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TWO WORKS ON WIRELESS TELEGRAPHY.

(1) *Précis de Télégraphie sans Fil. Complément de l'Ouvrage: les Oscillations Electromagnétiques et la Télégraphie sans Fil.* By Prof. J. Zenneck, Translated from the German by P. Blanchin, G. Guérard and E. Picot. Pp. x+385. (Paris: Gauthier-Villars, 1911.) Price 12 francs.

(2) *A Handbook of Wireless Telegraphy: its Theory and Practice. For the Use of Electrical Engineers, Students, and Operators.* By Dr. J. Erskine-Murray. Third edition, revised and enlarged. Pp. xvi+386. (London: Crosby, Lockwood and Son, 1911.) Price 10*s.* 6*d.* net.

(1) THE literature of wireless telegraphy grows apace, both in new books and new editions. This at least is a proof that the art is in a progressive condition. The book by Dr. J. Zenneck before us is a French translation, under the title "Précis de Télégraphie sans Fil," of a work by him which appeared in Germany two years ago, called "Leitfaden der Drahtlosen Telegraphie."

It is, as the author tells us, intended as a condensation and supplement of his larger treatise on "Electrical Oscillations and Wireless Telegraphy," published in 1905. In the present work mathematical discussions have been almost completely avoided, and the reader is referred to other sources for the systematic proofs of the few formulæ given. The book appeals therefore to the general reader or practical worker who wishes for a non-mathematical but scientific discussion of phenomena. The numerous excellent diagrams, curves, arrangements of circuits, and illustrations of apparatus are sufficient to convey to the careful reader a large amount of solid information on the subject. One good feature is that there is no attempt to describe various "systems" of wireless telegraphy by different inventors; but the separate elements which make up the arrangements generally used are scientifically discussed. Beginning with the analysis of the phenomena of oscillations in a condenser circuit and the measurement of the quantities concerned, we have successive chapters on the transformation of oscillations, resonance curves, antennæ, radiators, detectors, receiver circuits, and directive telegraphy.

The treatment for the most part follows orthodox lines as adopted in other standard treatises on the subject, and is characterised by a German thoroughness of treatment, though marked by an occasional tendency to claim for Germany rather more than is historically warrantable. Thus, for instance, the electric hot-wire thermometer figured on p. 66 is attributed to Riess, whereas Sir William Snow Harris first described it in the Philosophical Transactions of the Royal Society in England in 1827, long before Riess. In the same manner, Prof. F. Braun is given credit on p. 161 for the modern coupled transmitter, whether single coil or double coil, which is called "l'émitteur couplé ou émitteur de Braun," although the recent judgment of Mr. Justice Parker in the British High Court of Justice has declared that the modern tuned coupled transmitter first described by Marconi, whether used with a two coil or with an autotransformer, was not anticipated by the inventions of Braun. The double transformation transmitter, the arrangement of which is figured on p. 173, is the invention of this reviewer, whose name, however, is not mentioned in connection with it. The chapters on resonance curves and on antennæ are very good, but that on transmitters might have been improved by a little more attention to the description and theory of impact dischargers, which are of considerable importance.

In discussing the action of directive antennæ, Dr. Zenneck advances a theory—which is not, however, supported in this book by mathematical proof—that the explanation of the greater range of a bent antenna in the direction opposite to that in which the free end points is to be explained by the different shape of the wave surface on the two sides, so that the wave obtains a greater reach one way than the other, just as a rifle when fired carries further if elevated than if depressed. Another explanation has been given by the writer, based on an opinion expressed by Sir J. Larmor, that the bent antenna can be regarded as a combination of closed and open antennæ. This theory receives experimental support from the work of Bellini and Tosi on directive antennæ. One of the most interesting as well as practical questions in connection with long-distance wireless telegraphy is that of the atmospheric absorption and the influence of daylight in reducing the range of transmission for certain wave lengths. This is generally attributed to ionisation of the atmosphere produced by ultra-violet solar light. This solar radiation is, however, so rapidly absorbed by the atmosphere that the chief effect can only be produced at high altitudes. The theory that it is due to the direct action of ultra-violet light on the sending antenna is not supported by any experimental evidence. The hypothesis that it is due to ionisation of the air receives some confirmation from a certain variation of radiotelegraphic range with variations in atmospheric electricity. It is well known to radiotelegraphists that occasionally atmospheric conditions exist in which quite extraordinary and unusual distances are covered by day as well as by night, and that curious differences exist in the facility with which electric waves of large wave length are propagated in different directions.

We cannot say yet that the phenomenon has received adequate explanation, but materials are being slowly gathered which may in time point to an explanation. The same may be said of the abnormal manner in which electromagnetic waves of long wave length travel round the curvature of the earth. Marconi has succeeded in sending and detecting radiotelegraphic waves at a distance of 6000 miles, or a quarter of the way round the earth. The subject of this abnormal diffraction has been discussed mathematically by Poincaré and by Nicholson, but the complexity introduced by the purely atmospheric and sur-

face absorption of the wave makes it almost impossible to check the mathematical theory which has been given.

(2) The second book before us for review is a third edition of Dr. Erskine-Murray's well-known "Handbook of Wireless Telegraphy." The present edition contains a considerable amount of new matter, but the explanations given of fundamental effects, such as the creation of Hertzian waves, are somewhat too brief to be very useful. The student is not much assisted merely by reproducing on a double page Hertz's well-known diagrams of the electric radiation of a dumbbell oscillator accompanied only by an extract from Hertz's own book, and without further elucidation of the difficulties involved. Rather too much space is occupied in some parts by extracts from original papers, whereas the essentially new information could be concentrated and difficulties removed by a more independent authorship.

After the usual introductory chapters dealing with early history, three chapters follow on detectors for electric waves, considerable space being given to the theory of magnetic detectors and descriptions of forms which have not been much used for radiotelegraphy, whilst the contact or rectifying detectors are very briefly treated. With regard to Fleming's glow-lamp detector, the erroneous remark is made that Dr. de Forest "improved this detector." As a matter of fact, his improvements did not enable it to operate better than in its original form. Chapters viii., ix., x., xi., and xiii. are devoted to descriptions of the Marconi, Lodge-Muirhead, Fessenden, Hozier-Brown, de Forest, and Telefunken "systems" of wireless telegraphy. All of them, however, involve essentially the same system, viz. the spark method, and differ only in the details of the apparatus used. A chapter, which is, however, interesting, is given to methods and apparatus which have never reached the practically efficient stage, such as the "world wave telegraphy" described in chapter xviii., in which Tesla's somewhat tentative experiments are discussed. There is no evidence that any useful telegraphic work has been carried out by these methods.

In the chapter on theories of transmission, a large amount of information is collected on the influence of atmospheric states on radiotelegraphic transmission. Facts are being accumulated which seem to connect variations in received signals over long distances with changes in atmospheric electricity. Much work has yet to be done before a satisfactory theory can be evolved, and it is therefore perhaps premature to attempt to construct such theories in text-books issued now. For one thing, we need much more information than we now possess as to the variation in atmospheric conductivity at high elevations, which may some day perhaps be provided by the use of dirigibles or aëroplanes.

Dr. Murray's book concludes with a useful chapter on high-frequency electric measurements and appendices containing many valuable practical tables, curves, and memoranda. The book is well printed and fully illustrated, and certainly one to be included in any radiotelegraphic library. J. A. F.

THE SCIENCE OF SHIPBUILDING.

The Design and Construction of Ships. By Prof. J. H. Biles. Vol. ii., Stability, Resistance, Propulsion, and Oscillations of Ships. Pp. x+428. (London: C. Griffin and Co., Ltd., 1911.) Price 25*s.* net.

THIS second volume was originally intended to complete the work, but the author found his materials growing rapidly and wisely decided to develop more fully in a third volume his treatment of ship-designing. Like the first volume—reviewed in NATURE, February 18, 1909—the second is complete in itself. It will be of much value as a text-book for advanced students of naval architecture, and as a book of reference for men engaged on the practical details of ship-design. The contents are arranged in four sections; in which the stability, resistance, propulsion, and oscillations of ships are discussed. Under each head is presented an excellent *résumé* of the accepted theory of the subjects treated; in association with valuable data, drawn from recent practice, illustrating the characteristics of various types of ships. A mass of information which was previously widely scattered in various publications has thus been concentrated, including published results of the latest experimental research work.

In dealing with the geometric theory of stability the author has naturally followed the lines laid down by M. Charles Dupin in his memoir entitled "Stabilité des Corps Flottants" (published in 1814), one of the series of "Applications de Géometrie" presented to the Institute of France. Dupin for all practical purposes exhausted the subject, although certain corrections and extensions of his generalisations have since been made by other investigators, more especially as the result of determinations by calculation and experiment of the stability of actual ships made during the last forty years. Prof. Biles describes the methods of calculation, as well as the ingenious integrating instruments (devised by Amsler and others) by means of which arithmetic labour has been greatly reduced. Typical examples are given of curves of stability constructed for many classes of ships, and for different conditions of lading; and the whole section has been arranged in a manner which will enable advanced students to master present knowledge of the subject, while draughtsmen and others who are engaged in the work of calculations of stability will find help and guidance.

From the middle of the eighteenth century mathematicians and experimentalists have been attempting general solutions of the problems of water-resistance to the motion of ships, but with moderate success, and with small practical influence on ship-design, until the late William Froude, little more than forty years ago, introduced the system of experiments on models. Froude demonstrated the law of comparison between ships and models moving at "corresponding speeds," and showed how to make the necessary correction for frictional resistance when passing from models to ships. Model experiments are now universally regarded as necessary to successful steamship design,

when precedents have to be surpassed or greater speeds obtained. They can be applied both to the determination of the ship-forms most suitable under the conditions of a given problem, and to the selection of the most efficient propellers.

The first experimental tank, designed and built by Froude, was placed at Torquay, near his residence. It was comparatively modest in size and equipment, and was not intended to be permanent; but it continued at work for many years, first under the direction of the founder, and then under that of his son (Mr. R. E. Froude, F.R.S.), and yielded remarkable results, greatly to the benefit of the designs of ships of the Royal Navy. About twenty-seven years ago the Admiralty decided to construct at Haslar (near Portsmouth) a larger and better equipped experimental tank, to the designs of Mr. R. E. Froude, who has happily continued ever since in charge of its operations, and has greatly developed the system. This Admiralty tank has been the pattern adopted for tanks subsequently established in this country by a few leading firms of shipbuilders, and for many tanks established abroad. France, Germany, Russia, Italy, the United States, and Japan have followed the lead; and the latest, largest, and best equipped of the series is that which has been added to the National Physical Laboratory by the generosity of Mr. Yarrow. The primary purpose of that tank is the conduct of systematic experimental research, and great results may confidently be anticipated from its operations. Previous tanks have necessarily been chiefly devoted to experiments on models representing ships which are to be built, and pure research work has had to yield to more pressing requirements. At the same time, it is but fair to recognise the fact that many very valuable results of a general character, influencing the selection of the most suitable ship forms and propellers, have been published already. Mr. R. E. Froude (with the sanction of the Admiralty) has been the principal contributor; but Mr. Taylor, the superintendent of the United States tank, Colonel Rota of the Italian Navy, Prof. Sadler of Michigan University, and others have added to available information. Prof. Biles has summarised and analysed the results of tank experiments in the present volume, and has undertaken the labour of presenting the facts in a condensed and practical form; he has thus rendered a service to all who are interested in the subject.

Closely connected with the resistance experienced by ships in motion is the subject of propulsion, which is treated in the third section of this book in an adequate and practical fashion. Model experiments on propellers have been, and are of great value, but they require to be supplemented by trials on full scale. The author has brought together available data and indicated the need for further information. He states the conditions which chiefly govern the efficiency of screw propellers, and gives details of the methods of designing them. Progressive speed trials of actual ships are described and recommended, and there is universal agreement that such trials are essential to success in the practical application of model experiments. Numerous examples are given of the results obtained from experiments both on ships and models.

The subject of the oscillations of ships in still water and among waves furnished the opportunity for a second great contribution by the elder Froude to the science of naval architecture. His work in this direction really constituted a new departure in ship-design. Much has been learned from experiments both with ships and models since Froude indicated the way, and a great deal has been done towards endowing ships with greater steadiness and limiting their oscillations. This result has been due in part to a better understanding of the problem and partly to the use of bilge keels, moving weights, internal water tanks, and other special arrangements the action of which tends to limit the range of oscillation of ships in a sea way. These arrangements are discussed by Prof. Biles, and the effects produced by their use are illustrated by results observed on board ships when in actual service at sea.

Although this book is primarily intended for the use of students of naval architecture, it will be seen from the foregoing summary of its contents that it deserves a wider circulation. It should, in fact, have an interest not merely for students and naval architects, but be welcomed by mathematicians and others, to whom the subjects treated and the experimental results recorded should offer many attractions. W. H. W.

JURASSIC AND CRETACEOUS STRATIGRAPHY.

Traité de Géologie. By Prof. Emile Haug. Vol. ii., Les Périodes géologiques, fasc. 2. Pp. 929–1396. (Paris: A. Colin, n.d.) Price 10 francs.

THE Jurassic and Cretaceous systems were for long the most popular among British geologists, and the former will always be of special interest as the principles of historical geology were established by William Smith from work on the Jurassic rocks of the south-west of England. The second part of the second volume of Prof. Haug's "Traité de Géologie" is devoted to these two systems, and we are glad to note that he retains the Rhætic in the Jurassic. The work is of great value as a summary of a wide range of recent research, and its excellent photographs illustrating many well-known Continental localities are of unusual artistic merit. The book is a useful complement to the great treatise of de Lapparent, with its invaluable tabular correlations. Prof. Haug gives short, readable summaries of the stratigraphical classification and geographical distribution of the formations, and deals especially fully with the bathymetric conditions of their disposition. Lists of characteristic fossils are given, and he wisely gives only generic names. Exception may be taken to some of his palæontological conclusions, such as the affinity of Tetracidaris to Archæocidaris.

The amount of space devoted to different areas is very uneven. In spite of the historic importance of the English Mesozoic rocks, they receive very scant attention. Thus the list of literature on the Jurassic contains 361 titles, of which only eighteen, including eight by Mr. Buckman and two by Prof. Pavlov, deal with the British Jurassic. He apparently considers that British Jurassic geology has not been kept up to date, and remarks that it is difficult to determine

the precise equivalents of the Dorsetshire Kimeridge and Portland beds; he is disposed to adopt the view that the division between Kimeridgian and Portlandian should be drawn through the middle of the Kimeridge clay. The brief reference to the English rocks leaves more space for the account of their Continental representatives, of which a summary of recent work is of most value to British geologists.

The classification of the Cretaceous system adopted by Prof. Haug shows that there is no prospect of agreement as to the nomenclature. He subdivides this system into three groups, the Eocretaceous, all of which he regards as Neocomian; the Mesocretaceous, for the period of the great Cretaceous transgression during the Albian, Cenomanian, and Turonian; and the Neocretaceous, for the upper divisions, all of which he calls Senonian.

Prof. Haug, on the authority of Prof. Cayeux, accepts (p. 1161) the depth of the chalk sea as not more than 150 fathoms. Mr. Jukes-Browne, on the other hand, has recently reasserted the view that parts of the chalk are truly deep-sea deposits. M. Cayeux's low estimate is inadmissible for some zones of the English chalk.

One of the most instructive features of this treatise is its indications as to the progress of opinion on the principles and problems of stratigraphy, which are especially well illustrated by the Mesozoic rocks. Prof. Haug decides in favour of the existence in Jurassic times of well-defined climatic zones. The influence of climate on the distribution of the Jurassic fauna was recognised by Marcou in 1860, and Neumayr in 1883 defined five climatic zones approximately parallel to those of the present day. Several authorities have, however, denied their existence, and Prof. Haug shows that some of the arguments upon which Neumayr based his zones, can no longer be maintained. It would have been very surprising if thirty years' further palæontological research had not modified the known range of some of the fossils. Thus the genera Phylloceras and Lytoceras are less characteristic of the equatorial zone than Neumayr thought, and the distribution of those genera proves to be controlled rather by depth than by climate. There has also been a greater interchange between the faunas of the boreal zone and the north temperate zone in western Europe than was known to Neumayr. Nevertheless, Prof. Haug concludes that the existing evidence confirms the existence of the Jurassic climatic zones, though he retains only the boreal and equatorial zones of Neumayr. The fuller evidence now available enables him to recognise in Upper Jurassic times several well-defined zoological provinces.

The nature of earth movements is a problem of which Prof. Haug's solution greatly affects his views. He adopts a law that subsidence in one locality is compensated by simultaneous elevation in another. Hence transgressions of the sea upon the land are not universal, for while the sea is advancing in some places it is retreating elsewhere. This law is in direct conflict with the principles of Prof. Suess, and though there is no general discussion of the question in the present volume, attention is prominently directed to various instances where the evidence is consistent with Prof. Haug's law. Prof. Haug has prepared a series of maps of the distribution of land and water at various geological dates; their most novel and useful feature is the importance attached to the bathymetric conditions under which the beds were deposited. They, however, show an extreme acceptance of the view so characteristic of much French geology that beds were laid down in existing geosynclinals, and their occurrence in long, narrow bands is due to original distribution and not subsequent denudation. The maps of the world constructed on this principle do not look convincing. Thus Prof. Haug's map of the Jurassic world (p. 1113) represents by far the larger part as land with the seas in the Lower Jurassic limited, except in Europe, to narrow bands. Hence, according to Prof. Haug, instead of the oceans having been permanent throughout geologic time, there were periods with no oceans at all. The same map, moreover, considerably exaggerates the area in western Australia submerged by the middle Jurassic transgressions. Where the ocean waters were stored during the dry intervals is not explained, and the evidence available as to the Jurassic climates renders any such vast excess of land most improbable. Prof. Haug is to be congratulated on the value of this work, of which perhaps the chief drawback is the omission of economic geology. J. W. G.

PRACTICAL DIETETICS.

Food and Feeding in Health and Disease: a Manual of Practical Dietetics. By Dr. C. Watson. Pp. xvi+638. (Edinburgh and London: Oliver and Boyd, 1910.) Price 10*s.* 6*d.* net.

THE subject of food and diets has rightly attracted considerable attention of late. When dealing with a community of individuals—soldiers and sailors, jails, Poor-Law institutions, &c.—fed by the State or by a local authority, it is obvious that a knowledge of the food values, nutritive and calorific, of the articles of diet, may conduce to considerable economy. On the other hand, a mere knowledge of the chemical composition of the food materials is by no means all the information required, for although the requisite chemical elements may be present in the right quantity the material may not be properly assimilated. Thus gelatin is nearly related to protein in elementary chemical composition, but it can only partially replace the latter. The manner in which the material is prepared and served, *i.e.* the art of cookery, also plays a part in nutrition, for a "tasty" dish acts secondarily by increasing appetite and the flow of saliva and gastric juice.

In disease and convalescence it is essential for the well-being of the patient that both the kind and the quantity of his diet should be regulated.

In the present work the whole subject of food and feeding is exhaustively dealt with, both in health and in disease. Starting with the classification of foods, their absorption and digestion, the important question of the daily amount of food required in health is dealt with. The opinion is expressed that Chittenden's

dietary, in which the protein content is only one-half to one-third that contained in the ordinary standard dietary, will maintain the body in a satisfactory state of health, and that an ordinary dietary does give some excess which is injurious to health. At the same time, it is recognised that further observations are required before we can accept Chittenden's results as giving a standard for universal application.

Milk and milk products and eggs are next considered, and then animal foods and their composition. The information given is both varied and voluminous; for example, the influence of different breeds of cows on milk production is considered, and the usual Scotch method of cutting up an ox is illustrated. Full tables are given of the composition, constituents, and nutritive values of all foods—flesh, farinaceous, fruit, vegetable, and mineral. The condiments and alcohol are also considered. As regards that vexed question, the use of alcohol, the author expresses the opinion, with which we fully concur, that

"while the use of alcohol in the treatment of disease is now very restricted, there is no question as to its undoubted value in the treatment of certain diseases, more especially in their critical stages. . . . We must recognise that alcohol is a very valuable therapeutic agent in the treatment of some diseased conditions."

The dietetic treatment of disease is treated very fully and completely. Alternative views are stated with fairness and in a broad-minded manner. Not the least valuable parts of the book are the complete cookery recipes which are included; in this respect the work becomes one of very real practical worth and supplies a decided want. For them the author expresses much indebtedness to his wife.

We have read the book with great interest, and can recommend it as a complete and practical epitome for the student of dietetics, and one which should be of much value to every practising physician.

R. T. H.

FOREST MANAGEMENT.

Schlich's Manual of Forestry. By Sir Wm. Schlich, K.C.I.E., F.R.S. Vol. iii., Forest Management. Fourth edition, revised. Pp. x+403. (London: Bradbury, Agnew and Co., Ltd., 1911.) Price 9*s.* net.

THE fourth edition of the third volume of the above "Manual of Forestry" contains somewhat more matter than its predecessor. The volume is divided into four parts, in which the various departments of forest management are dealt with. A strong feature of the new and revised edition is the number of practical examples given to illustrate the use and application of the various formulæ.

Part i. deals with forest mensuration. A concise description of the various measuring instruments is given and also the procedure generally followed and the formulæ used in calculating the volume of single trees and whole woods. Determination of age and increment are also dealt with. This subject is treated of first, as it naturally forms the foundation of forest management and leads up to what follows in the succeeding parts.

Part ii.—forest valuation—is devoted to the consideration of forest capital and the returns yielded therefrom. The author has been very successful in his method of presenting and explaining this difficult and intricate subject to the reader. He starts by analysing the forest value into its several components, such as the forest soil, the growing stock, the forest as a whole, and the rental derivable from the soil or the forest as a whole. In order to deal with this subject fundamentally the author gives a preliminary chapter divided into four sections. Section 1 shows how the value of property is determined; section 2 shows how the rate of interest applicable to the forest industry may be fixed; section 3 contains the formulæ necessary for calculating with compound interest; and section 4 contains an explanation of the methods of estimating receipts and expenses. With these preliminary matters made plain, he proceeds in the next four chapters (occupying twenty-six pages) to deal with valuation of forest soil, growing stock, whole woods or forests, and the determination of the rental of forests. Chapter vi., which concludes this part, treats of the methods of calculating the financial results of forestry. This subject is usually dealt with separately under the heading "Forest Statistics," but it has been here condensed in a perfectly efficient manner into about sixteen pages as a logical appendage to forest valuation.

Part iii.—the foundations of forest management—likewise contains six chapters. A very interesting introduction is prefixed which sets forth the aims and objects of systematic forest management and forest working plans. The succeeding five chapters deal respectively with increment, rotation, normal age, classes, normal growing stock, and normal yield, while in the final chapter the relation between increment, growing stock, and yield is discussed.

Part iv. explains the preparation of forest working plans. This is the direct sequel and outcome of the previous part. In preparing his working plans the forester aims at bringing every part of his woods and forests into a state as near theoretical perfection as possible. His endeavour is to regulate and bring into a normal condition the increment, rotation, age-classes, growing stock, yield, &c. This necessitates an experienced survey and a very critical knowledge of the forest and its environment. The references in this part to pages and chapters of the previous volumes of the manual indicate in themselves that the forester must be thoroughly acquainted with the fundamentals of sylviculture before he can attempt to construct a rational working plan which is possibly the most important, and at the same time difficult, thing to do in the whole art of forestry, but, as has been indicated, the author has so clearly and thoroughly explained the fundamentals that the intricacies of the working plan may be easily understood. At the end of the book are given appendices containing many useful tables, such as tables for measurement, compound interest, and yield, working-plan schedules, and an index.

The author is to be congratulated upon the production of this volume, which can be warmly recommended to all students of forestry, foresters, and

forest owners. Its value at present is great, and it will become greater in direct proportion to the spread of scientific forestry training and the extended afforestation of suitable lands in this country.

A. W. B.

THE MECHANICS OF THE SOCIAL BODY.

Mécanique Sociale. By Prof. Sp. C. Haret. Pp. iv+256. (Paris: Gauthier-Villars; Bucarest: Ch. Göbl, 1910.) Price 5 francs.

