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Co-operative Indexing of Periodical Literature.

THE selection, examination, and classification of the valuable matter contained in periodical literature is performed by two agencies, viz. certain abstracting and indexing societies and journals. "Science Abstracts" and the abstracts published by the chemical societies of England, France, Germany, and the United States are examples of the former class, while the "International Catalogue of Scientific Literature," the "Engineering Index," the "Index Medicus," the "Index to Legal Periodicals," and the various indexes published by the Anglo-American library associations represent the latter. Almost without exception, where the same field is covered by both types of publication, the two agencies work independently of each other. Further, in this country the publication of abstracts generally precedes the corresponding index publication, especially where the latter makes any pretence to completeness. This obviously is an indefensible arrangement; for the index material, which is the result of the wider survey, should be accessible to the abstractor prior to the preparation of the abstracts. We propose to indicate how this change could be accomplished with a minimum of disturbance to existing interests. It should be observed that the phrase "periodical literature" is used in its widest sense to include society publications and institutional reports, as well as annual, quarterly, monthly, and weekly publications.

The growth of periodical literature owing to the

increased specialisation of knowledge is one of the most significant features of our times. A union catalogue of the current periodicals preserved in the German libraries, published in 1914, comprised some 17,000 entries. A similar list for the periodicals filed in the libraries of the United Kingdom, prepared in 1914-15 by some English State and Copyright librarians, was submitted for publication to the Department of Scientific and Industrial Research, but the proposal met with no encouragement. Yet the compilation of such a list is an essential preliminary to the proper national organisation of knowledge. For a union list indicates the relative strength and weakness of our national libraries in respect of their periodical collections: it enables the librarian to correct the latter without unduly increasing the expenditure of the library in that department of literature. Moreover, while primarily a time-saving expedient for locating the place of deposit of a periodical, it emphasises the essential unity of the library service in the satisfaction of the legitimate requirements of research. Our first proposal, therefore, is that representations should be made to the Trustees of the British Museum with the view of inducing them to undertake this necessary piece of national work. These representations would carry greater weight if accompanied by some guarantee of financial support. The work done in 1914-15, which is in the custody of the British Museum library authorities, would, of course, require considerable revision and extension, but the cost of its publication should not exceed 500*l.*—a portion of which would be recouped by its sale.

That a large proportion of periodical literature is of an extremely composite character is, of course, a commonplace; but the labour which this feature entails upon those responsible for the collection of material relevant to their particular fields of inquiry is not equally well realised. This composite character applies not only to the popular magazines and journals, but also to the repositories of original investigations in all branches of knowledge. The *Comptes rendus* of the Paris Academy, for example, furnish material not only for the seventeen sections of the "International Catalogue," but also for psychology, education, archaeology, and technology. In the *Sitzungsberichte* of the Berlin Academy theories of relativity jostle with disquisitions on Hittite inscriptions and Turco-Tataric philology. In short, periodical literature may be said to consist of two classes: (a) watertight

compartments containing homogeneous material, and (b) compartments which admit freely any literary matter of sufficient merit or popular appeal. The problem, therefore, is to devise a scheme by which information contained in the latter class—for class (a) presents no special difficulties—can be made to flow towards its proper recipient, and this, obviously, can be effected economically only by the acceptance of a common system of classification.

So far as the literature of science is concerned, a classification already exists in the scheme adopted by the "International Catalogue of Scientific Literature." This scheme has been incorporated in that of the Library of the United States Congress—a library the staff of which appears to possess special qualifications for dealing with the literature of the exact sciences. Further, this scheme has been published in two forms: (a) with its headings arranged in class order and issued in separate sections, e.g. Q=science in general [QA=mathematics, and so forth]; and (b) with its headings arranged in one general alphabet. Thus science possesses a classification stamped with its own hall-mark, but grafted on to a scheme for the general classification of knowledge. Still, the acceptance of the Library of Congress classification is not an essential feature of these proposals, which are based on the recognition (1) of the division of periodical literature into (a) the homogeneous and (b) the non-homogeneous classes; (2) of the economic advantage of dealing on a co-operative basis with the latter; and further, since the non-homogeneous periodicals cover all departments of knowledge, (3) of the necessity of adopting some agreed system of classification for the purpose of establishing a means of exchange between the different interests.

Thus we have shown that the core or *umbra* of a subject is comprised in a body of homogeneous literature which unquestionably can best be dealt with by its representative professional society, but that outside this core there exists a *penumbra* of relevant matter dispersed through a literature of gradually increasing irrelevance, with the result that the recovery of the relevant matter can be effected economically only by co-operative effort. The solution, therefore, would appear to be to bring into existence a Central Bureau which should deal solely with the indexing of periodicals of the non-homogeneous character—and in the first stages of its work, with a restricted list of periodicals assigned to it by the

contributory bodies. These bodies would receive from the Central Bureau entries from the periodicals examined corresponding to their specified requirements. But as the professional abstracts became more fully representative of progress in their respective fields the need for the publication of the corresponding indexes would tend to disappear. The institution, therefore, of a Central Bureau would ultimately make for economy in all branches of science in which the publication of abstracts is admittedly indispensable.

So far as science is concerned, it will probably be found that the simplest and most effective method for obtaining the necessary index slips would be to invite the Central Bureau of the "International Catalogue of Scientific Literature" to provide them. Indeed, the possibility of co-operation between the "International Catalogue" and the abstracting journals was one of the subjects considered at the conference held last September. Any such arrangement would probably begin with the year 1921, and, as a preliminary, the "International Catalogue" should be brought up to date by the publication of volumes for 1915–20. The provision of funds for this purpose is an urgent necessity, as explained in NATURE for October 7, 1920, vol. cvi., p. 195.

In the foregoing observations we have assumed that the proper bibliographical equipment of the sciences will in the main be founded upon the possession of adequate abstracts. But if the subject were threshed out in an open conference at which representatives of all branches of knowledge were invited to attend, this proposition would not be accepted as holding good universally. Some branches would probably prefer periodical critical reviews or summaries of the year's progress, while others would be content with alphabetically arranged index entries. Our final proposal, therefore, is that such a conference should be held in order that the special requirements of each division of knowledge should be authoritatively ascertained, and the feasibility of co-operative or co-ordinated action discussed.

Piezo-chemistry.

Piezochemie kondensierter Systeme. By Prof. E. Cohen and Dr. W. Schut. Pp. ix+449. (Leipzig: Akademische Verlagsgesellschaft m.b.H.: Gustav Fock, 1919.)

THE direction and extent of a physical or chemical change are frequently determined or modified by pressure. This fact has long been

known, and has been the subject of occasional investigation at various times, even from the earliest periods of systematic scientific inquiry. It occupied the attention of the first Italian academies, and was among the matters experimentally studied by the Fellows during the early years of the Royal Society. Until comparatively recent times, however, work on the subject was sporadic, intermittent, and directed mainly to the investigation of particular cases rather than to the elucidation of general principles. The necessities of modern chemical manufactures have created a demand for further and more accurate knowledge, inasmuch as the whole course of a chemical reaction and its economic aspect may depend upon it. Many instances of this fact might be cited. One of the most recent, and also one of the most striking, is seen in the case of the synthetic production of ammonia from its elements under the influence of catalysts, in which the question of the appropriate pressure is of fundamental importance.

Prof. Ernst Cohen, of the van't Hoff Laboratory of the University of Utrecht, and his collaborator, Dr. W. Schut, have placed chemists and physicists under a great obligation by their compilation of the book now under review. It does not profess to be a text-book on the subject. It is, as stated, a compilation of the facts known, or allowed to transpire, scattered through the volumes of some fifty different periodicals, and was originally made for the convenience of workers on the subject of piezo- (or pressure) chemistry in the laboratory which Prof. Cohen directs. The material thus accumulated has been arranged in a systematic and orderly manner. We have, first, a description of the methods of creating and measuring high pressures; next, a general discussion of compressibility, its methods, direct and indirect, with some account of their relative merits and defects. Then follows a full historical description of the several attempts to obtain accurate values of certain fiduciary constants generally necessary in piezometric work—viz. the compressibility coefficients of glass, mercury, water, and incidentally of ice, and their relation to temperature. Each section is accompanied by bibliographical references to the original sources of information.

The authors then treat of the compressibility coefficients of the various elements and such of their compounds as have been studied. Special attention is, of course, paid to the work of Richards, of Harvard, and his co-workers, and the question of the compressibility of atoms and

the existence of interatomic spaces in solids and liquids is shortly discussed, mainly in the light of the American chemist's published views on the subject. As regards liquids, an attempt is made to group them in conformity with their chemical relationships. Thus all the hydrocarbons are brought together, as are the alcohols, esters, halogen compounds, acids, etc., obviously with the view of facilitating the detection of general principles. It must be confessed, however, that as yet the data afforded by different investigators are too discrepant to afford a satisfactory basis for generalisations. This is due mainly to imperfections in the method of observation, and in a less degree in some cases to insufficient care in the purification of the liquids employed. Accurate work, like that of Bridgman, suffers by association with that of earlier inquirers whose measurements were largely of the pioneering order.

Although definite numerical values are lacking in many cases, certain conclusions may be said to be fairly well established. Thus, for example, Bartoli has shown that the compressibility-coefficient in an homologous series of the liquid paraffins decreases with the increase of molecular weight. That the same is true of the aromatic hydrocarbons appears from the observations of Richards and his co-workers. Measured at equal temperatures and pressures, benzol is more compressible than toluol, and toluol than xylol. The various isomerides of xylol have, however, different compressibilities, *o*-xylol being less compressible than *m*-xylol, which in its turn is more compressible than *p*-xylol, and still less compressible than ethyl-benzol. Identical thermometric temperatures, strictly speaking, are not absolute evidence of a comparable physical condition. Before any sound deductions can be made it will be necessary to establish what is a valid comparable condition. There is a considerable volume of work on the compressibility of liquids, but its treatment and discussion are vitiated by the circumstance that this point has hitherto been insufficiently appreciated. For a fuller account of the relation of compressibility to the chemical nature and constitution of liquids, Prof. Cohen's volume must be consulted.

The influence of pressure upon the expansion-coefficients of substances—solids, liquids, solutions, and alloys—and upon surface tension and melting-point has been studied by many observers. Their work has been systematically collated by the authors, and its outcome discussed. The case of water is of special interest, on

account of the abnormality it displays in so many particulars. It is well known that the temperature of maximum density of water is lowered by pressure, a fact which was established by Tait in 1883, and, later, by Amagat, and confirmed on theoretical grounds by van der Waals and Puschl. Each increment of 1 atmosphere pressure lowers the temperature of maximum density by 0.0217° C. The influence of pressure on the melting-point of ice is equally well known, and has been frequently studied since it was first pointed out by James Thomson and his brother, Lord Kelvin, in 1849, and its natural effect traced by Faraday and Tyndall in the phenomenon of regelation and the movement of glaciers. The large body of evidence on the relation of pressure to melting-point has been carefully collected and displayed in tabular form. For its discussion we must refer to the work itself.

A considerable section of the work is devoted to a consideration of the influence of pressure upon the flow and permanent increase of density of solid substances, and upon the viscosity of liquids. As regards water, the viscosity diminishes with increasing pressure up to 900 atmospheres, between 0° and 32° C., when it attains a minimum. Above this temperature it increases by pressure; below it it decreases in proportion to the increase of pressure. All the phenomena of the compressibility of water serve to confirm the general belief that it is an associated liquid—*i.e.* its molecular complexity under ordinary natural conditions is not properly represented by the simple formula H_2O .

Space will not permit of more than the briefest possible reference to the remaining sections of this valuable work. These treat of the influence of pressure on the electric conductivity of solutions and solids; on the thermo-electric properties of metals; on dielectric constants; on the validity of Faraday's first law; on solubility, diffusion, refractive index, and polarimetry.

It will be seen from this account that the work is mainly concerned with the influence of pressure upon the physical properties of substances, and to that extent its title is rather a misnomer. It might, perhaps, be more fittingly styled piezo-physics. However, the border-line between physics and chemistry is becoming more and more ill-defined, for the spheres of the two sciences gradually merge into each other. There is some point in the good-natured gibe that chemistry, after all, is only the dirty part of physics. We may, however, express the hope that the authors will add to our obligation by extending their work

so as to include the influence of pressure upon chemical change. There is now a fairly abundant literature upon the subject, but it requires to be collected, annotated, and digested, and its general principles elucidated.

