the Coast Range, about three hundred miles in length and not more than fifty miles in width. The extent of the disturbed area will remain unknown until inquiries have been made, but it is curious how few details on the subject have yet been published. Los Angeles (only 350 miles S.E. of San Francisco) does not seem to have been affected to any extent by the principal earthquake, though the shock was felt severely throughout the whole of the neighbouring State of Nevada, and there are vague reports of more distant observations.

Position of the Epicentre and Seismic Sea-Waves.

If the line drawn so as to bound the known area of destruction be even approximately correct, there can be no doubt that the epicentre was submarine and situated some little distance from the coast. The fact that the shock was felt at San Francisco two or three minutes after the epicentral time implied by the seismic records is also in favour of this conclusion. The chief difficulty in accepting it lies in the absence of any very great sea-waves. Much of San Francisco is only about twelve feet above high-water mark, and would have been submerged by any considerable wave. There seems, however, to have been some disturbance of the sea. Many vessels, it is said, were washed ashore with each disturbance, and washed out again by the receding waters. There are also unconfirmed reports that Terminal Island, a seaside resort about twenty miles from San Francisco, has been destroyed by a sea-wave, and that other places on the Californian coast have also been swept away. At present it is probable that the first decisive evidence of sea-waves, if any existed, will come to us from the eastern shores of Japan, which would be reached by them in about ten and a half hours after the earthquake.

Geological Relations of the Earthquake.

The earthquakes of California have been studied for some years by Messrs. Holden and Perrine, of the Lick Observatory, and the geology of the State is being revealed through the labours of Messrs. Russell, Diller and Lawson; while an admirable summary of their relations was recently presented in M. de Montessus' valuable work on "Géographie séismologique" (pp. 404–412). Between the Rocky Mountains and the Pacific are the parallel chains of the Sierra Nevada and the Coast Range. Among the Rocky Mountains earthquakes are few and slight; on the eastern slopes of the Sierra Nevada they are more frequent, and sometimes, as in the Owen's Valley earthquake of 1872, of considerable severity. The western portion of the Sierra Nevada, the Cascade Range, is remarkably free from earthquakes, though it is worth noting by those who see an intimate relation between volcanic and seismic actions that it contains the recently extinct cones of Shasta, Mount Hood and Mount Rainier. Again, the Coast Range, and especially the districts surrounding San Francisco and Los Angeles, is one of the great seismic regions of the globe. Lastly, to the west of California the sea-bed deepens rapidly, the contour of 4000 metres lying only a short distance from the land, and from this region many of the strong Californian earthquakes are known to proceed.

Recent studies have established a close connection between these earthquakes and the geological structure of the district. Whether the earthquakes take place under the Coast Range or beneath the adjoining ocean, the longer axes of the isoseismal lines are either parallel or perpendicular to the sub-oceanic contour-lines, the crust-folds of the Coast Range and the long lines of fault of the Pacific sea-board. It is difficult to resist the conclusion that in the western United States we are presented with mountains in four successive stages of growth. In the Rockies we have ranges so ancient that they have almost ceased to grow; in the Sierra Nevada to the west another which is approaching old age; the Coast Ranges are in the stage of youthful, vigorous growth, with the possibility of a long and active life before them; while, still farther to the west and not yet risen above the ocean, there seems to lie an embryonic range, of which the San Francisco and other earthquakes are the birth-throes.

The Unfelt Earth-Waves.

In all parts of the world delicate seismographs soon afterwards recorded the occurrence of a violent earthquake. The first waves reached Victoria (B.C.) at 1.16 p.m.; at Washington the movement was so strong that the pen passed off the recording sheet. In a quarter of an hour the seismographs of Great Britain took up the tale, large disturbances being recorded at Shide, Bidston, and Edinburgh; at Birmingham the pointer of the Omori horizontal pendulum swept three times off the drum. Passing over to the Continent, they set to work the instruments at Berlin, Heidelberg, Vienna, Laibach, Turin, Rome, and many other places. The pendulums at Florence shared the fate of those at Washington and Birmingham. The seismograph at Cape Town also registered the movement, while those in Japan were disturbed by the waves proceeding in the opposite direction across the Pacific. Only the scantiest details are as yet made known, but, if we may judge from the diagram at Birmingham, the complete series of records will be one of great interest and value.

The first series of preliminary tremors reached Birmingham at 1h. 25m. 3s. p.m. (G.M.T.); they were

small in amplitude and had an average period of 6·4 seconds. At 1h. 35m. 7s. they were followed by the second series of preliminary tremors, much larger in amplitude and with an average period of 11·4 seconds. These tremors, as is now well known, traverse the body of the earth with velocities of about 10 or 11 and 5 km. per second respectively. At 1h. 45m. 13s. began the principal portion of the movement, consisting of undulations which travel over the surface with a nearly uniform velocity of 3·3 or 3·4 km. per second. In the initial phase of this portion the undulations had an average period of 44·1 seconds; in the slow-period phase (which began at 1h. 50m. 22s.) of 25·2 seconds, and in the succeeding quick-period phase of 16·2 seconds. Unfortunately, this portion of the record is incomplete, for the pointer of the pendulum swept off and on the drum three times, several waves being thus lost, and the initial epoch of the quick-period phase cannot be determined. The end-portion of the disturbance began at 2h. 1m. 4s., and consisted of a long series of unusually clear and regular waves with an average period of 15·0 seconds. The duration of this portion is uncertain, for these waves were re-inforced at 3h. 28m. 38s. by the undulations of the principal portion which travelled through the antipodes along the major arc joining San Francisco and Birmingham. At 3h. 56m. 57s., however, the trace becomes nearly steady, but a careful examination reveals another series of long, low undulations from 4h. 58m. 32s. to 5h. 6m. 34s., which represent the return of the first series of surface-undulations after they had completed the tour of the globe and travelled once more as far as Birmingham. The interval between the first and third passages of these waves is 3h. 13m. 19s., and corresponds to a mean velocity of 3·36 km. per second.

MAGNITUDE OF THE SAN FRANCISCO EARTHQUAKE.

The mere fact that the earth-waves should disturb a seismograph after travelling 30,000 miles is sufficient evidence to show that the earthquake belongs to the very front rank. If we might estimate the intensity of a shock by the maximum range of movement at Birmingham, we should have to regard the San Francisco earthquake as much stronger than the Indian earthquake of April 4, 1905, but as inferior to the remarkable Central Asian earthquakes of July 9 and 23, 1905. The period of the larger waves approaches, however, so closely to that of the pendulums themselves that it by no means follows that the range and epoch of the maximum displacement of the instruments correspond with those of the earth's crust. Nor can we infer much from the extent of the destruction of the lofty, badly-founded houses of San Francisco. If the Colchester earthquake of 1884 had originated beneath the city and west-end of London instead of beneath the villages of Peldon and Rowhedge in Essex, the damage would have been considerable, and the earthquake would have held a higher place in our estimation. When, however, we consider the great area covered by the injured towns in California, the displacement of the superficial soil, the crumpling of the railway tracks, and the widespread registration of the unfelt waves, it is clear that we must give to the San Francisco earthquake a place inferior, no doubt, to the Lisbon earthquake of 1755 and the Indian earthquake of 1897, but probably one in the same rank as the Neapolitan earthquake of 1857, the Japanese earthquake of 1891, and the Indian earthquake of 1905.

C. DAVISON.

THE LIFE OF THE AUSTRALIAN BLACKS.[1]

BOTH for the anthropologist, who wants well-sifted and trustworthy material, and for the ordinary reader who would like to know something about the life of the native Australian, this is a most useful book. In fact, for the latter purpose it may be said to stand entirely alone. There is no other work on the Australians which gives anything like so good a general view; it is clear of superfluous technicalities, eminently readable, and written with so much sympathy that we cease to be surprised at the success of the writer in getting at such secret matters as male initiation ceremonies and beliefs about Byamee, all of which are strictly forbidden lore to the Euahlayi woman. Mr. Lang's introduction explains the bearing of the book on current controversies.

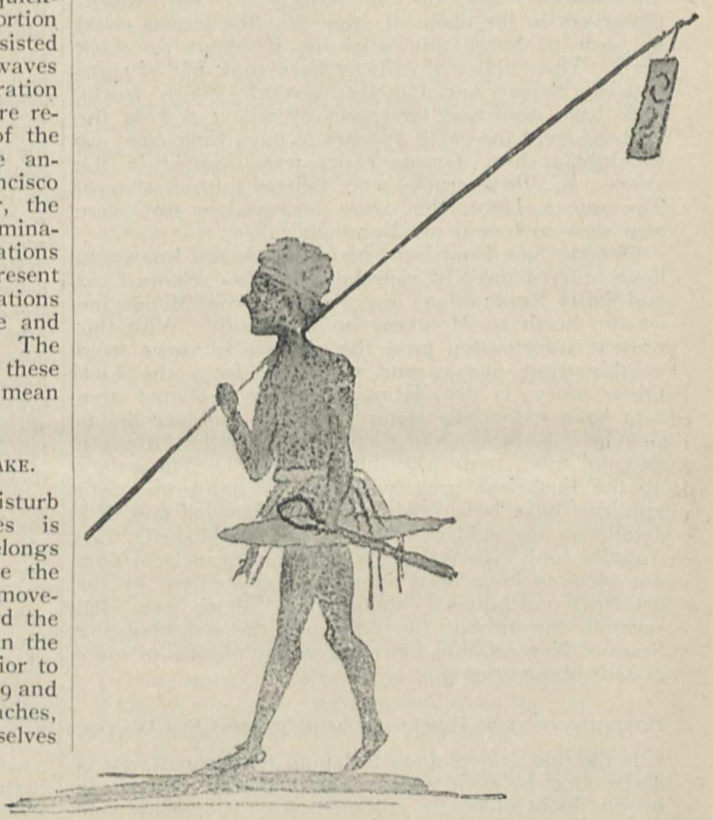


FIG. 1.—A native carrying a message-stick. From "The Euahlayi Tribe."

Besides these two important subjects, Mrs. Parker has much to tell us about the social organisation, magicians and their initiation, a witch woman whose feats are distinctly mystifying, the life of children of both sexes up to and including the initiation ceremonies, burial customs, dress, amusements, the provision of food, and mythology; and on many points we learn something which throws light on previous knowledge. Although we hear nothing of the so-called sex-totem among the Euahlayi, they hold that the male children are made by a lizard, the female by the moon, who is sometimes assisted by the crow. This looks like the raw material of the sex-totem. It

[1] "The Euahlayi Tribe, a Study of Aboriginal Life in Australia." By K. Langloh Parker; with an Introduction by Andrew Lang. Pp. xxvii+156; with 6 illustrations by a native artist. (London: A. Constable and Co., Ltd., 1905.) Price 7*s.* 6*d.* net.

may be noted that the lizard is one of the forms of the sex-totem in South Australia. In connection with children, it is interesting to note that we have in the Euahlayi a variant of the Arunta belief recorded by Strehlow, which has also a close connection with the belief of the northern Arunta visited by Spencer and Gillen.

An important subject, on which little information was previously available, is that of the *yunbeai* or individual totem, which is usually confined to medicine men, but among the Euahlayi is held to be granted to their special favourites. More important still is the information about Byamee. Unless Mrs. Parker's evidence can be impeached on the ground of European influence, it will henceforth be impossible to deny that the Australians have gods and a religion. We learn from this work that prayers are offered to Byamee both at the Bora and at the funerals of men.

Mrs. Parker alludes to the boomerang, and provides mathematicians with another problem in the shape of the performances of the *boodthul*, a miniature club which travels further if it is thrown through the top of a bush than if it has an unimpeded flight. The book contains six illustrations by a native artist. Mrs. Parker does not mention them, but she has informed the present writer that the artist had no European training. It may, however, be surmised that he had seen European pictures. N. W. T.

BORIC ACID AS A FOOD PRESERVATIVE.[1]

THE report of the English departmental committee on the use of preservatives in foods contains voluminous evidence on the harmful nature of most of the antiseptics employed in commerce. It was issued in 1901, and among its recommendations one finds that the use of any preservative in milk should be constituted a punishable offence. It, however, makes an exception in the case of butter and cream, which are substances taken in relatively small amounts, and allowed 0.5 per cent. of boric acid in the former, and 0.25 per cent. in the latter case.