THIS volume represents an attempt by Prof. Haret to apply the laws and methods of mechanics to the study of sociology. The condition of an individual at any point of time, he argues, may be conceived as indicated (at least, in its principal aspects) by the magnitudes of three different factors—his economic possessions, his intellectual state, and his moral state. Supposing these three quantities to be measurable, the condition of the given individual at the given time can be represented by the coordinates of a point P, with reference to three rectangular axes OX, OY, OZ, which define his position in the "social space." If these coordinates do not change, the individual is in a state of "social rest"; when they vary, he is in a state of "social movement." Any cause which may produce or vary a social movement is termed a "social force," and any such force may be represented by a vector in the social space. Two individuals are said to possess the same "social mass" when the same social force, applied for the same time, produces the same movement. With such definitions, it is argued, all the ordinary laws of statics and dynamics apply.

That the idea is a novel one, possessing some attractiveness, we are willing to concede. The scheme of coordinates chosen also emphasises the fact, occasionally forgotten in some statistical investigations, that economic, moral, and intellectual changes are not (to use the common phrase) on the same plane, and index-numbers which measure changes in such diverse quantities should not be averaged together. But that the laws of mechanics apply to a system of material points representing, in the way described, the condition of a given population, does not seem to be proved.

The very difficulty that would surely occur to almost any reader at the commencement is ignored, and this, it seems to the reviewer, is the source of all subsequent difficulties. The three axes chosen do not represent quantities of the same kind or dimensions, but quantities quite different in kind. The mere representation of movement in the "social space," the magnitudes and directions of velocities and accelerations, will all depend on the three arbitrary scales chosen. Forces parallel to the three axes do not differ merely in direction but in kind: we cannot speak of forces which are equal in magnitude but different in direction until the three scales are defined. That the ratio of the masses of two individuals is not the same for all forces is admitted: for a given force in one direction the acceleration produced in A may be greater than that produced in B; for a force in another direction the contrary may be the case. The "economic," "moral," and "intellectual masses" of the individual are, in fact, like "economic," "moral," and "intellectual forces," totally different things. Prof. Haret proposes to evade the difficulty by regarding the forces as varying instead of the masses, but this is surely inadmissible. If A and B move, say, with the same accelerations when subjected to the same economic force, but with different accelerations when subjected to the same moral force, it is impossible to say that one and the same force is, in the latter case, different for the two individuals merely in order to avoid admitting that their "masses" are different.

It is with regret that the reviewer finds himself unable to accept the author's thesis, for undeniably it possesses a certain picturesque suggestiveness. Economic forces, for example, are often of a more or less periodic character, and seem to be accompanied by moral forces which are also periodic. If these got a quarter of a period out of phase with each other, the social body would start revolving round its intellectual axis . . . What would happen? G. U. Y.

THE GUM-TREES OF AUSTRALIA.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol ii., part i.–part xi., of the complete work. Pp. iv+59+iv plates. Vol. ii., part ii–part xii of the complete work. Pp. iii+61–100+iv plates. Published by authority of the Government of the State of New South Wales. (Sydney: W. A. Gullick, Government Printer, 1910.) Price 2*s.* 6*d.* each part.

THE first part of this comprehensive work was issued in 1903, and it is wholly devoted to the description and illustration of *Eucalyptus pilularis*. Parts two and three appeared in the same year, each dealing with only one species, *E. obliqua* and *E. calycogona* respectively. When reviewing those early parts, each of which contains four plates of figures, we ventured to suggest that Mr. Maiden had commenced with a fullness of detail that might imperil the completion of the work, considering that the genus comprises many more than a hundred species. Two species, *E. incrassata* and *E. foecunda*, are described in the fourth part (1904), and illustrated by no fewer than twelve plates. At this rate the probabilities of completion seemed to be exceedingly remote, and the author apparently realised the fact, for succeeding parts have included successively a greater number of species; parts one and two of the second volume containing ten species each, illustrated by four plates.

It is almost superfluous to mention that the genus Eucalyptus is the most important commercially in the vegetation of Australia, and its elucidation is correspondingly desirable. Some of the species are very abundant and widely dispersed, whilst others are very rare and local, and consequently liable to extinction.

At least two other botanists—Bentham and Mueller—have dealt with the whole genus before Maiden took up the work, and Mueller also possessed field knowledge. But one generation of botanists by no means mastered all the details of classification of this

difficult genus. Mr. Maiden has the advantage of the results of the investigations of his predecessors, and he has fully availed himself of it, even to the extent of visiting Europe to study the types of the species described by the earlier botanists. The value of his classification can only be estimated after the practical use of it in the determination of new material. The figures in the parts under review are mostly of leaves attached to a small piece of the axis, detached inflorescences, and mature seed-vessels, the originals of all the figures being carefully recorded.

It may be mentioned, however, that the same author's "Forest Flora of New South Wales," so far as issued, contains figures of thirty-eight species of Eucalyptus, figures of larger branches, in flower and fruit, thus supplementing those of the "Revision." Of the latter, fifty-six plates have been published, illustrating fifty-nine species. Details of the economic value and the popular names are fully given only in the forest flora. The usefulness of Mr. Maiden's important work must remain comparatively limited until its completion; therefore any acceleration in its publication would be welcome. But it is to be feared that the author's arduous duties as director of the Sydney Botanic Garden and State botanist leave him little time for original research. Since the foregoing was written we have heard from the author that he had been laid up for two months and was only slowly recovering from a severe surgical operation.

W. BOTTING HEMSLEY.

AIRMEN AND AVIATION.

The Aeroplane, Past, Present, and Future. By C. Grahame-White and Harry Harper. Pp. xv+319. (London: T. Werner Laurie, 1911.) Price 15*s.* net.

THIS is one of those books which may be classed as ephemeral—that is to say, it is written for to-day and only for to-day; to-morrow it will be obsolete. The title is misleading, for throughout the book there is no general description of the machine or explanation of the principles of its actions. It is a curious circumstance that, although purporting to be written by a well-known aviator and a journalist who has specialised in the subject, yet out of the fourteen chapters which the book contains no fewer than ten of them are put down to the authorship of other writers.

The three anonymous chapters on "Flights and Records," "The World's Airmen," and "Aeroplane Fatalities" are but amplified lists such as may have been culled from the daily papers, and are already becoming somewhat out-of-date. A short chapter on "The Fascination of Flying" is presumably by Mr. Grahame-White, and gives a pleasant sketch of reminiscences.

Of the other chapters, that by Colonel Capper on "The Aeroplane in Warfare" is probably quite the most important; but this, of course, cannot be more than a series of suggestions. Although not new, it may be of interest to note that Colonel Capper firmly believes that the systematic use of aeroplanes "may revolutionise the tactics of the battlefield," but he wisely adds that in order to obtain such important results "no haphazard aggregation of individual machines and pilots, on the outbreak of war, can be relied on."

Mr. Howard T. Wright's chapter on "The Power Unit of Aeroplanes" records in simple language many interesting facts concerning engines and propellers. Mr. Henry Farman writes on "The Constructional Future of Aeroplanes," in which he says: "Personally, judging from what I know of the possibilities of the situation, I estimate that the maximum speed which will be reached during the year 1911 will be 150 kilometres an hour." We have not arrived at this yet, but there is time. Mr. Roger Wallace summarises some points on "Aerial Law." The chapter on "Sporting and Commercial Possibilities of the Aeroplane," by Louis Blériot, is somewhat disappointing, as is the "Future of Flying," by Louis Paulhan.

While the book is readable and interesting, it tells us little that is new or really instructive. Throughout it gives one the idea of having been rapidly put together and hurriedly produced, without careful planning or proper supervision. There is a profusion of excellent illustrations from photographs; in fact, there seem almost too many, since some of them, such as that of "Captain Dickson describing an aerial reconnoitring trip," might well have been omitted.

OUR BOOK SHELF.

La Haute-Loire et le Haut-Vivarais. Guide du Touriste, du Naturaliste, et de l'Archéologue. By Marcellin Boule. Pp. viii+366. (Paris: Masson et Cie., 1911.) Price 4.50 francs.

IN our own islands we have few guide-books precisely of the type of those edited by M. Boule. Praeger's guide to County Down comes first to mind, a book in which scientific considerations associate themselves with the choice of summer quarters and hotels. M. Boule has had the help of specialists in the description of the flora, commerce, archæology, and inhabitants of the picturesque region of which he treats; but the routes by road or footpath are known to him as a geologist, and he rightly loves the contrasts of "les froides et tristes planèzes vellaves" and the "chaudes et riantes vallées vivaraises." He points out the perfectly preserved craters of the chain of the Velay, piled above a fissure sixty kilometres in length, which broke through an upland of old granite, and the fantastic relics of earlier eruptions, like those on which St. Michel d'Aiguilhe and the high castle of Polignac stand. The country is certainly one for lovers of the unusual and the remote. Roman traditions remained in the municipal government of Le Puy down into the fourteenth century (p. 115), and the struggle of the commonwealth against the prince-bishops, who were supported by the kings of France, was as stubborn as the basaltic theatre in which the tragedy was played.

Le Puy, one of the most romantic towns in Europe, forms the natural centre for the district; but M. Boule guides us into the gorges of the Allier, where the railway forms in places the only foothold, and eastward across the broad volcanic upland, set with columnar "orgues," until we reach at Le Cheylard the rivers running to the Rhone. The upland itself has something fascinating, something not quite realised among the *burrons* of Auvergne. Fay-le-froid, in the grey light of a summer dawn, seems

remote enough from the pulse of France all round it. The author, aided by well-chosen views, shows us how the volcanic masses have controlled the higher features of the landscapes, and how the Loire stream-system has cut through the lava-flows, while, on the side of the Allier, lavas of the same age have descended into a pre-existing waterway (p. 326). Full justice is done to the phonolitic mass of the Mézenc, explored by Faujas de Saint-Fond in the middle of the eighteenth century (p. 294). We miss the name of this great investigator from the bibliography on p. 14, although Scrope's work in 1827 is mentioned. The users of this guide will become such good geologists that they will surely like to turn the pages of Saint-Fond's admirable folio. It may be hoped that M. Boule will send many lovers of unspoiled country to the strange and broken slopes of the Cevennes. "J'ai composé ce guide," he writes, "avec un rare plaisir." He has transferred this pleasure to the reader.

G. A. J. C.

The Pronunciation of English by Foreigners: a Course of Lectures to the Students of Norham Hall on the Physiology of Speech. By Dr. Geo. J. Burch, F.R.S. Pp. x+110. (Oxford: Alden and Co., Ltd.; London: Simpkin, Marshall and Co., Ltd., 1911.) Price 3*s.* net.

THIS is a delightful book. Works on phonetics are usually dry and uninteresting except to those who are willing to face the technical difficulties of the subject. But Dr. Burch, who is well known in other departments of science, invests the discussion with both wit and humour, while, here and there, he gives an amusing anecdote which is always appropriate and telling. He deals with the difficulties experienced by foreigners in catching the correct pronunciation of some of the sounds of the English language. The book is founded on lectures delivered at Norham Hall, Oxford, to foreign women students, and during the past ten years or so Dr. Burch has kept records of the chief difficulties in the pronunciation of 1305 persons of many different nationalities. He gives an excellent, although a short, account of the general mechanism of speech, and minutely describes the movements necessary for the articulation of the speech sounds of consonants, diphthongs, and vowels. There are also excellent remarks on the breathing apparatus.

It would seem that individuals of different nationalities have different methods of using their nervous and muscular mechanisms for articulate speech, so that if one wishes to reproduce the sound in any given language, one must learn how to train the articulating mechanism so as to obtain the required result. Dr. Burch gives minute directions, and it would seem that his system of teaching the correct tones of English to foreigners has had conspicuous success.

"During these ten years I have been greatly struck by the excellent pronunciation of the majority of those attending these courses. If I could speak those languages with which I am familiar with as good an accent as mine is spoken by them, I should have every reason to be proud. But this excellence has made a severer critic of me." (P. 59.)

Excellent, however, as the description of the movements of the tongue and other organs may be to guide the student in reproducing a given sound, an appeal to the ear is all-important, and those are fortunate who have had the instruction communicated by Dr. Burch's own living voice. We feel sure that if anyone takes up this little book he will not find it dry and wearisome, as its title might indicate. It is full of interesting information supplied by one who is an experienced and versatile teacher.

JOHN G. MCKENDRICK.

Praxis der Linsenoptik in einfachen Versuchen zur Erläuterung und Prüfung optischer Instrumente. By Dr. W. Volkmann. Pp. vii+176. (Berlin: Gebrüder Borntraeger, 1910.) Price 3.50 marks.

THIS little book is one of a series composing a "Bibliothek für naturwissenschaftliche Praxis," in which the object of each volume is to provide an introduction to some branch of practical science by means of simple experiments which can be carried out with inexpensive and easily constructed apparatus. The optical equipment here described consists of some half-dozen lenses of different focal lengths, a number of simple wooden stands, some clips and lens-carriers, diaphragms, and screen, with a spirit lamp and strip of gas-mantle to serve as light source. Even with these simple means it is, of course, easy to arrange an interesting and instructive series of experiments to illustrate the properties of lenses and the formation and defects of optical images. With a pinhole and some fine gauze, one can go further, and study effects due to the fact that light is a wave motion. With but little increased expenditure the range of such experiments could readily be extended; but the apparatus described is sufficient to enable practical acquaintance to be made with nearly all the main defects of optical instruments: spherical aberration, astigmatism, coma, distortion, and chromatic aberration can all be examined, and even the theory of resolving power can be studied. The book concludes with chapters on the photographic lens, the magnifying glass, the microscope, and the telescope, in which application is made of the experimental knowledge acquired to the examination of the characteristics of a well-designed optical instrument.

To follow out the course of experiments here suggested would no doubt be for an intelligent lad an excellent introduction to the study of optics, and, though the book is not designed for school use, the German schoolmaster might find in it useful hints in experimental science teaching. For the English reader, however, it has no special interest; it shows no exceptional ingenuity in the devising of experiments, and, from its aim, novelty is not to be expected, nor, perhaps, desired.

Rhododendrons and Azaleas. By Wm. Watson. Pp. xi+116. "Present-day Gardening" Series, edited by R. Hooper Pearson. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s.* 6*d.* net.

THERE are certain prevailing ideas with regard to the constitution and requirements of rhododendrons which are only partially correct that have tended to restrict their cultivation. Thus the necessity for peat in the soil is an exploded assumption, although the presence of lime must be recognised as an effectual bar to success. Then again the tenderness of many attractive species is only too obvious, but it is fortunately possible to obtain hybrids of a more hardy character. Further, it may be mentioned that no good popular book on rhododendrons is extant; therefore the present work is eminently desirable, and the publishers are fortunate in securing the services of an author who is an ardent enthusiast, and is also thoroughly conversant with the different classes of rhododendrons and their special features. The classification in itself is tolerably complex. Botanists recognise a single genus which includes the true evergreen rhododendrons, a small group of Indian azaleas, also evergreen—comprising *R. indicum* and its allies—and deciduous azaleas or swamp honeysuckles of North America. The true rhododendron species are best developed in China, while Himalayan species, owing their prominence to Sir Joseph Hooker, are a favourite but tender group, and the North American

contingent are valuable on account of their more hardy nature. The explanation of the various hybrids is difficult, and calls for the special knowledge possessed by the author. Famous collections, cultural directions, and a list of species make up the contents of a volume which every gardener—save perhaps the dweller on limestone—should purchase and study.

The Practical Flower Garden. By Helena R. Ely. Pp. xiii+304. (New York: The Macmillan Co., London; Macmillan and Co., Ltd., 1911.) Price 8*s.* 6*d.* net.

IF the descriptions of experience and garden stock presented by Mrs. H. R. Ely may be accepted as a trustworthy exposition of garden practice in the eastern States of North America, we are justified in assuming that there is very little difference between the methods pursued and the plants cultivated on the two sides of the Atlantic. We had anticipated that there would be at any rate very marked differences in the trees and shrubs; also that certain herbaceous plants would be better suited to the more extreme conditions prevailing in the States, whereas with few exceptions, such as Boltonia and Baptisia, all the border perennials mentioned in the author's lists are offered in any British horticulturist's catalogue; of the climbers or vines, *Dolichos japonicus* and *Vitis labrusca* are rarely grown in English gardens.

The reader who is searching for useful hints is likely to be rewarded by a perusal of the advice regarding fertilisers and plant remedies, although the pronounced commendation of a fertiliser of unknown composition passing under the name of Bon Arbor is tantalising if not savouring of quackery. It should also be noted that the author, like every good horticulturist, has a favourite specific, which in her case is bone-meal, especially for Delphiniums. Advice is offered on the subjects of colour-schemes and the making of lawns, but a more original note is struck in the account of a garden prepared for the growth—not cultivation—of indigenous plants. It may be conjectured that Mrs. Ely does not claim to be a botanist, as certain inexactitudes are apparent, although the only flagrant mistake is in the misuse of the term "annual."

A Short History of Ethics: Greek and Modern. By R. A. P. Rogers. Pp. xxii+303. (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

A USEFUL historical survey, chiefly descriptive but partly critical. The author's primary object is to give a short and accurate description of the leading Greek ethical systems and of those systems which represent the best type of modern philosophic ethics, from Hobbes to the end of the nineteenth century; secondarily, to show, by criticism and comparison, the connecting links between systems and the movements of thought by which new systems arise. Some familiar names are omitted, where the type of thought has already been illustrated by other thinkers; *e.g.* Reid is represented by Butler, and the French empiricists by Hume. Such recent systems as those of Wundt, Paulsen, Nietzsche, and the pragmatists are also omitted. The systems most lengthily considered are those of Plato, Aristotle, Epicurus, the Stoics, Hobbes, Butler, Hume, Kant, the German idealists culminating in Hegel, and the English utilitarians through Bentham, Mill, Spencer, and Sidgwick to T. H. Green, whose doctrine specially commands the author's admiration.

The book is well written, in commendably judicial tone throughout. It makes a modest claim—calling itself short and elementary—but those students who thoroughly master it will have obtained an excellent and more than elementary introduction to the subject.

LETTERS TO THE EDITOR.

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

The Forest of Auchnacarry.

THE letter in NATURE of June 1 would come as a shock to foresters throughout the world. It states that the Scotch pines at Auchnacarry are perhaps the largest and finest fragment that is left to us of the primæval Caledonian forest. In area about 1500 acres, the forest contains trees 200 to 300 years old of huge size, up to 6 feet in diameter. The scenery of the forest is of great beauty, and, save for a few isolated clumps, is all that we know to remain of the great forest of Scotch pine that once spread over all suitable ground in central Scotland. The writer also remarks that nothing is left so noble, so extensive, so worthy of preservation as this doomed forest of Lochiel's at Auchnacarry.

The photograph is striking. It is difficult to believe that forest such as this was once in the place of desolate and dreary bogland such as the Moor of Rannoch. But it was no farther back than Napoleon's time that the great forest of Rannoch was cut down and turned into the dreary waste of to-day!

Surely there is here a strong case—the strongest possible case—for the Development Commissioners! We read that they have 500,000*l.* yearly for five years, and this year an extra vote of 400,000*l.* in addition; and that a portion of their funds is to be devoted to forestry "by the purchase and planting of land."

The distant view is sometimes the clearest. To the man at a distance it is as clear as daylight that, whatever may be done for minor objects, this forest of Auchnacarry, this unique national monument, should be acquired for the country at any cost.

Italy has done much since it became a nation, but it has, perhaps unavoidably, neglected much. The most patriotic Italian will at once admit that Italy has neglected its forestry. Japan does more forestry in a week than Italy in many years! Yet Italy has nationalised the remains of its Apennine forests at Camaldole and Vallombrosa. Here are giant silver-firs not to be surpassed by any on this globe. And these most beautiful forests remain as national monuments ever pointing the way towards national regeneration, the restoration of the dreary and ruined Apennines to the beauty, the fertility, and the value of past days.

Spain is preserving the remnants of its ancient forests; Portugal is guarding them jealously. Is British forestry to sink to the level of Chinese? Surely, cost what it may, this remnant of the primæval Caledonian forest should be nationalised and preserved.

There is one important point to remember. The Italians, the Spaniards, and the Portuguese can replant and restore their national forests whenever they are strong enough as nations to do it. But these northern forests in Scotland and Sweden, near the limits of tree growth, can be restored only with extreme difficulty, if at all, when once they are destroyed. They seem to be the product of conditions that have passed away, or perhaps of geological time. Witness the Moor of Rannoch and many forests in northern Sweden. When once they have passed into bog and the great draining action of the trees has been removed, their restoration to forests seems nearly impossible at any practical expenditure. With forest near its climatic limits, this is the case in other lands and other climes.

D. E. HUTCHINS.
(Late Chief Cons. Forests B.E. Africa.)
Kenilworth, near Cape Town, July 20.

The Drought and the Birds.

As a rule, water has been left in my garden for the wild birds, and they have taken full advantage of the opportunity for bathing and drinking.

On Monday, however, a hen blackbird rather surprised me. The hose was working in a shady spot. Her ladyship

came near, with great caution, to drink some of the drops from the grass. Having quenched her thirst, she got under the sprinkler for a shower bath. Being disturbed she flew away, but came back for a second bath, and later for a third.

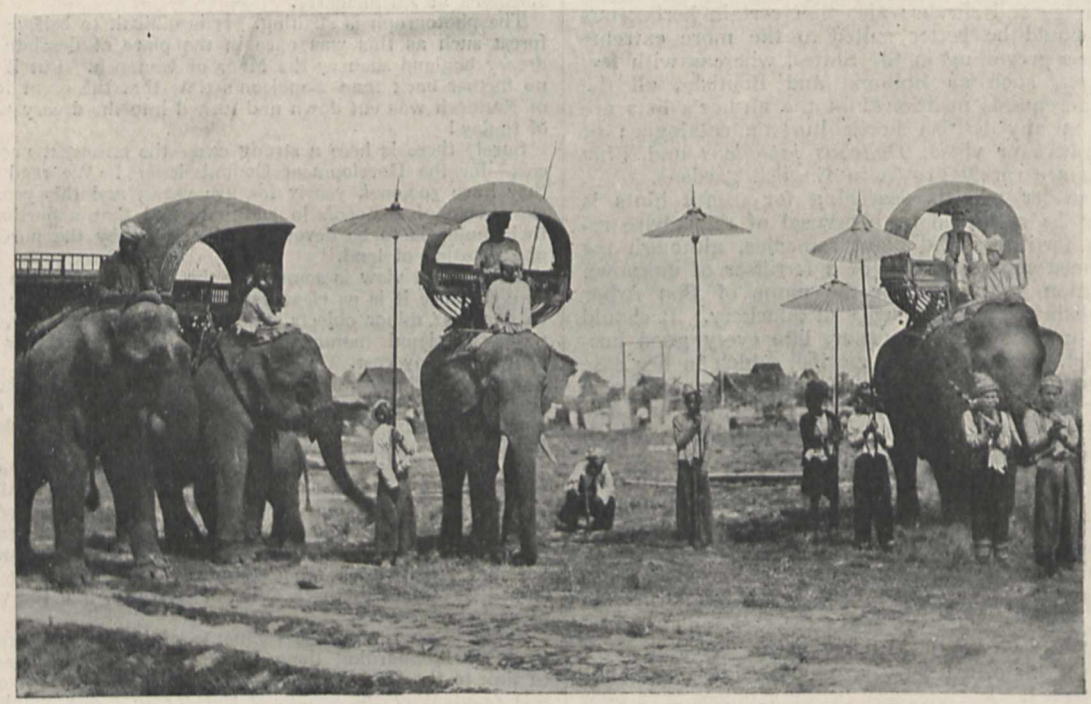
This morning she returned, apparently for another bath, waited a considerable time, but as no water was forthcoming flew away.

To me this is quite a novelty; possibly other readers have had similar experience. CHARLIE WOODS.

"Vectis," 2 Wellmeadow Road, Lewisham, S.E.,
August 16.

A HANDBOOK OF BURMA.[1]

WITH the conspicuous exception of Japan, scarcely a country has been more written about, in proportion to the extent to which it has been visited, than Burma; yet we are in agreement with the publishers of this book, that there is room for one of the character prepared by Sir George Scott. The etherealised visions of Fielding are fascinating reading, but give a very inadequate impression of the reality, and the ordinary book of travel is unsatisfying and inaccurate; yet between these and ponderous tomes, of which the weight and bulk make them unportable and repellent to all but the serious student, we have had no book which would give the visitor to Burma an idea of the history, administration, and sociology of the Burmese and other races, or of the aspect and productions of the country itself.



A Sawbwa paying Call. From "Burma: a Handbook of Practical Information."