T. E. THORPE.

Social Degeneration.

(1) (*Social Decay and Regeneration.*) By R. Austin Freeman. With an introduction by Havelock Ellis. Pp. xx+345. (London: Constable and Co., Ltd., 1921.) 18s.

(2) *The History of Social Development.* By Dr. F. Müller-Lyer. Translated by Elizabeth Coote Lake and H. A. Lake. With an introduction by Prof. L. T. Hobhouse and Prof. E. J. Urwick. (Studies in Economics and Political Science.) Pp. 362. (London: George Allen and Unwin, Ltd., 1920.) 18s. net.

(1) SAMUEL BUTLER tells us that the Erewhonians destroyed all their machines and lived happily ever after. An Erewhonian financier pointed to the "magnificent ruins of the railway-station" as an object of interest in his park. Mr. Austin Freeman, in all seriousness, agrees with the Erewhonians. His book is a searching indictment of the machine as the cause of our present discontents.

Ill fares the land, to hastening ills a prey,
Where wealth accumulates and men decay.

The decay wrought by machinery is not numerical; it is something much worse. The ultimate factor of national decline is racial deterioration; and in modern societies this is very extensive and pernicious. Unfavourable variations are not eliminated, and there is a reversed natural selection in favour of the unfit. The essential character of modern civilisation is a war of mechanism on man.

"Mechanism has destroyed industry and replaced it by mere labour; it has degraded and vulgarised the works of man; it has destroyed social unity and replaced it by social disintegration and class antagonism to an extent which directly threatens civilisation; it has injuriously affected the structural type of society by developing its organisation at the expense of the individual; it has endowed the inferior man with political power which he employs to the common disadvantage by creating political institutions of a socially destructive type; and finally, by its reactions on the activities of war, it constitutes an agent for the wholesale physical destruction of man and his works and the extinction of human culture. It is thus strictly analogous to those anti-bodies by

which the existence of aggregates of the lower organisms is brought to an end."

These charges are driven home in the most forcible manner. The old craftsman, who made a pair of boots and enjoyed his work, has been displaced by a crowd of factory hands, not one of whom could make a pair of boots, and whose work is irksome drudgery. By absorption into an organised aggregate the workman has become functionally atrophied; he has undergone degeneration. The working class is composed of men of a low average intelligence, in adjustment to the relatively small demands for intelligence made by the conditions of machine production. "That the working class consists largely of men of very slight skill was clearly shown during the war, when so-called 'skilled' men were called up for service and were easily replaced by admittedly unskilled men, or even by shop-girls and domestic servants." Machinery has changed a skilled into an unskilled population. The crew of the *Mayflower* could have established a civilised community; a modern company of factory hands and the like, who are normally parasitic on some machine, would starve on an uninhabited island, or relapse into complete barbarism.

Mr. Freeman has some criticisms, as true as they are scathing, on the component parts of our society. "Mere learning or scholarship, unaccompanied by additions to the sum of existing knowledge, furnishes no evidence of faculty above the level of mediocrity." "The professional politician whom democracy has brought into existence differs entirely from other professional men. He is totally unqualified. Such knowledge as the old parliamentary hand has acquired has no relation to social phenomena. It is purely egoistic." Our Government is as absurd as if medical and surgical knowledge were cultivated only by detached savants, while medical treatment was conducted and surgical operations were performed by strenuous but unlearned "men of action." The First Lord of the Admiralty may be a publisher, a brewer, or a stockbroker. Now that Government control is being extended in every direction, the system is disastrous, and has already produced social, economic, and industrial chaos. Our elaborate technical education, instead of training artists and craftsmen, produces only art-school masters and mistresses and technical-school teachers. The trade unions "have made no effort to regain liberty for their members as free workers or collective owners; though the money spent on a great strike would be sufficient to establish co-operative works on an extensive scale."

The manual workers are becoming frankly anti-social as well as anti-democratic. Their activities are directed, not against the employers, but against the community. "The working man tends to be a bad citizen." He plots "to starve the country into submission; to treat his fellow-citizens as a somewhat uncivilised invading army would treat an enemy population." "The profound lack of the most rudimentary ethical conceptions which underlies these anti-social actions becomes manifest when we contrast the implied standard of conduct with that of the more intelligent classes." We cannot imagine the medical profession striking for larger fees in the midst of an epidemic. The bulk of the men no doubt do not realise that they are committing a crime against their fellow-citizens; but this only proves the very low quality of their intelligence. "The sub-man is usually a radically bad citizen."

Society, in a word, is disintegrating. Parasitism, the curse of humanity, is becoming almost universal. "The manual labourer has long since ceased to support himself completely"; "he has obviously arrived at the belief that he has a definite lien on the property of his fellows." The industrious and intelligent—"the only class that matters"—are being taxed and bullied out of existence.

Mr. Freeman has perhaps not allowed quite enough for the power of a body politic, when attacked by disease, to generate anti-toxins to resist the invasion. But though his pessimism may seem too unqualified, the justice of his strictures can scarcely be denied. His remedy, however, is not practicable. It is the "voluntary segregation of the fit"; the establishment of self-contained communities of skilled craftsmen and others, who would help each other to live a wholesome and happy life. Such a community might well be founded in a new country—in Western Canada, Southern Chile, Tasmania, or Rhodesia; the experiment would be well worth making; but in this country the new community would not escape ruinous taxation for the benefit of incapables outside, and would, moreover, be attacked and destroyed by the trade unions.

(2) Dr. Müller-Lyer's book is as typically pre-war as Mr. Freeman's is post-war. It rests throughout on the assumptions of evolutionary optimism. Civilisation *must* be progressing towards a higher state. The author seems to be an admirer of Marx, for he repeats the false statement, so often refuted, that the course of industrialism has tended to make the rich richer and the poor poorer. [The presuppositions of the book vitiate its argument, but it contains many

interesting facts and reflections,] and, unlike English Socialists, the author sees clearly that the unchecked increase of population is the most fatal obstacle to social amelioration.

W. R. INGE.¹⁰⁰

X-rays in Medical Practice.

General Practice and X-rays. By Alice V. Knox.

With chapters on the production of X-rays and instrumentation by Dr. R. Knox. (The Edinburgh Medical Series.) Pp. xiv+214+xxxii plates. (London: A. and C. Black, Ltd., 1921.) 15s. net.

IN view of the great advance which has occurred in radiography and radiotherapy during the past ten years, the author is justified in her contention that the time has come to present to medical practitioners a general survey of the subject in order to enable them to gain a full appreciation of the value of X-rays in diagnosis and treatment. The author divides medical practitioners into three groups: (1) Those who look upon X-rays as something of a scientific plaything; (2) those who rely upon radiology to establish a diagnosis instead of making a careful physical examination; (3) those who recognise in the new science a powerful help in the daily fight against disease, to be applied after a thorough physical examination has been made, when it may be of the greatest use in establishing a diagnosis or in treatment.

When X-rays were first discovered, certain applications to medical diagnosis were at once obvious. These included the discovery and location of metallic foreign bodies, and the diagnosis of fractures and other injuries of the bones. As a natural corollary came the use of X-rays in the study of disease of the bones and joints. With improvement in the construction of apparatus, and with advance in technique, it was found possible to extend the uses of X-rays to the diagnosis of certain internal disorders, such as calculi in the kidneys, and disease of the lungs, heart, and aorta.

The most noteworthy advance of all dates from the discovery that insoluble opaque salts can be administered to patients in sufficient amount to fill the gullet, the stomach, and the intestines, and so enable these hollow organs to be studied. Not only are their size, shape, and position revealed by the opaque meal, but also their contractile activities can be studied. In this way many valuable additions have been made to our knowledge of the physiology and pathology of the organs of digestion. With this far-reaching addi-

tion to the uses of X-rays there remain few organs or parts of the body which are not accessible to investigation by them, with good prospect of settling a doubtful diagnosis. If this were all, it would be clear that no medical man could afford to dispense with the services of radiology in the practice of his profession; but X-rays have done a great deal more than this. They have revealed the fact—previously suspected by few—that all disorders of the digestive tract are interdependent: that the stomach, for instance, does not become the subject of a gastric ulcer if all other parts of the digestive tract are healthy, and that the appendix does not become diseased so long as it is in a healthy environment.

Text-books on medicine arrange all diseases under the headings of the various organs of the body. Each organ has a chapter to itself, and each disorder of this organ occupies a "water-tight compartment." For teaching purposes this arrangement, no doubt, has advantages, but it also has the great disadvantage of perpetuating the notion that a chronic disease can arise in an organ of a patient who is otherwise in perfect health. X-ray investigation of the digestive system has demonstrated the fallacy of this conception of disease; it has led to a wide recognition of the importance of "chronic intestinal stasis," a condition due to abnormal delay of the intestinal contents, setting up bacterial decomposition and leading to contamination of the blood-stream. The result of this "toxæmia" is that every tissue of the body receives vitiated blood and becomes depreciated, so that it loses some of its power of repelling the invasion of microbes. Many chronic ailments, such as rheumatism, arise in this way and resist all efforts to cure until the contamination of the intestinal contents has been rectified. The stretching of ligaments, which gives rise to spinal curvature, flat foot, etc., is likewise due to the toxæmia of chronic intestinal stasis. The far-reaching importance of this new conception is clear, for in prescribing remedial exercises to strengthen the muscles of the back, or those of the foot and leg, it is important to attend to the general nutrition of the patient and to the efficient drainage of the intestinal canal, for muscles that are depreciated by contaminated blood cannot respond to attempts to strengthen them by exercises, massage, or electrical treatment, although such treatment would certainly strengthen healthy muscles.

These are only a few instances of the way in which the radiological study of the digestive tract is modifying our entire conception of the causes and treatment of disease.

Our Bookshelf.

Report of the Proceedings of the Third Entomological Meeting held at Pusa on the 3rd to 15th February, 1919. Edited by T. Bainbrigge Fletcher. (In three volumes.) Vol. i., pp. xii+417+69 plates. Vol. ii., pp. vi+418-835+70-129 plates. Vol. iii., pp. vi+836-1137+130-182 plates. (Calcutta: Superintendent Government Printing, India, 1920.) Rs.17 8 annas (3 vols.).

This bulky report is a record of thirteen days' deliberations given to the discussion of almost every aspect of entomology which is likely to concern the Indian Empire. During the congress ninety-two papers were read, and these are printed in the three volumes before us, together with a verbatim report of the discussions which were the outcome of these papers. A good deal of the information has already been published elsewhere, but it is doubtless convenient to have it gathered together and made available within the compass of a single publication. It is gratifying to note that the meetings were attended by forty-six professional entomologists and other officials, a fact which indicates the importance which this aspect of zoology has attained in the East. It is also pleasing to find an instance where a Government Department has been sufficiently generous to allow the publication of so detailed and profusely illustrated a series of volumes during these times of financial stress.

The greater number of the papers directly concern the economic entomologist, and perhaps the two most important are those entitled "Borers in Sugar Cane, Rice, etc.," and "Stored Grain Pests," which are written conjointly by Messrs. T. B. Fletcher and C. C. Ghosh. The last-mentioned paper might well be read by all interested in the reports of the Grain Pests Committee of the Royal Society. A paper by Capt. F. de Mello on "The Trichonymphid Parasites of Some Indian Termites" is of general biological interest, and the author brings to light several new forms of these remarkable Protozoa. Major Fraser writes on certain night-flying dragonflies—a habit scarcely suspected among such insects. Mr. A. W. Slater contributes a paper on the preparation and reproduction of scientific illustrations, and Mr. C. F. C. Beeson details a method of subject-indexing entomological literature. These few examples fail to do any justice to the wealth of information embodied in this report, but they will perhaps serve to indicate the wide range of subjects which came up for discussion. The volumes are clearly printed and illustrated, and reflect great credit upon all concerned in their production. A. D. IMMS.