Those who have had the time to read the evidence will be struck with the almost complete unanimity of the medical witnesses on the harmful effects produced by boric acid and its compounds. Unfortunately there will always be some who disagree with the majority, and it is particularly unfortunate from the point of view of the public welfare that one of these is Dr. Oscar Liebreich, whose opinion is on most subjects entitled to careful consideration and respect. The special pleading on behalf of boric acid and borax contained in Dr. Liebreich's former publications are repeated in the pamphlet just issued, and we fear that the useful work of those who are trying to prevent adulteration, and protect the public from those tradesmen who cover their misdeeds and want of cleanliness by the employment of antiseptics dangerous to health, will be seriously impeded thereby.

The question has also become an acute one in America, and the United States Department of Agriculture appointed Dr. Wiley, their principal chemist, to investigate the matter on a large scale by experiments on human beings, over a long period. Dr. Wiley's report was most unfavourable to the use of these preservatives; the ill-health set up in the subjects of his experiments, and the alterations in bodily metabolism to which this was due, are described in detail, and furnish systematic evidence on the subject which confirms what was known from clinical experience, and to those who had experimented previously on animals. To the unprejudiced observer Dr. Wiley's report settled the matter once and for all.

The special object of Dr. Liebreich's new brochure is to criticise some details in Dr. Wiley's work. This is always an easy thing to do when the subjects of an experiment are numerous, and in the human subject in particular it is often difficult to obtain precise details. Some of these, on account of the ill-health set up by the drug, had to abandon the continuation of the observations. This obviously reduces the number of observations, but at the same time is in itself a striking piece of evidence against the continued use of borax and boric acid. Dr. Liebreich does not dispute the ill-health of Dr. Wiley's willing subjects, but he is driven to attribute this to other causes, like inefficient hygienic surroundings. He does not dispute the loss of body weight, but says this is not by any means always injurious.

Those interested in this most important question should of course read both sides, and one sincerely trusts that in this instance the weight of a great name will not be allowed to overbalance the all but universal testimony of others to the contrary.

[1] "Third Treatise on the Effects of Borax and Boric Acid on the Human System." By Dr. Oscar Liebreich. Pp. vii+70. (London: J. and A. Churchill, 1906.) Price 5s. net.

PROF. W. F. R. WELDON, F.R.S.

THE 'seventies of last century may be said to have witnessed the renaissance of biological studies in Cambridge. It was in the year 1870, if we mistake not, that Michael Foster, at the invitation of Trinity College, became prælector in physiology and founded the great school for which the university has since been famous. Of his pupils the greatest was F. M. Balfour. He very soon became the centre of a new system which was thrown off, so to speak, from the main body, and rapidly acquired form and influence.

Weldon was one of the most distinguished products of the zoological school which was in this way established. He was the son of Mr. Walter Weldon, F.R.S., the distinguished chemist, and was educated at King's College, London. He entered at St. John's College, Cambridge, in 1878, of which foundation he became first a scholar and in 1884 a fellow. After taking his degree in 1881 he at once threw himself with characteristic vigour and disinterestedness into zoological teaching and research. He became demonstrator in comparative anatomy in 1884, and held the office for one year. In 1885 he was appointed to the newly-established lectureship on the morphology of the invertebrata, which office he held until he left Cambridge in 1891. As a lecturer Weldon is not likely to be forgotten by those who heard him. He was remarkable for the ease and mastery with which he handled his subject, and for the earnestness and clearness of his teaching. It was impossible to sit inert under him; he had the gift of compelling attention.

Weldon's early researches were mainly concerned with morphological problems, the study of which had been so strongly stimulated by the work of Darwin. In the 'sixties, 'seventies and early 'eighties of last century the hope existed that it would be possible by minute morphological study actually to trace the pedigrees of existing organisms and to get some comprehension of the wonders and complexities of animal structure. In the 'eighties, however, with the progress of experience it began to be obvious that these hopes could not be realised, that the problem could not be solved by morphology, and that we must turn to other sources if we wanted to progress in ideas. Weldon was soon touched by the scepticism which thus arose, and cast about in the latter part of his time at Cambridge for new methods. These he saw must come in part at least from an exact study of variation, and

his work was henceforth mainly directed to that subject. He spent his vacations at the laboratory of the Marine Biological Association at Plymouth and in the Zoological Laboratory at Naples, and devoted himself to laborious and systematic measurements of the parts of various marine organisms. These researches were continued with increased vigour at University College, London, where in 1891 he succeeded Prof. Ray Lankester as Jodrell professor of zoology. Here he entirely fulfilled the expectations which had been formed of him at Cambridge. Effective and enthusiastic as a teacher, he soon gathered around him a body of young workers whom he inspired by his own intensive fire.

During his career at University College he played a leading part in initiating the changes which, after some set-backs, resulted in the recent reorganisation of the University of London as a teaching body. In the completion of this most important work he was debarred from active participation, for in 1899 he was appointed the Linacre professor of comparative anatomy in the University of Oxford.

At Oxford he devoted himself with signal success to the duties of his professorship, paying special attention to the subject of variation. He again formed the centre of an active school of research, and founded in conjunction with Prof. Karl Pearson the journal *Biometrika* to advance the subject which he had so much at heart. Of his biometric work much might be said, but this must suffice. He was the one English biologist who actually realised what the whole attempt to give quantitative exactness to biological concepts really means; and he was the first to calculate organic coefficients of correlation and to suggest their important bearing on evolution.

Weldon held the chair at Oxford until his death on Good Friday last, after an illness of little more than twenty-four hours. He was born in 1860, and was therefore a comparatively young man when he died. He had about reached the stage of life when the germinating processes of the brain have attained their maximum and the mind begins to take stock of its ideas and to seek for means of coordinating them and of so bringing them before the world. He had several works on hand, all of which are unfinished. The most important, perhaps, is that in which he hoped to set down the conclusions he had reached on the great subject of the origin and the handing on by heredity of the properties of organisms.

His work, therefore, is not finished, but of whom can it be said that his work is finished? He has at least carved out the steps by which others will mount. He has sown the seed. It is for us who remain and for those who come after us to reap the fruits of his labours.

He was essentially a good man, and happiness was his portion in this life. Blessed in his domestic circumstances, and in holding one of the most distinguished positions the zoological world has to offer; in the possession of good health, of considerable bodily strength and activity, of indomitable energy, of a quick and penetrating intellect which rendered all intellectual effort pleasurable, of acute literary and artistic instincts, of a simple, honest, and lovable nature which endeared him to all who came in contact with him, he had everything which is necessary for earthly happiness. So amply had nature lavished her gifts upon him that he might well have been counted among her spoilt children. But he was lofty in his aims and strenuous in his life. His early death is a grievous blow to science; to his friends it is an affliction hard to be borne; to those who loved him it can only appear as a cruel and unnecessary calamity; but yet, can we say that he was not happy in his death, as in his life?

> Under the wide and starry sky
> Dig the grave and let me lie,
> Glad did I live and gladly die
> And I laid me down with a will.

PROF. PIERRE CURIE.

M. PIERRE CURIE, co-discoverer with his wife, Mme. Sklodowska Curie, of the element radium, and the investigator of many of its properties, met his death as the result of a street accident in Paris on Thursday, April 19. He was crossing the Place Dauphine when he was knocked down by a cab and fell under a heavy van coming from the opposite direction. The wheels passed over his head, and when taken to the police station life was found to be extinct.

Cut off in the midst of a career of active scientific investigation, in the flower of life and at the height of a unique reputation, brilliantly won and universally acknowledged, his death will be mourned by the whole civilised world. In this country, where the importance of his work and discoveries was early and fully recognised, and where the fame attaching to his name has spread widely, deep sympathy will be felt for Mme. Curie in her tragic bereavement, coupled with a sense of loss that a partnership in science so illustrious and fruitful has been brought to so untimely a close.

Born in Paris on March 15, 1859, Pierre Curie received his early education at the Sorbonne, where he attained the degree of Doctor of Science. He was made professor of physics in the Municipal School of Physics and Chemistry in Paris in 1895, and in 1900 he became professor at the Sorbonne. His earlier researches, extending over the period 1885–1894, included investigations into the phenomenon of piezo-electricity, in conjunction with his brother, J. Curie, the construction and use of electrometers and guard-ring condensers, the magnetic properties of iron, oxygen, and other substances at different temperatures, and the construction of sensitive aperiodic balances.

In 1895 M. Curie married Marie Sklodowska, one of the senior students at the Municipal School, where he was professor, and joined his wife in the new field of research opened up by M. Henri Becquerel's discovery of the radio-activity of uranium and its compounds. From 1898 onwards appeared the remarkable joint publications dealing with the discovery of radium and the investigation of its properties. The great advances made by the two investigators in this field may be traced to the collaboration of a trained physicist and a skilled chemist in a subject which may truly be described as a meeting ground of the two sciences. M. Curie's earlier results on piezo-electricity, and the construction and use of electrometers and condensers were ingeniously applied to the requirements of the new work, and in his hands resulted in a ready and trustworthy method for the electrical measurement of radio-activity being worked out. In the detection and initial stages of the separation of radium and polonium in pitchblende, the method accomplished what in the hands of Bunsen the spectroscope had accomplished in the detection and separation of cæsium and rubidium in the waters of Durkheim. When sufficient radium had been obtained, M. Curie and his pupils investigated the physical properties, while Mme. Curie devoted herself to the more purely chemical problems, the determination of the atomic weight of the new element, and the attempt to separate polonium.

M. Curie's most important contributions to the study

of the nature of the new element comprise the discovery, in conjunction with Mme. Curie, of the so-called induced activity conferred by radium on surrounding objects, and the proof that the penetrating radiations transport negative electricity even after they have been made to pass through a sheet of metal connected to earth. In conjunction with M. Laborde he discovered and measured the spontaneous evolution of heat from radium compounds.

In 1903 the Davy medal was conferred by the Royal Society on M. and Mme. Curie, and they shared with M. Branly the Osiris prize, and with M. Becquerel the Nobel prize for physics. M. Curie was made a member of the Institute of France in 1905. He will be remembered in this country for the lecture on radium, delivered with characteristic modesty and simplicity of manner, at the Royal Institution in 1903. He refused the Cross of the Legion of Honour offered by the French Government, on the ground that he preferred to remain a simple citizen, holding no doubt the view that scientific discovery is its own sufficient reward.

It has been said by a recent writer that there will come a time when men will date the coming in of their kingdom to the day when Curie and Laborde discovered the spontaneous evolution of heat from radium. Certainly no limit can be set to the consequences in the near or distant future which may be expected to flow from the discoveries with which the name of Curie is associated.

Like Röntgen shortly before, Curie emerged at one step from comparative obscurity to universal fame, and what they achieved is still within the horizon of the humblest investigator. Like the soldiers of Napoleon, each of the rank and file of the army of patient investigators carries in his knapsack a marshal's baton. The career of M. Curie illustrates this, and continues as an inspiration and encouragement to others. None have set in motion more pregnant influences. No one stands in less need of the historian to perpetuate his memory. F. S.

NOTES.

In the disastrous earthquake at San Francisco, a detailed description of which is given in another part of the present issue, it is reported that upwards of 1000 persons lost their lives, and that material damage was done to the value of more than sixty million pounds sterling. There seems little reason to doubt that most of these lives and the greater part of the property were lost in the fire which followed the earthquake, and that a little forethought would have prevented, or at least greatly lessened, the awful calamity. Electric mains were broken by the earthquake shock at a time when the current was being supplied, and gas and water mains were shattered. The electric current does not appear to have been stopped at the power stations, and the consequent numerous short circuits which occurred soon inflamed escaping gas and set fire to buildings in many parts of the city. The broken water mains obliterated the water supply, and the only means of checking the fire seems to have been the demolition by dynamite of property in its path. The steel buildings in the city appear to be almost intact. The earthquake did not damage them, and the fire only consumed the woodwork. Despite the rumours which have been in circulation as to damage to universities and observatories in the disturbed area, it is gratifying to know that there is as yet no confirmation of such calamities. Upon inquiry at the Royal Astronomical Society, we learn that no news has been received about any of the Californian observatories. Astronomers are particularly anxious as to the fate of the Lick Observatory, situated as it is very near to the centre of disturbance, and in view of a rumour that has reached a London fire insurance company of serious injury to the observatory. The Solar Observatory at Mount Wilson—near Pasadena, which is ten miles N.N.E. of Los Angeles—is probably too far to the south to have been damaged.