In his preface, Sir George Scott disarms criticism. After stating that the sections of Mr. Oates on the fauna, of Captain Gage on the flora, of Mr. Bruce on the forests, of Mr. Richard on means of transport, and of Mr. Mariano on music could only be excelled by those who might have larger space allowed them, he goes on to say that it is certain that the book can be greatly improved, and expresses a hope that his critics and the public will write to show how this can be done, rather than indulge in mere carping and fault-finding. Yet it is hardly possible to suggest improvements without indicating faults, and in reading through the book there seems to us to be three conspicuous faults or possible improvements, according to the point of view.

First, we must regret that the course adopted for the flora, fauna, and other special subjects was not followed in the case of the geology; secondly, we suggest the provision of a more satisfactory map of Burma than the very poor little effort which the publishers have provided; and, thirdly, the omission of the word commercial on the cover of the book. The title-page describes the work merely as a "handbook of practical information"; on the cover this becomes "practical commercial and political information," but there can be little commercial value in statements based on statistics of no later year than 1905, and the deficiency in the case of Burma is especially striking, for the petroleum industry has been so revolutionised in the last three or four years that the description on p. 240 represents a condition of things which has passed away, and in the section devoted to agriculture no mention is made of the ground-nut, which, within the last few years, has risen to importance as a crop in upper Burma and an article of export from Rangoon.

For the rest we must perforce agree with the author that the book can be improved, for nothing human is perfect, but with this reservation we confess that the margin for improvement seems very small. It is not merely the best book in existence on Burma, but as nearly an ideal book as is conceivable for the purpose it is intended to fulfil. For the traveller or the intending resident, who wishes to have an intelligent appreciation of what he will see and come in contact with,

[1] "Burma: a Handbook of Practical Information." By Sir J. George Scott, K.C.I.E. New and Revised Edition. Pp. x+520. (London: Alexander Moring, Ltd., 1911.) Price 10s. 6d. net.

it will be an admirable companion, and even the resident of many years' standing cannot fail to find explanation of much that he has not understood before, and have his attention directed to many things which he had previously failed to notice.

PLAGUE IN ENGLAND.[1]

THE recent appearance of plague in East Suffolk forms the subject of some valuable reports and papers recently issued by the medical department of the Local Government Board. The reports are divided into three sections, each of which deals with the plague from different aspects. The first section contains the late Dr. Bulstrode's "report upon the occurrence, in the autumn of 1910, of four deaths at Freston, near Ipswich, from a rapidly fatal and infectious malady diagnosed as pneumonic plague, and upon the prevalence of plague in rodents in Suffolk and Essex." It also includes his report upon two localised outbreaks of disease in East Suffolk in 1909–10 and 1906–7, which may have been instances of bubonic and pneumonic plague respectively." The second section records the results of an inquiry by Drs. Martin and Roland, in the months of November and December, 1910, into rat plague in East Anglia, with special reference to the fleas infesting rodents; and the third section gives a report by Drs. Petrie and Macalister "upon the examination of rats collected in Suffolk and Essex for plague-infection between January 16 and February 14, 1911."

The information in the volume, though not sufficient to fix the exact origin of the Freston outbreak, or the avenues by which the other two outbreaks spread, is nevertheless very complete so far as the facts could be traced. The great loss which the medical department of the Local Government Board has sustained by the death of Dr. Bulstrode is impressed upon one when perusing his able report on the investigations which he made on the plague. Like all his former work, it is characterised by care, thoroughness, and good judgment.

It appears that between September 16 and September 29 there occurred in a four-roomed cottage in Freston three deaths. Daughter, mother, and father in a family of six succumbed to an obscure lung affection after a few days' illness. In a cottage a quarter of a mile away there also died on September 29 a woman with the same symptoms. She had nursed the mother, and had evidently caught the infection from her. The main features of the illness were the obscurity of the lung symptoms, the dark-stained expectoration, the high temperature, the great prostration, and the rapidly fatal issue in about three days without any corresponding serious physical signs to account for it. In three out of the four cases vomiting and purging were present. The anomalous character of the symptoms, the nature of which puzzled the medical men attending the cases, led to a bacteriological examination being made by Dr. Heath, the honorary bacteriologist to the Ipswich and East Suffolk Hospital, who found in the specimens and cultures a bacillus corresponding in its reaction and appearance with those of the plague bacillus. The illness was then recognised as pneumonic plague, which is well known for its infectivity and fatality.

No direct evidence could be obtained as to the manner in which the daughter, a child of seven years of age, who was first attacked, had become infected, but the inquiry as to the source of infection led to the important discovery that an epizootic affecting rats and hares was prevailing in the district. Bacteriological examination of a number of rats, hares, a cat, and a ferret showed them to be plague-infected, and accordingly afforded opportunities for human infection. There was evidence also that the epizootic among rats extended so far back as 1906. In that year a large number of dead rats had been observed at Shottley and its neighbourhood, about four miles distant from Freston. It was here that a sudden and fatal illness had occurred in December, 1906, in a poor family, and had extended to those who nursed the sick. Eight persons were attacked with what appeared at the time to be a virulent form of influenza, and six of these died after three to four days' illness.

Another outbreak of a puzzling character occurred in December, 1909, and January, 1910, at Frimley, on the north bank of the Orwell, and almost opposite Shottley. It was in a two-roomed cottage occupied by a family of seven in poor circumstances. The whole of the family was successively attacked by an illness unfamiliar to the medical men, and in some cases associated with glandular enlargements. Four of the family died and three recovered. One of the family went to stay with a friend for a few days, and subsequently the child of the friend was fatally attacked with similar symptoms. Dr. Bulstrode concludes from his investigation of the Frimley outbreak that, "although there are, from lack of full information, many lacunæ in the story, the balance of evidence certainly seems in favour of a view that the malady was bubonic and septicæmic plague."

It is an instructive story, and shows that in England as in other countries plague can be overlooked both in human beings and in the lower animals. It is evident that the infection of plague has existed in this part of the country for the past four years, introduced probably by infected rats in grain ships arriving from infected ports.

Drs. Petrie and Macalister's work is valuable in demonstrating that out of 6071 rats examined from the districts immediately surrounding those proved to be infected, all were of the *Mus decumanus* variety, and none were found to be infected with plague. It is to be hoped that the Government will continue this good work in the autumn and in the coming years, for it by no means follows that the rat plague-infections which, as has been shown by Drs. Martin and Roland, occur in pockets, have been all discovered, even with this large number of examinations.

The investigations of Drs. Martin and Roland have demonstrated some interesting facts relative to the rat-flea population. It appears that the rat-flea of India, *Xenopsylla cheopis*, could not be found on any of the rats examined; that more than 50 per cent. of the rat-fleas in East Suffolk consisted of the *Ctenophthalmus agyrtes*, which evidently does not bite men, and that the remainder of the rat-flea population is composed of *Ceratophyllus fasciatus*, which bites man, but not so readily as does *Xenopsylla cheopis*. These facts are cheering so far as they go, as it is estimated that on an average there is less than half a man-biting flea for a rat. It would be reassuring if it were proved that the flea was the only method by which human plague spreads, and if the history of the three outbreaks pointed in that direction. Unfortunately, two of them appear to have been of the pneumonic variety, and the third septicæmic and bubonic in character. The evidence so far scarcely lends itself to the view that the comparative freedom of the rat from man-biting fleas will secure safety from plague in England. Dr. Newsholme recognises the dangers from this aspect of the question, and the warning given by him and the late Dr. Bulstrode as to the necessity for vigilance is timely and none too strong. The

[1] Reports and Papers on Suspected Cases of Human Plague in East Suffolk and on an Epizootic of Plague in Rodents. Reports to the Local Government Board on Public Health and Medical Subjects. New Series, No. 52. (1911.)

optimism which leads to the relaxation of sustained effort in dealing with a plague epizootic is most dangerous.

The one important fact is that the plague-infection has gained a lodgment in this country after an absence of nearly 250 years, and the only safe course to be pursued is to prevent the rat-infection from becoming endemic. Nothing is to be gathered from the fact that only a few human cases have occurred in four years in a sparsely populated locality. This is the ordinary behaviour of plague in new localities in this pandemic. Because no human epidemic happens quickly the impression is produced that the country is immune. In London in the seventeenth century there were in seventy years only four severe epidemics, and for fifteen years before the great plague of London in 1665 there was only on an average fourteen plague deaths per year in the metropolis. It is well not to place too much reliance on the different conditions existing in the seventeenth century and now. In the former period the general sanitary conditions were undoubtedly much worse than they are at present, but we have the very poor, and more of them, still with us in our slums, and they still live in an overcrowded state, with none too much light or sanitation in their houses.

W. J. SIMPSON.

THE NUTRITIVE VALUE OF BREAD.[1]

DR. HAMILL has presented an admirable report, free in every way from prejudice, which will long serve as an authoritative statement on the somewhat vexed question of the nutritive value of bread. The account summarises the scientific and technical information at present available, and clearly indicates the complexity of the problem. Previous writers on this subject, when not biassed by commercial considerations, have as a rule dealt with the question from a restricted point of view, but this report in no way suffers in this respect.

The first section deals with the classes of wheat flour, and Dr. Hamill is careful to define the technical terms used, which are usually grossly misused by popular writers on the subject. The contention that nutritive flour cannot be made in roller mills is once for all disposed of, and the advocates of the stone mill are reminded that the hard foreign wheats with brittle skins, such as form the great bulk of the wheat grown in western America, cannot be satisfactorily milled between stones. A very much greater degree of separation can be obtained in the more complicated process of roller milling, and there is no reason for a return to stone mills even if this were possible economically. With regard to colour, patent grade flours, which are the whitest, have better baking qualities than households, and therefore command a higher price—the report, however, overlooks the fact that the colour of bread depends more on the "strength" of the flour used than on its colour in the dry state.

The second section, which is supplemented by much valuable tabular matter, summarises all that is known as to the nutritive value deduced from chemical analysis of various milling products and bread made from them. Much of the experimental work quoted has been done by the United States Department of Agriculture. It is to be hoped that now that this question has received so much notice in this country, the Local Government Board will itself initiate experimental work on some of the lines indicated by Dr. Hamill; indeed, the report contains analyses of various milling products made by Dr. Monier-Williams in the Local Government Board laboratories. Valuable as these are, it is now necessary to go somewhat deeper into the matter than the simple determination of elemental composition.

In a valuable section headed physiological considerations, it is shown that many of the opinions so confidently expressed in public by such bodies as the Bread Reform League are certainly untenable, whilst upon other points our knowledge is still too uncertain to enable a definite statement to be made. Highly erroneous is the notion that high-grade white patent flour is practically devoid of nitrogenous constituents—actually the very opposite is the case, and, other things being equal, a diet which consists wholly of bread would possess greater advantages in this respect when made from strong wheats. The degree to which bread is acted upon by the digestive juices, and the extent to which the products of digestion are absorbed and assimilated, are problems requiring further investigation, and although much has already been done this only serves to indicate the complexity of the subject and to show how many factors must be taken into account. The evidence available is given in full in the report.

Much has been written about the digestibility of bran. Results are quoted which indicate that the presence of branny particles, even when very finely divided, affects the digestibility of bread. It was found by Goodfellow, for example, that when milk is taken with wholemeal bread 3 per cent. less milk was digested than when the milk was taken alone. It is probable for this reason that the large class of wholemeal breads, sold to the public at an enhanced price, are inferior to white bread excepting when they are taken for definite medicinal reasons.

Regarding the whole question from a common-sense point of view, it is a fact that the differences in nutritive value between various grades of flour made from the same wheat are insignificant when compared with the differences between flours made from different wheats. So long as Britain derives its flour from all over the world this last question is the paramount one. The big millers are so skilful in blending wheats that the flour supply of the large towns is practically uniform in quality throughout the year.

The questions of germ and mineral requirements are fully discussed, and it is admitted that the knowledge of the latter point is still very imperfect. Here, however, Dr. Hamill ventures to draw a conclusion which will be disputed by many, namely, that to ensure as large a supply of minerals as possible it is advisable to substitute very finely ground entire wheat bread for a portion of the white bread in the diet of growing children.

He qualifies this subsequently by admitting that when bread is supplemented by other foods, such as are present in an ordinary mixed diet, the advantage which one kind of bread may possess over another becomes negligible. Many children whose food consists largely of bread do not get enough of it, and are underfed in respect of all the essential nutritive substances. It is better in such cases to increase the amount of bread taken rather than to substitute another form of bread, and still better to supplement the bread by other materials such as milk, which contains a substantial quantity of the nutritive materials lacking in bread. The effect of bread on the teeth is fully discussed: the differences between different kinds of bread in this respect would appear to be negligible. This again is a direct contradiction of recent assertions.

The preparation and properties of the so-called standard flour and bread are described at some length,

[1] Dr. J. M. Hamill's Report to the Local Government Board on the Nutritive Value of Bread made from Different Varieties of Wheat Flour. Pp. 53. (Published by H.M. Stationery Office.) [Cd. 5831.] Price 3*d*.

and it is made quite clear that standardisation of flour is impossible. Analyses made by Dr. Monier-Williams are quoted to show that the differences in protein and mineral matter between the standard flours and the household flours obtained from the same wheat are very small. These analyses should serve once for all to disprove the absurd claims made for standard bread by the Bread Reform League and other food reformers. According to Dr. Hamill, "entire" wheat flours do, however, possess additional constituents due to the presence of branny particles and germ which appear to have a value of their own in nutrition. Whilst the evidence on this point is as yet of the slenderest, it is sufficiently sponsored not to be lightly dismissed, and further experimental work is urgently needed.

Sufficient has been said to show that the report gives a very faithful summary of the present position of the subject, and it should remain authoritative until new experimental facts cause an extension of our knowledge of the obscure points. It is at all events clear that our bread supply is the best available, and that legislative action is not required.

THE INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES.[1]

THE most interesting part of the account lately published of the proceedings of the International Committee of Weights and Measures at their recent meeting at Sèvres is the information given respecting the work of the International Bureau of Weights and Measures during the last two years. Among the researches conducted at the Bureau may be mentioned an investigation of the suitability of vitreous quartz (fused silica) for metrological purposes, which was undertaken at the instance of Sir David Gill. Although the specimens experimented upon admitted of being ground and polished with facility, it was found quite impossible to engrave on them lines of permanent shape and sufficiently fine to serve as the defining marks of standards of length. Similar negative results had been obtained at the National Physical Laboratory by Dr. Kaye, who has, however, devised a method of obtaining perfectly satisfactory defining lines by depositing a layer of platinum on the silica and engraving the lines on the platinum.

The high price of platinum has led to investigations being made with the view of finding a suitable substitute for this metal in the construction of standard weights. Tantalum, which resists all the strong mineral acids except hydrofluoric acid, has been found to satisfy the necessary requirements of permanence and hardness, and it is suggested that a series of standard weights of 100 grammes made of this metal should be established for use in chemical research. Their cost would probably not be more than one-third that of iridio-platinum standards.

Dr. Stratton, of the United States Bureau of Standards, who is a member of the International Committee, communicated the results of investigations on the spectrum of neon. These tend to show that the yellow radiation of neon of wave-length 5852 tenth metres is much superior to the red radiation of cadmium as a unit for interferential measurements. Neon is also much more convenient to employ, as it does not require preliminary heating to a high temperature; it has a longer life, is less subject to accidents, is more brilliant, and requires much less attention on the part of the observer. Dr. Stratton proposes to make use of this radiation in a new determination of the length of the metre.

[1] Comité International des Poids et Mesures. Procès Verbaux des Séances. Deuxième série, tome vi. Session de 1911. Pp. vii+247. (Paris: Gauthier-Villars, 1911.)

The president of the International Committee, Dr. Foerster, invited particular attention to the important question of end measures of length. It was decided to address a circular letter to the various bureaus of standards requesting information as to their practice in regard to these standards, and describing certain patterns which the International Bureau regard as suitable for general adoption in the interests of uniformity. The patterns include three types of standards, viz., cylindrical plug gauges for measuring small thicknesses, end bars of 12 mm. diameter with spherical caps, for greater lengths, and plane-parallel blocks or plates for either the greater or smaller dimensions. The method of comparing end measures which was first employed by Airy some sixty years ago in connection with the reconstruction of the Imperial Standard Yard, has recently been tried at the Bureau, and has been found to give very satisfactory results. The verification of a series of gauges with plane ends, made by the Swedish firm Johansson, has demonstrated the extraordinary degree of accuracy which can be attained in the construction of gauges of this form.

There are several important appendices to the Procès Verbaux. The first, by Drs. Benoît and Guillaume, is an account of recent experiments with invar measuring wires. The growing popularity of these wires for geodetic operations, and the consequent demand for their verification and re-verification, have necessitated an immense number of comparisons at the Bureau, and the experience thus obtained has admitted of definite conclusions being arrived at as to how far the lengths of these wires under standard conditions can be regarded as permanent. The investigations show that in general the wires, when manipulated with the care usual in geodetic work, retain their original lengths well within one part in a million. Where greater deviations were found to occur they could in general be accounted for either by the small graduated scales at the ends of the wire having become in the course of use slightly displaced from their true tangential directions, or else by the wire having been used in regions bordering on the tropics, where it would be exposed to quite abnormal temperatures.

In the second appendix Dr. Guillaume describes a comparator designed by him for rapidly testing both line measures and end measures. The instrument, which was destined for use in the Chinese weights and measures service, in which both the metric and the native systems are recognised, was constructed to admit of measurements in both these systems to a degree of accuracy of nearly 0·01 millimetre. A simplified form of this comparator, intended for use in testing metric measures only, has also been designed by Dr. Guillaume, and promises to be a convenient apparatus for making rapid comparisons with a fairly high degree of accuracy. A measuring machine suitable for use in manufactories for checking workshop standards or for general purposes is also described by Dr. Guillaume (appendix 3).

The flexure of the 4-metre geodetic standard at the Bureau has been determined. This measure, which is made of invar, has a section of the **H**-form, the outside dimensions of which are about 4 centimetres. The results of the observations on this bar exhibited remarkable agreement with the calculated values based on the Euler-Bernoulli theory of the deflection of elastic beams (appendix 4).

The fifth appendix deals with the recent progress of the metric system of weights and measures. On January 1 last Bulgaria joined the Metric Convention, raising the number of contracting States to twenty-five. The metric carat of 200 milligrams has, up to the present, received express legal sanction in nine

European States, as well as in Japan; while in Germany, with the tacit consent of the Government, it has been adopted by the industries concerned. In eight or nine other countries the use of the metric carat is permissible, but other carats are not prohibited. Early in 1908 some of the principal diamond merchants in the United Kingdom were approached by the Board of Trade with the view of ascertaining whether the trade were prepared to adopt the metric carat. The replies received were mainly unfavourable to this project. It would be interesting to learn whether the fact that the metric carat is now generally recognised abroad has had any effect in modifying the views of the trade in this country on the subject.

Tome xv. of the Travaux et Mémoires of the Bureau is being rapidly prepared for the press. It will contain an account of the investigations by MM. Benoît, Fabry, and Perot on the determination of the metre in terms of wave-lengths of light, and an article by Dr. Guillaume on the recent progress of the metric system. If space permits, a memoir on end measures of length will also be included.

AUSTRALIAN ZOOLOGY.[1]

IT is a somewhat humiliating reflection for British zoologists that such an important and prosperous part of the British Empire as the Australian Commonwealth should have to depend so largely upon German enterprise for the investigation of the native fauna. It is, of course, true that a vast amount of good work has been done by naturalists resident in Australia, and by British scientific expeditions, and as regards the vertebrates, we perhaps already have a fairly complete knowledge of the Australian fauna.

So far as the invertebrates are concerned, however, the work seems to be little more than begun. The Australian Museum at Sydney has published in the "Records" and "Memoirs" numerous important contributions to our knowledge of special groups, and also the results of various collecting expeditions, which deal with more extensive sections of the invertebrate fauna. We remember also that the late Sir Frederick McCoy published several volumes of a prodromus of the Australian fauna, in which many invertebrates were excellently figured, but the series came to an untimely end. The late Mr. Bracebridge Wilson, again, made extensive collections of marine invertebrates in the neighbourhood of Port Phillip, but a portion only of these has ever been properly investigated. Individual workers, whose names are well known in the scientific world, have made most valuable contributions to our knowledge of special groups, such as the Sponges, Hydrozoa, Polyzoa, Earthworms, Land Planarians, Mollusca, Crustacea, Onychophora, Insecta, and Arachnida. One might almost say, however, that although a good many mouthfuls have been taken (especially in the plummiest parts), Australian zoologists have not as yet developed a sufficiently keen appetite to make any very serious combined attack upon the invertebrate pudding as a whole. This is by no means altogether their fault, for it is useless for men of science to devote their lives to laborious investigations—and those of a kind which brings but little credit except amongst a narrow circle of specialists—if there is not sufficient financial support forthcoming to publish the results in a satisfactory manner, to say nothing of paying the investigators. Even the greatest enthusiasm is soon damped for want of appreciation.

It is here that our German colleagues, with their usual thoroughness, are again leading the way. The Hamburg expedition to South-West Australia in 1905 must have reaped a rich harvest, and the results are now being given to the scientific world in a series of handsome and copiously illustrated volumes which do great credit to authors and publishers alike, and far excel any attempts which have been made for many years past to deal with the Australian fauna. The third volume is now in progress, and we have before us Lieferungen vi.–x. In these parts Dr. Carl Graf Attems deals with the Myriapods (excluding Scolopendridæ); Prof. Kieffer describes the Serphidæ and Evaniidæ; Ester Lager the Phyllopods; and Dr. Hentschel continues his account of the Tetraxonid Sponges. We notice that all the illustrations in these parts are text-figures, evidently reproduced by some photographic process, and the results obtained appear to be on the whole quite satisfactory. They are doubtless comparatively inexpensive, but from the artistic point of view they cannot be considered as equal to good lithographic work. This is more especially evident in the case of the sponge spicules.

It is, of course, quite impossible to notice such a work as this in any detail. We may say, however, that the volumes will be absolutely indispensable to future investigators of the Australian fauna, and we venture to hope that they will serve as a stimulus to the numerous British naturalists in Australia to continue their own excellent work in the same systematic and thorough manner.

[1] "Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905." Herausgegeben von Prof. W. Michaelsen und Dr. K. Hartmeyer. Band iii., Lieferung 6–10: Lief. 6, "Myriapoda exkl. Scolopendridæ," von Dr. Carl G. Attems; Lief. 7, "Serphidæ und Evaniidæ," von Prof. J. J. Kieffer; Lief. 8, "Actiniaria," von E. Lager; Lief. 9, "Phyllopoda," von Dr. E. Wolf; Lief. 10, "Tetraxonida," 2 Teil, von Dr. E. Hentschel. Pp. 147–393. (Jena: Gustav Fischer, 1911.) Price 18 marks.

PROF. W. SPRING.

AS already announced, Prof. W. Spring, professor of chemistry in the University of Liège, died on July 17, in his sixty-third year; by his death Belgium has lost one of her foremost men of science, and physical chemistry has been deprived of an eminent investigator.

From the point of view of British chemists and metallurgists, the work of Spring has been to some extent hidden by being published almost entirely in the proceedings of the Royal Belgian Academy, so that only the more striking results of his work have become generally known. Thus Spring's name is principally associated with his work on the effect of high pressures upon chemical combination and upon the welding of particles of metals and alloys. The progress of our knowledge of physical chemistry generally, and that of metals particularly, has made us very familiar with the idea and the phenomena of diffusion in solid bodies, even at temperatures far below their fusion-point, but the researches of Spring were among the earliest to give actual data on such phenomena. Thus Spring showed in 1894 that carefully surfaced pieces of copper and zinc placed in contact in vacuo became welded together, and that at the interface a layer of yellow alloy was formed. It was not until 1896 that the late Sir William Roberts-Austen published his own classic work on the interdiffusion of solid lead and gold. Spring's work on the effect of pressure in bringing about chemical reactions between finely-powdered bodies also tended to demonstrate the molecular mobility of solids.

Perhaps the best-known work of Spring was that in which he showed what he believed to be the formation of actual alloys by the action of high-pressures upon mixtures of the pure metals in powder form. His experiments were very striking, and showed clearly that by compressing metallic powders, solid blocks of metal could be produced, and he showed

further that this was accomplished without any fusion of the metal under pressure. The fact that the resulting masses were true alloys he sought to demonstrate by showing that, if the metallic powders were correctly proportioned, the resulting metal showed the low melting-points of fusible alloys and eutectics. Unfortunately the aid of the microscope was not called in for the study of these "alloys," and, indeed, the greater portion of Spring's researches were carried out before the modern methods of metallography were available, but it has since been shown that the compressed masses of solid metal produced by Spring consisted of the practically unaltered particles of the original powder, simply welded together under the action of the pressure, but without the formation of those structural constituents of the corresponding true alloys. The low melting-points of such mixtures must be attributed to local action at the boundaries of the constituents and the rapid diffusion following the appearance of liquid metal at these points. Although, therefore, Spring's original conclusions were not entirely confirmed by subsequent research, his work has borne much fruit; his demonstration of the possibility of extruding bismuth in the form of thin wire shed new light on the whole question of brittleness and plasticity, and has largely contributed to the development of the modern processes of extruding metals and alloys for industrial purposes.