Instinct in Man: A Contribution to the Psychology of Education. By Dr. J. Drever. Second edition. Pp. x+293. (Cambridge: At the University Press, 1921.) 10s. 6d. net.

DR. DREVER'S important book on "Instinct in Man," which was reviewed in NATURE of Jan-
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uary 31, 1918, is enriched in this second edition with an appendix which will be read with great interest by all who have followed the controversy over the nature of the human instincts and their relation to the emotions. The chapter is entitled "The Emotional Phase of Affective Experience."

There are two divergent views concerning the place the instincts occupy in the psychology of man, though the facts are not in dispute. What is in question is rather a principle of classification, which at times may seem no more than a matter of nomenclature. According to one view, the human instincts are a kind of action-patterns, or it may be chains of actions, automatically or even mechanically set in motion, similar in nature to the nest-building instincts of birds. In this view the human instincts are few in number, most of them probably vestiges, and all comparatively unimportant; but the affective or emotional side of experience becomes important. This is not limited to specific responses, but built up into "sentiments," which are affective systems and the foundations of human character.

The other view is that the whole basis of human experience is instinctive, and that the instincts are distinguishable and may be enumerated; but they are not partial and intermittent; rather they are pervasive and comprehensive. Each instinct is bound up with a specific emotion and only functions in connection with it, and these primary emotions, with their instincts, are practically constitutive of human nature.

Between these two views Dr. Drever does not exactly steer a middle course—he is too original to be content with that—but he does in his criticism try to conserve what is valuable in each and reject what is untenable. H. W. C.

Energétique Générale. By Dr. Félix Michaud. Pp. vii+229. (Paris: Gauthier-Villars et Cie, 1921.) 10 francs.

"ENERGETICS" deals with the relations between the various forms of energy according to a uniform plan. Each form is assumed to be representable as a product of two factors—an "extensity" or "capacity" (x), and an "intensity" (X), related by the equation $\partial U/\partial x = X$. In the case of heat the extensity is the entropy, Q/T , and the intensity the temperature, T . General laws are then reached connecting U , X , and x .

The problems considered in the present treatise are most varied; they include mechanics, electricity, heat, and chemistry. The applications of the general principles are very clearly and elegantly presented, and the treatment, which is mathematical, is strictly logical. The question arises as to whether thermodynamics, which is a branch of "energetics," according to the exponents of the latter, is best considered in this somewhat formal manner. Boltzmann and Planck have emphasised the essential distinction between heat and the other forms of energy, but the theory of probabilities seems to have no place in the scheme of "energetics." J. R. P.

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.]

Phenomena of "Intelligence" in the Protozoa.

I REGRET to observe the spirit of the letter in which Mr. Dunkerly (NATURE, May 26, p. 395) replies to Mr. Ludford, though, as being primarily responsible for the statement of the theory suggested, and periodically referred to of late years, I fully realise how extremely careful one should be in the choice of words in conducting the discussion. There is probably no theory occupying the attention of zoologists in connection with which the motto of the Royal Society, "Nullius in verba," applies with greater force. Unfortunately, the "journalistic instinct" of many writers on scientific subjects has led them to credit observers with views which they have—to put it mildly—not yet reached, and to saddle them with responsibilities which they have never assumed. For instance, in Prof. Boycott's letter on the same page he credits my friend Earland with my views on "the selective intelligence of the Foraminifera," which is the one subject upon which my esteemed collaborator does not entirely agree with me.

The term "gregarious instinct" used by Mr. Ludford is an unfortunate one. The "grouping" of Protozoa to which he refers must be considered with a cautious appreciation of the elements of (a) fear, (b) reflex action, and (c) surface tension, but the most indignant opponent of my views will scarcely deny that the sense of fear is perhaps the most elementary phenomenon dependent upon a sensory system. It is, no doubt, related to, but it must not be confounded with, the "intelligence" displayed by many arenaceous Foraminifera in building their tests of adventitious material, and in using that material in such a manner as to protect the surface of the test from naturally incidental dangers of damage, and to protect the apertures of the tests against the entrance of predatory parasites.

The "grouping" to which Mr. Ludford directs attention must not be confounded with the associations of marine Rhizopoda, which gain protection against suffocation in soft muds by the co-operative use of spicules, arranged as catamaran spars to maintain them upon the surface (as in *Psammosphaera rustica*, H.-A. and E.), or with the aggregation of simple arenaceous tests for purposes of strength and protection, which, unfortunately, has led some of the earlier rhizopodists to treat such associations as new genera or species. It is as if they were to describe a litter of little pigs huddled together for warmth (which is an elementary phenomenon of intelligence) as a new and "polythalamous" genus of pig.

EDWARD HERON-ALLEN.

Large Acres, Selsey, May 31.

An Algebraical Identity $4X=Y^2-37Z^2$.

THE following is a well-known theorem derived from the theory of numbers. Let p be any ordinary odd prime, and let $X=(x^p-1)/(x-1)$; then there is an algebraical identity

$$4X=Y^2 \pm pZ^2,$$

where Y, Z are polynomials of degree $\frac{1}{2}(p-1)$ and $\frac{1}{2}(p-3)$ respectively; and the sign of the ambiguity is + or - according as p is of the form $4n+3$ or $4n+1$. The cases up to $p=31$ inclusive have been published; the result for $p=37$ has just been communicated to me by Pundit Oudh Upadhyaya,

research scholar of the University of Calcutta. He finds that

$$4X=Y^2-37Z^2$$

with

$$Y=2x^{18}+x^{17}+10x^{16}-4x^{15}+15x^{14}-5x^{13}+17x^{12}-8x^{11}+11x^{10}-4x^9+11x^8-8x^7+17x^6-5x^5+15x^4-4x^3+10x^2+x+2,$$

$$Z=x^{17}+0x^{16}+2x^{15}-x^{14}+3x^{13}-x^{12}+2x^{11}-x^{10}+2x^9-x^8+2x^7-x^6+3x^5-x^4+2x^3+0x^2+x.$$

I have tested this result in various ways, and have no reason to doubt its correctness.

It should be noted that Y may be obtained by expanding $2(x-1)^{18}$, and reducing the coefficients to their absolutely least residues mod. 37. It would be interesting to know the least value of p for which this rule does not apply. It must be less than 61.

G. B. MATHEWS.

7 Menai View, Bangor, May 29.

Atmospheric Refraction.

THE following proposition regarding the effects of refraction may be known, but I do not remember to have seen it stated. It is: "The course of a nearly horizontal ray of light in the lower part of the atmosphere is a circular arc having a radius of 14,900 geographical miles."

The velocity of light in that lower part of the atmosphere for which the decrease of pressure with the increase of height is nearly linear is given by the relation

$$v_h=v_0\left(1-a\frac{H-h}{H}\right),$$

where v_0 is the velocity in vacuo, v_h the velocity at the height h above the ground, and H the height of

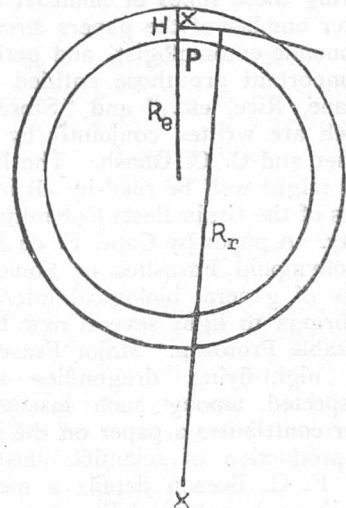


FIG. 1.

the homogeneous atmosphere ($a=0.00029$ nearly). At ground level the velocity is $v_0(1-a)$.

Let a plane vertical wave surface start from P as in Fig. 1. After the lapse of the time t it will have advanced v_0t at the height H , and $v_0(1-a)t$ at the surface of the ground. (This assumes the linearity of the relations between v_h and h to hold up to H , and though this is not true, the conclusions drawn from the assumption are correct, at any rate up to a few thousand feet.)

Thus at the time t the wave surface will be inclined forward, making an angle

$$\frac{v_0-v_0(1-a)}{H}t, \text{ or } v_0t\frac{a}{H}$$

with the surface at P. Since this angle is directly proportional to the distance between the two wave surfaces, the normal at any point—that is, the direction of the ray—varies at a constant rate, and is therefore the arc of a circle. If $v_0 t = x$ and R_r is the radius of this circle (which may be called the refractive radius),

$$R_r \frac{x}{H} = x, \text{ so that } R_r = \frac{H}{a}.$$

In geographical miles $H = 4.32$ about, which makes

$$R_r = 14,900 \text{ miles.}$$

The course of the ray is the same as it would be if it passed through an infinite number of vertically placed acute prisms of height H , having a refractive index $\mu_0/(1-a)$, with their bases occupying the whole surface of the ground. Since for horizontal rays these prisms are in the position of minimum deviation, rays which are pointed a few degrees up or down will still be arcs of the circle with 14,900 miles radius. The usual tables for the distance of the sea horizon assume that the horizon is x miles distant, when the height of the eye (h) = $\frac{x^2}{2 R_e}$, R_e being the earth's radius.

If refraction is taken into account,

$$h = \frac{x^2}{2} \left(\frac{1}{R_e} - \frac{1}{R_r} \right),$$

or, in numbers, without refraction,

$$h = 0.87 x^2;$$

with refraction allowed for,

$$h = 0.67 x^2.$$

Thus the sea horizon viewed from a height h , or a mountain of this height just visible from sea-level, is a good deal further off than the ordinary tables would indicate.

If an atmosphere of the same height and density as that of the earth covered a globe of 14,900 miles radius, an elevation at any one point of its surface would be visible from every other point, and a light at one end of a diameter would appear to an observer at the other end as a bright line extending round the whole of his horizon. A. MALLOCK.

9 Baring Crescent, Exeter, May 12.

Young's Interference Experiment and the Spectrometer.

IN NATURE of April 28, p. 268, Dr. R. A. Houstoun directs attention to the use of the spectrometer for Young's double-slit experiment. In a letter on "The Visibility of Interference Fringes and the Double Slit" (NATURE, July 26, 1917, vol. xcix., p. 424) the present writer made reference to a similar optical arrangement. In that letter emphasis was laid, not on the advantages of the method for observing fringes and evaluating wave-length, but on its use for studying the changes in the visibility of fringes which occur as the width of the spectrometer slit is altered. In view of Prof. Michelson's recent use of the double slit for the measurement of the angular width of distant stars, I may be pardoned for directing attention to my note of some years ago, and for pointing out the ease with which an experiment similar in method to that of Prof. Michelson may be performed by means of an ordinary spectrometer. It is true that, instead of using a source of fixed (but finite) width and a variable double slit, the converse arrangement was employed, but in principle the methods are identical. It might be worth while, however, to vary the experiment by replacing the spectrometer slit by a small circular aperture and using a double slit of variable width.

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May I also point out that the spectrometer may be used advantageously for an experiment on the limit of resolution of a telescope? It will be recalled that in the standard experiment a distant piece of gauze of fairly large mesh is viewed through a telescope before the objective of which an aperture is gradually narrowed until one set of wires disappears. If the slit of the collimator of a spectrometer be removed and in its place a piece of gauze of fine mesh be substituted, a much more convenient arrangement is available. During the past winter I found that students make quantitative measurements with such an arrangement without even darkening the laboratory.

In conclusion, it is well to note that for much of the above work even a spectrometer is not necessary. A telescope, a good lens, and adjustable slits are the only essentials. JOHN K. ROBERTSON.

Queen's University, Kingston, Canada,
May 12.

The Reparation Act and Scientific Research.

THE columns of NATURE could, no doubt, be crowded with complaints concerning the Reparation Act, but as a sufferer I may be permitted to give the following instance of the extraordinary way in which this Act is used to hinder research.