Some changes in the organisation of the Geological Survey of Canada have recently been made by the Premier, Sir Wilfrid Laurier. For more than five years Dr. Robert Bell, F.R.S., has been the acting-director of the Survey, and has managed the business as well as the scientific affairs to the satisfaction of the scientific, mining, and the general public. In this period he has accomplished much valuable work, initiated many useful new features, and raised the standing of the Survey in general estimation. Since the Survey began, sixty-three years ago, about 470 maps have been prepared and issued, and nearly one-third of this number have been published during the past five years, while others are nearly ready. By the change of organisation which has just been instituted, a business administrator has been appointed, while Dr. Bell is given the title of Chief Geologist of the Dominion. Dr. Bell will continue to prepare his reports, maps, and other works, and will have a free hand in geological matters, so that he ought apparently to be congratulated on being relieved of a troublesome and difficult part of his work.

The bi-centenary of the birth of Benjamin Franklin was celebrated by the American Philosophical Society at Philadelphia on April 17–20, in accordance with the programme announced in Nature of March 29 (p. 515). Addresses were read from the universities of Oxford, Cambridge, Glasgow, and Edinburgh, the Paris Academy of Sciences, and many other institutions. A statue of Franklin, presented to the City of Paris by Mr. J. H. Harjes, was to have been dedicated on April 20 at an international festival, in which the French Government had arranged to take part, but the celebrations were postponed in consequence of the catastrophe at San Francisco.

Prof. W. Ostwald has been elected a foreign member of the Danish Academy of Sciences.

Prof. Gabriel Oltramare, who for fifty years held the chair of mathematics at Geneva University, died on April 10, in his ninetieth year.

The death is announced, at sixty-five years of age, of Dr. N. S. Shaler, professor of geology at Harvard University and dean of the Lawrence Scientific School.

The annual meeting of the South African Association for the Advancement of Science will be held at Kimberley on July 9–14, under the presidency of Mr. G. F. Williams.

Dr. Dudley Buxton has been elected chairman of the council of the Selborne Society for the ensuing year, during which the society will attain its majority, having been founded in 1885. The annual *soirée* will be held on May 25, when the president, Lord Avebury, will deliver an address.

A telegram from Sarajevo, Bosnia, states that at 11 a.m. on April 19 a short, sharp earthquake shock was felt there. The shock was undulatory in character, and travelled from west to east. An earthquake shock was felt at Grants Pass, Oregon, at 1.11 a.m. on April 23. The Wellington correspondent of the *Times* reports that both the Eastern

Company's cables between New Zealand and Australia suddenly broke on April 23, as the result, it is presumed, of submarine disturbances. A sharp earthquake shock was felt at San Francisco at 10.39 p.m. on the same date. It lasted about three seconds, and the motion was from east to west.

DR. V. F. L. MATTEUCCI, director of the Vesuvius Observatory, has issued the following reports:—*April* 18.—A very violent squall blew the plume of smoke which hung over Vesuvius on to the observatory, bearing with it a quantity of dust and asphyxiating gases. The crater, though shrouded in thick mist and rain, seems to be quiet. *April* 20.—The shower of ash has ceased and the cloud of dust has dispersed, leaving visible the crater, which continues to eject, though more calmly, globular masses of vapour containing lesser quantities of dust, which fall on the eastern slopes of the volcano. No further shocks have occurred, only very slight movements being reported by the more sensitive seismographs. *April* 23.—The seismic instruments are very steady. The crater is emitting grey vapour, together with small quantities of dust at intervals.

ACCORDING to the *Chemiker Zeitung*, the number of patents applied for during 1905 in Germany was 30,085 as against 28,360 in 1904, whilst the number of patents fully taken out was 9600 against 9189. Of the different applications, 22,030 were by Germans, 1769 by Americans, 1410 by Frenchmen, 1264 by Englishmen, 873 from Austria, 707 from Switzerland, 473 from Belgium, 249 from Hungary, 246 from Russia, 230 from Denmark, 188 from Italy, 174 from Sweden, 48 from Norway, &c. The largest number of new patents for the year came under the heading of electrotechnics. During the year 8623 patents expired or for other reasons ceased to be worked, while at the end of the year 32,430 patents remained in force.

FROM Budapest we learn that the director of the Hungarian Chemical Agricultural Institute has presented a strong petition to the Government urging the complete reorganisation of the institute, which was opened twenty-five years ago by the Minister of Agriculture as a central experimental station for agricultural chemistry. In the first instance it is proposed that no further analyses for private persons be undertaken, as this is not only unfair to the private laboratories, but provides so much work for the institute as to hinder members of the staff from following up any line of scientific research. Great stress is laid upon the advisability of bringing all the experimental stations into intimate union with the Imperial Institute of Hungary. According to the director's proposal, the reorganised institute shall be divided into seven departments, each under the supervision of a head chemist.

THE Easter party of naturalists and students at the Liverpool Marine Biology Committee's station at Port Erin, in the Isle of Man, has been larger than usual, and the available accommodation in both hatchery and laboratory has been fully occupied. In addition to senior students from the botanical and zoological departments of the universities of Manchester and Liverpool, the following professional workers have occupied tables in the laboratory:—Dr. H. E. Roaf (bio-chemistry), Mr. J. Pearson, Mr. W. Gunn and Prof. Herdman, and Mr. Chadwick, the curator of the biological station. In the sea-fish hatchery the season has been a good one. Although the first fertilised plaice eggs were obtained from the spawning pond on February 13, only one day earlier than last year, embryos in large numbers appeared comparatively early in the season, and the output of young fish is now about a million in advance of the corresponding date in 1905. Five and three-quarter million plaice eggs have now been obtained from the pond, and nearly three and a half million larvæ have been set free in the Irish Sea. The largest number put out on one day was 470,000, on April 20.

THE latest report of the Decimal Association, of which Lord Kelvin is a vice-president, states that it is proposed to open a new Parliamentary campaign to prepare the way for the introduction of a Bill in the House of Commons, on the lines of the Bill which has already passed the House of Lords. The report goes on to point out that advocates of the metric system of weights and measures in the United States of America have been encouraged by the introduction of a Bill in the House of Representatives by Mr. Littauer, which provides for the exclusive use of metric weights and measures in all Government departments. This Bill, as has been recorded already in these columns, is now before a Standing Committee of the House of Representatives, and there is every hope that it may be reported on favourably. The executive committee of the association records in the report its thanks to the Association of Trade Protection Societies for its continued advocacy of the compulsory adoption of metric weights and measures. Since this association represents retail as well as wholesale traders, its support may be taken as a distinct refutation of the assertion that the shopkeepers of the country do not wish to see the adoption of the decimal system of measurement. The report mentions also that the Canadian Government has appointed as lecturer a professor of the University of Toronto to devote a year to the task of explaining the metric weights and measures in all the leading cities from Halifax to Vancouver.

REPORTS are being received of twilight glows and of the deposition of dust, supposed to be due to the recent eruption of Vesuvius. Prof. Stanislas Meunier has collected on the roof of his house in Paris dust said to be identical with the dust of the eruption of 1872. At Southall, Middlesex, Mr. G. Gibson has also collected dust apparently of similar nature. Dr. F. A. Bather, writing from Wimbledon, informs us that on the evening of April 18 the sunset was strongly reminiscent of the Krakatão glows. It will be interesting to learn whether similar observations have been recorded in other localities. The distribution of the dust would depend chiefly upon the upper air currents, which are usually different from those at the surface, and although the surface winds have recently been from north and north-east, the dust may have been carried to north-west Europe by currents in the upper air.

IT is stated in the *Cologne Gazette* that the German Government is making preparations for the issue shortly of weather forecasts for agriculturists. The forecasts will be sent free or at a nominal charge, and the success of the undertaking will be judged from returns of the subsequent weather supplied by the recipients of the information. We think this is a step in the right direction; the experiment has already been made with much success in the United States and elsewhere. Prof. Willis Moore, *e.g.*, in an article in the *National Geographic Magazine* for June, 1905, says:—"No large grower of fruits or vegetables is content to be excluded from the receipt of the frost forecasts." During the hay and corn harvest (June–September) special forecasts have been, for many years, issued to farmers in this country by the Meteorological

Office. The only charge now made is for the actual cost of the telegrams, and the success of the work is judged, as proposed in the German scheme, by the returns made by the recipients themselves. From the last published annual report (1904–5) we see that the total and partial success of the forecasts amounted to 92 per cent. for the country generally, and that 58 per cent. were completely successful.

THE Bulletin of the Italian Meteorological Society is now issued in two-monthly parts, and includes original contributions and monthly results of observations at a considerable number of stations. The issue for February-March contains an interesting account of the ascents of two unmanned balloons in August last, near Treviso, Venice, in both of which readings were obtained at altitudes exceeding 10,000 metres. The first important inversion of temperature, amounting to 6° C., was experienced between 10,000 metres and 10,385 metres, on August 4, notwithstanding the fact that a few hours previously a very violent thunderstorm occurred at the station. The second ascent was made on August 30, at the time of the solar eclipse; the inversion of temperature was not so marked as in the previous case, but amounted to 3° C. between the heights of 18,000 metres and 20,000 metres. The exact altitude of the inversion during this ascent is somewhat uncertain, as the barometric trace was partially obliterated by the peasants who picked up the records. Thunderstorms were also prevalent about twelve hours prior to the time of this ascent. The discovery of such inversions of temperature is known to be one of the most interesting results connected with the recent explorations of the upper air.

To vol. xxvi., part iv., of Notes from the Leyden Museum, Dr. H. W. van der Weele contributes three papers on Malay Neuroptera, the most important of these dealing with the representatives of the family Sialidæ. Among other notes, Dr. J. G. de Man discusses and redescribes certain Malay crustaceans of the genus Palæmon, while Dr. R. Horst describes a parasitic copepod crustacean of the genus Penella infesting a large fish from the Moluccas.

A HAND-LIST of Philippine birds has been drawn up by Messrs. R. C. McGregor and D. C. Worcester, and published at Manila by the Bureau of Government Laboratories. A slip inserted within the cover announces that the publication of the Bulletins of the Bureau has been discontinued, and that in their place will be issued a new serial, the *Philippine Journal of Science*, while the Bureau itself becomes the Bureau of Science of the Philippine Islands.

THE January issue (vol. x., part i.) of the Transactions of the Leicester Literary and Philosophical Society contains a report of the president's address at the annual meeting in October last, in which attention is directed to the decadence of artistic feeling and good taste in the design and execution of architectural and kindred objects in and around Leicester. The contents include a paper by Mr. J. R. Plant on the geological history of molluscs, and a second, by Mr. H. Donisthorne, on Isle of Wight beetles.

No. 1442 of the Proceedings of the U.S. National Museum is devoted to notices of the type specimens of Ordovician and Silurian Bryozoa collected and described by Mr. U. P. James. These fossils, which came from the Cincinnati group, are mostly in the Walker Museum at Chicago, although some are preserved at Washington. According to the author of the paper before us, Mr. R. S. Bassler, the original determinations were for the most part erroneous. Descriptions of new South American moths, by Mr. W. Schaus, of Twickenham, form the subject of No. 1444 of the same serial.