Spring's activities were not confined to the physical chemistry of metals, however, but extended to researches on the colour of sky and water and on colloidal solutions—to mention only a few of the other sides of his work. It is even claimed for Spring by his friends that in his researches on turbid media he anticipated the "ultra-microscope" in principle to such an extent that the apparatus he describes differs from that now in use only in regard to the power of the microscope employed.

The sum-total of the late Prof. Spring's researches constitute a monument of a life of intense scientific activity, and it may be hoped that these researches may now be gathered together so as to make them more readily accessible, and thus to secure for them the full recognition which they deserve.

NOTES.

THE German Emperor has conferred upon Sir William Ramsay, K.C.B., F.R.S., president-elect of the British Association, the order "Pour le Mérite."

WE notice with regret the announcement of the death, on August 18, at eighty years of age, of Mr. S. H. Burbury, F.R.S., distinguished by his work in mathematical physics, especially in the theories of electricity and magnetism and the kinetic theory of gases.

A REUTER message from St. Petersburg states that the Minister of the Interior has prohibited for the year 1911 the trade in marmots along the Eastern Chinese Railway, and also the forwarding of marmot skins, flesh, and fat by rail. This measure has been taken as a precaution against pneumonic plague.

THE divisions of vertebrate and invertebrate palæontology and palæobotany in the U.S. National Museum have been combined, we learn from *Science*, into a new division of palæontology, with Dr. R. S. Bassler as curator in charge, Mr. J. W. Gidley as assistant curator of fossil mammals, and Mr. C. W. Gilmore as assistant curator of fossil reptiles.

IT is officially announced that the Governor of British Guiana has reported the adoption, as from August 1, of maritime time, which is standard time four hours slow on Greenwich time. The same standard time has been adopted in the island of Granada, as from July 1, the effect being to put back the local time of that colony by seven minutes.

IT is surprising at the present day, when the system of time-reckoning by reference to standard meridians is being adopted throughout the civilised world, that the city of Canterbury seems determined to maintain its own local time. The Dean and Chapter, in mediæval spirit, refuse to recognise any such "modern innovation" as Greenwich time, and have recently distributed cards intimating that the time observed in Canterbury Cathedral is 4½ minutes ahead of Greenwich time. The post-office and railway clocks are kept to Greenwich time, and the others anywhere between that and the cathedral clock. The resulting confusion has induced Mr. A. Lander, of 17 High Street, Canterbury, scientific instrument maker, and secretary of the East Kent Natural History Society, to make an electric clock which is kept to standard time by means of the wireless time signal from the Eiffel Tower. The first of the three time signals is received on Morse tape travelling at the rate of half an inch per second, and the half-minute contacts of the electric clock are also recorded on the same tape, so that the rate of the clock can be accurately determined. The second signal is utilised to correct the pendulum of the master clock, and the third signal is again received on the tape to show that the clock is exactly correct. This master clock works a number of clocks and instruments on Mr. Lander's premises, such as a rain-gauge, sunshine recorder, barograph, and also a large dial in the shop window, and drops a time-ball exactly at each standard hour.

THE twenty-second annual general meeting of the members of the Institution of Mining Engineers will be held at Cardiff on Wednesday, September 13, under the presidency of Dr. J. B. Simpson. The following papers will be read, or taken as read:—the reduction, control, and collection of coal-dust in mines, S. Mavor; a rope-driven coal-cutter, W. Maurice. A number of papers which have already appeared in the Transactions of the institution will also be open for discussion.

THE death has occurred, in his seventy-second year, of Dr. J. P. Schweitzer, who was connected with the University of Missouri from 1872 to 1906 as professor first of chemistry and later of agricultural chemistry. He was a native of Berlin, and after studying at Göttingen was for a time assistant to Heinrich Rose at Berlin. He went to America in 1865, and held posts at the polytechnic institute of Philadelphia and the Columbia School of Mines before receiving his Missouri appointment.

A REMARKABLE crystal of aquamarine was described by Dr. G. F. Kunz before the New York Academy of Sciences on April 3. It was discovered by a miner on March 28, 1910, in a pegmatite vein at Marambaya, near Arassuahy, on the Jequitinhonha River, in Minas Geraes, Brazil. Its colour was greenish-blue, its form a slightly irregular hexagonal prism terminated at both ends by flat basal planes, its length 48·5 cm. and width from 40 to 42 cm., and its weight 110·5 kg., and its transparency was so perfect that it could be seen through from end to end. It is estimated that 200,000 carats of aquamarines of various sizes could be cut from it.

MR. J. ALLAN THOMSON, who has been appointed palæontologist to the Geological Survey of New Zealand, was the first New Zealand Rhodes scholar at Oxford, where he was also Burdett-Coutts scholar. He received

his university training in geology and palæontology both in New Zealand and at Oxford, but for the last five years or so his work has been mainly in the direction of petrology. The New Zealand Geological Survey possesses more than one hundred thousand fossils from various horizons, but little appears to have been done hitherto to describe them or to make them available for study. It is hoped that now the survey has appointed a palæontologist on its staff the specimens will be properly described and arranged.

At the 1909 meeting of the International Mathematical Congress, held at Rome, the subject of mathematical teaching was brought forward, and upon the initiative of Prof. D. E. Smith, U.S.A., it was decided to form an International Commission on the Teaching of Mathematics, this commission to report to the next triennial meeting of the congress, which will be held at Cambridge (England) in 1912. The commission will meet at Milan on September 18–20 of this year to take stock of the work done so far. As regards the United Kingdom, the work of collecting and issuing reports has been taken up by the Board of Education, which has appointed as delegates Sir George Greenhill, Prof. E. W. Hobson, and Mr. C. Godfrey. A number of reports have already been issued (Wyman, price 3*d*. each), and when the international series is complete it will form the most valuable collection of material at present available for the use of teachers of mathematics. The central committee consists of Prof. F. Klein (Göttingen), Sir G. Greenhill (London), and M. H. Fehr (Geneva).

It is announced in *Science* that the Nantucket Maria Mitchell Association offers an astronomical fellowship of 200*l*. to a woman, for the year beginning June 15, 1912. The year will be divided into two periods. June 15 to December 15 will be spent on Nantucket, where the observatory is equipped with a five-inch Alvan Clark telescope, and this period will be occupied in observation, research, or study, and in lectures or instruction. February 1 to June 15, 1913, will be spent at one of the larger observatories, and the time occupied in original research and study. Every fourth year the fellowship will be available during the entire year for study at one of the larger observatories in Europe or America. The fellowship will be awarded annually, but in order that the work at Nantucket may be combined advantageously with the work at the selected observatory, the preference will be given to the same candidate for three successive years. A competitive examination will not be held. The candidate must present evidence of qualifications, giving an account of previous educational opportunities and training, and of plans for future work, as well as examples of work already accomplished. Application for the year beginning June 15, 1912, should be made, before March 1, 1912, to Mrs. Charles S. Hinchman, 3635 Chestnut Street, Philadelphia, Pa., from whom full particulars can be obtained.

The long drought has been brought to a termination, and the excessive temperature which has continued with such persistence over England has given place to more normal conditions. The anticyclone which has so long been centred over our islands and their immediate neighbourhood has given way to shallow cyclonic disturbances which have arrived over us from the Atlantic. At Greenwich there was no rain from August 2 to August 18, and the aggregate fall from July 1 to August 18 was 0·32 inch, which fell on four days. Copious rains have, however, now fallen over London, and on three successive evenings, August 19, 20, and 21, sharp thunderstorms were experienced. On August 22 the highest temperature in London was 68°, which is the lowest maximum reading since July 2, a period of more than seven weeks. The disturbances which occasioned the recent thunderstorms over England were moving away to the eastward of our islands, and an anticyclone, centred in the Atlantic, was extending to our area. This change in the general conditions is likely to occasion a return of the fine weather with a gradual increase of temperature, although it is improbable that the temperature will be so high as that recently experienced. The summary of the weather for the week ending August 19 issued by the Meteorological Office shows that the mean temperature for the period was from 6° to 7° in excess of the normal over the entire kingdom, except in the north and east of Scotland and in the north-east of England; the excess of temperature, however, was not so great as in the preceding week.

Mr. D. E. Hutchins, Chief Conservator of Forests, British East Africa, after ten years' forest service in India, twenty-three in South Africa, and four in Equatorial Africa, has now retired on pension. It fell to his lot both in South Africa and in Equatorial Africa to demarcate and arrest the further destruction of large areas of the beautiful extra-tropical forest that extends with but little change from the extreme south of Africa along the eastern highlands to the equator. As the latitude decreases the altitude increases. The forest that occurs at sea-level in the Knysna district of the Cape, at 3000, 4000, and 5000 feet in Natal and the Transvaal, is seen at an elevation of 7000 to 10,000 feet under the equator. The distribution of this forest is governed by the topography and rainfall of the highlands. There are wide gaps in its extension along the highlands. As one goes north, it changes somewhat in species, though but little in character. It is seen at its best on the equatorial highlands in what is now British and German East Africa. Here the trees grow with greater vigour than in the south, and the forest is enriched by the addition of a very valuable timber, the pencil cedar of Abyssinia (*Juniperus procera*). The preservation of this forest is of national importance to Africa, especially to extra-tropical Africa, the White Man's heritage; for it is a forest resembling that of the Nilgiri Shola forest of India, a forest with a dense couvert and slow-growing—the ideal water-holding forest. As a fact, it is a forest from which streams of water flow on every side, perennial streams that feed the rivers when they are most wanted. The future of this forest is assured in South Africa, the bad forestry of Natal having happily come to an end with Union. The Germans are preserving it carefully in German East Africa, no forest of this class having been alienated since 1900. But in British East Africa there hangs out a danger signal! The Colonial Office will have to see that its forest policy there is duly upheld. There is a danger that settlement, so right and necessary, in a new country may be pushed too far, to the ruin of the most valuable public assets of the country—its water and timber. Settlement is obviously the first requisite; but settlement must not be allowed to touch an acre of highland forest in a country where the forest area is only 1½ per cent. of the total area, and that is the position in British East Africa.

A special "tuberculosis" number of the Bulletin of the Johns Hopkins Hospital has been issued (vol. xxii., No. 245). The principal article is on stereoscopic X-ray examination of the chest, with special reference to the diagnosis of pulmonary tuberculosis, by Drs. Dunham, Boardman, and Wolman. It is illustrated with three excellent stereoscopic views of the condition present in three cases of pulmonary tuberculosis.

WRITING from Chinanfu, Shantung, China, Mr. Alfred Tingle refers to a statement made in a note in NATURE (June 8, p. 493) that "rice in China takes the place of wheat with us as the chief source of starchy food," and points out that in Shantung rice is little used, other cereals being substituted, and that the diet is a liberal one. The statement, of course, was only a general one; and obviously in a country so huge as China, with climates varying from tropical to almost Arctic, the diet in different districts must be equally variable.

IN a paper on the chemical differentiation of species, Miss Muriel Wheldale suggests that the presence of particular chemical compounds in plants may be of value either in the differentiation of, or in accentuating resemblances between, orders, families, genera, or even species. Thus the glucoside "aucubine" was first isolated from *Aucuba japonica* (Cornaceæ), and subsequently from seven species of Garrya, another genus of the Cornaceæ. It is also stated to be present in various species of Plantago (Plantaginaceæ). It would be interesting to discover if there are other connecting links between these two groups. Some of the purins are known only in the genus Thea (*Bio-Chemical Journal*, v., 1911, No. 10, p. 445).

IN his report on the Giza Zoological Gardens for 1910 Captain Stanley Flower states that the number of visitors continues to show a gratifying increase, and that the number of animals, other than fishes, in the collection is larger than in any previous year, comprising at the annual stock-taking 1464 specimens, referable to 391 species. Among the more important additions were a rhinoceros and a Blue Nile elephant.

IN *The Field* of August 12 Mr. R. I. Pocock illustrates the different ways in which the Indian and the African elephant use the tip of their trunks. In the former, some small object, such as a handful of bran, is held by the tip of the trunk being bent on itself, so that the object is squeezed between the tip and the lower surface of the trunk, whereas in the latter the object is held between the two lips of the trunk-tip, much after the fashion in which fruit is placed in a cornucopiæ.

THE recorder of Section D (Zoology) of the British Association sends us the following provisional programme of the section for the forthcoming meeting at Portsmouth:—Presidential address, Prof. D'Arcy W. Thompson. *Discussions:* On the origin of the Mammalia, Prof. G. Elliot Smith, Dr. C. W. Andrews, Prof. A. Keith, and Dr. Marett Tims; on Wallace's line, C. Tate Regan and Guy Marshall; on the systematic position of the cyclostomes, Dr. Woodland, Prof. Dendy, and E. S. Goodrich; on the nutrition of marine organisms, Dr. Dakin, Prof. Herdman, Prof. Gamble, and Prof. V. H. Blackman. *Lectures* (with illustrations): Mr. F. Enock, on fairy flies; Dr. C. W. Andrews, on the extinct reptiles of the Oxford Clay of Peterborough. *Papers:* Recent advances in sex problems, G. Smith; some points in the anatomy of Squilla, Dr. Woodland; new species of Balanus collected by the *Siboga* in the Malay Archipelago, Dr. P. P. C. Hoek; a new epizoic hydroid on a copepod (n.g.+n.sp.) parasitic on *Scopelus glacialis*, Prof. H. Jungersen; note on the manus of a young Indian elephant, Prof. R. J. Anderson; some points in the manus and pes of Primates, Prof. R. J. Anderson; on the effect of Sacculina on the fat metabolism of its host, G. C. Robson; notes on a trypanosome found in a sheep tick, and its probable connection with the disease known as louping-ill, Major C. F. Bishop, R.A.; on the dorsal vibratile organ of the rockling (Motella), Dr. J. Stuart Thomson; momentum in evolution, Prof. Dendy; Polytrema and its allies, Prof. S. J. Hickson; the life-history and metamorphosis of Murænoids, Dr. J. Schmidt (Copenhagen); le cycle animal des glandes génitales de l'*Echinocardium cordatum*, Prof. Caullery (Paris); the hypostome and antennæ in a reconstructed trilobite (Calymene), Prof. Malcolm Laurie; (1) the vernal-plumage changes in the adolescent blackbird (*Turdus merula*) and their correlation with sexual maturity; (2) case of a remarkable egg of *Falco tinnunculus* laid in remarkable circumstances, Prof. C. J. Patten; (1) the lantern of Aristotle as an organ of locomotion; (2) solaster development, Dr. James F. Gemmell.

MESSRS. FRIEDLANDER, of Berlin, have conferred an inestimable benefit on zoologists and palæontologists by the issue of a second edition of the "Zoologischer Adressbuch" (International Zoologist's Directory), which contains the names and addresses, so far as they could be ascertained, of all living persons specially interested in zoology, anatomy, physiology, and animal palæontology throughout the world, together with taxidermists and natural history dealers. The previous edition was published by the German Zoological Society in 1895, to which a supplement appeared in 1901. The present volume comprises 1109 pages, of which 88 are devoted to the index of names. As in the American "International Scientist's Directory," the names of the persons referred to are entered under the heading of their respective countries, but in place of the names being arranged in alphabetical order, they are classified according to the place of residence. Whether this is an improvement or the reverse we do not propose to discuss; but, whatever may be the general opinion on this point, the index renders it perfectly easy to find the individual addresses. Taking the British Isles as a sample of the whole, we find, so far as we are acquainted with them, both the names and the addresses entered with what is really marvellous accuracy. The names of a few deceased naturalists, such as the late T. Southwell and C. J. Cornish, are retained on the lists, while a few living naturalists, *e.g.* Mr. Hugh Gladstone, are omitted; and we notice some confusion between the officials of the Victoria and Albert Museum and those of the Science Museum. Errors of this nature are, however, practically unavoidable, and the publishers are to be heartily congratulated on the manner in which they have carried out an arduous task. As the expense in producing the work must have been very heavy, it is to be hoped that they will receive liberal support from that section of the public interested in natural history.

IN the current issue of *Scientia* M. J. Costantin directs attention to some of the recent phases of the culture of orchids. He points out that 600 hybrids have been produced in the genus Cypripedium alone, many of which do not resemble their parents but look like new species, and are indefinitely fertile, and so can be crossed with each other. Observations are added on the association with orchids of a mycorhiza, three species of which have been recorded; one of these is found in the roots of Cypripedium, Cattleya, and Lælia, another in Phalænopsis and Vanda, and the third in Odontoglossum. The inoculation of an orchid with a species of mycorhiza other than that usual to it leads to one of three results: either the plant dies, the fungus dies, or they become accommodated to each other; but in this case a plant of unusual form is produced. The author suggests that these facts indicate that the environment may be responsible for the appearance of new characters.

PROF. EMIL ROHDE (in *Zeitschr. f. wiss. Zool.*, Bd. xcviii., 1 Heft) shows that chromatin diminution occurs in various tissues other than the germ cells. In the blood cells of various vertebrates the nuclei undergo a maturation process similar to that exhibited in oogenesis, portions of chromatin being cast out of the nucleus and out of the cell. In the red blood cells of mammals this process goes on to such an extent that the whole nucleus is lost. The nuclei of other tissue cells, especially those of the central nervous system of vertebrates, exhibit diminution of chromatin which the author compares with that observed in spermatogenesis. The nuclei of the nerve cells in karyokinetic division give off spherical masses of chromatin, which later lie between the resting nuclei. In other cases the nucleus breaks up into several small daughter nuclei, which Prof. Rohde compares with the division of the sperm mother cell into spermatozoa. The fact that diminution of chromatin takes place in so many different tissues and animals (those investigated range from Mustelus to man) indicates that it has a general significance; the author regards it as a characteristic of adult, that is, of maturing and dividing cells in general. Other memoirs in the same journal deal with the innervation and sense organs of the wings of butterflies and the nephridial funnels of earthworms.

To *The Journal of Economic Biology* for July Dr. H. B. Fantham contributes an important article on coccidiosis in game-birds and poultry. Owing, it is suggested, to the great increase of motor traffic, and the consequent pollution of the air in many parts of the country, white diarrhœa and other forms of coccidiosis, which chiefly affect young birds, appear to be on the increase, and there is, accordingly, urgent reasons that every available means should be taken for keeping them in check. The two important objects which should be kept in view are, first, the taking of such precautions as will tend to prevent the pollution of air and soil by coccidian oöcysts, and, secondly, to endeavour to raise the vitality of young birds, and thus enable them the better to resist the onset of the disease. In the case of domesticated poultry, cleanliness is a matter of the first importance, both as regards the young birds themselves and their surroundings; and it is probable that if such preventive measures were properly enforced and carried out, coccidiosis would eventually disappear. The author gives a full and detailed account of the structure and life-history of the parasite of coccidiosis and of its effects on the intestinal tract of its victims, but these are too long and too technical for quotation, even in brief abstract, on this occasion. *Eymeria avium*, or *Coccidium avium*, as it was formerly called, is a minute animal parasite belonging to that section of the Protozoa known as the Sporozoa, on account of the production of resistant spores. Although in some cases the whole intestinal tract of the bird may be riddled by the parasite, the duodenum and the paired cæca, or blind guts (especially long in grouse), are the parts chiefly attacked. The life-cycle of the parasite is complicated by the fact that there are two distinct phases of development, namely, an asexual phase, known as schizogony, during which there is a multiplication of the parasites by fission in the lining of the intestine of the infected bird, and subsequently a sexual phase, in which resistant cysts and spores adapted for life outside the body are produced in myriads. It is by these spores, which are swallowed by fresh birds with their food and drink, that the disease is spread.

THE difficulty of obtaining trustworthy data, at any rate in India, to prove or disprove the influence of forests on atmospheric and soil moisture is reasonably argued in an article appearing in *The Indian Forester* (July). Not the least interesting portion is the transcript of a note on the subject submitted to the Indian Government by Dr. Walker, the Director-General of Observatories. It reflects great credit upon the Government of India that, in spite of opinions mainly adverse, they assent to the initiation of a few experiments in selected localities for the purpose of tabulating information with respect to local differences in rainfall, temperature, and humidity inside and outside forest areas, as also to differences in level of the underground water table and extent of floods that might be referable to the proximity of forest areas.

AN account of the Percy Sladen Memorial Expedition (1910–11) to the Orange River through Little Namaqualand, contributed by Prof. H. H. W. Pearson, is appearing as a series of articles in *The Gardener's Chronicle*. In the current number (August 19) the author touches on the existence of a flora with a strongly marked Cape affinity occurring on the Khamiesberg range, while the low country shows entirely different vegetative formations, in which succulents predominate. The Khamiesberg is one vegetative island, while another is found on the Huilla plateau in South Angola, and possibly similar floras will be discovered on the unexplored peaks in German South-West Africa. If these islands show the remnants of a flora once continuous, whence, it is asked, and by what route, came the ancestors of the plants occupying the lowlands. The illustrations represent some of the more striking succulents, such as *Mesembryanthem digitiforme* and *Augea capensis*.

OWING to the receipt of numerous specimens of inflorescences from the graft hybrid, *Laburnum Adami*, sent to Kew Gardens for identification, Mr. W. J. Bean contributes a short article on the subject to *The Kew Bulletin* (No. 6), in which he explains how this particular novelty arose as a chance development from a graft of the dwarf purple broom, *Cytisus purpureus*, on the common laburnum. From the graft there arose a shoot which produced the intermediate type of purplish-yellow flower. Subsequently portions of trees propagated from the shoot reverted to the parent types, so that a single tree may bear at the same time the purplish flowers of the presumed hybrid, yellow flowers of the laburnum, and purple flowers of the broom. Two further examples of graft hybrids, *Crataego-mespilus Dardari* and *Crataego-mespilus Asnieresii*, are also described. They both arose on the same tree, a medlar grafted on a stock of common hawthorn, as branches showing composite characters. *Crataego-mespilus Dardari* has shown a tendency to break up into three forms, representative of the type *Asnieresii*, pure medlar, and itself. The different forms are illustrated from a photograph of three sprays gathered last June from a specimen of *Crataego-mespilus Dardari* growing in Kew Gardens.

IN the August number of *Petermann's Mitteilungen* Prof. Maurer describes a conventional projection for conveniently representing the lines of magnetic declination. For their study Mercator's projection is unsuitable, however well adapted it may be to the requirements of the navigator, since the areas in the neighbourhood of the poles are not represented, and the zones in higher latitudes are greatly distorted. In his projection the polar regions are well shown, the central point of the map being in $\phi = 0°$, $\lambda = 90°$ E. South America is considerably distorted from being unfavourably placed, but other continents suffer less.

THE Journal of the Meteorological Society of Japan for June contains original articles, with brief abstracts in English, (1) on the construction of protected rain-gauges,

by Mr. J. Sato. The author gives the history of the works of some of the principal writers on this subject, and describes a gauge devised by himself, which is a modification of one adopted by the late Dr. Billwiller in the Swiss Meteorological Service. (2) An analysis by Mr. H. Maruoka of the Osaka seismogram at the time of the severe earthquake felt in Mexico on June 7. The time of its commencement in Osaka was 9h. 17m. 48s. (135th meridian); its total duration was 2h. 34m. 31s. in the E.-W. component, and 2h. 31m. 23s. in the other component. (3) Discussion of rainfall observations at Osaka for the years 1883–1910, by Mr. K. Yamada. The results of this valuable investigation are not given in English.

THE experiments of Profs. Boltwood and Strutt, and of Dr. Eve, on the amounts of uranium and radium present in radio-active minerals, have led to the conclusion that the ratio of the amounts of the two present is a constant independent of the nature of the mineral so long as its age was considerable. A long series of measurements made in Madame Curie's laboratory by Miss Ellen Gleditsch seem now to cast doubt on the constancy of the ratio. The methods used by Miss Gleditsch appear to offer little ground for criticism, and her results show a variation of the ratio of radium to uranium from $1{\cdot}8\times10^{-7}$ to $3{\cdot}7\times10^{-7}$ for the twenty-one minerals examined. These differences she is disposed to attribute to the existence of the long-period ionium and possibly another long-period element between the parent uranium and radium, but does not exclude the further possibility of the "constants" of radio-activity being influenced by external circumstances more than we at present believe.