I ordered a case of chemicals from Germany for myself and other workers in the Biochemical Laboratory, Cambridge, on February 2. In order that these should not come under the Reparation Act, they were dispatched on March 24 and arrived on April 8. Although the Reparation Act did not come into force until April 15, the goods were seized at Grimsby, and after a week's delay I was asked for all the original documents showing that the goods were ordered before March 8 and delivered before April 15. These were at once sent to London, but no reply was received from the Customs until I was forced to request the Medical Research Council, for whose work the chemicals were required, to apply to the Customs to free the goods as soon as possible. After three weeks' delay I received a letter from the Customs saying that the original documents were insufficient, and that a statutory declaration was required to confirm the particulars and to prove that the contract had not been fulfilled. This necessitated two visits to a commissioner of oaths and the preparation of a lengthy manuscript document adorned with red seals, the cost of which I have still to discover. This evidence was forwarded to the Customs a fortnight ago, and I have received no answer. The goods are still at Grimsby, the work of several people is being delayed, and the goods will apparently remain impounded (although they never came under the Act) unless I am prepared to submit to what might almost be called blackmail. To obtain the chemicals I must pay the full 50 per cent. myself, the funds of the Medical Research Council being unavailable for the purpose, and I must trust to recover the money from the Customs when my claim has been recognised—evidently a very doubtful eventuality.

All this delay, the expense, including the commissioners of oaths, not to speak of the worry and waste of time of an interminable correspondence, are apparently due to nothing but the red tape of a Government office. H. ONSLOW.

May 27.

British Laboratory Ware and Chemicals.

THE question of the quality, supply, and prices of British laboratory glassware, porcelain, and chemicals, including research chemicals, is under consideration by a committee of the British Science Guild. The

committee, the chairman of which is Sir Richard Gregory, is anxious, in view of the conflicting statements which have appeared from time to time on these matters, to obtain the views of scientific workers who have experience of recent articles of the kind described, both of British and foreign manufacture. It is obvious that the information can be of use only when it applies to goods of definitely known origin. The points on which information is desired are:—The quality of the goods; their price as compared with that of imported articles of the same quality; the facilities for obtaining supplies; and the effects, if any, on research work of restrictions imposed on the importation of German goods. The committee would also welcome statements made, or reasoned conclusions arrived at, by competent bodies who have investigated these questions recently, and from manufacturers who wish to add any further definite information to that which has already appeared in the Press. The information should be sent to the secretaries of the committee, Prof. J. R. Partington, East London College, or Mr. C. L. Bryant, 23 Peterborough Road, Harrow, as soon as possible.

J. R. PARTINGTON.
C. L. BRYANT.

Science and Technology in Palestine.

In a lucid article, "Water-Power of Jordan," which appeared in the *Times* of May 18 the twofold scheme of the Jewish engineer, Mr. Rutenberg, was explained. Mr. Rutenberg proposes, first, to establish a barrage at the southern end of the Sea of Galilee to be used as the main power-house for the general purpose of electrification. Secondly, the malaria-breeding marshes of Lake Huleh are to be drained and a power-house constructed which will utilise the fall of the Jordan between Lake Huleh and the Sea of Galilee for power generation.

Readers of NATURE may be interested in a few further details of these plans. The latest calculations value the total potential water-power of Palestine at 1,000,000 h.p., plus a water-supply which will suffice to irrigate 1,200,000 acres of land. There is, of course, no intention of generating electricity to the full extent of this power; e.g. the proposed power station on the lower part of the Jordan, capable of generating 100,000 h.p. in twenty-four hours, would be sufficient to electrify the already existing railways of Palestine—which would need approximately 30,000,000 kw.h. per annum—as well as to supply the present general needs of Palestine. This station would also produce about 200,000,000 cubic yards of water for irrigation purposes; the installation would probably cost about 2,000,000l.

It is not necessary to emphasise the value of such schemes, both as regards increased fertility and productivity of the land, and in their effects on the social and economic life of the country.

In view of the local need for scientific knowledge, particular attention has to be paid to the Scientific Department which is to form the nucleus of the proposed University of Jerusalem. Already in 1913 Dr. Weizmann and the University Committee (whose chief scientific adviser was the late Prof. Paul Ehrlich) decided that research institutes should be founded, to be transformed as soon as possible into complete teaching faculties. Institutes of physics, chemistry, and microbiology were included in the initial scheme. It is hoped that through these institutes opportunity will be given for the solution of practical problems by Jewish experts on the spot. Obviously, from a practical point of view, it is better that Jewish talent should be utilised locally in this way, and from a

wider point of view the University in its humanitarian as well as in its scientific aspects will form an integral part of the national life.

DAISY L. ADLER.
The Zionist Organisation, 77 Great Russell
Street, London, W.C.1, May 20.

Foreign Scientific Literature.

PROF. GARDINER in NATURE of May 19, p. 359, writes of the difficulty of obtaining Continental publications, whilst the complaint from Central Europe is all about the difficulty of getting English scientific literature. Perhaps something can be done by exchange. There are probably readers of *Die Naturwissenschaften* and of the *Elektrotechnische Zeitschrift* willing and eager to exchange with NATURE and the *Electrician*. Second-hand books with pages cut and owners' names inscribed would probably follow the analogy of worn clothes and be exempt from the interest of Customs officials. A year ago the Swiss bookshops in Berne seemed to carry a heavy stock of recent German scientific literature. Travellers returning from the Alps may wish to inspect these. For exchange of transactions of learned societies the mediation of the Anglo-American Library (hon. secretary, Mr. B. M. Headicar, School of Economics, Clare Street, London, W.C.2) might be invoked.

HUGH RICHARDSON.

Stocksfield-on-Tyne, May 26.

Flint Implements in the Cromer Forest Bed.

SINCE the reading of my paper on the humanly fashioned flints found upon the foreshore at Cromer before the Royal Anthropological Institute on May 3, I have again visited the Norfolk coast. This visit, in company with my friend Mr. Frank Barclay, of Cromer (who has recently collected close upon one thousand specimens of the ochreous artefacts from the foreshore), has resulted in the discovery of two flints, exhibiting the now well-known yellow coloration, *in situ* in the surface of the ferruginous "pan" or Stone Bed resting upon the chalk, and exposed, I conclude recently, at the base of the cliff above the beach deposits under Beeston Hills at Sheringham. This ferruginous deposit is of extreme hardness, and the two ochreous flints discovered could be dislodged only with great difficulty. There is, therefore, no doubt of any kind that the specimens form part of the deposit in which they occurred, which, without question, passes in under the very lofty cliff present at this spot.

Mr. Clement Reid ("Pliocene Deposits of Britain," p. 155) regarded the "pan" and Stone Bed at Sheringham as of Weybourne Crag age, and I think that, speaking generally, this opinion is correct. The two flints which have now been found were embedded in the surface of the Stone Bed, associated with a number of examples of clay pebbles such as occur in the lowermost strata of the Cromer Forest Bed deposits, and seem, therefore, to be referable to the horizon mentioned by me (NATURE, February 10, 1921) as that to which the Cromer artefacts might, in all probability, belong.

I have now found that the ochreous flint implements and flakes occur upon the foreshore exposed at low water at Sheringham and West and East Runton, as well as at Cromer, though they are much more numerous at the latter place. The peculiar form and technique of the specimens from all the sites mentioned are almost precisely similar, and I entertain no doubt that they may all be referred to one and the same "industry." The two flints now discovered, to which this letter especially relates,

are not large, and have attached to portions of their surfaces the very hard ferruginous matrix in which they were embedded. The larger specimen is a roughly shaped flint such as are found in some quantity at Cromer. The yellow-stained surfaces are typical, and exhibit the well-marked band of black unchanged flint under the layer of cortex. The other specimen is a small flake, with bulb of percussion, radiating fissures, and *écaillage*, and shows similar characteristics to the last-described flint, together with a whitish coloration on the bulbar surface, which is encroached upon extensively by the ochreous staining. This discovery establishes the fact of the occurrence at Sheringham of ochreous flints, comparable in every respect with many found at Cromer, *in situ* in the surface of the sub-Crag Stone Bed. It is established also that artefacts of the same order are to be found scattered among the large flints resting upon the chalk, and exposed at low water immediately opposite to the section in the cliff where the two flints were found *in situ*. There would seem, therefore, to be little doubt that the Cromer specimens are referable to the same horizon as those discovered at Sheringham, namely, the basal layer of the Cromer Forest Bed deposits.

In my paper read before the Royal Anthropological Institute I record the finding, at the Cromer site, of a large, yellow-stained flake exhibiting a mass of ferruginous "pan" material firmly adherent to a portion of its surface. This ferruginous deposit appears to be, in all respects, similar to that in which the two Sheringham flints were embedded, and its presence upon this flake supports the conclusion above stated as to the geological age of the Cromer artefacts.

J. REID MOIR.

One House, Ipswich.

The Physical Status of "Space."

It does not appear from Dr. Jeffreys's letter in NATURE of May 26, p. 394, that we are at variance about anything really vital. What I do contend is this: that, thanks to the searching character of the theory of relativity, the time has come when it is profitable to attempt a much-needed unification of fundamental terms and conceptions, particularly in face of the curious indifference to such matters shown by some of those physicists who, with consummate skill, have developed the differential equations representing the natural forces. As the space of NATURE is limited, may I briefly, in a series of categories, amplify my previous letters (April 7 and 21 and May 5), stating the case for the extension theory suggestively, but in no way dogmatically?

(1) If you objectify the pure spatial co-ordinate system of the mathematician you are of necessity dealing with attributes of some entity which, speaking within the limitations of human experience, must be supposed to answer to the designation "physical." I press for no other use of the term "æther," and this only as a safeguard against language suggestive of nothingness or absolute emptiness.

(2) The validity of the logical step (1) is supported by the theory of relativity, particularly the generalised theory, which actually affirms that the only objective space of human experience is physical space—out of which basis of experience the mathematician constructs his subjective spaces and pure geometries (in Dr. Jeffreys's sense of the word) representing various ideal, or possible, universes.

(3) The whole trend of twentieth-century physics is to teach us to think in terms of energy, not in those of matter. Matter is to be regarded as so much bound energy, as symbolised, indeed, in Einstein's expression, mc^2 , for the energy equivalent of mass. It

seems legitimate, therefore, to infer that the attribute of extension or extendedness ultimately belongs to energy.

(4) In the light of (1), (2), and (3), I submit that a desirable unification of ideas can be effected, and much confusion of thought avoided, if, instead of regarding the universe as *containing* energy, we regard it as *being* energy. Let the physical universe be defined as an evolutionary system of energy—that is to say, as an extensive entity the very nature of which is to express itself in changes and transformations (motions). This definition would render Comdr. McHardy's artifice of "container" and "content" (NATURE, May 19, p. 360) unreal; and I cannot see that the distinction he makes is ontologically sound. Furthermore, does not the picture of the universe herewith presented throw into relief the necessary association of time with space, and illustrate that physical difference which leads us to regard time as *imaginary* space?

Finally, I would like to refer to the passage in Sir Oliver Lodge's article (NATURE, February 17, p. 800) wherein he speaks of the necessity of "diving down into the æther." The metaphor is literally pregnant with meaning. It suggests, indeed, that when we shall have peered into the untold depths of the mere nameless *thing*—call it "space," "æther," "world," "metric," "substratum"—which is the scene of such momentous phenomena as light transmission and gravitational potential, it will prove to be a veritable mine of energy and a truly formidable physical reality. The great "æther" controversy seems now nearly spent, and I think it could be settled to-day if only the "non-ætherites" would frankly acknowledge that the world-energy is *continuous*, and the "ætherites" would think of their entity as an energy *continuum* rather than as functioning as a kind of independent luminiferous medium.

L. C. W. BONACINA.

May 29.

The Colours of Primroses.

IN view of the turn given to this discussion by Dr. Heslop Harrison's letter in NATURE of May 19, it may be worth while to state that in the Island of Sark twenty-four years ago, in addition to an abundance of normal primroses, there were also plenty of (a) white, (b) pink, and (c) red flowers. Necessarily there can have been no appreciable difference of altitude.

Occasionally we find red primroses hereabouts, but my impression is—although I will not venture to write positively—that they do not run to the deep red of the Sark specimens. I remember finding one plant on the edge of a field three miles east of Polperro at an altitude of possibly 200 ft. or so.

I feel fairly certain that I never saw any cowslips in Sark—and I explored the island fairly thoroughly.

FRANK H. PERRYCOSTE.

Higher Shute Cottage, Polperro, R.S.O.,
Cornwall, May 27.