THE life-history of the North American cave-salamander, *Spelerpes maculicaudus*, by Messrs. A. M. Banta and W. L. McAtee, forms the subject of No. 1443 of the Proceedings of the U.S. National Museum (vol. xxx., p. 67). This handsome salamander appears to be confined to the Mississippi valley, where, although commonly found in caves, it may occasionally be met with in woods. When in caves, it is generally to be found at no great distance from the entrance, usually but little beyond the twilight zone. For breeding purposes, however, these creatures penetrate deeper into the recesses of the caves, where the larvæ are produced; such full-grown larvæ as are met with in the open country having probably been washed out by freshets. Within caves the adult salamanders are usually to be found in crevices or upon rock-shelves.

THE March number of the *Museums Journal* contains an account, by Dr. W. E. Hoyle, of the new zoological institute at Breslau; while Prof. J. T. Wilson's paper on the Australian Museum, Sydney, which was read last year at the Worcester conference, is printed in full. In another article it is stated that Mr. E. Lovett, of Croydon, has formed a large collection of manufactured objects which he is desirous of using as the basis of a "Folk Museum." A schedule is given of the collection of appliances and allied objects used by primitive man, arranged to illustrate the evolution of idea, form, and design, with the amount of superficies required for their proper display in a museum.

IN parts i. and ii. of vol. xxxv. of Gegenbaur's *Morphologisches Jahrbuch*, Prof. B. Hatschek, of Vienna, commences a series of studies on the theory of the primitively segmental structure of the vertebrate skull, dealing in this instance with the anterior extremity of the spinal neural system of the lancelet. Dr. Fleischmann's series of papers on the morphology of the cloaca and related organs in the amniote vertebrates is continued by Messrs. H. Dimpfl and J. Schwarztrauber, who respectively discuss these structures in the guinea-pig and the sheep. In a long paper Mr. G. Ruge brings to a conclusion an elaborate series of studies of the external form of the liver in the Primates, dealing in this instance with the monkeys of the Cercopithecus group. As might have been expected, these display a very generalised character in respect to this organ, which is markedly different from that of the anthropoid group. Among other papers on vertebrate morphology is one by Mr. H. Braus on the question whether the formation of the skeleton is dependent on the muscular layer, and a second, by Prof. G. Jelgersma, on the origin of the vertebrate eye. For the conclusions in both these cases we must refer our readers to the original papers, as they are too long to be given here.

THE authors of a forthcoming monograph upon "Eclipse"—the famous racehorse—ask us to announce that they would be very glad to be informed of any references to this celebrated horse in contemporary literature; to his breeder, the Duke of Cumberland; to his purchaser, Wildman; and to his subsequent owner, Dennis O'Kelly. The monograph will be as completely illustrated as possible from contemporary paintings and engravings and other sources, and will contain detailed photographs of the

anatomy of "Eclipse" and the most famous of his descendants, which should prove interesting both to biologists and breeders. It is important that information should reach the authors before June 1 if possible, and all letters, manuscripts, prints, or pictures addressed to "Eclipse," c/o Mr. W. Heinemann, 21 Bedford Street, London, W.C., will be acknowledged before that date, and will be treated with the greatest care.

MR. HENRY S. WELLCOME, of Snow Hill Buildings, E.C., is organising an exhibition in connection with the history of medicine, chemistry, pharmacy, and the allied sciences, and has issued a circular indicating the range of the proposed exhibition. The loan of any objects of interest is solicited; these will be insured and carriage paid both ways. The date of the proposed exhibition has not yet been definitely settled.

IN the *Comptes rendus* of the Paris Academy of Sciences (April 2, p. 823) M. Lortet gives an account of an examination of the contents of four vases containing the viscera of King Rameses II., the Sesostris of the Greeks, who is believed to have died about 3164 years ago. Profs. Hugounenq, Renaut, and Rigaud were associated with M. Lortet in the examination, and three of the vases were surmised to contain the stomach, intestine, and liver of the great king preserved with soda and aromatic resinous substances, and enclosed in linen bandages. A fourth jar contained the heart of the monarch, hard and horn-like, but on microscopical examination showing the typical bundles of muscle fibres of cardiac muscle, crossing one another.

IN the April number of the *Monthly Review*, Mr. Paul Uhlenhuth writes on the blood-relationship of man and apes, and describes how, by means of the precipitin test, various albuminous substances and the blood of different animals may be distinguished from one another. The test has also considerable medico-legal importance, and biologically may be employed to ascertain the relationship of various animals to one another. In this way it may be shown that the anthropoid apes are most nearly akin to man, while the lemurs are but distantly, if at all, related to him.

SOME years ago Dr. A. Gallardo advanced a dynamical interpretation of the karyokinetic figures in cell division that was explained in NATURE of November 13, 1902, by Prof. M. Hartog. Dr. Gallardo has somewhat modined his former theory, and applying the results obtained from a study of the properties of colloids, he postulates in a paper published in *Annales del Museo Nacional de Buenos Aires*, vol. xiii., a negative charge for the chromatin and a positive charge for the cytoplasm around the poles of the spindle. In proof of his theory the writer reproduces the figures obtained with special apparatus on a metallic plate forming one electrode in an electrolytic solution.

IT is remarkable that, despite the numerous investigations during the last ten to twenty years into the coffee-leaf disease caused by species of Hemileia, the complete life-history of the fungus has not been worked out. Mr. G. Massee directs attention to the want of information concerning the æcidial stage in his revision of the genus published in the Kew Bulletin, No. 2, 1906. Four species, two of them recently determined by Mr. Massee, are described, and the probability of the æcidial stage is considered. In addition to an announcement regarding the publication, and a list of the contents of a volume on the "Wild Fauna and Flora of Kew Gardens," a supplementary list of fungi prepared by Mr. Massee is given, among which three species new to science are described and illustrated.

ACCORDING to the *Pioneer Mail*, the Bombay Government has decided that arrangements should be made for the starting of experiments in the cultivation of rubber plants both in the southern and northern circles, and in the garden of economic botany which is about to be established in Bassein. In the northern circle Mr. Ryan has been requested to prepare and submit, under the direction of the conservator, a scheme for the plantation of the *Ficus elastica*, and for experiments with a view to ascertain the yield of rubber and its commercial value, and to suggest other rubber plants likely to show good results. At the Bassein garden Mr. Gammie has been asked to prepare a scheme of experiments on a smaller scale with numerous rubber-yielding plants with the object of ascertaining which are the most likely to succeed in the coast districts of the Bombay Presidency. For the southern circle orders have been given for the preparation of a scheme for experimental plantation, more particularly of Hevea, in one or more localities under the direction of the conservator.

MR. O. F. COOK, in an article entitled "The Vital Fabric of Descent," published in the Proceedings of the Washington Academy of Sciences (vii., p. 301), urges that kinesis is the main factor in the evolution of organisms. "Kinesis is not a mysterious force or mechanism to be sought in reproductive cells; it is a general property of organisms, as gravitation is of matter. And of kinesis we know more than of gravitation. Two factors and two results are already obvious. The factors are heterism, or intra-specific diversity, and symbasis, or inter-breeding in a specific network of descent. . . ." "Natural selection neither originates species nor actuates their further development; progressive change would go on whether selection were active or not, and whether the environment were uniform or not. Nevertheless, selection conduces to adaptation, since by permitting changes in some directions and forbidding them in others, it deflects the specific motion. The workings of natural selection are adequately explained only by the kinetic theory."

IN the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde (1906, No. 3) appears the first part of an interesting historical paper on the measurement of geographical areas before the invention of the planimeter, by Dr. W. Schmiedeberg.

THE new issue (vol. xix., part i.) of *Mitteilungen aus den deutschen Schutzgebieten* contains papers on the daily variation of temperature and pressure at Windhuk, German South-West Africa, and of temperature at Herbertshöhe, Bismarck Archipelago, by Dr. J. Hann. Dr. P. Heidke contributes a paper on the meteorology of German East Africa, dealing with the means for the years 1899 to 1902 from twenty-two stations.

THE April number of the *Bollettino* of the Italian Geographical Society contains an extremely interesting paper, by Dr. Roberto Almagia, on the earliest Italian contribution to oceanography. The pamphlet described is the "Relatione del Mare" of Giovanni Botero, published in Rome in the year 1600, and it is remarkable that not only the main division of the subject into statical and dynamical sections, but the subdivisions of each of these into special parts, follow closely the method of treatment adopted in modern research.

We have received a reprint from the *Numismatic Chronicle* of a paper, by Sir John Evans, K.C.B., describing the silver medal or map of Sir Francis Drake, which commemorates the voyage round the world completed in 1580. Three, or at most four, examples of this medal are known, two of which are in the British Museum and one in Sir John Evans's collection. Sir John Evans agrees with Mr. Miller Christy that the silver map and that which is attached to the work of Peter Martyr, "De Orbe Novo" (Paris, 1587), are from the hand of the same engraver, about whom it is only known that the initials of his name were "F. G."

Two reports (Nos. 107 and 108) have been issued by the British Fire Prevention Committee containing particulars of experimental tests of the fire resistance of concrete floors. The two floors were practically identical in design, and were subjected to the same conditions. The results of the tests were, however, very different according to the concrete aggregate used. The one having Thames ballast concrete for the protection of its steel-work failed, whilst the other, with clinker concrete and coke breeze protection to the girders, remained intact. No independent fire tests on such a scale with floor areas measuring 15 feet by 22 feet have been previously carried out.

At the Institution of Civil Engineers an interesting paper on the resistance of iron and steel to reversals of direct stress was read by Dr. T. E. Stanton and Mr. L. Bairstow on April 10. The results of their experiments, which were carried out at the National Physical Laboratory, may be summarised as follows:—The superiority, in resistance to reversals of stress, of moderately high-carbon steels over low-carbon steels and wrought irons, which was discovered by Wöhler to exist when the rate of reversals was 60 per minute, still holds when this rate is increased to 800 per minute, although, according to Reynolds and Smith's experiments, this superiority no longer exists when the rate of reversals is in the neighbourhood of 2000 per minute. So far as comparisons can be made between the results of the authors' experiments and those of Wöhler and Sir Benjamin Baker, there is no marked reduction in resistance due to raising the rate of reversals to 800 per minute. Experiments in which the ratio of tension to compression varied from 1·4 to 0·72 indicated that between these limits the value of the maximum range of stress was practically independent of the actual values of the limiting stresses in tension and compression. The resistance of the materials in three typical cases of rapid reduction of area of the specimens has been determined. The failure of iron specimens due to the development of the slip-lines of Ewing and Rosenhain into cracks has been determined for the case of direct stress, and the failure of moderately high-carbon steel, due to the development of cracks in the ferritic areas of the structure, has also been established.

Messrs. Archibald Constable and Co., Ltd., will publish shortly a work on "Recent Advances in the Physiology of Digestion," by Prof. E. H. Starling, F.R.S.

Sir Martin Conway has written a history of Spitsbergen which the Cambridge University Press will shortly publish under the title of "No Man's Land."

The London Stereoscopic and Photographic Company, Ltd., has issued a new catalogue of photographic apparatus intended primarily for the use of amateurs. The list is attractively produced and conveniently arranged, and copies may be obtained post-free on application.

The Country Press, 19 Ball Street, Kensington, has published a series of twelve picture post-cards of the leaves of British trees and shrubs showing the exact venation in each case. These cards are intended for the use of children and others taking up nature-study; but it is to be hoped that teachers will prefer to direct the attention of their pupils to the actual leaves of plants, and to encourage the children to collect and study natural objects themselves rather than pictorial representations of them, however correct and artistic these may be.

OUR ASTRONOMICAL COLUMN.

Employment of Selenium Cells during Total Solar Eclipse.—During the total eclipse of August last, the observers at Tortosa made use of selenium cells for the double purpose of determining the variation in sunlight during the progress of the eclipse, and of ascertaining the exact moments of the beginning and end of totality.

As is generally known, the electrical conductivity of selenium increases on exposure to sunlight, being especially sensitive to the less refrangible end of the spectrum; therefore, by placing the cell in series with a battery and a delicate reflecting galvanometer, the amount of light falling on the selenium may be registered by registering the movements of the galvanometer beam of light.

Whilst the decrease of light, during an eclipse, is not *visible* until the eclipse is well advanced, the galvanometer needle at Tortosa was seen to move immediately after first contact, and for nearly an hour showed a uniformly increasing resistance.