THE sensation produced on the retina by a source of light of short duration has for the last three-quarters of a century been taken as proportional to the product of the intensity of the source into its duration. The early experiments of Talbot and of Swan, and the later ones of Bloch and of Charpentier, provided ample justification for the law so far as it related to sources of considerable intensity. In the *Journal de Physique* for July, MM. A. Blondel and J. Rey point out that for weak sources the intensities of which are not much greater than the lowest perceptible the statement cannot be true, or there would be no lower limit to perception. On this ground they argue that the sensation should be proportional to the product of the *excess* of the intensity of the source over the minimum just perceptible into the duration of the source, and this conclusion they have verified by means of the measurements made by seventeen observers by two independent methods of observation.

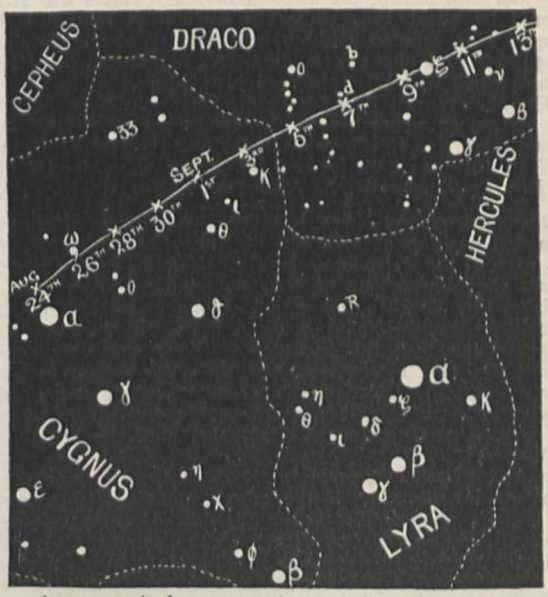
WE learn from *The Engineer* for August 11 that the new Italian Dreadnought *Conte di Cavour* was successfully launched at Spezia on August 10. Admiral Mirabello's crusade against lack of homogeneousness is beginning to produce its fruits; it is not likely that Italy will add to its armoured cruisers, as opinion has turned in favour of Dreadnoughts, of which four were designed by General Masdea. The *Conte di Cavour* is the second example of these. She will have a displacement of 21,500 tons, and her turbine machinery, of 24,500 horse-power, is designed for a speed of 22 knots. There will be twenty water-tube boilers of the Blechynden type. The normal coal and petroleum capacity will be 1000 tons. The armament will comprise thirteen guns of 305 mm., twenty guns of 120 mm., and thirteen guns of 76 mm. There will be three submarine torpedo tubes, two lateral and one stern.

A COPY of the "Reports and Transactions," for the year ending September 30, 1910, of the East Kent Scientific and Natural History Society has been received. Among much other interesting information contained in the report, some facts about salt rains, contributed by Mr. W. H. Hammond, may be mentioned. On December 14, 1910, a very heavy gale from the south-east with a deluge of rain in the night occurred; on the following day all the windows which faced south-east had quite a frosted appearance when dry. Some of the substance scraped off and dissolved in distilled water was proved to consist of common salt. At Milton Chapel some years ago, in the 'eighties, on one occasion a north-east window was coated with salt after a gale, and on the *Dane John* about the same time a salt gale was experienced; it made the young leaves look as if they had been scorched by fire. Mr. Hammond states that in 1871, when a student at the Royal Agricultural College, Cirencester, Prof. Church told his class that the rain which came in a gale one day from the direction of the Bristol Channel was loaded with salt; this must have travelled about sixty miles. The report also contains observations of the "nailbournes" in the Elham Valley, Petham, and Drillingore in the Alkham Valley, Dover. Useful meteorological statistics and notes for the year 1910 from various observing stations throughout east Kent are also included, as well as natural history notes and reports of lectures and addresses.

OUR ASTRONOMICAL COLUMN.

THE COMETS 1911*b* AND 1911*c*.—Numerous observations of the comets discovered by Kiess and Brooks, respectively, are now being recorded, but they contain nothing that is strikingly new; the Kiess comet is now invisible in these northern latitudes.

In No. 4517 of the *Astronomische Nachrichten* Prof. Pickering reports that a photograph of the spectrum of comet 1911*b*, secured with the 8-inch Draper telescope on July 7, shows the bands at λλ 3883 and 4737 as bright, and of nearly equal strength; the latter was much the brighter in the case of Daniel's comet, 1907*d*.



Apparent path of comet 1911*c* August 24–September 13, 1911.

From Mr. F. C. Leonard, of Berlamont, Mich., U.S.A., we have received a lengthy report of observations of both comets made during July. Kiess's comet developed appendages on both the preceding and following sides, and on July 26 a long streamer was seen to extend for some distance in a direction perpendicular to the axis.

Brooks's comet, observed on July 25, 26, 27, and 29, presented the mottled appearance of a condensed nebulous cluster, and was 3′ or 3·5′ in diameter.

The following is a continuation of the ephemeris published by Dr. Ebell in No. 4517 of the *Astronomische Nachrichten*, and on the accompanying chart the apparent path of the comet among the stars is approximately shown; the new elements, upon which these positions depend, give October 27 as the time of perihelion passage:—

Ephemeris (12h. *M.T. Berlin*).

1911	α (true) h. m.	δ (true) ° ′	log r	log Δ	mag.
Aug. 24	20 41·9	+46 43·8	0·1552	9·8033	8·0
,, 26	20 28·5	+48 30·6			
,, 28	20 13·4	+50 14·0	0·1345	9·7770	7·8
,, 30	19 56·5	+51 52·1			
Sept. 1	19 37·7	+53 22·4	0·1125	9·7542	7·6
,, 3	19 16·9	+54 42·0	0·1010	9·7444	7·5
,, 5	18 54·3	+55 48·2	0·0891	9·7357	7·4
,, 7	18 29·9	+56 38·2	0·0768	9·7282	7·3
,, 9	18 4·1	+57 9·6	0·0641	9·7220	7·2
,, 11	17 37·5	+57 20·4	0·0510	9·7172	7·1
,, 13	17 10·6	+57 9·4	0·0374	9·7136	7·0

It will be noted that on August 26 the comet will pass very near to ω Cygni (magnitude 4·9), and on September 10 within a few minutes of ξ Draconis (magnitude 3·9).

THE NEW CANALS ON MARS.—It will be remembered by readers of these columns that, during the last opposition of Mars, Prof. Lowell claimed to have discovered conspicuous canals which reference to the large accumulation of earlier observations showed to be new; they were not to be found on any of the earlier drawings.

Telegraphing to the Kiel Centralstelle, Prof. Lowell now states that these two new features near Syrtis are still visible. The importance of establishing the novelty and permanence of such conspicuous "canali" as these appear to be cannot be overrated.

A QUICKLY MOVING COMET-LIKE OBJECT.—Dr. Franz reports the observation at Breslau on July 22 of a rapidly moving nebulous object, which may have been a comet very near to the earth. At 13h. 4m. (M.E.T.), the position of this object was α=4h. 15·0m., δ=+20° 36′ (1855·0), and during an interval of six minutes the R.A. altered by about 3m., while the declination remained the same. This nebulous-looking body was of about the sixth magnitude and about 6′ in diameter, not unlike the Kiess comet which had been observed just before.

The observers at Kiel searched unsuccessfully on July 23 for an object answering to the conditions named by Dr. Franz, and Dr. Graff was equally unsuccessful at Bergedorf on July 24; both he and Dr. Franz were clouded out on July 23 (*Astronomische Nachrichten*, No. 4517).

OBSERVATIONS OF NOVA LACERTÆ.—A number of magnitude and position observations of Nova Lacertæ appear in No. 4509 of the *Astronomische Nachrichten*. Prof. Eginitis shows that the colour of the star changed from red to bluish-white during the period January to March, its magnitude meanwhile decreasing from 7·9 to 8·9. M. Luizet shows that this change of colour was very rapid during the first six weeks, and then the colour became nearly constant. Herr Jost's observations of magnitude show very small oscillations up to the end of February, and then a nearly constant diminution until the beginning of May.

At the Simeis Observatory Prof. Beljawsky made an elaborate investigation of the nova's magnitude as shown on various photographs taken through different coloured screens. The results, together with the measures of position, are given and discussed in No. 41 (vol. iv., No. 5) of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo*.

PROMINENCES OBSERVED ON APRIL 28.—In view of the total eclipse of the sun on April 28 last, Prof. Riccò made special arrangements for the visual and photographic observations of prominences at Rome and Catania, and now publishes the results in No. 4, vol. xl., of the *Memorie di Astrofisica ed Astronomia*. There was a large prominence in position-angle 48° (N. through E.), and lesser ones at 36°–42°, 163°–168° (given as 192°–198° on the figure accompanying the article), and 294°–300°.

A STAR WITH CONSIDERABLE PROPER MOTION.—Mr. Baldwin reports, in No. 4513 of the *Astronomische Nachrichten*, that the observations made at Melbourne Observatory show the star C.P.D. −70°447 to have a large proper motion amounting to −0·071 1s. in R.A. and +1·214″ in declination. The position of the star, for 1900·0, is 5h. 45m. 41·036s., −70° 12′ 50·91″, and it was observed at Melbourne in 1892 and 1907.

AN ASTRONOMICAL SURVEY OF SOME PEMBROKESHIRE CIRCLES.

THE Rev. W. Done Bushell first directed the attention of the members of the Cambrian Archæological Association five years ago to some monuments in Pembrokeshire as illustrative of Sir Norman Lockyer's findings elsewhere, and a well-illustrated paper of fifty-two pages, published in the journal of that association, shows that, so far as Wales is concerned, the archæologists wish to give this "new thing" a hearing.

The author confines himself to ten groups of monuments on the southern slopes of the Prescelly Hills, covering a tract of land seven miles from east to west. As during the last five years he has made repeated visits to the district, he has gathered almost heartrending evidence of the progressive destruction of ancient monuments. "There were at Eithbed until very recently three circles, and probably three cromlechs also were associated with them. They are now no more. The largest was destroyed, we know not when or how" (pp. 17, 18). "We find this circle duly given in the earlier edition of the 25-inch Ordnance Map; it is entirely absent from the later edition issued in 1908." The author was able to trace its outline. "It has an average diameter of no less than 150 feet." "Two other circles . . . have both of them been wilfully destroyed," one in 1905 and the other in 1909. "These circles, with the accompanying cromlechs, must have formed a very noble and important group before they were thus demolished." The author, fortunately, had photographed some of the monuments before they were destroyed. Last year he recognised some of the temple materials in an "ugly house which stands close by, a veritable monument of shame" (pp. 19, 20). All archæologists will, of course, deplore such vandalism; but the significance of the loss is well expressed in the author's remark:—"We may add that the existence of three circles in immediate contiguity suggests, as in the case of the Hurlers and elsewhere, adjustments rendered necessary by precession" (p. 22).

At Cil-y-maen-llwyd, in the same district, an observer about the year 1738 saw "a circle of mighty stones very much like Stonehenge in Wiltshire, or rather like the Rollrych Stones in Oxfordshire" (p. 38). There remains just one of the mighty eighty stones.

Of the existing remnants of temples second to few in Britain, the author has secured most useful angular measures. He acknowledges the assistance of his son, Mr. Warin F. Bushell, and of Lieut.-Colonel Tupman, in preparing the plans given. A useful declination table for lat. 52° by the latter is given as an appendix. The paper is an admirable illustration of what may be done with little trouble in every district towards recording the testimony of the stones, the speediest and most effective method of outwitting the vandals. Photographs are good, plans are better, but measures are indispensable.

Given trustworthy data, we can put up with any deductions. Some of the author's opinions are tolerable only on such ground. Because of the difficulty in these latitudes of observing any celestial bodies right on the horizon, he is inclined to think that the alignments had only a ceremonial use. Early man, he thinks, "did not require the aid of an astronomer" (p. 44). "Nor would so many observation-circles have been required had their prime object been, as has been suggested (Lockyer, 'Stonehenge,' p. 17), the determination of the seasons. England has many churches, but only one Greenwich" (pp. 45, 46). Yet in a passage cited the author speaks of "adjustments rendered necessary by precession." Such, however, are some opinions which the author puts forth as "alternatives to any premature acceptance of Sir Norman Lockyer's

interesting theory, at least in its entirety" (p. 44). Nothing like a proved alternative is offered, nor is it shown that the data supplied require any alternatives. Such a happy observation as that cromlechs generally are oriented so as to command the most extensive view obtainable is not universally true to the facts, and could not have been always "a primary consideration with the cromlech-builders" (p. 20). The exceptions prove what the primary consideration was, as at St. Lythans' fine cromlech, which is definitely oriented to the equinox in the opposite direction to the extensive view. JOHN GRIFFITH.

RECENT ENGLISH AGRICULTURAL PUBLICATIONS.[1]

SCIENTIFIC work in agriculture in this country is published exclusively in the Journal of Agricultural Science, but there are certain papers published in the technical journals which possess considerable scientific interest. These alone will be dealt with in the present article.

The Board of Agriculture publishes each month the Journal of the Board of Agriculture, which can only be described as an unqualified success. There are usually three or four signed articles, primarily of technical importance, but often of scientific value as well, followed by a number of short articles or notes summarising work done on a particular subject, or directing attention to important work being done elsewhere.

The progress of the sugar beet industry in Norfolk is described by Mr. W. E. Sawyer. Last year's trials showed beyond doubt that sugar beet could be produced in sufficient quantity, and of the necessary good quality, for the purposes of a factory. This year it is sought to ascertain whether the crop will pay as well as other crops, and in organising the work advantage is being taken of last year's experience. Generally speaking, it has been demonstrated that sugar beet can be produced in most parts of England, but we now require experiments on the large commercial scale to ascertain whether or not the industry will be profitable.

Dr. Goodwin writes on molasses and sugar foods for live stock. Molasses, whether from beet or from cane sugar factories, contains about 30 to 35 per cent. of sucrose and 25 to 30 per cent. of dextrose and other sugars. There are also present some nitrogenous compounds, betaine, amino-acids, &c., and also some ash constituents, but the great value of molasses as a food consists in its sugars. Unfortunately there are certain drawbacks to its use: it is very sticky and difficult to handle, and is said to be liable to theft. To overcome these difficulties the practice has arisen of adding some absorbent material to the molasses and making a mixture that could be dried, powdered, and handled easily. The absorbents are of the most varied kinds; cocoanut meal, hay, spent hops, bran, sugar-cane pith, and peat have all been used, and not a few extravagant claims have been put forward by the patentees about the beneficial effects of the absorbent. Dr. Goodwin examines certain of these claims, and shows by actual digestibility trials with sheep that only a small proportion of the added cellulose is digested in some cases.

The relation of weeds to crops is discussed by Miss Brenchley. Over a limited area, where the climatic conditions showed no great variation, *i.e.*, between Harpenden and Bedford, there was a clear connection traceable between the weeds and the nature of the soil, but none between the weeds and crop, with a few readily explained exceptions. The so-called "seeds" crops, clover, and rye grass, &c., effectually keep down certain weeds, no doubt because they so densely cover the ground; other weeds will only grow in the thin patches of cereal crops, and in other open situations.

It has long been an agricultural practice to grow certain crops simply with the intention of ploughing them into the ground, and thus adding organic matter to the soil to be converted into humus. Mr. Hall describes experiments made at Rothamsted on the relative effects of mustard, rape, crimson clover, and vetches: as was expected, the leguminosæ gave the largest increase in subsequent crops. At Woburn a different result was obtained, it being found that mustard gave better results than the leguminous tares.

[1] The Journal of the Board of Agriculture; The Journal of the Royal Agricultural Society.

Dr. Lander, in an interesting note, shows that small amounts of prussic acid, such as might be generated from a linseed cake in which the glucoside-splitting enzyme had not been destroyed, are not necessarily harmful to stock. In view of the widespread occurrence of cyanogenetic enzymes, it is highly desirable that authoritative information should be at hand as to the effect of continuous small doses of hydrocyanic acid on animals.

The Journal of the Royal Agricultural Society is published once a year only, and its appearance is always an event in the agricultural world. In the current number there is a paper by Dr. Russell, giving a connected account of the work he and his colleagues have been doing on the production of plant food in the soil, and bringing together a number of agricultural practices, previously unexplained, that fall into line with the recent work with which he is associated.

Mr. W. W. Skeat contributes an interesting account of the origin of some old agricultural words, directing special attention to the "Dictionary of English Plant-names," by Britten and Holland, and the "English Dialect Dictionary." Sir John McFadyean deals with the very important question of tuberculosis in cattle. The idea still finds credence that the offspring of tuberculous cattle will necessarily develop tuberculosis: experiments, on the other hand, have shown that if the calves are at once removed from their dams and kept free from infection they do not become tuberculous. Nor does Sir John admit that they show any special tendency to tuberculosis. All breeds of cattle are liable to tuberculosis, but no families exhibit any special liability not shown generally by their particular breed.

State aid to agriculture in Canada is authoritatively described by Mr. E. H. Godfrey, of the Canadian Agricultural Department. Mr. Godfrey has the enormous advantage of knowing English institutions, and his article will, therefore, be found of great interest to all engaged in agricultural administrative work in this country. In addition, there are the usual reports from the consulting botanist, chemist, and zoologist; Prof. Biffen reports a case where the somewhat rare hoary cress (*Lepidium draba*) obtained a footing on arable land, and spread to such an extent as to become a nuisance; while Dr. Voelcker reports the effect of zinc and other salts on crop growth in pots.

MEDICAL RESEARCH IN INDIA.

THE scientific memoirs by officers of the Medical and Sanitary Departments of the Government of India,[1] issued from time to time, contain matter and researches of the utmost importance and value.

Memoir 43 deals with the relation of tetanus to the hypodermic or intramuscular injection of quinine. For some forms of malaria injection of quinine is by far the most efficient treatment, but every now and then is followed by the dreaded tetanus or lockjaw, even when every possible care has been taken to ensure the sterility of the fluid and of the syringe used to inject it.

Tetanus is caused by a bacillus which occasionally is present in dust and earth, and may be introduced into a wound, and so give rise to "traumatic tetanus." It is a curious fact that tetanus spores free from other organisms and free from any adherent toxin may be injected into an animal without harm, and may remain latent at the site of inoculation for months. If, however, the spores have adherent toxin upon them, or if at the same time a little weak lactic acid is injected, the organism grows and multiplies and sets up tetanus. Apparently some agent must be present which weakens the resistance of the tissues before the tetanus bacillus can develop. Sir D. Semple, the author of this memoir, finds that quinine injected into the tissues produces necrosis or death of the tissue at the site of injection, and that pure washed tetanus spores

[1] No. 43: "The Relation of Tetanus to the Hypodermic or Intramuscular Injection of Quinine." By Lieut.-Col. Sir D. Semple, Kt. Pp. v+61. Price 1*s.* 2*d.*

No. 44: "The Preparation of a Safe and Efficient Antirabic Vaccine." By Lieut.-Col. Sir D. Semple, Kt. Pp. v+32. Price 9*d.*

No. 45: "Epidemic Dropsy in Calcutta." Being the First Report of an Inquiry carried out by Major G. D. W. Greig. Pp. ii+47+map+vi charts. Price 2*s.* (Calcutta: Government Printing Office, 1911.)

when mixed with quinine and injected invariably set up tetanus. Even when the quinine is injected into a site remote from the site of injection of the washed tetanus spores, tetanus may ensue. Sir D. Semple, therefore, suggests that tetanus following quinine injection when every precaution has been taken, may result from the fact that the individual has tetanus spores lying latent in some situation, introduced by some previous wound, and that on the injection of the quinine these latent spores become active. Tetanus spores were searched for in solutions of quinine, but were never found. Tetanus infection is also sometimes present in the bowel in healthy individuals. A small dose of tetanus antitoxin given at the same time as the quinine injection will effectually prevent the development of tetanus. Sir D. Semple also deals with the preparation of a safe and efficient antirabic vaccine in Memoir No. 44. He finds that rabies virus is killed by a 1 per cent. solution of carbolic acid in twenty-four hours at a temperature of 37° C., but still forms a safe and efficient antirabic vaccine, and he suggests that this method may be employed for the prophylactic treatment of persons bitten by rabid animals.

Epidemic dropsy in Calcutta is the subject of Memoir No. 45, by Major Greig. This disease, which occurs also in other parts of India, is much like ship beri-beri. The patients suffer from dropsy and neuritis of the lower limbs, shortness of breath, and weak heart. The general conclusion is that the disease is caused by a "one-sidedness" in diet, due to the use of "polished" rice and wheaten flour deficient in essential constituents. By the "polishing" of rice, the pericarp and seed-coat containing phosphorus compounds, and the fat and aleurone layers, are removed, leaving the inner endosperm, which contains little else than starch. Epidemic dropsy, however, occurs in severe outbreaks at particular periods, and it is necessary to correlate the food hypothesis with this fact. Major Greig states that, so far as his researches at present go, there is a remarkably close relationship between the price of food grains and the prevalence of epidemic dropsy. We shall await with interest the further report which is promised us on this subject. R. T. H.

MARINE BIOLOGY.

FOUR *Publications de Circonstance* have just been issued by the International Council for the Exploration of the Sea. Mr. Sven Palitzsch gives a very interesting account of investigations into the concentration of hydrogen ions in sea water, carried out on board the Danish investigation ship *Thor* during 1910. Of known methods of determination, the electrical method is the most accurate, but it is unsuitable for use on board a ship in a rough sea. The author has developed a colorimetric method, making use of standard solutions of known hydrogen-ion concentration, and comparing these with the water sample, using either phenolphthalein or naphtholphthalein as indicators. The standard solutions were sodium borate containing hydrochloric acid. The value of the determination of the concentration of hydrogen ions in sea water in comparison with the older methods of determining the "alkalinity" are discussed, and it is shown that the former factor is that which is of the most importance in relation to biological processes. The paper is a good example of the way in which the methods of marine biology can be supplemented by those of pure physical chemistry. The results may be quoted here: expressed as gram-equivalents of hydrogen-ions, the concentration varies from $10^{-7.95}$ to $10^{-8.35}$ per litre of sea water.

Two papers in the same series, by Mr. H. J. Buchanan-Wollaston, deal with the construction of a plankton net for making vertical hauls in a rough sea. It is well known that the difference between theory and practice is very great in such cases, and that plankton hauls which are called "vertical" are not, as a rule, truly so. The author suggests a net which "fishes" as it descends into the sea. It is lowered on a slack line, and whether or not the ship drifts during the operation, the apparatus descends vertically since it falls by its own weight. At the bottom, or at the required depth, the net is closed in the same way as the well-known Nansen net is "throttled," and it is hauled in the closed condition. The filtration coefficient of the net must now be determined—this is the factor expressing what fraction of the vertical column of water equal in section to the area of the mouth of the net does actually pass through the pores of the latter. Its calculation is so difficult, and the results so uncertain, that it has not been attempted except by the Kiel planktologists, by whom the method was originally devised. For such an inverted action of net as Mr. Wollaston suggests, however, the filtration coefficient can be approximated to with much greater accuracy than was hitherto possible. Mr. Wollaston's suggestions are decidedly novel, and since no attempt has been made since Hensen's time to improve the vertical quantitative plankton net, they constitute a real advance in methods.

The remaining *Publication de Circonstance* deals with the spawning and statistics of various species of gadoid fishes of the North Sea, and is written by Dr. P. P. C. Hoek. At the same time, the council has issued the fifth volume of the *Bulletin Statistique*. In spite of the international cooperation of the Governments of the principal European fishing countries for the purposes of fishery investigation, no uniform system of statistical collection of returns of fish landed has yet been developed. The council has therefore published a statistical statement of the fisheries of the various countries in which the returns have been converted and expressed in common units. The present instalment, edited by Dr. H. M. Kyle, deals with the fisheries of the year 1908, and the total value of the fish landed in the different countries during that year was about 18,000,000*l*. Of this total the North Sea contributed about one half, and Great Britain about 11,000,000*l*.

RURAL EDUCATION.

THE Board of Agriculture and the Board of Education have issued two reports by the Rural Education Conference dealing with rural education.

The "Report on a Suggested Type of Agricultural School" states the conclusions of a committee of the conference on the question "as to whether there is any place in the system of rural education, either generally, or in particular counties in view of special local conditions, for schools giving to boys leaving elementary schools a three years' course from the age of twelve or thirteen in the theory and practice of agriculture, together with continued general education."