Gold-coloured Teeth of Sheep.

DURING the early part of the war the transport of sheep about the country districts was strictly regulated so that a local butcher could state definitely in which locality his meat had been fed. I noticed a large number of sheep's teeth encrusted with bright yellow tartar, identical in appearance with good average bright non-arsenical iron pyrites. I was assured that the sheep were fed upon Rye Marshes. I have a number of these jaws, and I should be pleased to send specimens to any museum interested in them or to anyone who would undertake to publish a full analysis and report upon the material.

W. J. LEWIS ABBOTT.

Prehistoric Art in Caves and Rock-shelters.

By M. C. BURKITT.

PREHISTORIC art is a branch of prehistoric archaeology or prehistory, and, as a study, is comparatively new. Although the discovery of the Altamira paintings was made many years ago, their palæolithic age was not accepted until after Rivière's discoveries at La Mouthe (Dordogne). Rivière, in the course of digging out the Magdalenian deposits of this cave, discovered an entrance leading to a long passage behind. The entrance had been completely obstructed by undisturbed layers of the deposit. Man could only have entered the inner cave previous to the deposition of these datable layers. In the cave behind were found a number of engravings, many of them quite primitive, and a few paintings. Once the palæolithic age of these drawings was accepted, M. Piette recalled the then almost forgotten paintings of Altamira. The fact that animals like the bison were found painted there (*i.e.* animals long ago extinct in Spain) further vindicated their palæolithic age, and any stray sceptic was finally won over by M. Cartailhac, when he published his famous retraction.

Since the beginning of the present century a very great deal of work has been done and further discoveries have been made in this fascinating study of early art. Not only do all the recognised text-books on prehistory devote considerable space to this early art, but also a number of books dealing specially with the art itself have appeared. These profess to cover the whole development of the art from its first appearance until early historical or even later times. The specialist, however, generally finds that there is a certain lack of balance in books of this type, which is by no means the fault of their authors, but simply due to the fact that a very large amount of material, especially of Neolithic or Eneolithic age, has not yet been published. Practically all the work on prehistoric rock drawings or paintings has been due to the Abbé Breuil (professor at the Institute of Human Palæontology, Paris). All the drawings that we see in the popular books are reproductions from his tracings of the originals. But besides these there are a great number which he has not yet had time to prepare for publication. The present writer, who is a pupil of Prof. Breuil, and has travelled with him in Spain and elsewhere, has neither the space here nor the right to anticipate his future publications, but perhaps a general survey of the rock drawings and paintings from Palæolithic to Bronze-age times may not be out of place, as well as a brief account of some of the more important recently published discoveries that have been made.

The prehistoric art in Western Europe that is to be found emblazoning the walls of caves and rock shelters, etc., can be divided into six groups:—

1. The ordinary Upper Palæolithic cave paintings and engravings.
2. The Eastern Spanish style, rock shelter paintings of Upper Palæolithic age.
3. The Spanish third group rock shelter paintings of Neolithic and Eneolithic age.
4. The Western Scandinavian rock carvings and paintings of Late Neolithic and Eneolithic age.
5. The South Swedish Bronze-age group of rock carvings, with an outlier on the shores of Lake Onëga, North Russia.
6. The group of rock carvings, probably of Bronze age, that occurs high up on the flanks of Monte Bego, etc., in the Maritime Alps.

It may be well to discuss briefly each of these groups.

Group 1. The distribution of the ordinary Upper Palæolithic cave art depends first of all on the presence of suitable natural caves. This in turn demands the presence of limestone formations in the district. Secondly, it depends on whether the prehistoric tribes of the region employed this particular form of magic ritual to ensure a good success in hunting. These suitable conditions are found:—

(i) In Dordogne (France), especially concentrated round the little village Les Eyzies, on the River Vézère, some miles above where it falls into the River Dordogne.

(ii) In the Pyrenees, especially concentrated, so far as it is at present known, in the Ariège and adjacent departments.

(iii) In Cantabria and Asturias, North Spain, *i.e.* north of the Cordillera Cantabrica, that chain of mountains which forms a continuation of the Pyrenees along the north coast of Spain. Geographically, this region is South France rather than North Spain. The cave art here is specially concentrated near the town of Santander, which forms a good centre for visiting the caves.

(iv) A small series found in caves in South Spain. There is no doubt of the similarity of the art of this series and of the rest, but the apparent absence of the Upper Palæolithic cultures over the intervening Iberian Peninsula makes the actual connection rather obscure.

(v) In a single cave in the extreme south of Italy.

A proof of the age of this group has already been adduced, and there are others into which we need not go here. They would seem to have been executed for magical purposes, and this is shown from the following considerations:—

(a) The animals are often painted or engraved one on the top of another haphazard, which would not be the case if they were made for decoration.

(b) They are found in deep caves and often in obscure spots, difficult of access. At Niaux (Ariège) they are not found until the explorer

has penetrated half a mile into the hill. Man did not live in deep, dank caves requiring artificial light; his habitation was made under overhanging rocks on the sunny side of the valley, or occasionally in the mouth of a cave. These cave drawings, then, were not home decorations, and one could scarcely imagine a prehistoric man rushing half a mile into a hill with a blazing brand to light him in order to paint an animal in some narrow crack from mere *joie de vivre*. The only other explanation is that this art was used for some form of magic or ritual ceremonial. When we recall that the animals sometimes show arrows in their flanks, and when we find the human hand depicted (in one cave at any rate, mutilated by certain joints of the fingers being removed), not to speak of the presence of a number of queer signs at the meaning of which we can only guess, we are forced back to the conclusion that sympathetic magic is the sole explanation. A good catch is all-important to a hunting people,

figures of even a later date are sometimes placed in a fifth phase. The fact that the succession of styles is the same over such a wide area indicates either schools of tradition for the medicine men or priestly caste—*i.e.* for those who did the magic in the caves—or, at any rate, a fairly close intercourse between the various regions. This is still more startling in the case of decorated bones from the deposits themselves, where we find similar peculiar geometric decorations from Cantabria to the Ukraine.

In a new and unpublished cave there is the painting of a sorcerer masked as a stag dominating a frieze of engraved animals.

Group 2. The Eastern Spanish style. This is thought to be of Upper Palæolithic age, for the following reasons: (a) There is a painting of a bison at Cogul; of an elk at Cueva del Queso; of a chamois at Tortosilla (chamois have long ago disappeared from the province of Albacete, South Spain); of an elk, a reindeer, and a rhinoceros at

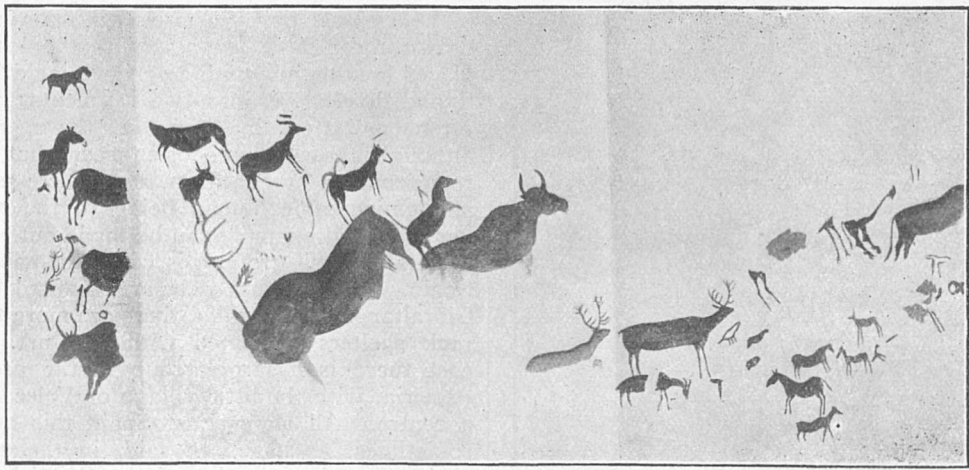


FIG. 1.—Panel in the second rock shelter at Cantos de la Visera (Albacete, S. Spain). Paintings in the Eastern Spanish group of horses, stags, bulls, etc.

and no doubt these paintings and engravings, that are so lifelike in appearance, were used to further this object.

All the drawings are not of the same age, and they can be divided into a number of phases of different ages. These phases are determined by a careful consideration of the various styles that are painted or engraved one over the other. When such a palimpsest occurs, the engraving or painting on the top is obviously newer than those underneath. When a number of caves in the various regions are examined it is found that the succession of the styles is the same, whether we are in Cantabria, in the Pyrenees, or in Dordogne. Of course, certain local styles make their appearance in various places, but the main succession is the same. Detailed studies have enabled us to assign dates to these various styles, and we can now confidently affirm that phase 1 is Aurignacian; phase 2, Lower Magdalenian; phase 3, Middle to Upper Magdalenian; and phase 4, Upper Magdalenian. Certain geometrical

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the newly discovered rock shelter of Minateda (Albacete). (b) The figures of horses painted in the Eastern Spanish group at Cantos de la Visera are exactly similar in technique to a small horse painted in red among the northern group 1 at Portel in the Pyrenees. This Eastern Spanish style is peculiar in that it is found, not in deep caves, but under rock shelters, that are, however, deep enough to protect the paintings from actual moisture, which would give rise to moss growth that would soon destroy the paintings. The climate of East Spain is neither rigorous nor damp, and there is no reason why these paintings, made with oxides of iron as pigments, should not have lasted until to-day. Another characteristic of this group is the number of human beings depicted, often armed with bows and arrows. The most important discoveries made in this group in recent years are: (a) The rock shelter of Cantos de la Visera; (b) the rock shelter of Minateda; (c) the rock shelters of the Barranco de Valltorta (province of Castellón). The first of these was

discovered by the writer, and is of importance from the occurrence of horses, which have been compared with one at Portel (see above) (Fig. 1); also by the occurrence of two painted birds (a great variety at all times in Palæolithic art, and above all in the Eastern Spanish group).

Minateda is important from the great wealth of paintings found there, among which are animals long ago extinct in the region. There is also a battle scene of men fighting (Fig. 2). Prof. Breuil has been enabled, from a study of the superpositions of the paintings, to unravel a very large number of different styles. These do not seem, however, to indicate any very great difference in age, or, if they do, we have as yet no means of correlating them with deposits of Upper



FIG. 2.—Panel at the new rock shelter of Minateda (Albacete, S. Spain). It belongs to the Eastern Spanish style, which is of Upper Palæolithic age.

Palæolithic age, as the latter seem to be absent from East Spain.

The rock shelters of the Barranco de Valltorta are specially interesting for the number of painted human beings which they contain, exactly similar in style to those found in Bushman paintings. The resemblance is startling—in fact, a research student in ethnology at Cambridge, when shown pictures of these rock shelters without being told their provenance, turned away, saying, "Oh, yes, those are some more Bushman paintings." There are several hunting scenes depicted.

The object for which paintings of this Upper Palæolithic, Eastern Spanish group were made cannot be determined with the same degree of certainty as in the case of Palæolithic group 1; it

is probable, however, that magic was at the bottom of it.

Group 3. The Spanish third group of Neolithic or Eneolithic age. This group comprises scores of rock shelters all over Spain. Examples are also found in East Spain alongside the older Spanish group 2. Where examples of both groups occur in the same rock shelter, the examples of the Spanish group 3 are always painted over, and are therefore newer than the Spanish group 2. The style is altogether different, whereas in the Spanish group 2 the animals at any rate are naturalistic, even if the human beings are more or less conventionalised. In Spanish group 3 there is no attempt at a naturalistic drawing at all; the animals are often similar to what a child of four would make, and even more simplified than this, while conventions for the human form are bewildering. For example, the human form is sometimes represented by a vertical line from which two pairs of oblique lines are drawn forming arms and legs, or by the painting of a sort of hour-glass, or by a circle with a vertical line drawn through it, or again by the letter "D" placed horizontally with a vertical line drawn from it, and dividing it into two segments; an eye is often indicated in each of these segments; although these figures often seem but remotely to resemble a human form, a complete series from an unmistakable human being to the most conventionalised example can be made out.