Assuming that the light during totality was of the same quality as that obtaining at dawn, the results derived from the observations show that its brightness was about equal to that of the sky some thirty or forty-five minutes before sunrise.

The results obtained regarding the instants at which totality began and ended were very satisfactory, and it is suggested that, by placing similar equipments along the line of totality during future eclipses, far better results could be obtained than by the visual observations hitherto depended upon (*Astrophysical Journal*, No. 2, vol. xxiii.).

Catalogue of Pleiades Stars.—We have received from Dr. R. S. Dugan, of the Princeton (N.J.) Observatory, a copy of the inaugural dissertation presented by him for the doctorate of the Heidelberg University.

This publication contains the magnitudes and mean places (for 1900·0) of 359 stars of the Pleiades group. In addition to the catalogue, Dr. Dugan discusses the methods employed in measuring the plates and reducing the data thereby obtained. A chart of the group, on which the catalogue number of each star is shown, also accompanies the dissertation.

The Total Solar Eclipse of the Sun of January, 1907.—Among the numerous important papers communicated to the meeting of the Astronomical and Astrophysical Society of America, held at New York on December 28–30, 1905, there is one by Prof. David Todd which will probably be found to be of special interest to eclipse observers.

Prof. Todd and Mr. Baker have computed the essential data for ten possible stations, and have discussed the latter and the means of getting to them. It appears that the new railway across Russian territory will afford the greatest facilities for reaching the Turkestan stations, whilst observations will also be possible some 600 miles north-west of Peking. The complete discussion is to be published in the *American Journal of Science* (*Science*, No. 586, vol. xxiii., N.S.).

Observations of Nebulæ.—Since the year 1884 M. Bigourdan, of the Paris Observatory, has been assiduously employed in making a complete survey of nebulæ.

The results of this survey are to be published in five volumes, of which two (iv. and v.), dealing with the nebulæ situated between 14h. and 24h., have already appeared.

At the meeting of the Paris Academy of Sciences held on March 19, M. Bigourdan presented the second part of

vol. i., including the measures of nebulæ situated between oh. and 2h. of right ascension. The first part of this volume will contain the introduction, and will include a full description of the instruments and methods employed in the research.

Vol. ii., including the section 2h.–9h., is to appear soon, and will be followed by vol. iii., giving the results for the region 9h.–14h. (*Comptes rendus*, No. 12).

A LARGE PHOTOGRAPHIC NEBULA IN SCORPIO.—On examining the photographs obtained during his sojourn at Mount Wilson last year, Prof. Barnard found that an immense region near to π and δ Scorpii is occupied by a large nebula which is comparable in size, and in the peculiarities of its several branches, with the great nebula in Orion and the extended nebulosity of the Pleiades.

A short description of this nebula, together with a splendid reproduction of a photograph of it, taken with the 10-inch Brashear lens of the Bruce doublet, is given in No. 2, vol. xxiii., of the *Astrophysical Journal*.

The nebula extends some $4\frac{1}{2}°$ or 5° in a north and south direction, and its brightest portion lies about $\frac{1}{2}°$ to the south of π Scorpii.

A striking fact in connection with this object is that all the larger stars connected with it are, as might be expected, of the Orion type.

Prof. Barnard thinks that the branching, straggling character of this and similar nebulæ tends to discredit the accepted form of the nebular theory of stellar evolution, and doubts whether that theory would have ever been constructed if, at the time, our present knowledge of the appearance of nebulæ, as shown by photography, had been available.

CANADIAN TIDES.

A PAPER on tide levels and datum planes on the Pacific Coast of Canada was read recently by Mr. W. Bell Dawson, the engineer in charge of the tidal survey, at the meeting of the Canadian Society of Civil Engineers. The survey of the Canadian waters on the Atlantic side has been in progress now for some years under Mr. Dawson's charge, and has so far advanced that permanent tide gauges have been fixed at several representative parts of the coast, and sufficient tidal observations obtained to enable the Marine Department to issue tide tables for most of the principal ports. The survey has now been extended to the Pacific Coast.

In the paper under notice the bench marks and data used by the Admiralty, the Hudson's Bay Company, and the town authorities on the coast have been connected up by levelling, and the bench marks at Victoria, Esquimault, Vancouver, and other tidal stations referred to one common standard. These levels are given in the pamphlet. The importance of publishing such results is emphasised by the fact that the bench marks of former surveys are now to a great extent useless, because they were never made public, and the level books containing the records of these surveys have been destroyed by fire, and so a large amount of good work has been rendered useless, and subsequent trouble and expense caused.

The tides on the Pacific Coast are peculiar, the leading feature being a pronounced diurnal inequality which accords with the declination of the moon, and is subject to an annual variation with the change in the declination of the sun; also there is an unusually large solar effect relatively to the lunar, especially in the northern part. In some parts of the coast during the greater part of the day there is a long stand or only slight fluctuation near high-water level, with a sharp, short drop to the lower low water which occurs once in the day. Owing to this diurnal inequality the two highest and lowest points in the tide curve for the month may be as much as five days before or after the full and new moon. While the tides on the Atlantic side of Canada follow the phases of the moon, and accordingly the alternations of spring and neap tides are the dominant features, the tides on the Pacific side may be described as declination tides.

The careful study of the tides and of the mean sea-level appears to indicate that this coast is rising at a rate as great as 1 or 2 feet in the century.

THE INTESTINAL TRACT OF MAMMALS.

IN a memoir "On the Intestinal Tract of Mammals" (Trans. Zool. Soc. of London, xvii., part v., December, 1905, pp. 437–536), Dr. Chalmers Mitchell extends to mammals the line of investigation which has already, in his hands, yielded results of great interest when applied to birds, namely, the systematic study of the pattern and arrangement taken by the folds and coils of the intestinal tract. With this object, the author describes the pattern of the intestinal coils in a great number of mammals dissected by him, representing examples of each of the principal subdivisions of the entire class. The descriptions are supplemented by an excellent series of text-figures, which show the arrangements in a semi-diagrammatic, but clear and accurate, manner. In the case of mammals of which the author has not been able to procure specimens for dissection, he quotes from the existing descriptions of other authors such details as apply to the problems which are the object of his investigation. Thus the memoir before us gives an account, which is practically complete, of what may be called the general morphology of the mammalian intestinal tract, that is to say, of that portion of the gut comprised between the stomach and the anus. From his investigations the author arrives at a number of interesting conclusions, of which only a few can be mentioned in the limits of this article.

Starting from an ancestral type of vertebrate, in which the alimentary canal ran a straight course through the body, suspended by a mesentery from the dorsal wall of the body-cavity, the gut becomes thrown into a series of folds as the result of a process of growth, whereby it becomes longer than the straight length between its extreme points. The process of elongation can be traced both phylogenetically, by a comparison of different vertebrate types, and ontogenetically, in the development of any given species. The more or less complicated folding of the gut which results involves the dorsal mesentery, and also the blood-vessels draining from the different parts of the gut, which tend to take short circuits between portions of the gut approximated to each other by the process of folding.

The intestinal tract, in both birds and mammals, is divided into two regions, anterior and posterior, by the outgrowth at a certain point of a cæcum or pair of cæca. Probably in all cases a pair of cæca were primitively present, as is usually the case in birds. In mammals, as a general rule, a single cæcum is formed, but in some cases two complete cæca, or a rudiment of a second in addition to the usual one, still occur. In a few cases, however, all trace of a cæcum has disappeared entirely. The intestinal tract anterior to the cæcum is divisible into two regions, the duodenum and the small intestine, or "Meckel's tract," as the author proposes to call it. The latter represents only a very short portion of the primitive straight gut, not more than two or three body-somites; but in nearly all birds and mammals it becomes the longest portion of the gut, growing out to form the greater part of what is known as the "pendant loop" in mammalian embryology, and is the chief absorbing portion of the gut. The intestinal tract behind the cæcum may be called the hind-gut, and corresponds to a much larger portion of the primitive straight alimentary canal than the duodenum and Meckel's tract together. In birds the hind-gut is relatively very short. In mammals, however, it is always long, sometimes extremely so, and becomes divided into two regions, the colon and the rectum. The colon is often greatly lengthened, and thrown into loops or coils. The rectum may also be considerably lengthened, but, as a rule, it is not very much longer than the portion of the primitive straight gut which it represents.

In certain groups of mammals a very primitive type of intestinal tract is still found. As the author points out, however, likenesses which are due to the common possession of primitive features, once possessed by the whole group, cannot be regarded as evidence of near relationship. Equally useless for proof of affinity are resemblances due to the loss or reduction of parts that were once the property of the ancestral stock. Clues to affinity must rather be sought in resemblances depending on definite anatomical peculiarities that are new acquisitions, and the more

complex these structures, the more convincing the evidence they furnish, since it then becomes so much the less probable that the same anatomical device should have been produced twice than that it should have been acquired once only. In the Artiodactyla, for example, "a definite case of an anatomical peculiarity, so well marked and complex as to be a safe guide to affinity," is seen in the elongation and spiral coiling of the proximal portion of the colon. The Perissodactyla and rodents supply other examples of evolution along a definite radius from the ancestral centre. From his investigations the author deduces inferences of importance for the general theory of evolution, especially as regards the limitation of the possible range of variation of organs in any set of animals which have once come to occupy a particular radius. Further changes and elaborations are then restricted by the past history, that is to say, by the limited material which it has furnished for further specialisation. In this way a simple explanation is given for the definite grooves, recognised by many writers, along which the specialisation of organisms must necessarily move, without having recourse to the assumption of any mysterious directive forces. E. A. M.

SCIENTIFIC REPORTS OF THE LOCAL GOVERNMENT BOARD.[1]

THE first half of the volume under notice is devoted to the medical officer's report, statistical data, and details of various inspections and inquiries by the Board's inspectors. The second half contains reports of the auxiliary scientific investigations carried out for the Board. The first of these is a memorandum by Dr. Theodore Thomson on rats and ship-borne plague. The conclusion arrived at is that "the part played by the rat in transmission of plague to man, although real, falls far short of the importance which has generally been attributed to it." This may be true, but in view of the predominant part played by the rat in the dissemination of plague in the various Sydney epidemics, it is to be hoped that the campaign against this rodent will in no way be relaxed.

Bearing on the same subject, Drs. Haldane and Wade report on methods of rat destruction and disinfection on ship-board. In this especial attention is directed to the Clayton process, in which sulphur is burned at a high temperature, and air charged with the products of its combustion is pumped into the ship's hold. The gas is rapidly fatal to rats and other vermin, and is germicidal to non-sporing microbes, but it does not penetrate a loaded hold well, and has a deleterious action on certain articles. On the whole, however, it seems to be the best method to employ for rat destruction. Dr. Klein details further experiments on the two types, virulent human and less virulent rat, of the plague bacillus differentiated by him and described in a previous report. Dr. Klein also records some interesting observations on the influence of symbiosis on the virulence of microbes.

An important paper on the differentiation of various streptococci and staphylococci is contributed by Dr. M. H. Gordon. Hitherto the differences exhibited by the members of these classes of micro-organisms, particularly the streptococci, have been slight and indefinite, but by making use of culture media containing various mono-, di-, tri-, and poly-saccharides and glucosides, important differential characters are obtainable. Dr. Sidney Martin has continued his studies on the toxic action of microbes, dealing in the present volume with that of the *Proteus vulgaris*. The results, however, in this case are somewhat indefinite, the toxic reaction being mainly evinced by the development of agglutinin in the blood. Dr. Houston gives a detailed report of the bacteriological examination of normal human dejecta, and of the intestinal contents of sea-fowl and of fish. All gulls contained typical *B. coli* in their excrement in enormous numbers, but guillemots did not contain *B. coli* of any sort. As regards fish, those obtained "from a source seemingly above all suspicion of objectionable contamination, may contain sometimes apparently typical *B. coli* in their interior; in the great majority of cases the results were either wholly negative or the microbes that were isolated proved to be atypical in character."

Dr. Alan Green contributes further observations on chloroformed calf vaccine which prove that the quality of the lymph prepared by this method is of a high order.