The committee has considered separately the case of boys who intend to get their living as farm labourers and of boys who intend to become farmers or small occupiers. For the former, owing to the desirability of getting such boys into practical work on the farm as soon as possible, and to the expense and loss of time involved, they consider that there is no demand or place for schools of the type suggested.

A different view is taken of the case of those who intend to become farmers. The committee considers that this class of boys require something beyond the ordinary elementary school, and that they "should not leave school without acquiring a good knowledge of the theory and practice of agriculture (so far as it can be taught in school), together with good general instruction."

In districts where no facilities already exist (*e.g.* rural secondary schools), the report recommends the "trial by way of experiment" of one or two new types of school.

One they suggest might be termed a "Higher Grade Rural School," and worked on somewhat similar lines to the French École Primaire Supérieure. Practical agriculture would not be taught, but the curriculum would include practical gardening, nature-study, mensuration and surveying, and rural economy. The pupils would visit farms occasionally and receive some teaching in manual work incidental to farming.

The other type is described as a "Centralised Rural Continuation Day School," where boys actually engaged in farm work might be brought in several sets for one or two days per week and receive instruction in elementary science and rural economy.

The report on the "Qualification of Teachers of Rural Subjects" deals with the question of the "lack of teachers properly qualified to give instruction in rural subjects in

elementary schools and the means which should be taken to raise the standard of efficiency in these subjects."

It appears that attempts hitherto made by the Board of Education to give teachers a special training in rural subjects have not been successful, and the only real progress made in this direction has been due to the efforts of local education authorities in providing special courses for the teachers in their rural schools. The report recognises that there is no inducement for teachers to qualify themselves for rural schools. The rate of pay is lower and chance of promotion less than in town schools, so that young teachers naturally object to become earmarked for country schools.

The chief recommendations of the committee are:—the extension of the training-college course so that teachers would be able to specialise in rural subjects during the third year; the provision by county local authorities of classes and courses in rural science; the encouragement of rural teachers by making their pay more nearly equal to that of the town teacher; the inclusion of rural subjects in the curriculum of secondary schools attended by intending rural teachers; and increased grants by the Treasury to the local education authorities.

Summaries of the evidence received is given in the appendices contained in both reports. J. J. G.

ESKIMO MUSIC.[1]

IN 1888 Franz Boas published nineteen melodies of the central Eskimo in his well-known work on this people. In 1899 and 1900 R. Stein obtained thirty-nine songs from the Eskimo of Smith Sound, on the land west of the extreme north of Greenland. Between 1903 and 1906 William Thalbitzer collected a far greater number of melodies from North-West and East Greenland. It is good to hear that from some twenty-five of his many phonographic records permanent matrices in bronze were made, and that these are now deposited in the phonogram archives of the Danish Folklore Collection at Copenhagen.

Possessed of such extensive material first- and second-hand, Herren Thuren and Thalbitzer have endeavoured to review "the whole musical system of the Eskimo." Herr Thuren is responsible for the work of transcribing the phonographic records. This he appears to have been able to do with all the care that such an operation demands. For instance, "as in most cases an A (435 wave-lengths) was blown into the phonograph before the beginning of the melody, we were able in writing this off to set the phonograph to the speed used when the tunes were played, and thus frequently knew the absolute pitch." It is, however, a pity that equal care was not bestowed on the English dress in which this valuable monograph appears. Herr Thalbitzer is the collector of the music; a great number of melodies which were not sung into the phonograph were noted down by him "directly on the spot, the singer repeating his song for me several times whilst I used my violin to help in fixing the notes."

Unfortunately, the music of the western Greenlanders is much contaminated by European influence. In South-West Greenland "it is the European music which interests the Greenlander, and not rarely we hear Danish street melodies, to which the Greenlanders themselves put the words." The melodies, however, are always altered by adoption, and it is often difficult to determine whether these melodies are transformed European tunes or have been composed by Eskimo who have had some knowledge of European songs. In North-West Greenland European influence is less, and here "we might certainly talk of the pentatonic scale." The authors of this monograph believe that this choice of pentatonic intervals is due to the recent acquaintance of the Eskimo of North-West Greenland with European music, and that "their earlier, individual choice of intervals" is that "still found in East Greenland."

The North Greenlanders' songs resemble in several respects those of the Smith Sound Eskimo. On the other hand, the East Greenlanders differ from the latter in "that the melodic recitatives of the Smith Sound Eskimo are interwoven with or end in more complete melodic periods, whilst the East Greenlanders carry the recitative throughout the whole melody when the recitative is at all used. The very prominent East Greenland motifs constructed on the first, fourth, and fifth are not found at all among the Smith Sound Eskimo. Lastly, even the joining of the strophes to form a melody is different for the two tribes." Herr Thuren divides the East Greenland music into the following groups:—(i) recitative melodies; (ii) melodies based on the scale CFG (15) or CFGA (17); (iii) melodies based on the scale FAC (15), or F(G)AC (27), or F(G)ACD (20); (iv) melodies not included in the above (9). The arabic numbers enclosed in brackets give the number of songs belonging to these groups and sub-groups.

The writers direct attention to a curious feature of East Greenland music, the tendency for the melody to rise instead of to fall at its close. They find that just those divergencies from our own diatonic scale which occur there have been noted among the Indians of British Columbia. They also lay stress on the complexity and accuracy of the rhythms characterising East Greenland music. "The more we study the songs of the East Greenlanders, the more we become convinced that not even the smallest rhythmic feature is due to chance. The same complicated accentuation, the same extremely fine subdivision of the melody come again when the periods are repeated."

These extracts are sufficient to demonstrate the importance of the study of primitive music, alike for comparative æsthetics and for ethnology.

[1] "The Eskimo Music. (1) On the Eskimo Music. (2) Melodies from East Greenland." By H. Thuren and W. Thalbitzer. Pp. ii+112. (Copenhagen: Printed by Bianco Luno, 1911.) Reprinted from "Meddelelser om Grønland," xl.

THE KNEE-JERK.

A RECENTLY issued number of *The Quarterly Journal of Experimental Physiology* (vol. iv., No. 1, p. 67) is notable in containing a paper by Dr. W. A. Jolly, of Edinburgh, which finally settles a long-disputed question as to whether or not the knee-jerk is a reflex action. Everyone knows that when the tendon just below the knee-cap is tapped smartly, the leg is suddenly jerked forward, and the importance of this phenomenon arises mainly from the fact that its presence, absence, exaggeration, or diminution is a valuable diagnostic sign in certain nervous diseases. A reflex action demands the journey of a nervous impulse from the point struck up to the spinal cord, and down again from the spinal cord to the muscles of the thigh, and the statement has been generally credited that the time interval between the tap and the jerk is so short that it is impossible for this to occur. It was therefore held that the jerk was the direct result of stimulating the muscle itself. Nevertheless, the knee-jerk increases and decreases under the same conditions as those which increase and decrease actions which are undoubtedly reflex.

Various elaborate explanations, the best known of which is that of Sir William Gowers, have therefore had to be invented to reconcile these two statements. Such explanations are no longer necessary, now that we know that nerve impulses are in man propagated at the rate of 120 metres per second, and not at the rate of 30 metres per second, as was formerly supposed.

Dr. Jolly has made careful time-measurements, and shown that in the knee-jerk there is sufficient time for the nerve-impulse to travel to the spinal cord and back again, but that the time occupied in the cord itself is only about half that which is necessary in the case of ordinary co-ordinated reflex actions, such as the withdrawal of the feet when the soles are tickled. This is explicable on the assumption that, in the case of the knee-jerk and other similar tendon reflexes which do not involve the cooperation of several muscles, the number of nerve cells traversed in the cord is less. The increased rapidity of a tendon reflex is useful, for a sudden strain on a ligament would rupture some of its fibres or lead to injury of the joint surfaces if too great a time intervened before the muscles could contract to save the joint.

We should like to add a word of congratulation to Prof. Schäfer, the editor of the journal in which this paper appears, on the continued excellence of the new physiological periodical, which has now entered on the fourth year of its existence.

AFFORESTATION IN SCOTLAND.

WHEN a board or council is constituted for promoting afforestation, it is evidently essential that the body should be invested with considerable freedom of action, because many of the schemes will present special problems requiring special consideration and localised knowledge. The council of the Scottish Arboricultural Society has published as a separate volume (xxv.) of their Transactions a report, compiled with great care and labour by Lord Lovat and Captain Stirling of Keir and other experienced authorities, providing a specimen example of a scheme that illustrates very definitely the complex factors that arise for consideration.

The concrete example presented is situated in the Highland district of Glenmore, Inverness-shire, and has been selected for various reasons, but chiefly because it contains wintering land of sheep farms and deer forests, and is also well suited for the creation of small holdings. Economic considerations, especially avoidance of an increased local rate, occupy a prominent place in the proposition, and it becomes obvious that the scheme of afforestation, to be financially sound, must fit in with farming and sporting conditions. The nature of the staff, and particularly the requirements of the foresters, is a second matter. The sylvicultural problems comprise a working plan, stocking of the ground, and utilisation of existing woodland produce. The afforestable land is computed at 15,000 acres, of which about two-thirds falls within deer forests and the remainder is sheep ground; according to the proposed scheme, 450 acres would be planted annually for fifteen years, and thereafter 300 acres per annum.

The tenor of the conclusions is to indicate that under a well-framed scheme large areas of land can be afforested without injury to existing interests; further, that afforestation should eventually pay its way, besides providing a great deal of permanent and periodic employment. Suggestions are also offered with regard to the nature of a proposed Central Forest Authority for Scotland, different systems of land tenure under afforestation, and the conditions of agreement between landowner and State.

PLANKTON STUDIES ON THE WEST COAST OF SCOTLAND AND IN THE IRISH SEA.

THE areas in which plankton studies have been carried on during recent years in European seas, under the official international scheme of investigation, have not included the west coast of Great Britain. With the view of filling, at least in part, this lacuna in our knowledge of the plankton of the British area, Prof. Herdman has, during the years 1907 to 1910, made numerous vertical and surface hauls from his yacht during July off the west coast of Scotland, and during August and September in the Irish Sea. The material collected has been examined, and the results are presented in an interesting account by Prof. Herdman and Mr. William Riddell.[1]

In the Irish Sea the phyto-plankton reaches a maximum in April or early May, the sea swarming with diatoms (chiefly Chætoceras, Thalassiosira, and Lauderia); then the phyto-plankton gradually dies away, and is replaced by the zoo-plankton (copepods, Oikopleura, &c.), which is characteristic of the summer months. In September and October diatoms (chiefly Rhizosolenia, Chætoceras, and Lauderia) again appear in profusion, constituting an autumnal phyto-plankton maximum, usually not so marked in bulk or duration as that in the spring. This in its turn dies away, giving place to the scanty winter zoo-plankton—the minimum plankton of the year—which persists until the reappearance of diatoms in the spring. There is thus in the Irish Sea a clear periodicity in the plankton and marked differences in the nature of the plankton of the different seasons.

Examination of the gatherings made off the west coast of Scotland shows that localities not very far apart differ considerably in the nature of their plankton at the same time of the year. For instance, a vertical haul taken in the Hebridean Sea, off Canna, is a typical fine phyto-plankton, consisting chiefly of diatoms of the genus Chætoceras, whereas a vertical haul, at the same time of the year, at the entrance to Loch Fyne shows a typical coarse zoo-plankton containing large numbers of copepods. This is in marked contrast to the conditions in the Irish Sea, where a zoo-plankton and a phyto-plankton do not occur simultaneously a few miles apart. A list of the Scottish stations is given, with some particulars of the nature of the catch at each, and a detailed analysis in twenty-six cases. The evidence shows that, off the north-west coast of Scotland, at one time of the year (July), in several successive seasons, the plankton was of different types in different localities, but maintained a fairly constant character in each.

A comparison of the Scottish records with those from the Irish Sea shows that, in species present and in their abundance, the Loch Ranza plankton in July is much more nearly similar to the September than to the April phyto-plankton of the Irish Sea. But the phyto-plankton gatherings made north of Mull show resemblances to the vernal rather than to the autumnal phyto-plankton of the Irish Sea. There are three possible explanations of the differences observed between the summer plankton of the Hebrides and of the Irish Sea:—(1) the great vernal maximum, which dies away in May and June in the Irish Sea, passes off more slowly further north, and is found lingering, in some parts of the Hebrides, until the end of July, or even longer; (2) in some of the deep northern channels the diatoms, which elsewhere constitute the vernal maximum, persist in comparative abundance throughout the greater part of the year; (3) the diatoms of the July phyto-plankton may have invaded the Hebridean Sea from the North Atlantic at some period subsequent to the vernal maximum. The authors are inclined, on the evidence available, to regard the first of these suggested explanations as the most likely, but point out that further periodic observations are necessary before the matter can be decided definitely.

The authors discuss briefly the classification of diatoms into oceanic and neritic species, and give a provisional list of the two categories. A consideration of the phyto- and zoo-plankton shows that the west coast of Scotland is divisible into three well-marked areas, not merely geographically, but by reason of the distribution of its summer plankton:—(1) the Clyde sea-area to the south of, and inside, Cantyre, characterised by zoo-plankton, the species of which are, in the main, oceanic; (2) the area around and to the north of Mull, extending from Cantyre to the south of Skye, which contains in July a well-marked phyto-plankton, mainly neritic in character; (3) to the north of Skye, where a zoo-plankton again appears, which contains some oceanic species.

The plankton distribution of the west coast of Scotland may be explained in terms of hydrographic movements if it be supposed that Atlantic water gains access more freely in summer to the Clyde sea-area and to the region north-east of Skye than to the large intervening area of the west coast, that is, that an oceanic current reaches the Clyde area and another flows in round the north of Skye, while little or no such current invades the area north and south and around Mull. The authors conclude by pointing out that further observations are required in order to determine how far this explanation holds good, and also to gain fuller knowledge of the changes in the plankton. These changes are bound up with many problems of a fundamental and far-reaching nature connected with the nutrition of marine organisms, and an intimate knowledge of the changes in the plankton is essential to an understanding of the movements of the shoals of migratory fishes.

[1] Trans. Biol. Soc., Liverpool, vol. xxv., pp. 60–113, 11 figures.

THE PRUNING OF TREES IN TOWNS.

THE services of Prof. Bayley Balfour, F.R.S., have been obtained by H.M. Office of Works to inquire into the justness or otherwise of complaints made in regard to the treatment of the young trees in the Mall. His report, which has just been issued from the Stationery Office (Cd. 5823, price 2½d.), must be gratifying to those who have charge of the trees, for he finds nothing to justify adverse criticism of the pruning. On the contrary, he was impressed by the evidence of sound practical knowledge and

scientific principle shown in their treatment. It was high time that someone in a position of authority should have been called on to lay down the principles that govern, or should govern, the pruning of trees in public thoroughfares. The outcry periodically made in the daily Press is usually marked by want of knowledge and unfairness. As a matter of fact, there is no work more thankless in nature than the management of street trees. In London and other great urban areas the planter's choice is restricted to a few species (of which the plane is the chief and best) which experience has proved will thrive, but which, as regards size, are quite unsuited to the spaces usually available for them. In the Mall this difficulty does not arise, for the space is ample. The object there is to control the growth of the trees that have been planted so that the foundations of a stately avenue may be laid.

Perhaps the most valuable portion of Prof. Balfour's report is that in which he shows that nature herself is always pruning. That is an aspect of the case which never strikes the lay critic. Yet the smothering out of weakly and overcrowded growths is continually going on. Correct pruning anticipates nature's end, and substitutes the prompt action of the knife for that of slow decay. If one compares the branch-system of a fully grown plane with that of a young specimen, and notes how few of the numerous branches of the latter survive, we see how drastic nature's pruning is. In such a place as the Mall it is essential that the trees should possess a certain uniformity and balanced proportions. The means to secure this end have been admirably chosen, and there the matter may be allowed to remain. But we may recommend Prof. Balfour's report to those who desire to gain some insight into the fundamental laws of tree growth with which the pruner's art should be in unison.

AN EXHIBITION OF BIBLICAL NATURAL HISTORY.

AS a supplement to the literary and historical Biblical exhibition which has been arranged at Bloomsbury for the tercentenary of the Authorised Version, an exhibition of the animals, plants, and minerals mentioned in the Bible has been arranged in one of the bays of the Central Hall of the Natural History Museum, South Kensington. The animals and minerals, respectively, have been selected, arranged, and labelled by Mr. R. Lydekker, F.R.S., and Dr. G. F. Herbert Smith, under the general supervision of the keepers of zoology and mineralogy; the plants have been dealt with by Dr. A. B. Rendle, F.R.S., the keeper of botany. The interesting guide-book to the collection is in great part a reprint of the exhibited labels, which were mainly based on the careful work of the late Canon Tristram. The minerals, which Tristram did not consider, are dealt with in a scholarly essay by the director, Dr. L. Fletcher, F.R.S., who explains how modern interpretations of the ancient names of Biblical minerals have been deduced.

The collection, and the guide to it, will be of special interest to those to whom Bible plants and animals are rich in picturesque associations; but it is, of course, part of a liberal education to know that the "unicorn" was probably the extinct wild ox or aurochs, "behemoth" the hippopotamus, the "coney" the hyrax, and the "leviathan" of Job the crocodile. Some of the corrections are curious; thus the "ferret" of Lev. xi. 30 was probably a gecko, and the "mole" of the same verse a chamæleon, and the "chamæleon" of the same verse a monitor, and the "spider in king's palaces" a gecko. An up-to-date suggestion is noticed, though not accepted—that the "badger" of Exod. xxvi. 14 was the okapi. We do not see any reference to the "fiery serpent," though the museum used to have a specimen of *Filaria medinensis*, the guinea-worm, with a label indicating that *it* was probably that reptile.

What must strike the reader most, especially perhaps when he comes to the botanical part, is the large proportion of misses that the translators made. And if we might venture on a criticism of a carefully executed piece of work, we would suggest that a little more might have been said in explanation of this. A paragraph or two on the backward state of natural history when the authorised translation was made three centuries ago would have been interesting. We also wonder why our leading scientific institution has not used this opportunity, which is undoubtedly one of wide popular interest, to tell us—who could do it better?—what is scientifically interesting in the fauna and flora of Palestine.

LIEBIG AND HIS INFLUENCE ON THE PROGRESS OF MODERN CHEMISTRY.[1]

A HUNDRED years ago Europe was still plunged in the misery of war. Almost every country had suffered the bitter experience of seeing the devastation caused by the passage of contending armies, the death and suffering of thousands of fighting men, and the want and desolation spread over still greater numbers of a helpless population. Amid all the wretchedness of the time, insecurity of property, dearness of food, frequent changes of governments, and every condition which would appear to be unfavourable, the study of nature steadily went on. France, still staggering from the fierce shocks of the revolutionary period, had still many distinguished men of science, Laplace, Berthollet, Lamarck, Cuvier, while the memory of Lavoisier was fresh and green, and Gay-Lussac, Dulong, Arago, and Chevreul were among the coming men. England, still engaged in the struggle with Napoleon, possessed Humphry Davy, Rumford, and Dalton, and Herschel among the astronomers. Henry Cavendish was still living, though an old man, and Priestley was but lately dead. In Germany, Goethe might be counted among the votaries of science, and Prussia had sent forth Humboldt to survey the world, while in Italy, Volta was busy in the study of electricity, and Avogadro, little noticed by the world, was meditating on the properties of gases and preparing for the enunciation of the great principle which is now associated with his name, though it took the chemical world half a century to recognise it. One other name must not be forgotten, and that is Berzelius, the Swede, then young, and preparing, by his eager activity in research, for that great position of almost undisputed authority in the chemical world, which he filled for nearly forty years.

To understand the influence which any one man appears to have had in his day and generation, it is necessary to bear in mind the condition of the world into which he was born, as well as the quality of his genius. The one reacts on the other. In endeavouring, therefore, to estimate the nature and extent of the services rendered to science, and to the world in general by Liebig, it is necessary to get a clear view of the state of knowledge in chemistry at the time when he appeared on the scene.

Born in Darmstadt, on May 12, 1803, where his father was a colour manufacturer, he passed through an unsuccessful school career at the local gymnasium, and, at the age of sixteen, was apprenticed to an apothecary. It soon became evident, however, that he was as little fitted to become a pill-maker as he was to be a Greek scholar, and he ultimately persuaded his father to allow him to go to the then newly-founded University of Bonn, whence he followed Kastner, the professor of chemistry, to Erlangen. But Liebig soon became convinced that he could not study chemistry effectively in Germany, and after taking his degree at Erlangen, at the age of nineteen, he proceeded to Paris. There, after many difficulties, he ultimately obtained the privilege of working in Gay-Lussac's laboratory, where he remained about two years. In 1824, on the recommendation of Humboldt, he was appointed extraordinary professor of chemistry at Giessen, being then only twenty-one years of age. He became ordinary professor two years later, and remained at Giessen until called to Munich, in 1852. There he died on April 18, 1873.

Such was the main course of Liebig's career; but to draw a picture of the man from descriptions of his personal characteristics is not easy. In early youth he became familiar with the poet Platen, who noted in his diary "the friendly earnestness in his regular features, great brown eyes, with dark shady eyebrows, which attracted one instantly."

Those brown eyes, shining with earnestness, remain in the portraits which have come down to us, and as a

[1] Lecture delivered at Oxford on August 23, at the Fifteenth Summer Meeting, by Sir William A. Tilden, F.R.S.

family feature, reappear in the faces of some of his children. Ardent, eager, enthusiastic in the pursuit of experiment, his remarkable power of exact observation stood him in good stead. Kindly and tender with children, there were times when eagerness in research or controversy led to exhibitions of impatience, but the steadfast character of the man is illustrated by the persistence of his lifelong intimacy with Friedrich Wöhler. This intimacy resulted in a correspondence which extended over more than forty years, and had consequences in the lives of both men, which were full of importance for the progress of chemical science. To this reference must be made further on.

We may now endeavour to sketch, in outline, the state of knowledge and theory when Liebig entered on his career.

The modern use of the term element, which had been introduced by Robert Boyle in the seventeenth century, was by this time universally adopted, and to the metals on the list had been added such important substances as oxygen, hydrogen, nitrogen, and chlorine. To use the words of Davy, in one of his researches on chlorine, "Neither oxygen, chlorine nor fluorine are asserted to be elements; it is only asserted that they have not been decomposed." And that is the sense in which the term has, in modern times, always been used. The process of burning or combustion was, of course, now always explained by Lavoisier's doctrine, according to which a body in burning combines with the oxygen of the air, and forms one or more chemical compounds with it. At the time that Liebig went to Giessen, in 1824, Sir Humphry Davy was still living, but his scientific career was practically closed, and Berzelius was the predominant authority in matters of theory. Gay-Lussac, in Paris, had made important discoveries relating to the proportions in which gases enter into combination. Dalton's atomic theory, propounded in 1808, though not generally accepted, was gaining ground. Broadly, the position was this: elements were clearly distinguished from compounds, chemical combination was explained by the supposition that it was due to the close approximation of atoms of opposite kinds, and the union of atoms to form a chemical compound was attributed to the attraction caused by charges of electricity of opposite nature, which were supposed to be resident on the atoms.

But the composition and nature of "organic" compounds were practically unknown. A few such substances had been isolated, *e.g.* milk sugar and grape sugar were known as distinct substances, and were differentiated from common sugar. Alcohol, nearly pure, had been known, in the form of spirit of wine, from early times. Acetic acid was known, as well as several acids found in vegetable tissues, such as oxalic, formic, malic, tartaric, and benzoic acids. There were, however, no means of determining their composition, and although Lavoisier had devised an apparatus in which organic compounds could be burned in oxygen, and the water and carbon dioxide thus formed could be collected, the process was both cumbrous and incapable of yielding exact results.

A most interesting autobiographical sketch was discovered among Liebig's papers many years after his death, and from this we learn that in his early life "at most of the universities there was no special chair for chemistry. It was generally handed over to the professor of medicine, who taught as much as he knew of it, and that was little enough, along with toxicology, materia medica, &c." But the total neglect of experiment was the source of much mischief, and the persistence of the degenerate deductive method led to neglect of the careful observation of nature. The lectures of Prof. Kastner Liebig describes as without order, illogical, and they resembled the jumble of knowledge which he carried about in his own head. When he got to Paris all was different, and the lectures of Gay-Lussac, Thénard, and Dulong had for the young student an indescribable charm. The lecture consisted of a judicious series of demonstrations—experiments of which the connection with each other was pointed out and explained; and soon the consciousness dawned on him that all chemical phenomena, whether exhibited by the animal, vegetable, or mineral kingdoms, are connected together by fixed laws.