This Spanish group 3 is widely distributed over Spain. In the south-west area limited by Cadiz, Gibraltar, and Bobadilla, there are more than sixty rock shelters decorated with this art. Further east there is a large group in the province of Almeria, with the little village of Velez Blanco as a centre. All along East Spain this art occurs, sometimes, as has been said, in the same rock shelters, with examples of the Spanish group 2. The Sierra Morena and its continuation towards Portugal contains numerous examples of this group, while further north, south-west of Salamanca, in the valley of Batuecas (mentioned by Borrow in his "Bible in Spain" as a weird place, full of queer legends), this Spanish group 3 art is found in conjunction with some small semi-naturalistic figures that are of rather earlier date.

As in the case of the Spanish group 2, this Neolithic or Eneolithic art is found painted on the walls of fairly shallow rock shelters. The shelter, however, must be sufficient to prevent the access of damp, which, by promoting the growth of moss, etc., would rapidly destroy the paintings.

Certain pots dug up from deposits, dated as being of Late Neolithic or of Eneolithic age, carry engravings of the human form, etc., conventionalised in the same way as those found in the rock shelter. Pots of this nature have been discovered by M. Siret and Don Federico de Motos in the province of Almeria, while Dr. Obermaier has described the same kind of thing from near Madrid. The discovery of these engraved pots enables us to date

the similarly conventionalised drawings of this Spanish group 3. Further, there is a painting of a man armed with a sickle, and another with what must have been a metal hatchet. Stone hatchets are, however, also occasionally figured. Again, a painting of a man occurs at Peña Tú, convention-

side of a prominent bluff, jutting out into a wide valley, made it eminently suitable for some form of temple, but the ritual could no longer have been a simple, sympathetic magic to ensure a good catch of game. Was there an element of real religion, and were these drawings, although apparently not orientated one to another, of the nature of pictographic writing? The other example is near Velez Blanco, where there is a small rock shelter known as Gabal. It contains no paintings, but a niche over the entrance, reached to-day by a ladder, contains quite a number. Are these the sacred emblems of the household; a protecting *talisman* for the "Home" below?

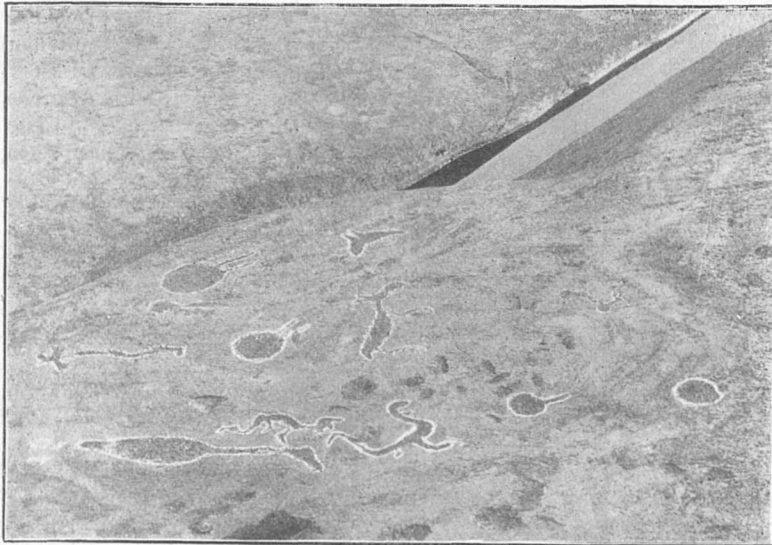


FIG. 3.—Two groups of rock engravings on the shores of Lake Onëga (N. Russia). Probably of Bronze age.

alised in the same way as some found carved on certain menhirs, etc.; and in another rock shelter there is a painting of a man leading an animal, which indicates that domestication of animals had been learnt.

The object for which they were made would seem to be rather different from that of the Palæolithic groups. It may be noted, first, that the animals are no longer naturalistic, and, secondly, that the human form is the commonest object figured. At the same time, these rock paintings were not made for decorative purposes, for in many cases they are painted in situations difficult of access and impossible as homes.

Two examples of this may be given. In the western region there is a small cave called Las Figuras. This takes the form of a short tunnel about 10 yards long which opens some 15 ft. up on the side of a precipice. From the entrance the tunnel slopes up so steeply that it is with difficulty one can avoid slipping back over the edge of the entrance. The walls and roof of the tunnel are covered with paintings, and there are no signs left in the cave walls that any wooden constructions had ever existed, such as would have been necessary if man had ever inhabited the tunnel. The position of Las Figuras, opening as it does on the

Group 4. The Western Scandinavian engravings. This interesting group of rock carvings on hard, glacier-worn surfaces of rock is found fringing the western coast of Scandinavia from Narvik, in the north, to Vingen Fjord, in the south. Occasionally, when the mountains of the interior open out, they are to be found stretching back, even into Sweden. They consist of a number of carvings of semi-naturalistic animals, the best of which is the well-known reindeer at Böla. A few paintings of this age are also known, including some conventionalised human figures at Leka. Prof. Breuil has always considered that there is some connection in culture, if not in time, between

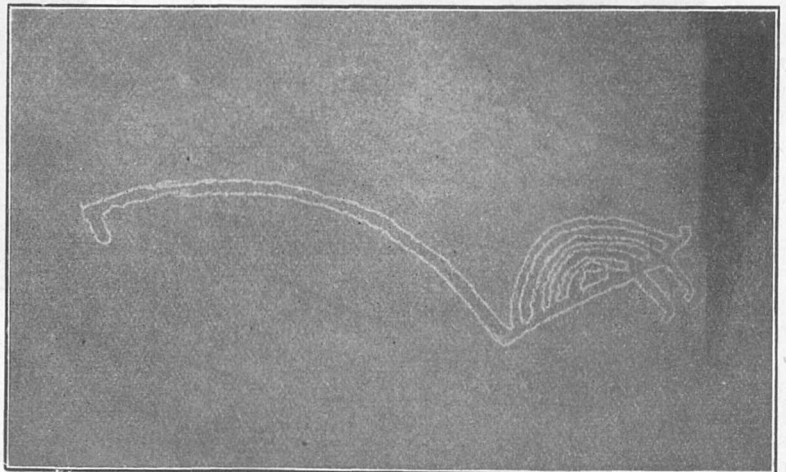


FIG. 4.—Onëga (site B). A swan with wing feathers indicated.

the folk who made these carvings and the Maglemose civilisation of the Baltic areas. This group is certainly earlier than the next Bronze-age group, for at Bardal, near Trondhjem, the latter is found superposed upon it. On the other hand, it has been thought that the

rocks at Bardal were under the sea before *Allée Couverte* times. There may have been a cultural survival from the Maglemose civilisation, even if they are Late Neolithic in age. Is it possible that the new and interesting find of an engraved animal on a piece of crust at Grime's Graves is to be correlated with this group?

Group 5. Bronze-age rock carvings of South Scandinavia, with an outlier in North Russia. This group, which is especially concentrated in Bohuslain (north of Göteborg), is too well known to be discussed here further. It is dated from a consideration of the form of daggers figured, as well as from the carved ornamentation. Runes

are never found in association with these rock carvings.

The North Russian outlier is of some interest, and will be partly described this year. The carvings are found here on extremely hard, glacier-worn surfaces of rock, forming the eastern shore of Lake Onëga, south of Pudosh, and north of the Black River. There are ships, swans, a devil 10 ft. long, animals, a phallic scene, fish, signs, etc. (Figs. 3 and 4).

Group 6. Maritime Alps. This group is also too well known to require further discussion. The occurrence of a ploughing scene, very similar to one found in the Bronze-age group of South Scandinavia, may be noted.

Dark Nebulæ.

By DR. A. C. D. CROMMELIN.

SEVERAL years ago photographs taken by Profs. E. E. Barnard and Max Wolf rendered the hypothesis highly probable that many of the dark lanes and spaces met with in the Galaxy and in regions of diffused nebulosity were due to the intervention of occulting matter rather than to actual diversity of star distribution. One of the most notable examples occurs in a long strip of nebulosity that runs southward from

here reproduced, and is quite startling from the hard, clear-cut outlines of the marking, which is blacker than the neighbouring sky background. It would seem that this sharp outline must indicate a stratum of dust rather than one of gas; it can be traced for some distance outside the long nebula, and is probably connected with an isolated bright nebula some 15 minutes of arc distant to the north-east. It will be remembered that a great part of Orion is covered with faint nebulosity, first revealed as a large spiral by Prof. Barnard's photo-

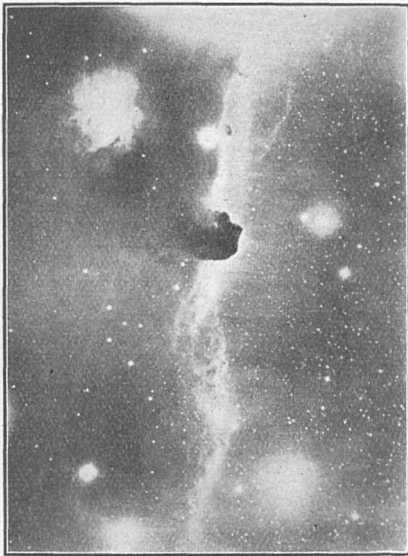


FIG. 1.—Nebulosity south of ζ Orionis. From a photograph taken by Mr. Duncan with the 100-in. telescope of the Mount Wilson Observatory.

ζ Orionis. Dr. Isaac Roberts noted that there was "an embayment, free from nebulosity, dividing it into halves." Prof. Barnard afterwards remarked that this space appeared to be "a dark body, projected against, and breaking the continuity of, the brighter nebulosity." More recently still the object has been photographed at the Lick and Mount Wilson observatories. The Mount Wilson photograph, taken with the 100-in. Hooker telescope, is



FIG. 2.—Enlargement of dark nebulosity in Fig. 1.

graphs with a lantern lens. There is a striking falling off of star-density to the east of the long ζ Orionis nebula as compared with that to the west, which presumably indicates a general absorption of light.

The Proceedings of the Amsterdam Academy of Science, vol. xxiii, No. 5, contains two papers by Dr. A. Pannekoek on a region of dark nebulosity in Taurus. Dr. Pannekoek refers to a paper by Sir F. W. Dyson and P. J. Melotte (M.N.R.A.S., vol. lxxx., p. 3). He uses their figures of star-density in these regions to make an estimate of

the distance of the occulting screen, and obtains the distance 140 parsecs, which is about four times that estimated for the Hyades. Since the angular extent is 30° , this implies a real length of 70 parsecs, and gives a vivid idea of its gigantic dimensions.

Dr. Pannekoek next proceeds to make an estimate of the mass of the nebula; he first works on the assumption that it is composed of hydrogen. The star-counts indicate an absorption of two magnitudes. Using Dr. Abbot's absorption coefficient for atmospheric air, and taking the thickness of the stratum as 10 parsecs, he finds 10^{-15} for the density of the gas-cloud. The mass is independent of the thickness assumed, and comes out twenty thousand million times that of the sun. This is greater than many estimates of the combined mass of the whole sidereal system, and at once suggests the probability that the larger portion of that mass is not condensed into stars, but distributed in cosmic clouds. Some striking consequences of the presence of such a great mass at a comparatively moderate distance are drawn by

Dr. Pannekoek. The sun would travel round it in a very eccentric ellipse in a period of some two million years, being now near apocentron.

While so large a mass of the universe as a whole would render it easier to account for the numerous cases of high velocity among the stars, it would make the moderate velocities of the bulk of the stars difficult to explain. The author notes a suggestion by Prof. De Sitter that the necessary mass of the occulting clouds may be greatly reduced if we postulate that they consist of dust instead of gas. It has already been pointed out that the aspect of the dark marking near ζ Orionis accords with the hypothesis of solid matter. However, even in this case the necessary mass is enormous, since it is *a priori* improbable that the thickness of the stratum should in all cases be a very small fraction of its visible dimensions.

The demonstration of the existence of these immensely massive cosmic clouds seems to make it desirable to rediscuss the dynamics of the stellar system.

Obituary.

PROF. E. B. ROSA.