The above brief review shows that this report contains matter of the greatest interest and importance which should be studied by all bacteriologists and by those to whom the care of the public health is entrusted.

R. T. HEWLETT.

[1] "Thirty-third Annual Report of the Local Government Board, 1903-4." Supplement containing the Report of the Medical Officer for 1903-4.

INFRA-RED SPECTRA.[1]

THE record of an enormous amount of work on the absorption spectra of organic compounds and emission spectra of various metals and gases in the infra-red region is given in the volume under notice. The investigations were commenced whilst the author was a graduate student at Cornell University, and completed under the auspices of the Carnegie Institution of Washington.

Even to summarise the mass of valuable information contained would exceed the limits of our present space, but it may be said at once that, to workers along similar and related lines, these results, and the descriptions of the apparatus and methods whereby they were obtained, are indispensable.

Part i. occupies nearly seven-eighths of the whole volume, and deals with the absorption spectra of 131 organic compounds up to 15 μ. As is pointed out in the very complete historical review, all previous workers in this subject have abandoned the investigation at 7 μ for the alcohols and 10 μ for some few other compounds.

The description of the apparatus and methods is exhaustive and invaluable. From 0·8 μ to 2·5 μ a quartz prism was employed, beyond that, and up to 15 μ, one made of rock-salt. The source of the radiations was a Nernst lamp "heater," which gives a spectrum of which the energy curve is smooth and continuous. A reflecting spectrometer of 35 cm. focal length was employed for the explorations of the spectrum up to 15 μ, and a considerable portion of the work up to 7·5 μ was repeated with a spectrometer of 1 m. focal length.

The distribution of the energy in each spectrum was determined by means of a radiometer similar to that devised by Nicholls, but with some modifications.

The principal reasons for this investigation were the determination of the influence of molecular weight upon absorption spectra, and also the effect of molecular structure. The results show that in different compounds each of these causes in turn acts separately, whilst in other compounds the absorption is produced by the combined effect.

In recording the quartz-prism results the author deals separately with each absorption band in the nineteen compounds investigated, whilst in the other results the compounds are treated separately, notes being made of the chemical structure and properties of each substance where necessary.

Numerous tables set out the numerical results in various forms, whilst 140 full-page *transmission* curves show them graphically. In addition to these the author has written seven brief appendices dealing with side-issues in connection with the apparatus and the investigation and its results.

In part ii. Mr. Coblentz deals with the infra-red emission spectra of various metals, metallic chlorides (alkalies), and gases. The metals were employed as the poles for the arc producing the radiations, whilst the chlorides were volatilised on carbon arcs. The apparatus was very similar to that described in part i., except for a few modifications rendered necessary by the greater intensity and unsteadiness of the radiations.

With the metals, a black-body spectrum due to the oxides, and sufficiently strong to obliterate any emission lines which might be present, was found, and in the alkali chloride spectra no lines were discovered beyond 2 μ. Of the gases investigated—in vacuum tubes—N was found to be the only one having strong emission lines in its infra-red spectrum. CO_2, CO, and the vapour of C_2H_5HO were

[1] "Investigations of Infra-Red Spectra." By William W. Coblentz. Pp. vi+331. (Washington, D.C.: The Carnegie Institution, 1905.)

found to exhibit a very strong emission band at 4·75 μ. The emission spectrum of C_2H_5OH shows that a vapour in a vacuum tube can emit a continuous spectrum.

Ångström's conclusions—deduced from the fact that the total radiation *increases*, while the luminous radiation *decreases*, with increase of pressure in the gas—that there are two kinds of radiation present during the electrical discharge are found to be in close agreement with the observed facts. These different discharges were named "regular" and "irregular" (*i.e.* luminescence) by the previous observer. An interesting theoretical discussion of the action of pressure in this connection is given in the volume.

W. E. R.

DISEASES OF VINES.[1]

TWO parts of the *Annales de l'Institut Central Ampélologique Royal Hongrois*, devoted to two of the vine diseases, have lately reached us.

In one of these parts (part iii.) an account is given of the little known disease caused by the attacks of *Phyllosticta Bizzozeriana*. The disease was first noticed in the year 1900, and it has been kept under observation since then, with the result that its spread has been traced in some detail. The symptoms are somewhat similar to those of the dreaded "black-rot," but it does not appear as if it will prove so dangerous a parasite. In addition to a brief life-history of the fungus, illustrated by an excellent plate, a useful compendium of the species of Phyllosticta occurring on the vine is given.

Part iv. contains an unusually complete account of the "grey-rot" caused by *Botrytis cinerea*. This is one of the parasites of the vine which the cultivator most dreads. All aërial parts of the host-plant are attacked indiscriminately, and quickly become covered with a greyish or brown mould, which produces enormous quantities of ashy-grey spores. This stage is succeeded by the formation of small black sclerotia in the diseased tissues of the stems, leaves, and fruits. Naturally the fungus has been investigated time after time, but the researches of Istvanffi, published in this volume, have added a number of fresh facts to our knowledge of its life-history. In the first place, a series of laboratory investigations was made with the object of determining the conditions under which the fungus brought about the infection of the host-plant. The optimum temperature for the germination of the spores proved to be 25° C., whilst the spores were killed by exposure to a temperature of 38° C. to 41° C. The effects of drying the spores were then investigated. One day's drying over sulphuric acid at laboratory temperatures, either in light or darkness, was sufficient to kill 75 per cent. of the spores, and desiccation for thirty-six days was fatal to all of them. Spores previously germinated and exposed to this treatment suffered still more severely. The results of freezing were again seriously to diminish their germinating capacity.

The action of a number of the commoner fungicides on spores was then examined, with interesting results. Thus a 1 per cent. solution of Bordeaux mixture only prevented the germination of some 60 per cent., and a 10 per cent. solution about 10 per cent. Spores which were allowed to dry after soaking in Bordeaux mixture all failed to germinate. Others sown in drops on the foliage of the host-plant not only germinated, but infected the tissues below them. On examining the action of the constituents of this mixture, lime water proved to be singularly efficacious in preventing germination.

In the majority of these experiments the spores of Monilia and of Coniothyrium were exposed to the same conditions, with results, on the whole, similar to those already quoted. At the same time, the life-history of the fungus was traced in detail. Istvanffi succeeded in germinating the sclerotia, and has settled the point once for all that they do give rise to the apothecia of *Sclerotinia fuckeliana*. So many observers have failed to obtain this ascigerous stage that it is well to have this definite statement. The sclerotia retain their germinating capacity for at least twenty-one months. Another interesting point brought out in the course of this research is that the well known adpressoria of the fungus are the early stages in the development of the sclerotia. In addition to the microconidia observed by Brefeld and others, Istvanffi records the production of an oidial stage.

For further details, and for methods to be adopted for checking the spread of this pest, the original must be consulted. It is full of points of interest to the student of plant pathology, and makes one regret more and more that this country possesses no institute similar to the Central Ampélologique Royal Hongrois, where the pressing problems of plant disease can be adequately examined. Here we have to trust to the private individual for what investigations are made, and he all too rarely has opportunities to make them on the comprehensive scale possible at such an institution.

[1] "Annales de l'Institut Central Ampélologique Royal Hongrois," tome iii., livre 3 and 4, 1905. (Budapest, 1905.)

EARTHQUAKE ORIGINS.

AMONG the most interesting and important of the new ideas, which have been introduced into seismology, in late years, must be classed Major E. G. Harboe's notion of the nature of earthquake origins. Originally treated as a point, the focus of an earthquake has long been recognised as an area, but we are still in the habit of regarding it as restricted in size and small in comparison with the dimensions of the area over which the earthquake is felt. On this hypothesis the decrease in violence is correlated with increase in distance, and due to a gradual diminution of intensity as the disturbance travels from its origin; according to Major Harloe's conception, the focus of an earthquake is no longer restricted in size, but ramifies, with a varying degree of initial violence, over nearly the whole of the seismic area.

On the generally accepted hypothesis the coseismal lines should more or less correspond with the isoseismal, a decrease in violence being accompanied by an increase of time interval, but such is far from being the case, and we have been in the habit of attributing the irregularities to errors of observation; Major Harboe has now shown that another explanation is possible, and that the irregularities in recorded times almost disappear if his hypothesis of the nature of the origin is adopted. From the discussion of the records of earthquakes he reaches the conclusion that the true rate of propagation of the sensible shock is about 0·4 kilometre per second, the higher velocities obtained by other investigators being compounded of the rate of propagation of the disturbance along the origin, and that of the wave-motion set up by this disturbance.

This rate of propagation is that of the sensible shock, which can be felt by human beings, and not that of the large waves recorded by seismographs outside the seismic area proper; the latter, the rate of propagation of which is about 3 kilometres per second, are regarded as different in character, and propagated in the consolidated rock at some little depth below the surface, the sensible shock being due to quite superficial waves propagated through the more fissured and less coherent surface rocks.

One of the weightiest of the objections to this hypothesis was the value of $3·28 \pm 0·05$ km. sec. obtained by Profs. Sekiya and Omori in 1902 from the seismic triangulation started by Prof. Milne in 1884. This is dealt with in vol. viii., part iii., of Gerland's *Beiträge zur Geophysik*, where Major Harboe remarks that, in spite of the long period over which the observations extended, only four earthquakes seem to have given usable records from all the stations, three earthquakes at three stations, and one at two stations. Taking two of these earthquakes, for which records from a number of meteorological observatories have been published, he finds that the velocity and direction of propagation, deduced from the triangulation, lead to most discordant results at other stations, irregularities which disappear if a branch of the origin is supposed to have trayersed the field of triangulation and the disturbance to have spread outwards to the stations.

Whether the hypothesis stands the test of future investigation or not, it seems to explain many previously inexplicable anomalies, apart from those of time. It appears to work out satisfactorily in the case of those earthquakes by which Major Harboe has attempted to test

it, but the only true testing must be left to investigators of the future, for it is to be feared that in the past seismologists have been inclined to reject, as bad, all records of time which failed to fit in with their preconceived ideas of the direction of propagation of the shock, though they might have fitted in with a less simple, though possibly truer, conception of the form and extent of the earthquake origin.

R. D. OLDHAM.

CURRENTS IN THE STRAITS OF MESSINA.

FOR our knowledge of the physical conditions at the bottom of the sea we are very largely beholden to the enterprise of submarine cable companies; indeed, it is difficult to imagine a more thoroughly satisfactory method of survey than that employed by them. Duties connected with the maintenance of cables have led to the discovery of details in the configuration of submarine gullies, of fresh-water outlets beneath the sea, and of alterations in the bed of the ocean itself, which would otherwise have eluded observation. Prof. Platania, of the Istituto Nautico of Catania, has directed attention to another rather surprising fact, namely, that in the Straits of Messina there are deep-water currents of sufficient velocity to cause the interruption of the cables joining Sicily with the mainland ("I cavi telegrafici e le correnti sottomarine nello stretto di Messina," reprinted from the *Atti della R. Accademia Peloritana*, vol. xx.). The period under observation covers the last forty years, during which time there have been twenty-six interruptions; neglecting two, nineteen occurred between November and April, and five between May and October. The strong currents cause a continual attrition by sand and pebbles. The rocks on the sea bottom are swept free of mud and sand, and their rough surfaces, thus exposed, have worn out the cables lying upon them. In one case a cable seems to have been corroded by a sulphurous spring. The surface currents attain a speed of five miles an hour. They have always been a danger to navigation, and the wrecks of two large vessels which were lying last summer upon the Sicilian shore show that Scylla and Charybdis have lost none of their power. The existence of correlated strong deep-water currents had been suspected. Biologists have long been attracted to Messina by the plentiful harvest of deep-sea animals which are occasionally brought up to the surface by a vast turmoil of waters, thus affording almost unique opportunities. M. Thoulet and others have repeated the classical experiments of our countryman, Captain Richard Bolland, made in 1675 in the Straits of Gibraltar, and have demonstrated the existence, at twenty fathoms, of an undercurrent flowing in a contrary direction to that on the surface, but these currents have not yet been as systematically studied as the importance of the subject demands. The tides, as is frequently the case in narrow straits, as, for instance, inside the Isle of Wight, are doubled.