Liebig therefore returned from Paris to his own country with the intention of founding an institution in which students could be instructed in the art and practice of chemistry, the use of apparatus, and the methods of chemical analysis. In view of the total absence of such provision elsewhere, it is not surprising to learn that, so soon as its existence became known, students streamed into the Giessen laboratory from every civilised country. It is interesting to learn from Liebig's own words what was the method he adopted. Obviously, in order to teach a large number at one time, it is necessary to have a systematic plan, and in his case this had first to be thought out and then put to the proof, as no course existed which could be used as a model. He says, however, that "actual teaching in the laboratory, of which practised assistants took charge, was only for the beginners; the progress of my special students depended on themselves. I gave the task and supervised its carrying out. There was no actual instruction. Every morning I received from each individual a report on what he had done the previous day, as well as his views about what he was engaged on. I approved or criticised. Everyone was obliged to follow his own course. In the association and constant intercourse with each other, and by each participating in the work of all, everyone learned from the others. Twice a week in winter I gave a sort of review of the more important questions of the day. We worked from break of day till nightfall. Dissipation and amusements were not to be had at Giessen. The only complaint which was continually repeated was that of the attendant, who could not get the workers out of the laboratory in the evening when he wanted to clean it."

Such was the spirit and such the method by which a great school was created! Nor was this the only result. To the influence and example of the school at Giessen may be attributed the rapid spread of the new method of teaching chemistry. In 1824 there were no laboratories devoted to the purposes of instruction. A few of the most eminent professors of chemistry—Berzelius in Stockholm, Gay-Lussac in Paris, for example—admitted one or two students already advanced in the subject to practise in their private laboratories, but only as a great favour. In this way Mitscherlich, Rose, Wöhler, and Magnus had repaired to Berzelius in Stockholm as Liebig had gone to Paris. But in a few years the fame of what Liebig was doing in Giessen penetrated to other countries of Europe, and many of the men who had studied under his direction became teachers in other lands. Here in England no chemical laboratory for general instruction existed, and only in the medical schools were a few tests described and shown. In London the Society of Apothecaries had a laboratory which had existed since 1671; but this was not used for teaching, but as a place of manufacture of drugs for use in medicine. At Cambridge the professor of chemistry was a country clergyman, who came up once a year to give a course of lectures. At Oxford the professor of chemistry was also, later, professor of botany, and in neither university was there a laboratory for instruction, nor was chemistry a subject recognised in the curriculum for a degree. Twenty years later things began to improve. In this country the first laboratory for instruction in practical chemistry was provided by the then newly instituted Pharmaceutical Society of Great Britain at their premises in Bloomsbury Square. This was in 1844, and in the following year a new and enlarged laboratory was fitted with places for twenty-one students.[1] About this time the College of Chemistry was established in temporary quarters in George Street, Hanover Square, and soon afterwards the Birkbeck Laboratory, modelled on that of the Pharmaceutical Society, was built at University College. Many other laboratories were opened about this time. In 1848 Pélouze founded in Paris a laboratory to which some English chemists resorted. But the Giessen laboratory under Liebig's direction continued to supply the majority of the teachers who in the succeeding generation founded schools, not only in Germany, but in other countries—Hofmann, for example, at the Royal College of Chemistry, and Williamson, who was appointed at University College in 1849.

Liebig's career as a chemist and investigator was influenced in no small degree by his friendship with Wöhler. Born three years before Liebig, Friedrich Wöhler

[1] I saw this laboratory about 1857. It had the aspect which one usually associates with ideas of the alchemists. Many of the operations were connected with the use of furnaces, such as fusion, sublimation, &c., and the place was full of smoke and fumes.

studied medicine at Marburg, but subsequently pursued chemistry at Heidelberg under Leopold Gmelin. Having relinquished medicine on taking his degree, he obtained the privilege of working with Berzelius in his laboratory at Stockholm. On his return from Sweden in 1824 he was appointed teacher of chemistry in the Trade School in Berlin. Some years later he became professor in the University of Göttingen. Soon after his return from Sweden he met Liebig in Frankfort, and a close intimacy at once sprang up, which continued for more than forty years to the end of Liebig's life. Two volumes of their correspondence have been compiled by Hofmann, and the perusal of these letters, extending from 1829 to 1873, affords a view of the subjects which occupied the minds of both, as well as many of the incidents of their lives. One only we have time to notice here. Liebig paid several visits to England, and in a letter to Wöhler dated from Giessen, November 23, 1837, he tells him that he has travelled through England, Ireland, and Scotland in every direction, and has seen many surprising things, but has learned little. The absence of scientific knowledge in England he attributes to the badness of the teaching. In another letter, addressed to Berzelius nearly at the same time (November 26), he says:—"England ist nicht das Land der Wissenschaft," only there is a widespread "dilettantismus," and he complains that "die Chemiker schämen sich Chemiker zu heissen, weil die Apotheker, welche verachtet sind, diesen Namen an sich gezogen haben."

Liebig's contributions to pure chemistry, though so numerous and important, can be recalled only briefly. They may be placed under three heads, namely, first, the invention and perfecting of a method for analysing organic compounds, which in all essential features is still practised everywhere.

Secondly, the discovery of a large number of new compounds, of which even the names cannot now be mentioned for want of time, but which include chloroform and chloral and many cyanides. He also established the formula of uric acid and the nature of aldehyde.

Thirdly, we owe to Liebig the conception of the theory of compound radicals, which arose out of his researches jointly with Wöhler (1832) into the products from essential oil of bitter almonds.

In a letter to Wöhler (May 26, 1839), Liebig writes that he is occupied with the study of the phenomena of fermentation and putrefaction, and having sent an account of his views to Wöhler, another letter, dated June 3, discusses the criticism which he has received from him. In the postscript to this long and interesting letter, we find a concise statement of Liebig's hypothesis concerning the action of ferments.

Before proceeding further, it will be well to understand what is meant by fermentation. If we take a solution of sugar, and add to it a very small quantity of brewers' yeast, or, if we take grape juice without any addition, in a short time, especially in warm weather, a frothing, due to the escape of minute bubbles of gas, soon sets in, and this continues until the liquid has lost its sweet taste, and has become more or less alcoholic and intoxicating. The escaping gas is carbon dioxide, vulgarly called carbonic acid, and the liquid retains, beside alcohol as the chief product, small quantities of other things. Somewhat similar changes go on in the leavening of bread, the souring of milk, the putrefaction of meat, and apparently also in the animal body in the course of many feverish diseases. One peculiarity of the process consists in the fact that the ferment, the yeast for example, serves to bring about chemical decomposition in a relatively large, almost indefinitely large, quantity of the sugar or other substance in solution.

Liebig's explanation of these changes was based on purely mechanical ideas as to the motions of the hypothetical particles or atoms. He imagined the atoms of a substance which causes fermentation or putrefaction to be in a state of unceasing vibratory motion, and that this state of agitation was communicated to the molecules of the sugar, causing them to undergo an internal rearrangement, and to break down into simpler structures of a more stable nature, in the case of alcoholic fermentation of sugar, in fact, into alcohol and carbon dioxide.

Liebig made the mistake of ignoring, as nearly all chemists and biologists of that time ignored, the constitution of the ferment. In 1859 and following years, Pasteur, the great French chemist, demonstrated the essentially vitalistic character of the phenomenon, and showed that the destruction of the sugar was an effect concomitant with the growth and multiplication of the cells of a minute organism, visible under the microscope. A special form and character of organism is concerned in each type of fermentation.

The organised character of yeast had been proved many years before by the observations of Kützing, Cagniard Latour, and Schwann. Nevertheless, the views of Liebig prevailed for some time. In the English version of his famous letters on chemistry, in the fourth edition, which appeared in 1859, there is a chapter headed "Theory which ascribes fermentation to fungi refuted." As a matter of fact, it was about this time established.

Liebig was ultimately convinced of the organic nature of yeast, but he still contended for his theory of molecular destruction by communicated agitation, as furnishing the explanation of the physiological act which comes about within the cells of the yeast. An important step was taken much later, when, in 1897, it was shown by Buchner that something can be dissolved out of yeast which, independently of the cells, is capable of resolving sugar into alcohol and carbon dioxide. Thereupon, it seemed to some that Liebig's views might be resuscitated. But the changes which occur are now known to be very complicated, involving, in the first place, a process, not of destruction, but of building up molecules of a more complex nature, before they are broken down into the final products of fermentation. Liebig's theory, therefore, disappears from the scene.

Before 1840 it may be stated as almost literally true that physiology in the modern sense of the term did not exist, and certainly there was but a small basis for chemical physiology. The chemical production of urea independently of animal life, by Wöhler, in 1828, was a fact of which the deep significance appeared only much later. The studies in organic chemistry, into which Liebig had plunged alone, or in conjunction with his friend, necessarily attracted his attention to problems connected with the phenomena of animal and vegetable life. His visit to England, in 1837, was largely occupied with observation of the methods of agriculture then prevalent, and during the succeeding years we find in the catalogue of his scientific papers, many signs of his activity in pursuit of questions connected with the application of chemistry to agriculture, the growth and nutrition of plants, the formation of fat in the animal body, the composition and classification of foods, the source of animal heat, and the chemical processes connected with respiration and digestion. It is not possible for us to enter freely into the discussion of all these great subjects, but we must glance at Liebig's views in regard to two of them, not because those views have retained their predominance, but because of the stimulus they gave to inquiry and the encouragement he gave by precept and example to the fundamental principle on which the greater part of modern science is built, namely, the constant appeal to nature, not only by observation, but by systematic experiment.

In Liebig's time all biological processes were supposed to be controlled by what was called "vital force," that is, something which is not mechanical force, nor heat, light, electricity, nor chemical affinity. We are still a long way from knowing what life is, but to show how far some physiologists have travelled in the opposite direction, I will make a very short quotation from a recent book. Concerning the use of the word "metabolism," which is a comprehensive word covering all chemical changes which go on in the body during life, the writer directs attention to its implication "that all the phenomena of life are, at bottom, chemical reactions. When a muscle twitches no less than when a gland secretes, it is not too much to say that when we are moved to tears or laughter, it is chemical reactions that are the underlying causes to which ultimate analysis must lead us." I quote this as an extreme view.

Let us turn first to Liebig's classification of foodstuffs. It is necessary to account for the maintenance of the animal functions, the growth and repair of the body, the maintenance of its temperature.

Liebig attributed, as we believe correctly, the heat produced in the body to the process of burning, which goes on in the tissues in consequence of the absorption of

atmospheric oxygen. Liebig was also right in his assertion that animals do not necessarily derive fat from their food, but the animal body is a laboratory, in which fat may be manufactured from carbohydrates, such as sugar and starch. The substance burned in the body is material derived from the food, but it has long been known that the substance thus burned does not consist exclusively of sugar, starch, and fat, which Liebig called *respiratory* foods.

The other constituents of food, now included under the general term protein, which contain nitrogen, and are more or less like white of egg in properties, he called *plastic* foods. These were supposed to produce new tissue, or repair waste, and to be the source of muscular energy or power to do work.

It is now known that the case is by no means so simple, and, in fact, this classification now possesses only historical interest. The whole question when considered in the light of modern knowledge is, in fact, a mass of difficulties, and very far from being clear of serious controversy. Liebig's name is associated in the public mind almost exclusively with the extract of meat, which he prepared for the first time in connection with his studies of food. This is to do him less than justice. Liebig never proposed it for use as a substitute for meat, because it contains only a part of the constituents of flesh. It appears that his idea, in the first instance, was to turn to account the flesh, which would otherwise be wasted, of animals which in Australia and South America were then bred solely for the sake of their wool and fat. Extract of meat is to be regarded as a valuable stimulant to be consumed together with bread or other vegetable food.

Let us now turn to the investigations into the operations and theories of agriculture with which Liebig's name should be for ever associated. Whence do plants get their carbon and nitrogen, which, together with hydrogen and oxygen and water, form the material of their tissues? What is the use of the mineral substances found in the ash left on burning vegetable matter? Why are different soils adapted to different crops, and what is it that gives fertility to a soil?

The state of knowledge on such subjects is indicated roughly by the summary which had been provided by the lectures of Sir Humphry Davy in 1813. During the subsequent twenty-five years very little had been done in the way of experiment, but it would be only fair to mention the name of the great French agricultural chemist Boussingault as one of the pioneers a little in advance of Liebig in the study of such questions. Briefly, the position was somewhat as follows: it was known that plants decompose the carbonic acid of the air, using the carbon and letting the oxygen go free, but it was commonly supposed that the brown or black substance in the soil, which is usually called *humus*, and is the result of the decay of preceding vegetable growth, was the chief source of the carbon in growing vegetables. Liebig pointed out that this was impossible, because it failed to show from what source the original plants from the decay of which humus was formed derived their carbon. Liebig was the first to study carefully the mineral constituents of plants and to recognise the importance of certain substances, especially potash and phosphates. The services which Liebig rendered to the world in connection with plant physiology and agriculture are, however, less to be recognised in the shape of positive contributions to knowledge than in the example set and in the influence of that example in stimulating systematic investigation of agricultural questions. By 1840 Liebig was one of the most famous chemists in the world, and the effect of his inquiries is shown in the activity which became manifest almost immediately after the communication of his first report to the British Association at the Glasgow meeting in 1840. In Germany the Government instituted a large number of Versuchs Stationen in different parts of the country, and in 1843 the systematic experiments were started at Rothamsted which must for ever place the names of Lawes and Gilbert among the benefactors of the world.

But here I must pause to remind myself and my hearers that the subject of my lecture is Liebig and his influence on the progress of modern chemistry. He died in 1873; but the period of his greatest activity in science lies further back by thirty years. Since either period vast changes have been brought about by chemical discovery, which, be it always remembered, is based on experimental work in the laboratory. That is the reflection which supplies the explanation of Liebig's great influence on the progress of science. That influence was fully recognised by the generation of chemists now passing away, or almost gone, and it seems to be a duty to preserve as long as possible a memory so rich in past benefits and so full of suggestion for future use.

Liebig made many discoveries in chemistry; but his great and permanent service to the world was not in the isolation and study of individual compounds or series of compounds, nor in the conception of theories of chemical action, nor even in views which he promulgated concerning the operations of agriculture, the composition of food, the processes of digestion, or the source of animal heat. His great service consisted in showing how chemistry should be studied and how it should be taught, in setting the example of submitting all questions to the light obtained by direct experimental study of nature, and in thus affirming and illustrating the principle that what is called pure science is of greater permanent value than what is called applied science; a knowledge of the laws of nature is more useful than many inventions.

In the Giessen laboratory were trained a considerable number of chemists, many of whom became the teachers of the next generation. From these teachers and their pupils, guided by the same principles as those of the Giessen school, came discoveries of first-rate importance. If Hofmann, a student of Liebig's, had not been attracted to the study of aniline, an inconsiderable constituent of coal tar, if his pupil, Perkin, had not been led to a further study of its transformations, we should have had to wait a long time for the coal-tar dyes and the industries connected therewith. If a host of workers trained in Liebig's laboratory, and others emulating their example, had not cultivated the study of all sorts of carbon compounds, often unimportant in themselves, we should not have seen the numerous applications of chemistry to medicine—the saccharin, aspirin, antipyrin, sulphonal, &c.—nor the artificial perfumes, such as those of violet and lilac, which are now made independently of the original source in the flowers. Without the foundation work I have mentioned we could not now have the beginnings of the true physiology based on the study of chemical and physical processes and reactions, nor the possibility of following the changes brought about by all sorts of ferments, on the combined results of which we may hope to have a complete development of a scientific system of medicine and the treatment of disease.

But there is one other direction of Liebig's activity to which I have not alluded. Discoveries in the study of nature are of little value unless they can be communicated to that part of the world which can and will make use of them. Up to the end of the eighteenth century there were no means of publication except, on one hand, through the transactions of the half-dozen academies, and these were the only scientific periodicals, or, on the other, by the special treatises prepared by investigators for the purpose of making known their own discoveries or opinions. Thus we have the famous works of Robert Boyle on the Spring of the Air, and the Sceptical Chemist, Scheele's works on Air and Fire, Priestley's Experiments and Observations on different kinds of Air, Dalton's New Chemical Philosophy, and many others. The publication of such books was often accomplished only after years of preparation. In 1832 Liebig founded the *Annalen* which have ever since borne his name. Out of Trommsdorff's old *Annalen der Pharmacie* Liebig created a journal which has been for eighty years one of the chief repositories of the best products of the laboratories of the German Empire. Into this journal were poured the results of Liebig's and Wöhler's several or joint researches. At the time of Liebig's death, in 1873, 165 volumes of the *Annalen* had appeared, and there has been an equal number since that date.

I need do no more than mention the titles of the "Handwörterbuch" which Liebig, with the cooperation of his friends Poggendorff and Wöhler, produced between 1836 and 1856, the "Handbuch der Chemie" in 1843, and the famous "Letters on Chemistry," which were originally

published as newspaper articles in the *Augsburger Allgemeine Zeitung* with the object of bringing within the ken of the general public some of the more important consequences of the advance of knowledge in connection with the affairs of everyday life.

Again, up to 1847, Berzelius had for many years prepared annually a "Jahresbericht über die Fortschritte der physischen Wissenschaften," but near the end of his life this laborious undertaking was no longer possible for him, and Liebig, in association with Hermann Kopp, the physical chemist, commenced the "Jahresbericht," which, so far as chemistry and the allied sciences is concerned, continues to this day. It is no longer so important as formerly, having fallen behind in date, but for certainly forty years it was indispensable to every practising chemist who was directly or indirectly interested in the progress of the science.

Since the days of seventy or eighty years ago, when Liebig set these enterprises in motion, the number of periodical publications devoted to recording advances in chemistry has greatly increased, and a number of journals now appear at regular intervals of a month, a fortnight, or even a week, which have become necessary in consequence of the specialisation which is characteristic of our time. We have therefore journals of inorganic chemistry, physical chemistry, applied chemistry, and some limited even to one topic, such as electrolysis or radium. Liebig's *Annalen*, however, continues to hold an honoured place in every chemical library.

Since Liebig's day we have advanced in many directions very far. Not only has the atomic theory given us by Dalton long since become the mainstay of the chemist, but we confidently assume, on good evidence, that we know the order in which these small bodies stand in a molecule of sugar, for example, and the relation of this order to the visible forms of the crystals in which such substances are often presented. We know, too, the relative masses of these minute bodies—the atomic weights, so called—and it is certain that these weights are directly connected with the properties of the bodies the atoms compose. There is also a relation among the atomic weights, which is broadly summed up in what is known as the periodic law, from the study of which most chemists are convinced that the so-called elements were evolved out of something of a simpler order, possibly one or two primal matters to which the term element would more properly belong. Nor is this all. Everyone has heard of radium, but few of the public, I suppose, know its history. Henri Becquerel, so late as 1897, observed that compounds of the metal uranium emit something which passes through many bodies opaque to ordinary light, and which renders the air around it conductive of electricity. Following up this observation, Madame Curie discovered radium. Radium is a metal in many respects like others previously known, but differing from them in the extraordinary power of throwing off electrically charged particles with enormous velocity, together with a remarkable gaseous emanation. According to the generally received view, which we owe to Prof. Rutherford, we are face to face with a process which is the reverse of that by which we may suppose the ordinary elements, or some of them, to have been formed. The decay of matter is thus indicated, and, though the process affects only minute quantities of stuff in the earth, it is sufficient to provide food for reflection to the geologist who wants to account for the rate of cooling of the earth and to the cosmogonist who can imagine the operation proceeding elsewhere on a far larger scale. There is temptation enough here to the speculative mind. Everything is now supposed to be expressible in terms of electricity, concerning the nature of which no one knows anything. Chemical action is attributed to exchanges of electric units, and matter of all kinds is supposed to be made up of the same. In the midst of all this confusion the clear duty of the chemist, at any rate, is to follow the practice inculcated by Liebig and stick to experiment, observation, and careful inductive reasoning.

One word in conclusion. The creation of a school of thought, such as that of which the chemical school at Giessen was the centre, requires originality as well as learning in the teacher, intelligence in the taught, and a sympathetic relation between professors and students. These are more important than buildings and appliances. But much influence is exercised by the environment; that is, by the attitude of the public. Appreciation of learning and interest in the results of research have long been provided more freely in Germany than in England. Though we cannot now admit, without qualification, the reproach of Liebig, already quoted, it is still true to some extent that what the public in England wants is invention rather than discovery; the applications of knowledge before the knowledge itself.

Some people will doubt, perhaps, whether we are so much behind Germany, "learned, indefatigable, deep-thinking Germany," as Carlyle called her. We have an immense amount of popularisation of the results of science, but it is to be feared that much of this is too easy, shallow, and misleading.

I think the difference between the two peoples is to be partly acounted for by the attitude of the Governments in the two countries. In England it is the custom to leave the investigation of many important subjects, like agriculture, to the chance of private benefaction or voluntary effort. In England, again, it is only in comparatively recent times that assistance out of public funds has been given to the universities. This attitude of the Government has an immense influence in directing popular views of institutions, of things, of men. That which the masses find placed in positions of advantage by the powers set over them are naturally held in higher esteem than those which are always kept in the background or in a position of evident inferiority. In Germany the university chairs are occupied by the greatest specialists in every department, and these are men who are honoured at Court, consulted by Ministers, and trusted by manufacturers. But, after all, when we have exhausted the enumeration of all the adventitious influences at work in both countries, it seems as though there were some elements in the mental constitution of the different peoples which leads them to handle the same subject of inquiry in different ways. It has been so in the study of chemistry.

At the beginning of the nineteenth century, with the aid of the principles bequeathed by Lavoisier, the facts which had been established by Priestley and Cavendish, the discoveries of Humphry Davy, and the atomic theory of Dalton, France and England were engaged in laying the foundations of the new science. At that time Germany had no chemists. Liebig himself bears witness, in his autobiography, that in his youth "it was a very wretched time for chemistry in Germany." During the latter half of the century there arose in nearly every German university a famous school of chemistry, and in practically all cases it has been a school for the cultivation of so-called "organic chemistry," in which department German chemists have achieved the most brilliant successes. Nothing can be more important than Kekulé's theory of the aromatic compounds. Nothing can be finer than the synthetical work of von Baeyer and Emil Fischer in connection with indigo, the sugars, and the proteins, or albuminoid substances, the chief basis of the animal tissues. But it cannot be maintained that they have been equally distinguished for the discovery of broad general principles. German triumphs have been more frequently the result of that patient attention to detail which seems characteristic of the German mind.

Take, by way of illustration, the problems which at the present time loom largest before the chemical world. There are first the relations among the atomic weights, discovered by Newlands, an Englishman, and worked out by Mendeléeff, a Russian; next, the arrangement of atoms in space, or stereo-chemistry, to which the clue was furnished by Le Bel, a Frenchman, and van 't Hoff, a Dutchman; next, the process of electrolysis and the constitution of salts in solution, of which by far the most important theory, the theory of free ions, was supplied by Arrhenius, a Swede. Again, there is radio-activity with all its consequences, the isolation of radium by Madame Curie, and the greater part of its wonderful history, worked out by Rutherford and Ramsay, both British chemists. To those great fields of inquiry Germany has, doubtless, made contributions, but she did not discover them.

My own impressions are strengthened by a passage which I will venture to quote from a modern work, "The History of European Thought in the Nineteenth Century," by Dr. Theodore Merz, himself a German, though domiciled in England. He says (vol. i., p. 300): "The largest

number of works, perfect in form and substance, classical for all time, belongs probably to France; the greatest bulk of scientific work probably to Germany; but of the new ideas which during this century have fructified science, the larger share belongs probably to England."

After all, German chemistry can always point with just pride to the great teacher of us all, Justus von Liebig.

EXCAVATIONS AT MEROË IN ETHIOPIA.[1]

THE ruins of the Meroë were noticed so long ago as 1772 by the famous traveller James Bruce; but his identification was not generally accepted, and it was not until three years ago that Prof. Sayce, in the course of an official inspection on behalf of the Sudan Government, recognised that unquestionably they were the remains of Meroë, and invited Prof. Garstang, then at work in Egypt, to undertake the excavation.

The Government of the Sudan encouraged the work by facilities and assistance, including the construction of a railway siding, the provision of water tanks, and materials.