THE death, on May 17, of Prof. Edward Bennett Rosa, of the Bureau of Standards at Washington, at the age of sixty years, is a serious blow to electrical science. Born in 1861, Prof. Rosa gained distinction as a student in the Johns Hopkins University under Rowland, and after some experience in professorial work in the Wesleyan university where his early undergraduate days had been passed was in 1901 appointed to the staff of the Bureau of Standards as a physicist. There his main work was done. In 1910 he became chief physicist, and as head of the electrical department was responsible for many of the valuable researches which have been carried out at the bureau.

Among the earliest of these was his determination, in collaboration with Dr. Dorey, of "*v*," the ratio of the electrical units, and most of them turn on questions relating to the measurement of the fundamental units, the ohm, the ampere, and the volt. He combined in a marked degree the insight required to design and carry through to a successful result a difficult experiment and the mathematical skill needed to develop to a high degree of accuracy the theory on which the experiment is based.

Prof. Rosa's papers on the calculation of coefficients of self- and neutral induction, and on the theory of the instruments employed in absolute measurements, will always be standard; while his own experimental determinations of some of the fundamental quantities are among the best which have been made. He realised the need for accuracy and exactness in the processes of measurement, whether applied to scientific work or to industry, and he organised the electrical section

of the bureau in a manner which fitted it to respond to the requirements both of scientific and industrial research. The list of his papers covers a wide range, and in all of them he added to our knowledge in a substantial manner.

Prof. Rosa visited England in 1908, acting, along with Dr. Stratton and Prof. Carhart, as one of the American representatives to the International Electrical Conference, held in London under the presidency of the late Lord Rayleigh. At that conference a formal distinction was drawn between the absolute and the international units of measurement: between the ohm (10^7 absolute C.G.S. units) and the international ohm—the resistance at 0° C. of a uniform column of mercury weighing 14.521 grams, and 106.300 centimetres in length; or the ampere (10^{-1} absolute C.G.S. units) and the international ampere—the current which under certain carefully defined conditions deposits from a solution of nitrate of silver a mass of 1.11800 milligrams of silver per second.

Prof. Rosa would probably have preferred to retain as standards for legal purposes the absolute magnitudes 10^7 C.G.S. units for resistance and 10^{-1} C.G.S. units for current, but he accepted the views of the majority of the conference, and at a later date lent his valuable assistance in defining accurately the conditions necessary for the realisation of the international ohm, ampere, and volt. As the outcome of the work of the conference, a committee, known as Lord Rayleigh's Committee, was appointed to define these conditions, and representatives of England, France, and Germany met at Washington and carried out a series of experiments, the results of which have determined the practice of all National Standardising Laboratories. Of the

committee engaged in this work Prof. Rosa was the active head, and its successful issue was due in no small degree to his skill in overcoming the technical difficulties of the task and to his tact in dealing with the varied views of those engaged in the research.

The volume giving an account of these experiments, published by the Bureau of Standards in 1912, will form a fitting memorial of one who for the last twenty years devoted himself unwearyingly to the advancement of electrical science. During the war he directed the development of a number of instruments of great use to the American forces in France. Among these may be mentioned a sound-ranging device and much radio apparatus suitable specially for aircraft. He was greatly instrumental in establishing the splendid radio laboratory at the bureau. Throughout his life he was keenly interested in the prevention of industrial accidents and in the provision of safety standards for the guidance of public authorities. The national electrical safety code at present in use in the United States owes much to him. His last work, now in the press, was an analysis of the expenditure of the Government Departments, which contains a number of statistics of great importance and interest.

Prof. Rosa was married in 1894, and Mrs. Rosa survives him; she has the deep sympathy of all those on this side of the Atlantic who knew her husband and appreciated his work.

MISS CZAPLICKA'S sudden death on May 20 cuts short a brilliant career. Having studied geography at Libau and Warsaw, she came with a research scholarship to this country in 1910, and soon after joined Somerville College, Oxford. She then turned her attention to anthropology, and, after taking the diploma in that subject, conceived the bold project of an expedition to the almost un-

known part of the Siberian *tundra* lying between the Yenisei and Lena valleys—a project that was carried out with brilliant success in the years 1914-15. It was in keeping with her spirit of thoroughness, however, that by way of preparation she should first review the existing literature, mostly Russian, relating to this region, thus producing "Aboriginal Siberia" (Clarendon Press, 1914), a book not only full of out-of-the-way information, but likewise showing interpretative power of a high order. Her return from an adventurous journey involving great privations was marked by the appearance in 1916 of a popular work, "My Siberian Year"; but the full report by herself and her colleague, Mr. H. Hall, of the University of Pennsylvania, has not yet been published. At Oxford Miss Czapliska acted as lecturer in ethnology until the end of the war, when she passed on to the University of Bristol to serve in a like capacity under Prof. Fawcett. In the meantime she found time to compose a valuable monograph on "The Turks of Central Asia," as well as to contribute many articles on the Siberian tribes to Hastings's "Dictionary of Religion and Ethics"—articles which might well be reprinted together in book-form. This brief account must suffice of the work of one whose intellectual energy was on a par with her personal charm and lofty spirit of self-devotion. Poland, so prolific of genius, can count her among its best. In Oxford, London, and Bristol alike she was the centre of a circle of admiring friends, whose lasting regret it now is that they did not somehow prevent the too courageous spirit from fatally overtaking the delicate frame.

R. R. M.

WE regret to announce the death, on May 31, of COL. JOHN HERSCHEL, R.E., retired, F.R.S., youngest son of the late Sir J. F. W. Herschel, Bart., in his eighty-fourth year.

Notes.

THE list of honours conferred on the occasion of the King's birthday includes the following names of men known to the world of science:—*Knights*: Prof. Arthur Keith, Hunterian professor and conservator of the Royal College of Surgeons; Dr. T. Lewis, hon. consulting physician since April, 1918, to the Ministry of Pensions; Dr. S. Russell-Wells, Vice-Chancellor of the University of London; Dr. F. Conway Dwyer, ex-president of the College of Surgeons, Ireland; Mr. J. B. Harrison, Director and Government Analyst, Department of Science and Agriculture, British Guiana; and Brig.-Gen. D. J. McGavin, Director-General of Medical Services in New Zealand. *C.B.*: Mr. L. S. Lloyd, Assistant Secretary to the Department of Scientific and Industrial Research. *K.C.I.E.*: Col. W. H. Willcox, late Medical Adviser to the Civil Administration in Mesopotamia. *C.I.E.*: Dr. M. N. Banerjee, Principal of Carmichael Medical College, Belgatchia, Bengal. *Companion Imperial Service Order*: Mr. G. J. Williams, Senior Inspector of Mines, Mines Department.

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AN interesting ceremony took place at the Cosmos Club in Washington on Tuesday, May 10, when Mr. Henry S. Wellcome presented Dr. F. B. Power with a gold medal, specially struck to commemorate the latter's tenure of the directorship of the Wellcome Chemical Research Laboratories in London from their foundation in 1896 to 1914, when for family reasons he returned to the United States. During that period more than 170 papers were published from the laboratories, mostly in the Transactions of the Chemical Society. These papers deal chiefly with the constituents of plants, more especially with those plants used in medicine, and they form a notable contribution to our knowledge of the chemistry of drugs of vegetable origin. It will be remembered that in 1913 Dr. Power received the Hanbury medal, which is bestowed periodically by a joint committee of the Chemical, Linnean, and Pharmaceutical Societies in recognition of specially meritorious research on drugs.

A DISCOVERY in the Channel Islands of considerable interest to archæologists is announced in the *Times*

of May 31. Mr. L. M'Lellan Mann, of Glasgow, has found on the surface of a rock at Green Island, Jersey, a series of shallow depressions or "cups." Similar cup-markings are found in Great Britain and on the Continent, and are widely distributed over other parts of the world, including India, Australia, and North America. Green Island, where these cups have been found, is an island at high tide only, and has been severed from the mainland in comparatively recent times. From previous discoveries it is known to have been the site of a Neolithic burial-place. This would be in agreement with the usual attribution of rock carvings, such as these in Jersey, to the Neolithic or early Bronze age. On the other hand, cup-marks with one or more concentric rings, which have a more restricted distribution and, with a few exceptions, are found only in the United Kingdom and Sweden, are usually more or less closely associated with remains of the Bronze age. It is stated that cup-markings have not hitherto been recorded from the Channel Islands. This, however, is an error. Sir J. Y. Simpson figured two cup-marked stones from Guernsey, one being the prop stone of a dolmen with eleven cups, the other a conical standing stone with three large cups placed at some distance apart (J. Y. Simpson, "Archaic Sculptures," Proc. Soc. Scot. Ant., 1864-65, plate viii., Figs. 2 and 3; see also C. Rau, "Observations on Cup-shaped and other Lapidarian Sculptures in the Old World," in "Contributions to North American Ethnology," vol. v., Washington, 1882, pp. 12-13). No cup-marked stones have, however, previously been recorded from Jersey.

THE Advisory Council for Scientific and Industrial Research has quite recently granted an application made to it to assist in carrying out a piece of research work relating to the determination of the parallaxes of stars having a certain type of spectrum. The grant has been made to Mr. W. B. Rimmer, who up to the present has been employed in spectroscopic researches at the Imperial College of Science and Technology under the direction of Prof. A. Fowler, but will now carry out this research at the Norman Lockyer Observatory at Salcombe Hill, Sidmouth. This observatory was founded by the late Sir Norman Lockyer in 1912, and the programme of work has been confined strictly to the photography of the spectra of stars and their subsequent classification according to his scheme of increasing and decreasing temperatures, which has been confirmed in its general features by the more recent work of Russell and Hertzsprung on giant and dwarf stars. The researches of Prof. W. S. Adams have now rendered it possible to differentiate almost at a glance between a giant and a dwarf star. As a large amount of spectroscopic material was available at the Norman Lockyer Observatory for the application of Adams's method a trial research was begun. The method is based on a connection found by Adams to exist between the true brightness of a star and the intensity of certain lines in its spectrum. These line-intensities were determined by him by estimation, the plates being examined under a spectro-comparator. At the Norman Lockyer Observatory the method employed is to cover

the lines gradually with a dark wedge, the position of which when a line is obliterated indicates the intensity of the line. The results of this trial research have proved very satisfactory, and were commented upon very favourably by Prof. H. N. Russell on the occasion of a visit to the observatory. The above grant has been awarded to aid the extension of this research to all stars of suitable type down to declination -10° and of magnitude 6.5 and brighter. It is very opportune, for the staff of the observatory is small, and the work could not have been undertaken without such additional help.

THE annual visitation of the National Physical Laboratory, Teddington, will be held on Tuesday, June 28, from 3 to 6 p.m.

THE Safeguarding of Industries Bill was read a second time in the House of Commons on Tuesday, June 7.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Thursday, June 30, from 8.30 to 11 p.m.

AT the meeting of the Physical Society of London on June 10, to be held at the Imperial College of Science, South Kensington, S.W.7, Sir Ernest Rutherford will deliver a lecture entitled "The Stability of Atoms."

PROF. EINSTEIN was expected to arrive at Manchester yesterday, and will deliver the Adamson lecture on "Relativity" at the University at 5.0 this afternoon, June 9, when the honorary degree of Doctor of Science will be conferred upon him. He will leave Manchester for London to-morrow morning, June 10.

MR. CHURCHILL announced at Manchester on Tuesday, June 7, that the Government has decided to devote the sum of 1,000,000*l.* to fostering cotton-growing in the British Empire. The money will be placed at the disposal of the British Empire Cotton Growing Corporation, and will be in place of the Government's former promise of 50,000*l.* a year for five years to the corporation.

THE Hugo Müller lecture of the Chemical Society, entitled "The Natural Photosynthetic Processes on Land and in Sea and Air, and their Relation to the Origin and Preservation of Life upon the Earth," will be delivered by Prof. Benjamin Moore on June 16 at 8 p.m. in the lecture hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

AT a general meeting of members of the Royal Institution held on June 6 special thanks were given to Sir Humphry Davy Rolleston for his present of a safety-lamp which was in the possession of Dr. John Davy, brother of Sir Humphry Davy, and to Sir David L. Salomons for his present of a privately printed *Life and Study of the Works of Breguet*, the famous watchmaker, Arago's watch, and two others of special interest, the first working aneroid made by Vidi in 1857, and a series of models illustrating the development of the chick.