A PERIODICAL FOR PALÆONTOLOGISTS.

THIS new venture in scientific literature,[1] which is to appear quarterly, and leads off with a double number, will be warmly welcomed by all palæontologists, for since the "Annales des Sciences Géologiques" ceased to exist, there has been no accredited journal for palæontology in France. The "Annales des Sciences Naturelles: Zoologie," it is true, has on occasion offered the hospitality of its pages, but the whole of its space is not too great for the living subject.

Material enough and to spare lies ready to hand at the Paris Museum in collections from all parts of France and its colonies, while it is further intended to carry on D'Orbigny's incompleted tasks begun in his "Paleontologie Française" and "Prodrome de Paléontologie stratigraphique universelle." The publication of illustrations of the yet unfigured types of the latter work, with reprints of the author's diagnoses, accompanied by notes and explanations, an undertaking of great merit, is begun in this first part.

As regards guiding principles, the editor, while not wishing in any way to dictate to his contributors, gently suggests in his introduction that he has preferences. On the one hand, he seeks memoirs on stratigraphical or purely systematic palæontology, in which the principal object will not be the multiplication of genera and species, holding as he does that *mieux valent des choses sans noms que des noms sans choses*. On the other, he inclines to papers having a philosophic bearing.

With his former predilection all must be in accord, while of the latter, the very first paper, one by the veteran Albert Gaudry, "Fossiles de Patagonie. Les attitudes de quelques Animaux," is an excellent example, where "attitudes" is used to express the comparative bearing, gait, and appearance, and not posture alone. The author points out that in Tertiary times in Patagonia Plantigrades and Rectigrades predominated over Digitigrades.

The editor and M. A. Thevenin give the first instalment of a series of memoirs on the palæontology of Madagascar, in which they deal with the molluscan fauna from newly discovered Upper Cretaceous beds on the eastern side of the island. Some of the species enumerated are identical with those found by the Rev. R. Baron in the northern and north-western districts, that were described by Mr. R. B. Newton in the Quart. Journ. Geol. Soc. for 1889 and 1895, a fact to which, however, allusion is not made. This fauna presents considerable analogy with that which lived during the same epoch in India.

The second contribution to the same series, by M. Douville, treats of some nummulitic beds in Madagascar.

M. Boule adds a memoir on "Les grands Chats des Cavernes," principally the lion, that takes the form of a popular review of current knowledge on the subject.

The part concludes with the opening portion of the descriptions and figures of D'Orbigny's types already referred to.

Altogether there are 100 pages of text, with nine phototype plates, besides abundant illustrations in the text, all the figures being most excellent, and veritable works of art.

There is, indeed, but one objection to raise, and that is against the adoption of dual pagination, each paper having its distinct pagination in addition to that of the volume, because the disadvantages of this system for purposes of citation far outweigh any possible benefits.

It is to be hoped that the glossy surfaced paper selected, so suitable for modern text illustrations, though not for type of the face employed, is not of that perishable description which we have been lately warned will deprive future generations of the fruits of our intellectual labours.

B. B. W.

[1] "Annales de Paléontologie, publiées sous la direction de Marcellin Boule." Tome i. fasc. 1 and 2. January, 1906. Pp. xi+100; 9 plates. (Paris: Masson et Cie.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for mathematics has put forward new proposals, both with regard to the mathematical tripos and the mechanical sciences tripos, which involve far-reaching changes. The first-named report points out that in the opinion of the special board the existing mathematical tripos is unsatisfactory as an examination. The special board proposes to substitute for the present part i. a new part i., which may be taken by a student either at the end of his first or second year. Part i. will not qualify for a degree without further examination. It is hoped that this part will be taken by many who propose to proceed later to study engineering or natural sciences. The board further proposes that for the existing part ii. a new part ii. be established, which must be taken at the end of the third year. The position of senior wrangler is abolished, but the class list of each part will contain three classes, the names in each class being arranged alphabetically. Schedules are published for each of the proposed new parts.

With regard to the report of the mechanical sciences tripos, the special board of mathematics suggests that part ii. of the tripos should be abolished, and it is proposed to modify part i. by the inclusion of a number of

papers on questions of greater difficulty or of wider range than the average of those now set. The other papers of this part are, however, to be made easier than the present average. The board hopes to include a paper on chemistry in the future. It is also considered to be desirable that the examiners should be empowered to take into consideration the laboratory and drawing-office work done by the student during his course; but perhaps the most important of the recommendations is that every candidate for the mechanical sciences tripos, unless he has obtained honours in one of the honours examinations of the University, must pass a qualifying examination in elementary mathematics and mechanics, which will be held twice a year.

The special board for biology and geology has renominated Mr. F. A. Potts, of Trinity Hall, to use the University table at Naples for four months from April 1. Applications for the use of this table and for that at the Marine Biological Association's laboratory at Plymouth should be sent in to the chairman of the special board (Prof. Langley) on or before May 24.

Dr. Haddon is giving a special course of lectures on magic and savage religion on Mondays during this term.

PROF. FRIEDRICH CZAPEK, of the Prague Technical High School, has been appointed professor of botany in Czernowitz University. Prof. Armin Tschermak, of the University of Halle, has been appointed professor of physiology and medical physics in the Veterinary High School, Vienna.

IT is announced by *Science* that Adelbert College, Western Reserve University, has received 30,000*l.* from the grandchildren of Mr. Joseph Perkins, formerly a trustee of the college. The money is to be used for a department of sociology and a chemical laboratory.

ON Commemoration Day at Glasgow University on April 18 the honorary degree of Doctor of Laws was conferred upon Mr. James S. Dixon, founder of the lectureship of mining in the University, and Mr. R. E. Froude, superintendent of the Admiralty experimental works at Haslar.

ALTHOUGH we are far behind other nations in governmental recognition of the claims of anthropology, the universities, the older ones leading the way, are following their Continental sisters in making it a subject of systematic study by providing courses of instruction and establishing diplomas and other distinctions. The Oxford committee for anthropology has just issued the regulations for the diploma and the list of lectures for the next two terms. It is pointed out by the committee that not only members of the university, especially those whose work will bring them in contact with native tribes, will benefit from the newly-established course of study, but also those already in contact with native races who feel the need of extending their anthropological knowledge during their "long leave." The schedule of lectures shows that although no provision can yet be made for systematic instruction covering the whole of the very wide field in even a summary manner, students who present themselves are sure of finding helpful and stimulating teaching in all the more important branches of the subject: the chief omission at present is the failure to include social organisation, usually a crux for missionaries and the untrained generally, among subjects on which aid may be sought. The secretary of the committee is Mr. J. L. Myres, Christ Church, from whom all information may be obtained.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"A Further Communication on the Specificity and Action *in vitro* of Gastrotoxin." By Dr. Charles **Bolton.**

An analysis in the test-tube of the gastric cytotoxin obtained by injecting the rabbit with guinea-pig's stomach cells has shown that it is a complex body. After a single injection there is a great increase in the hæmolysin normally occurring in the rabbit's blood, and after further injections an artificial hæmolysin makes its appearance. The artificial hæmolysin is distinguished from the natural hæmolysin, because the former can be complemented by guinea-pig's normal blood serum, whereas the latter cannot. There is also present in the immune serum a substance which agglutinates the red blood corpuscles. Closely associated with the appearance of this artificial hæmolytic immune body is that of an agglutinin which acts upon the gastric granules, and also that of a precipitin which acts upon the soluble proteids of the gastric cells. By repeating the injections these substances are found to be present in the blood for several months. Whether they are one and the same or distinct bodies has not yet been proved. After several injections, and not less than about five weeks from the first, a further substance appears in the blood, which possesses an action upon the intact gastric cells. In spite of repeated injections this substance disappears from the blood in about four months. It is probably of the same nature as a hæmolysin, but this point requires proof.

The hæmolytic factor is only active against blood. The actions of the agglutinin and precipitin are not confined to the constituents of the gastric cells, but extend to other proteids of the body. Whether there are separate agglutinins and precipitins for different proteids, or whether the same substances act upon all proteids, has not been determined; at all events, if the same bodies are concerned in all cases, their action upon the proteids of the stomach cells is probably greater than that upon other proteids. Whether the gastrolysin itself is truly specific remains to be proved.

The few experiments that have been undertaken in the case of the human stomach indicate that the human gastric cytotoxin is identical in constitution with that of the lower animals.

February 8.—"Explosions of Coal-gas and Air." By Prof. Bertram **Hopkinson.**

The explosion of homogeneous mixtures of coal-gas and air at atmospheric pressure and temperature is investigated by means of platinum resistance thermometers placed at various points in the explosion vessel. The vessel is of dumpy cylindrical form and 6·2 cubic feet capacity, and the mixture is fired by an electric spark at the centre. Each thermometer consists of a loop of bare platinum wire about 5 centimetres long and 1/1000th inch diameter, which is placed in series with a battery of constant potential and a reflecting galvanometer, of short periodic time, the deflection of which is recorded photographically on a revolving drum. On the same drum the pressure of the gas is recorded. The arrival of the flame at any wire is marked by a sharp rise in its resistance, and the rate of rise, when corrected for the time lag of the wire, gives a measure of the velocity with which the gases about it combine. It is found that with a mixture consisting of one volume of gas and nine of air the flame spreads from the spark in a somewhat irregular manner, but at a rate of roughly 150 centimetres per second. A thermometer placed near the spark shows a sudden rise of temperature to about 1200° C., after which the temperature remains nearly constant until the flame approaches the walls of the vessel. With the rapid rise of pressure which then occurs the adiabatic compression of the burned gas at the centre causes the temperature there to rise to about 1900° C., with the result that the wire of the thermometer generally melts. At a point near the walls the gas is compressed to near the maximum pressure before ignition, and the temperature consequently rises suddenly to 1200° C. or 1300° C., and as there is little subsequent compression there is not much further rise of temperature. Thus, in consequence of the different treatment of the gas at different points in the vessel, differences of temperature of 500° C. exist in the gas at maximum pressure after an explosion of this kind. That such differences must necessarily exist after an explosion even in a vessel impervious to heat does not appear to have been noticed hitherto. These differences are rapidly obliterated by convection currents, but their magnitude at the moment of maximum pressure is such as to make it impossible to obtain an accurate estimate of the specific heat from the pressure record after the manner of Messrs. Mallard and Le Chatelier. The work of these experimenters is not, however, open to the chief objection that has hitherto been urged against it, viz. that combustion was incomplete when they measured the specific heat. The experiments here described show that the combustion at any point is prac-

tically finished 1/40th of a second after it begins, and that 1/30th of a second after the attainment of maximum pressure the gas in the vessel may be regarded as a mixture of CO_2, steam, and inert gases in chemical equilibrium.

The pressure of the ignited gas at the centre of the vessel is increased during the spread of the flame from one atmosphere to six. During this time it loses no heat, and the rise of temperature observed is from 1200° C. to 1900° C. It follows that between these limits of temperature the average value of γ for these gases is 1·25.

With a weaker mixture containing one volume of gas and twelve of air the spread of the flame is very much slower, about 2½ seconds elapsing before all the gas is burned. Owing to the slow propagation of the flame, convection currents play an important part during the process of ignition; the burned gases rise to the top of the vessel, and the last portion of gas to be ignited is not close to the wall, but immediately under the spark, and a short distance from it; but though the flame is propagated very slowly, the combustion of any given portion of gas, when once started, proceeds almost as rapidly as in the stronger mixture. There is no "after-burning" in the sense of the slow completion of a reaction already begun. Within 1/10th of a second before the time of maximum pressure some gas is still unburnt; within 1/10th of a second after all the gas is completely burned, and the mixture everywhere in chemical equilibrium.