In addition to the visible results, archæology has received some new and important contributions, for, until this work was undertaken, nothing was known of the subject of the Ethiopian civilisation from the specialist's point of view, and this fact naturally doubled the difficulties of an excavation of this kind. For this reason, primarily, the first experiments (season 1909–10) were made in the tombs and isolated knolls, as being the most accessible sources of information as to the character of ordinary Meroitic objects.

The tombs, being of unknown type and securely cemented down, for some time baffled the workmen, but at last there came to light some thousands of vases—found, in some instances, as many as thirty or forty in a single tomb chamber. They were all of a style new and peculiar, without any noticeable trace of Egyptian influence. In the tombs furthest to the north vases of a special and rare kind were recovered made of thin pottery, decorated with paintings in colours (the subjects being animals, trees, or natural features), or with designs stamped upon the clay. Similar vases in more perfect state were found in 1911 among some ruined buildings in the west of the city area.

FIG. 1.—View in the Temple of Amon. Place of sacrifice in the foreground, the high altar beyond.

In this way the wants of 500 or 600 workmen were provided for. The camp became a stopping place for certain trains, which brought provisions, and it marks the site of a new station which will shortly be available to visitors. Practically nothing of the ancient city was visible above the soil when the party arrived upon the scene—no ruined buildings or connected walls, only mounds of débris and a few carved stones here and there—for the well-known pyramids of Meroë that mark the spot lie back several miles in the solitude of the desert.

The gates of the city opened, as it were, one by one before the ordered and methodical attack of the excavator's trained Arab workmen. Great temples, royal palaces, and public buildings emerged gradually from the sands; the city walls and gates and quays stood once more in their places; colossal statues, altars, and public monuments disclosed their whereabouts; the tombs yielded up their secrets; and numbers of small, artistic remains were trapped in the busy sieves.

[1] From the Guide to the tenth annual exhibition of antiquities discovered at Meroë, and the second interim report upon the excavations, by Prof. J. Garstang.

In addition to pottery vessels there were in the tombs a variety of objects not merely funerary in character.

In obedience to primitive instinct, the dead was laid to sleep on his bed in his subterranean chamber surrounded by the things which would be to him the most useful upon his awakening. The soldier had his weapons (sword, lance, dagger, &c., all of iron); the huntsman his bow and arrows—even his hounds were sometimes sacrificed with him. The women had equally their beads and their jewels. In a few cases the frame of a decayed wooden bed might be traced; and in every tomb the vases and dishes seemed to have contained drinks and food. It is probable that originally one of the doors was left so that it might be opened for the regular renewal of the offerings.

While this experiment was in progress, the position of the great temple of Amon was determined, and the task of uncovering it was begun. The entrance proved to be a pylon in the Egyptian style, and the central aisle leads through a series of columned halls to the sanctuaries, at a distance of 130 yards, beyond which the temple abuts on the great wall of the city. Towards this end, in the main axis, there still stood the high altar, carved in a single

block of stone, decorated in relief with the figures of gods and of the king in his character of chief priest. At the foot of the altar were found the last votive offerings where they had been laid just previous to the destruction of the city.

Two small temples in the neighbourhood gave further information. One was dedicated to the Egyptian goddess Isis. In this ruin two buildings were superposed, and in the foundations of the later one (which was built, for the most part, out of the ruins of the earlier) were found two great statues of columnar form representing the king and queen of Ethiopia. The upper building did duty at a later time as a Christian church.

FIG. 2.—Deep excavation to the north of the royal enclosure.

The second temple seemed to have been dedicated to the lion god, a primitive cult of which there are a number of indications. It was situated on the east side of the town towards the desert, a fact which recalls to mind that travellers of last century speak of the great number and the ferocity of the lions in this district. Inside were found two sculptured lions in stone, one on each side of the door, and several other emblems of the same animal. Included among these was a slate plaque, carved on both sides, on the one with the design of the king in his gorgeous state robes, on the other the lion god in human form standing upright upon a man's legs. Each sculpture was also inscribed in the language and writing of Meroë; and in the inscription, thanks to the assiduous study of philologists, there can now be recognised the names of gods and personages.

The temple of the sun was discovered and uncovered at the same time. The building is surrounded by a square enclosure wall with four doorways, but the chief entrance is from the east; in this direction also there are two shrines, also constructed in stone. The outside wall of the temple is decorated with scenes of war, of triumph, and of sacrifice. A sloping way leads up from the east to the chief platform, which is entirely surrounded by a cloister. The architecture, both in the proportion of its columns and interspaces, as well as in the elegance of form and the exactness of construction, recalls the best Greek works of antiquity, and not at all the styles common upon the Nile. The sanctuary is in the middle and raised above, being approached by a number of steps in black stone. Its floors and its walls were originally covered with glazed tiles, blue and yellow, of which a number are still in position. Round the sanctuary was a kind of corridor or perambulation, exposing to view on the outside the processions and the ceremonies of the priests.

Such were the results of the first year's explorations of Meroë. There was no doubt that it was necessary to continue the excavations, and funds were provided by which the work was able to go forward during the past winter. Some of the results of this season's work are described below.

The temple of Amon was completely excavated; previously the chambers around the sanctuary alone had been cleared, but in this season's work chambers 272, 278, and 277 were found to form a part of the main building. The first two were unimportant, except that in No. 272 there was found just at the foundation-level a remarkable cameo of Greek workmanship representing a pair of galloping horses, one black and the other white; its date may be approximately fixed at 300 B.C. In the same chamber there was found a small tablet of stone decorated with low reliefs representing the king and the queen making offerings respectively to Ram-headed Amon and the goddess Isis. Below were several lines of inscriptions in Meroitic cursive character. It is unfortunate that this object (now in the museum at Khartoum) was much broken, as it is a characteristic specimen of Ethiopian art. In the chamber 277 there were evidences of a colonnade, and at its western extremity a small shrine enclosed within a screen of columns. In the main avenue, in the centre, that is to say, of chamber 270, there was found in the paved floor of the building a place specially prepared for the sacrifice of larger animals; it was about 3 metres square, surrounded by a trench and enclosing a central space about 1 metre square, in which had stood a dish of stone lined with glazed tiles. In the outer hall (No. 271) the base of an obelisk of black granite was found *in situ* just to the left hand of the entrance to chamber 270. This obelisk must have been originally about 3 or 4 metres in height above its plinth; the upper part of it, however, was broken entirely away, so that only about half a metre of the inscribed faces remain. The inscription is in lines of Meroitic cursive script clearly engraved, and, supplemented by the numerous fragments found scattered around, constitutes one of the longest Ethiopian texts hitherto discovered. To the south of the central

FIG. 3.—Roman Bronze portrait head, probably Augustus.

sanctuary 279 there was found against the main wall of the hall a stone dais approached by several steps and carved in a single piece. It is decorated around the outside with a design of bound prisoners, while upon the steps themselves are similar representations of humble captives upon which anyone mounting the dais must place his feet.

The general plan of the temple of the sun, as previously published, was confirmed. A number of subsidiary chambers were found, however, against the southern wall, and these are represented in the new plan. On this side from the west there may be seen also an ascending ramp, leading up, doubtless, to a door in the southern wall of the building. On the same side to the east there came to light a small chamber enclosed between the main wall and the colonnade. In the floor of this were numerous vases of earthenware filled with incinerated bones and charcoal, a proportion of the bones being apparently human. Just above, upon the outer face of the main wall, there are scenes representing the slaughter of young men and boys, while among the sculptures which decorate the walls (some of them now falling away from their original places) there may be recognised scenes of torture. Of special interest is a group of decorative carvings upon the west wall of the main building, supplemented by fragments, which give a contemporary picture of the whole temple as it originally stood. The wall of the inmost sanctuary may be seen rising above the colonnade which represents the cloister upon the main platform; both the inner and outer pylon are also quite distinct. Another part of the scene represents a four-columned building, apparently that of which the ruins are traceable just to the east of the enclosure wall of this temple. The sloping way leads up to this building, and a number of figures included in the decorative scheme are arranged in two groups similar to one another in which a bound captive may be seen dragged up the slope by a cord attached to his leg, while a soldier from behind encourages him to mount with the point of his spear. The representations of the king seated upon his throne and of warriors mounted on galloping horses complete these interesting scenes.

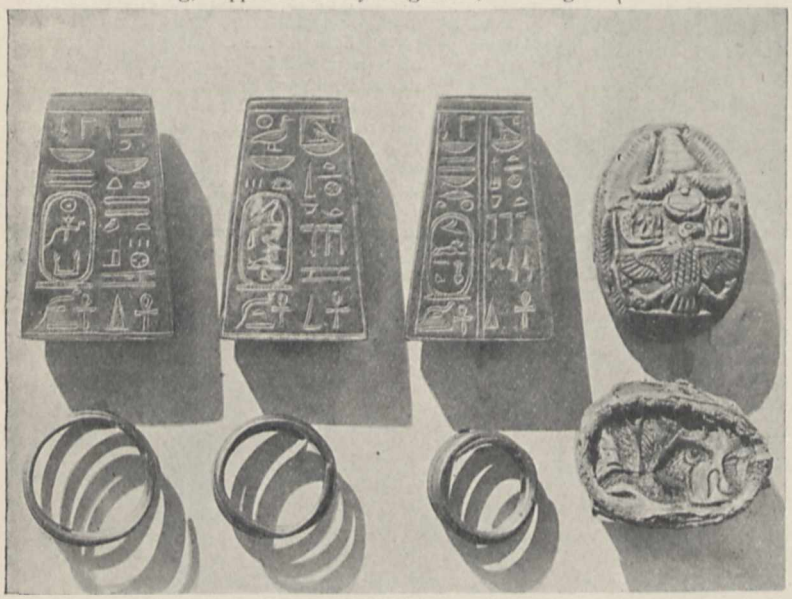


FIG. 4.—Royal jewels discovered with a hoard of gold.

Several other smaller buildings have been included in the season's explorations—temples, houses, baths, chambers for workers in metal, the furnaces for pottery and bricks, and all the evidences of the active life of a great city of the East. But of even greater immediate interest was the discovery and excavation of the royal city and its palaces. Following under the surface the great wall, bounding the Amon temple on the west, which all the time was the centre of these investigations, it was found that it continued with the same width of five or six yards for a length of more than 300 yards. At last, instead of turning towards the east, and thus including the temple of Amon, it turned at each corner to the west and enclosed a space of 150 yards wide. On the west side, without doubt, it touched the river in ancient times—a fact which corresponds with tradition—and here there were noticeable specially built terraces to resist the action of the water, as well as a place of disembarkation and a quay communicating with the interior.

Inside there were two prominent mounds. That to the north covered a great columned hall, with frescoes of the king and queen in scenes of ceremonial and triumph painted on its walls. In the middle there had been constructed, at a second period, a massive pedestal, as if for an equestrian statue or group, with its foundations half as high as the original columns. In front of the entrance, interred in a pocket of clean sand, there was found, on the third day of the excavations, the massive bronze head represented in the illustration. It is a wonderful specimen of Roman art, in perfect condition, and clearly work of the age of Augustus, about the time of the birth of Christ. The eyes are of alabaster, with the iris inlaid, and pupil of dark glass, while the eyelashes are in bronze. It is twice life-size. To judge from the profile, it is just possible that this head represents Germanicus (B.C. 15–A.D. 19), who during his military career was stationed at one period in Syria, and is known from the Annals of Tacitus to have made a voyage by the Nile to Aswan; but the resemblance to the Prima Porta head of Augustus makes it more probable that it represents the first emperor.

Lastly, towards the end of the season, work was concentrated upon the palaces covered by the southern mounds. In a rubbish well were found pieces of glazework, sistrums, ankh-signs, and vases on which were the names of several royal personages of Ethiopia, of date probably towards the sixth or seventh century B.C. Among them may be noted *Aspelut*, whose other name was *Mer-Ka-Ra*; also *Uaz-Ka-Ra* (*Hor-ma-ti-leq*) and *Mal-nefer-neq*. In another place a piece of a big scarab gave the name of the Queen Tiyi and Amenhetep III., names familiar in the eighteenth dynasty of Egypt, in the fifteenth century B.C. Finally, towards the end of the work there were found two jars of pottery full of gold-dust and nuggets, of 22½ carats, and sterling value about 1700*l.* One jar contained also some royal jewels, inscribed with the two royal names last noted, as well as money, rings, scarabs, crude amethyst, and beads of coloured glass. This, without doubt, formed part of the traditional treasure of the Ethiopians; the vases must have been stolen in ancient times from the treasury, which was found destroyed to the very last stone, and the thieves had hidden them in the place where the excavators' spades have now disclosed them.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced in *Science* that Mr. John G. Archbold has made a further gift of 8000*l.* to Syracuse University, and that Governor Dix has approved two Bills passed by the recent New York Legislature, one granting 28,000*l.* for the Oswego Normal School, and one granting 10,000*l.* for an Agricultural College, Cobleskill.

DR. A. N. WHITEHEAD, F.R.S., fellow of Trinity College, Cambridge, has been appointed to succeed Mr. E. Cunningham, as lecturer in the department of applied mathematics and mechanics in University College, London; and Dr. J. Sherwood New to succeed Dr. F. N. Kay Menzies as

assistant and lecturer in the department of hygiene and public health.

FOLLOWING the example, set first by the London County Council, of arranging annual conferences of teachers of science for the discussion of methods of teaching and other important matters, the Director of Public Instruction for Ceylon, Mr. J. Harward, was instrumental in bringing about a second conference on science teaching in Colombo last March. We have received a report of the proceedings at this year's meetings, which were largely attended. The interest with which the proceedings were followed showed clearly that the conferences are a movement in the right direction. Four papers were read and discussed, as follows:—the teaching of elementary mechanics, by Mr. C. W. B. Arnold; the value of ugliness in electrical apparatus, by Mr. A. J. Bamford, of Colombo Observatory; the position of biology in education, by Dr. J. Pearson; and physiology in boys' schools, by Mr. E. Evans, of the Government Training College.

THE Department of Agriculture and Technical Instruction for Ireland has issued its "Programme of Experimental Science, Drawing, Manual Instruction, and Domestic Economy for Day Secondary Schools" for the session 1911–12. Among the more important alterations which have been introduced are: a course of physical and commercial geography has been substituted for that in geology in the special courses; students who have worked satisfactorily through the third-year syllabus of physics will be permitted to proceed to the fourth-year syllabus of mechanics, without having worked previously the third-year syllabus of the latter subject; students who are more than eighteen years of age on June 1 in the year in which the course is entered upon will be ineligible for grants; and grants will be payable, under certain conditions, upon the attendance of students at instruction in a fourth-year syllabus during a second year. We notice that summer courses for instruction for teachers will be continued as heretofore, but the hope is expressed that the courses will shortly have satisfied the need of qualifying teachers, and will develop into "post-graduate" courses on special subjects for those already qualified.

REFERENCE was made in the issue of NATURE for July 20 (vol. lxxxvii., p. 101) to a scheme arranged by the Royal Commissioners for the Exhibition of 1851 for the award of industrial bursaries to young men who, after a course of training in a university or approved technical college, desire to enter engineering, chemical, or other manufacturing works. The scheme is another indication of the desire of educationists to establish a link between education and industry; it is based on the assumption that college-trained men are not able, as a rule, to obtain remunerative employment in industries immediately after the completion of their college course. Its main characteristic is to lead the students to the manufacturers. In the issue of *The Times* for August 14, the writer of an article on "Commerce and the Universities," after directing attention to this scheme, gives an interesting account of the industrial fellowships inaugurated in the University of Kansas. They were initiated by Prof. Duncan in 1907. The fellowships are tenable in the chemical department by students appointed by the University, and the emoluments are provided by manufacturers. To illustrate the conditions under which the fellowships are held, those attaching to a fellowship (No. 7) established by a glass company may, says *The Times* contributor, be taken as typical. The object of the fellowship was investigation into the optical properties of glass in relation to its chemical constitution. The fellow contracted to devote the whole of his time to this investigation, with the exception of three hours a week, which he gave to teaching in the University, in return for which he was exempted from the payment of university fees. The tenure of the fellowship was for two years, and the emoluments, 300*l*. a year, were provided by the company. All discoveries made by the fellow during the tenure of the fellowship become the property of the company, subject to the payment of 10 per cent. of the net profits to the fellow; and any patents taken out by the fellow are assigned to the company. The fellow is allowed to publish any results the publication of which, in the opinion of the company, would not injure their interests. At the end of the tenure the fellow is required to present to the University a complete monograph on the work done, and, after the expiration of three years, the University is at liberty to publish the results for the use and benefit of the people.

THE executive committee of the General Council of Church Training Colleges has presented a memorandum to the President of the Board of Education dealing with the qualification and supply of teachers. The memorandum states there has been a marked and general falling off in the number of candidates for entrance into training colleges owing largely to the agitation of the last two years, which arose out of the over-supply of teachers and consequent difficulty in many cases of obtaining employment. A careful investigation leads the council to the conclusion that a pressing need of the time is the framing and publication by the Board of Education of a definite and comprehensive policy with reference to the qualification and supply of teachers. If such declaration be made, the following steps would follow in due course: (1) The definite announcement would be made that after a certain date no more (or, according to policy, a much smaller percentage of) untrained or uncertificated teachers would be appointed. Special arrangements would have to be made in the case of smaller country schools. (2) A thorough inquiry would be made into, and a careful estimate formed of, the consequent requirements of the schools throughout the country and of the existing provision to supply their needs. (3) The council feels strongly that as the revised staffing would involve increased expenditure, more care should be taken in the preliminary selection of candidates for the teaching profession, and suggests (i) that no young person should be appointed as bursar who has not shown some qualities and aptitude (apart from merely intellectual tests) for the teacher's profession; and (ii) that no bursar should be allowed to proceed to a student-teachership who has failed to prove such fitness. (4) To avoid any possible hardship to any person now engaged in teaching, existing qualifications should be recognised, subject to the requirements of efficiency, although the council is of opinion that it might be reasonable to require, or at any rate useful to encourage, untrained, uncertificated, and supplementary teachers to improve their qualifications within a certain period.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 7.—M. le Général Bassot in the chair.—Sir William **Ramsay**: The action of niton (the radium emanation) on thorium salts. Commenting on a recent paper by M. Herschfinkel on this subject, the author gives details of the method of purification of the thorium nitrate used in his experiments, with especial reference to the destruction of any organic matter which might have been present in the crude salt.—Kr. **Birkeland**: Are the rings of Saturn due to an electrical radiation from the planet? A description of the phenomena observed when a magnetised globe is placed in a strong electric field. Three photographic reproductions of the appearance of the globe under these conditions show the similarity of the luminous ring with that of Saturn. Observations by other workers are also cited in support of this view.—J. **Guillaume**: Observations of the Kiess comet (1911*b*) made with the Brunner equatorial of the Lyons Observatory. Data are given for July 15, 17, 20, and 21.—J. Ph. **Lagrula** and H. **Chrétien**: The Kiess comet (1911*b*). Its photographic aspect and its spectrum. One photograph showed a well-defined tail to the comet 1° in length. The spectrum contained cyanogen bands and the blue hydrocarbon band.—Marcel **Brillouin**: Crystalline elements and molecular orientation.—Daniel **Berthelot** and Henry **Gaudechon**: The photolysis of alcohols, acid anhydrides, ether oxides, and esters by the ultra-violet rays. Alcohols are characterised by evolution of hydrogen and formation of aldehydes. Ethers give carbon monoxide, hydrogen, and saturated hydrocarbons. Various esters were also submitted to ultra-violet light, and the gases produced are tabulated.—Amé **Pictet** and Alphonse **Gams**: The synthesis of berberine. Starting

with homopiperonylamine, hydroberberine has been synthesised with homoveratryl-homopiperanylamine, and veratryl-norhydrohydrastinine as intermediate steps. Berberine has already been obtained from tetrahydroberberine, so that the synthesis is complete.—L. **Tchougaeff** and G. **Pigoulewsky**: Dithiocamphocarbonic acid.—S. **Losanitch**: The constitution of divalolactone.—E. **Caille**: A modification of the Friedel and Crafts reaction yielding α-naphthalenic ketones exclusively. The reaction is effected in carbon bisulphide at a temperature of 0° C. The yield of ketone is high, 60 per cent. to 80 per cent.; five examples of the application of the method are given.—Maurice **Arthus**: The specific characters of the antivenom serums. Anticobra serum and the poisons of the hamadryas (*Naja bungarus*) and krait (*Bungarus coeruleus*).—J. **Courmont** and A. **Rochaix**: Negative attempts at antituberculous immunisation by the intestine.—J. Kunckel **d'Herculais**: Observations on the habits of a myriopod (*Scutigera coleoptrata*). Its utility in destroying flies. The action of its poison: its supposed accidental presence in the digestive apparatus of man.—Pierre **Girard**: The preponderating *rôle* of two electrostatic factors in the osmosis of solutions of electrolytes. Normal osmotic movements.—Em. **de Martonne**: Results of the morphological analysis of the erosion levels of the Arc and Isère valleys.

August 14.—M. Armand Gautier in the chair.—J. **Boussinesq**: The spontaneous vibrations of a bar fixed at the ends and impermeable to heat, which is put in thermal equilibrium with an atmosphere at constant temperature. Simplified solutions for two problems previously studied by M. Roy and M. Annycke.—H. **Douvillé**: The geological explorations of M. Perrier de la Bathie in Madagascar.—Édouard **Heckel**: The cultural bud mutations of *Solanum maglia*, and on the first cultural results of these mutations. The first result has been the production of a violet variety. The plants show great resistance to cryptogamic diseases, and suggestions are put forward as to a means of obtaining strains of potatoes from wild plants capable of resisting disease.—A. **Calmette** and L. **Massol**: The antigenic function of the tuberculins.—M. **Verschaffel**: Observations of a double shooting star.—Armand **Denjoy**: *Analysis situs* of the plane.—Victor **Henri**: The influence of various physical conditions on the ultra-violet radiation of quartz mercury vapour lamps. Using the citrate of silver method described in a previous note for measuring the intensity of the ultra-violet radiation, the author has made determinations of the activity of a Westinghouse Cooper-Hewitt lamp under varying conditions of cooling. It was found that the ultra-violet radiation of the lamp is more intense as the temperature of the luminous tube increases. Cooling the tube with water gives only one-fourteenth of the ultra-violet radiation obtained when the lamp is in air, the watts consumed remaining the same. A study of the activity of six lamps of different makes and ages showed that for experiments in photochemistry a quartz mercury vapour lamp may be relied upon as a constant source of ultra-violet rays, the radiation being defined when the voltage, amperage, and length of the tube are known.—G. **Chesneau**: The analysis of monazite sands. Full details of the suggested method are given, accompanied with a complete analysis of a monazite sand from Madagascar.—M. **Kunz**: Feeling at a distance as a factor in the power of orientation possessed by the blind. A study of the so-called "sixth sense" of the blind. This is found to be localised on the skin, and is not exclusively an attribute of the blind. It is not connected with the sense of hearing, as is shown by the results of numerous experiments specially directed to this point.—Émile **Yung**: The insensibility to light and the blindness of the vine snail (*Helix pomatia*).

MELBOURNE.

Royal Society of Victoria, June 8.—Prof. E. W. Skeats in the chair.—A. M. **Lea**: A new Australian genus of Phoridæ, associated with termites.—F. **Chapman** and A. O. **Thiele**: A limburgite rock occurring as a volcanic plug at Balwyn, near Doncaster.

July 13.—Prof. E. W. Skeats in the chair.—Kathleen E. **Oliver**: The displacement of the optic lobes during the development of the brain of the fowl. The paper consists mainly of a series of drawings in the round of the different stages.—Helen **Kelsey**: Subdivision of the spinal canal in the lumbar region of chick embryos. In chicks of fifty-two hours' incubation the canalis centralis is bifurcated in the lumbar region. The observations extended over three years, and a large series was examined.—A. **Grouvelle**: Description de quelques nouveaux espèces de Coleoptères australiennes.—F. **Chapman**: Some Silurian species of the genus Lingula, with notes on its shell structure and a parasitic plant. Canals in the corneous laminæ were found in the fossil as in the recent *L. albida*.—J. H. **Gatliff** and C. J. **Gabriel**: Some new species of Victorian Mollusca. One new genus, Edenttellina, and eight new species, are described.—J. H. **Gatliff** and C. J. **Gabriel**: Additions to, and alterations of, the catalogue of Victorian marine Mollusca.—F. L. **Stillwell**: Notes on the geology of Broadmeadows.

CAPE TOWN.

Royal Society of South Africa, July 19.—Mr. S. S. Hough, F.R.S., president, in the chair.—J. C. **Beattie**: Terrestrial isomagnetic lines in South Africa.

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