Incidentally, the difference of temperature between a fine wire immersed in the gas and the temperature of the gas is determined by comparing the temperatures of two wires, one having double the diameter of the other, placed close together in the same explosion. The error due to radiation is thus found, and it is shown that if a wire 1/500th of an inch in diameter is getting hotter at the rate of 1300° C. per second, then it must be 200° C. colder than the gas surrounding it. The results are used to find the actual temperature of the gas from that of a wire 1/10000th of an inch diameter immersed in it, and the conclusion is drawn that the temperatures in a gas-engine cylinder cannot be obtained by the use of a wire thicker than this, except by applying corrections amounting to several hundred degrees centigrade.

The bearing of the results on the question of "after-burning" in the gas engine is discussed, and it is shown that the high specific heat of the products of combustion, together with some loss of heat during the passage of the flame through the compression space, accounts for all the peculiarities of the gas-engine diagram. The form of diagram obtained with weak mixtures is due simply to the very slow propagation of the flame, and not to any delay in the attainment of chemical equilibrium at a point which the flame has already reached.

March 15.—"A Discussion of Atmospheric Electric Potential Results at Kew, from selected Days during the Seven Years 1898 to 1904." By Dr. C. **Chree**, F.R.S.

The paper contains an analysis of atmospheric electricity results at Kew on selected fine-weather days—usually ten a month—from 1898 to 1904.

All days were excluded when rain fell or negative potential was recorded. All data are given in absolute measure (volts per metre). The diurnal inequalities for individual months and the year are represented by curves. These all show two distinct daily maxima and minima. The minima always occur near 4 a.m. and 2 p.m. The times of the maxima are more variable, the day interval between the two being longer in summer than in winter.

The highest mean potential gradient occurs in December. Whilst the amplitude of diurnal inequality is greatest in mid-winter, the ratio in which it stands to the mean daily value is then least. The diurnal inequalities for the several months are analysed in 4-wave Fourier series. The 12-hour term is, in general, the most important; the changes in its amplitude and phase angle throughout the year are comparatively small. The 24-hour term is much larger in the winter than in the summer months, and its phase angle varies greatly. Attention is also given to the phenomena of individual days. The difference between the highest and lowest hourly values averages two and a half times the amplitude of the regular diurnal inequality, and is fully larger than the mean value for the day.

Of various meteorological elements temperature is found to have much the most marked influence, high mean potential and large diurnal range of potential being associated with low temperature in every month of the year, except the hottest (July).

An appendix compares the diurnal inequalities of potential and barometric pressure. Diurnal inequalities were got out for each month of the year for the barometric pressure at Kew for an 11-year period. The similarity between the diurnal inequalities of the two elements is found to be confined to the 12-hour terms; the 24-hour terms present diametrically opposed phenomena in the two cases. The afternoon minimum and evening maximum of potential are in every month notably in advance of those of barometric pressure. If any relationship of cause and effect exists between the *regular* diurnal changes in the two elements, the pressure change would seem to be the effect, the potential change the cause.

Geological Society, April 4.—Mr. R. S. Herries, vice-president, in the chair.—A case of unconformity and thrust in the Coal-measures of Northumberland: Prof. G. A. L. **Lebour** and Dr. J. A. **Smythe**. The sections described occur on the coast north of the Tyne, near Whitley Sands, between Table Rocks and Briar-Dene Burn. The base of the "Table-Rocks Sandstone" is found to rest unconformably upon a series of alternating shales and sandstones, among which is a well-marked band of clay-ironstone crowded with *Carbonicola acuta*, one of those "mussel-bands" which are found to be perhaps the most remarkably persistent strata in the north of England Carboniferous rocks.—The Carboniferous succession below the Coal-measures in North Shropshire, Denbighshire, and Flintshire: Dr. Wheelton **Hind** and J. T. **Stobbs**. This paper opens with a critical account of previous research among the Carboniferous rocks of North Wales. Then follows a detailed account of the various beds, exposed in numerous quarries worked for road-metal, iron manufacture, lime, cement, chert, or building-stone. Fossil lists are given from each exposure of importance. A range table is given of the chief brachiopods and corals, and the palæontological sequence is compared with that occurring at Bristol and in the north of England.

Chemical Society, April 5.—Prof. R. Meldola, F.R.S., president, in the chair.—An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light: W. H. **Perkin**, sen. The improved apparatus consists of a short but very powerful coil carrying a powerful electric current. The coil is cased with steel, and has a 3-inch gun-metal tube through the centre, the interior of this being the position of the magnetic field. The glass measuring tubes are supported in this tube in a metal trough which can be kept at any required temperature. A method of obtaining a powerful sodium light was described, which consists in heating a platinum boat containing sodium chloride by a small oxygen-coal gas flame. This causes the sodium chloride to volatilise, and the vapour, passing into a flame produced by a large Bunsen burner, gives a very intense, yellow light, which can be maintained for a long time.—The rusting of iron: G. T. **Moody**. The explanation of rusting as a process involving the production of hydrogen peroxide, as advanced by Dunstan, is directly negatived by experimental evidence, which shows that atmospheric corrosion results first from the interaction of iron and carbonic acid, whereby ferrous salt is formed, and subsequently from the more or less complete oxidation of ferrous salt by oxygen. It is found, moreover, that the composition of iron rust is not fairly represented by the formula $Fe_2O_2(OH)_2$, as stated by the foregoing investigator.—The estimation of carbon in soils: A. D. **Hall**, N. H. J. **Miller**, and N. **Marmu**. The soil is treated with chromic acid, and the resulting gases passed over a short length of copper oxide. The carbon dioxide formed is absorbed by alkali and estimated by double titration.—Electrolysis of salts of $\beta\beta'$-dimethylglutaric acid: J. **Walker** and J. K. **Wood**.—Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid: J. K. **Wood**.—Some new *o*-xylene derivatives: G. **Stallard**.—A new solvent for gold, preliminary note: J. **Moir**. The author finds that gold-leaf dissolves fairly readily when floated on an acid solution of ordinary thiocarbamide, and solution

is accelerated by the presence of an oxidising agent. The gold compound produced forms brilliant, colourless, six-sided lozenges, and contains 45·4 per cent. of gold.—The molecular condition in solution of ferrous oxalate, a correction: S. E. **Sheppard** and C. E. K. **Mees.**—Acetyl and benzoyl derivatives of phthalimide and phthalamic acid: A. W. **Titherley** and W. L. **Hicks.**—The dynamic isomerism of phloroglucinol: E. P. **Hedley.** The following conclusions were established:—(1) that in neutral solutions phloroglucinol exists in both modifications, the enol being greatly in preponderance over the keto-form; and (2) that this equilibrium is undisturbed by the class of solvent.—Studies in asymmetric synthesis, v., asymmetric syntheses from *l*-bornyl pyruvate: A. **McKenzie** and H. **Wren.**—*l*-Methyl*cyclo*hexylidene-(4)-acetic acid: W. H. **Perkin,** jun., and W. J. **Pope.**—Condensation of benzophenone chloride with α- and β-naphthols: G. W. **Clough.**—The constitution of coerulignone (cediret), a preliminary note: J. **Moir.**—A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radical: T. V. **Barker.** On comparing the perchlorates with the permanganates, it is found that the effect of replacing an atom of chlorine by one of manganese is much the same as that induced by the substitution of sulphur by selenium, say, in the sulphates of the same metals. The crystallographic evidence for placing manganese in the seventh group of the periodic classification, so far as such evidence goes, is therefore of the strongest possible kind.—Contribution to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another: T. V. **Barker.**—Constitution of salicin. Synthesis of pentamethylsalicin: J. C. **Irvine** and R. E. **Rose.** It is shown that salicin (and hence also helicin and populin) contains the same γ-oxidic linking as the methylglucosides and sucrose.—A product of the action of *iso*amyl nitrite on pyrogallol: A. G. **Perkin** and A. B. **Steven.** The main bulk of the product formed in this reaction has the composition $C_6H_4O_3$, and it appears likely that it may consist of hydroxy-*o*-benzoquinone.—A reaction of ellagic and flavellagic acids: A. G. **Perkin.** Ellagic acid is oxidised by sulphuric acid to a compound having the formula $C_{14}H_{16}O_{10}$. Flavellagic acid yields a similar oxidation product.—Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines: O. C. M. **Davis.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

SOCIETY OF ARTS, at 4.30.—Seistan, Past and Present: Colonel A. H. McMahon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews.

MATHEMATICAL SOCIETY, at 5.30.—Perpetuants and Contraperpetuants: Prof. E. B. Elliott.—(1) A Question in the Theory of Aggregates; (2) The Canonical Forms of the Ternary Sextic and Quaternary Quartic: Prof. A. C. Dixon.—On the Question of the Existence of Transfinite Numbers: P. E. B. Jourdain.—Some Theorems connected with Abel's Theorem on the Continuity of Power Series: G. H. Hardy.—On a Set of Intervals about the Rational Numbers: A. R. Richardson.—On Two Cubics in Triangular Relation: Prof. F. Morley.—On the Accuracy of Interpolation by Finite Differences: W. F. Sheppard.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Ore Deposits and their Distribution in Depth: Prof. J. W. Gregory, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: Louis Greaven.

PHYSICAL SOCIETY, at 5.

AËRONAUTICAL SOCIETY, at 8.—The Use of the Balloon in the National Antarctic Expedition: Captain Robert Falcon Scott, R.N.—The Experiments of the Brothers Wright: Sir Hiram S. Maxim.—The Carrying Power of Aëroplanes: M. José Weiss.

MONDAY, APRIL 30.

INSTITUTE OF ACTUARIES, at 5.—Reversionary Securities as Investments: C. R. V. Coutts.

TUESDAY, MAY 1.

SOCIETY OF ARTS, at 4.30.—Social Conditions in Australia: Hon. J. G. Jenkins, Agent-General for South Australia.

ZOOLOGICAL SOCIETY, at 8.30.—Additional Notes on Anthropoid Apes, with Exhibition of Specimens: Hon. Walter Rothschild.—On Mammals collected in South-west Australia by Mr. W. E. Balston: Oldfield Thomas, F.R.S.—On the Lepidoptera collected during the Recent Expedition to Tibet: H. J. Elwes, F.R.S., and Sir George Hampson, Bart.

WEDNESDAY, MAY 2.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fourteenth "James Forrest" Lecture: Unsolved Problems in Metallurgy: R. A. Hadfield.

SOCIETY OF ARTS, at 8.—Submarine Signalling: J. B. Millet.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Fat in Homogenised Milk: H. Droop Richmond.—Milk Analysis: H. Droop Richmond and E. H. Miller.—Note on the Composition of Saffron: A. E. Parkes.—On the Polenske Method for the Detection of Cocoanut Oil in Butter: Dr. S. Rideal and H. G. Harrison.—On the Presence and Detection of Cyanogen in Java and other Beans: R. R. Tatlock and R. T. Thomson.—On the Examination of Linseed, Olive and Other Oils: R. T. Thomson and H. Dunlop.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers:* On a Static Method of Comparing the Densities of Gases: Prof. R. Threlfall, F.R.S.—The Stability of Submarines: Sir William H. White, K.C.B., F.R.S.—The Action on Bacteria of Electrical Discharges of High Potential and Rapid Frequency: A. G. R. Foulerton and A. M. Kellas.—The Action of Pituitary Extracts upon the Kidney: Prof. E. A. Schäfer, F.R.S., and P. T. Herring.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption-Spectra and Chemical Constitution, part v.: The *iso*Nitroso-compounds: E. C. C. Baly, E. G. Marsden, and A. W. Stewart.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Malonate, part ii.: W. H. Perkin, jun., and J. L. Simonsen.—Brazilin and Hæmatoxylin, part vii., Some Derivatives of Brazilein: P. Engels, and W. H. Perkin, jun.—Pipitzahoic Acid: J. M. Sanders.—The Constitution of the Hydroxides and Cyanides obtained from Acridine, Methyl-acridine and Phenanthridine Methiodides: C. K. Tinkler.—The Constitution of Ammonium Amalgam: E. M. Rich and M. W. Travers.—Action of Light on Potassium Ferrocyanide: G. W. A. Foster.

LINNEAN SOCIETY, at 8.—Origin of Gymnosperms (*Continuation of Discussion*): Dr. D. H. Scott, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Observations on Bacterial Tank Operations: Dr. W. O. Travis.

CONTENTS.