It is proposed to hold an additional ordinary meeting of the Royal Meteorological Society for the reading and discussion of papers in Edinburgh on September 7. The British Association will be in session in Edinburgh on September 7-14, and arrangements are being made to hold the society's meeting, probably in the afternoon, immediately before the work of the Association begins. The possibility of a "meteorological luncheon" and of an excursion of special meteorological interest is also under consideration.

THE Newcomen Society for the Study of the History of Engineering and Technology is one of our younger societies, having been founded only a year ago. The titular name adopted by the society is that of the eighteenth-century engineer to whose labours we owe the steam-engine as we know it to-day. The subject which the society takes for its field is one which has been too much neglected in the past, perhaps more so in this country than elsewhere, in spite of the fact that England has been the cradle of so many leading inventions. To some extent this indifference is caused by the fact that the materials needed by the historian in this branch of human endeavour are all too scanty, and it is the aim of the society to help in supplying this deficiency. Besides holding meetings, the society intends to help in the preservation of records, MSS., and drawings of engineering work, as well as of biographical matter concerning those who have been prominent in such work. It is also intended to publish at the end of each session a yearbook containing original papers and historical matter not readily accessible. The summer meeting will be held in Birmingham on June 16-17 (headquarters, Queen's College, Paradise Street), under the presidency of Mr. A. Titley, and visits to places of interest are arranged for both days. On the first day the president will give his address, and Mr. A. Seymour-Jones will read a paper on "The Invention of Roller Spinning." This is appropriate in view of the little-known fact that the first attempts in this direction were made in Birmingham. The hon. secretary of the society is Mr. H. W. Dickinson, and communications should be addressed to him at the Science Museum, South Kensington, S.W.7.

THE thirty-second congress and health exhibition of the Royal Sanitary Institute will be held on June 20-25 at Folkestone under the presidency of the Earl of Radnor. Some five hundred delegates have already been appointed to attend the meeting, representing Government Departments interested and health authorities of the British Isles, as well as delegates from Australia, New Zealand, Canada, France, and Denmark. The congress will be divided into five sections:—Section A (president, Sir Leslie Mackenzie) will deal with sanitary science and preventive medicine; Section B (president, Major W. H. Prescott) with engineering and architecture; Section C (president, Mrs. H. A. L. Fisher) with the hygiene of maternity and child welfare; Section D (president, Mrs. R. G. Wood) with personal and domestic hygiene; and Section E (president, Viscount Burnham) with industrial hygiene. Conferences have been

arranged for medical officers of health, sanitary authorities, engineers and surveyors, veterinary inspectors, sanitary inspectors, health visitors, and rat officers. A long list of subjects for discussion has been published, among which are such important topics as the control of developmental and wasting diseases, the relation of hospitals to preventive medicine, tuberculosis, industrial fatigue and welfare, the prevention and destruction of rats, and smoke abatement. A popular lecture on June 23 by Prof. E. Mellanby on "Vitamins and their Relation to Health" has been arranged, and excursions will be made to places of interest in the neighbourhood of Folkestone. June 25 will be devoted to a whole-day visit to Boulogne, during which the members of the various sections will be conducted over appropriate institutes in the town. Further information on local arrangements can be obtained from the Secretary, the Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1.

DR. CAPITAN and M. Peyrony have contributed to the *Revue Anthropologique* a *résumé* of the works of art which they have discovered at La Ferrassie. The specimens are now deposited in the museum of the Château des Eyzies. The engravings, etc., belong to an early phase of the Aurignacian period, and are among the most ancient works of art known to exist. One of the earliest, which the explorers themselves unearthed, is a human figure from which the head and limbs are absent and only the trunk remains. This is rudely shaped and by no means beautiful; it is not steatopygous. Deeply outlined carvings of horses' heads and deer's heads were found on rocks. All the figures are exceedingly rude. One stone is occupied with cup markings in concentric circles, and cups appear mingled with other designs. Two complete figures of deer in outline, coloured red and black respectively, were found. Another figure represents the head of a rhinoceros, but only one engraved human figure appears. The authors note that all the engraved figures were placed face downwards, except in one case which could not be so treated; this had been designedly mutilated. They hold that these rudimentary, yet already complicated, images are the earliest known artistic manifestations and are ritual representations of magical practices.

MISS NINA F. LAYARD has published an interesting account of her discovery of mammalian remains with Mousterian flint-implements in a Pleistocene clay in the Stoke railway cutting at Ipswich (Proc. Pre-historic Soc. East Anglia, vol. iii., part ii.). Besides well-preserved teeth and bones of the mammoth, horse, large ox, and red deer, there are remains of three individuals of a large lion and fragments of a large bear. There are no traces of the reindeer. Close to the crushed skull of a mammoth were found some characteristic pieces of the shell of the small freshwater tortoise, *Emys orbicularis*, which had not previously been observed in late Pleistocene deposits in England. Miss Layard desires to mention that all the fossils were named in the geological department of the British Museum (Natural History).

THE greater part of the skull and neck, with a nearly complete shoulder-girdle, of a new Plesiosaurian from the Wealden of Berwick, Sussex, has just been added to the exhibited series of fossil marine reptiles in the geological department of the British Museum (Natural History). The specimen was found in a hard nodule in the pit of the Cuckmere Brick and Tile Co., and was presented to the museum by the managing director, Mr. Stanley Tooth. It represents a small reptile, about 6 ft. in length, and is of great interest as probably being a freshwater species. Just as among existing Cetacea the river-dolphins are generally smaller than the marine porpoises, so among the extinct Plesiosaurs the freshwater forms may have been smaller than those living in the sea. In the structure of its shoulder-girdle the new species resembles the early Jurassic Plesiosaurs more closely than those of later Jurassic times. It, therefore, seems to have been an out-of-date survivor preserved by such an isolated mode of life as a freshwater habit would allow. The shoulder-girdle is uncrushed, retaining its original shape, and showing that the reptile was round-bodied, not depressed like a turtle.

THE Rhodesia Museum, Bulawayo, being in urgent need of a new exhibition gallery, has been promised 100*l.* by the Rhodes Trustees, and Sir Otto Beit has promised 250*l.*, provided the sum of 750*l.* be subscribed by the public. By the end of 1920 486*l.* had been subscribed, and the museum committee now appeals for further donations.

WE are glad to see that the *Museums Journal* is not fulfilling its threat to appear only quarterly instead of monthly, though it has overcome a temporary difficulty by an April-May number. In this Dr. Hecht, of the Nancy museum, makes some suggestions for co-operation between French and British curators, which should bear fruit when the Museums Association meets in Paris next month. One is that examples of the rings attached to migrating birds should be shown in the museums of the Continent, so that visitors to them may become aware of their meaning.

THE report of the South African Museum for 1920 records the death of the old Seychelles tortoise known as "Peter." It proved to be a female. So long ago as 1834 she had reached a gigantic size, but how old she then was is not known. One of the Cape tortoises belonging to the museum had reached a great size in 1843, and still fulfils the objects of her sex. Among much other interesting matter in this report, Dr. Peringuey adduces fresh evidence that the stone querns of the Bushmen were not for grain, but were grinding mills for crushing ore. The craft of these African smiths, however, never enabled them to make so much as an iron hammer or to dispense with the use of stone implements.

THE *Journal of the Royal Society of Arts* for May 13 contains a paper by Sir James Cantlie describing Thomson's machine for armless men in whom the amputations are so high that it is impossible to fit artificial limbs. The apparatus consists of a table under which are pegs which are worked by the toes.

These actuate rods and levers which communicate movements to rods above the table, which constitute artificial "arms" by means of which all kinds of instruments may be grasped and worked. The patient is thus able to use a spoon, knife, and fork, drink from a cup, pick up a cigarette from the table, place it in his mouth, open an ordinary box of matches, strike a match, and light the cigarette, write with pen or pencil, typewrite, turn over the leaves of a book, play draughts, wash and dry his face and neck, etc. The condition of the armless is indeed pitiable, and the inventor deserves the greatest commendation for the design and construction of this ingenious machine.

IN the *Gardens' Bulletin*, Straits Settlements (vol. ii., Nos. 9-11, 1921), Mr. T. F. Chipp publishes a list of the fungi of the Malay Peninsula, which it is hoped may facilitate the work of mycologists engaged on the study of plant diseases and lead to a more detailed systematic study of Malayan fungi.

SEVERAL papers dealing with the fungus flora of South Africa appear in the *Transactions of the Royal Society of South Africa* (vol. viii., part 4, 1920, and vol. ix., part 2, 1921). Miss Ethel Doidge contributes a revision of the native species of a family of moulds (*Microthyriaceae*) which are abundant on the leaves of plants in humid wooded districts. Descriptions, and in many cases figures, are given of the species, a large proportion of which are new to science. In a second paper Miss Doidge describes in detail the method of attack and nutrition of the tropical genus *Meliola*, which occurs on shoots and leaves of forest trees and shrubs. The fungus is shown to be a true parasite, sending penetrating suckers through the epidermis of the host, blocking up the stomata, and causing considerable disorganisation of the cells. Mr. Paul van der Bijl describes for the first time a fungus (*Ovulariopsis papayae*) which attacks the pawpaw plant along the coast of Natal, forming a powdery covering on the under-face of the leaves.

THE Liverpool Geological Society has done well in publishing in its *Proceedings* (vol. xiii., part i., 1920) a translation, somewhat abbreviated, of Dr. A. Heim's paper "The Weight of Mountains." The original appeared in the *Annual of the Swiss Alpine Club* for 1918, and the illustrations are now reproduced. The map shows the variation of gravity throughout Switzerland from what is regarded as the normal value, and is based on results recently obtained with the seconds pendulum for a large number of localities. The measurements are recorded as if values below the normal were due to an excessive thickness of rock underlying the station with a specific gravity of 2.4, and curves are drawn representing these thicknesses at 100-metre intervals. Lines of normal gravity-effect (0) occur on the south side of the Black Forest and north of the Lago Maggiore. Between these regions the lines are approximately parallel with the strike of the Alpine folding, and the gravity-defect runs up to -1600 in the Engadine and to -1450 on the southern flank of the Rhône Valley near Visp. Dr. Heim regards the Alpine mass as floating, partially submerged, in a plastic "sima" underlayer, into which

it has sunk back to some extent since its maximum elevation in late Miocene times. There is thus beneath its surface a region of mass-defect, a "gravity-synclinal." The sheets of detritus from the early chain now dip towards their source, and the author once more urges that the lakes penetrating the foothills on either side are due to a reversal of the slope of primary valley floors. The paper thus presented to English readers is a clear and valuable addition to the literature of isostasy.

In the *Meteorological Magazine* for April a summary is given of the rainfall of San Domingo, dealing chiefly with the eastern half of the island. Meteorological data from the Dominican Republic are said to be extremely rare; the rainfall records discussed have been received by the Meteorological Office, and are roughly summarised by Mr. C. E. P. Brooks. The observations were forwarded by Mr. W. A. Elders, the general manager of the Samana and Santiago Railway, who since 1913 has had twelve rain-gauges installed. A map is given showing the annual average results for the twelve stations, which are situated along the valley of the Yuna River and its tributaries. Detailed monthly averages are given for Sanchez, on the border of Samana Bay, at the eastern extremity of the island, and for La Vega, situated near the centre of the island, about sixty miles westward from Sanchez. Results for Port au Prince, in the west of the island, are added for comparison. Over the eastern half of the island the heaviest rain occurs from May to August, and there is a subsidiary maximum in November. The driest months are from December to March. There is a considerable range in the annual rainfall. At Sanchez the average for the year is 71.09 in., ranging from 56.00 in. in 1918 to 81.52 in. in 1913; whilst at La Vega the average annual fall is 67.58 in., ranging from 41.28 in. in 1920 to 100.85 in. in 1917. The prevailing wind is from the east, distinctly a trade wind, trending somewhat from the south-east in the summer months and from the north-east in the winter months. The country is mountainous, but very fertile in the valleys.

At the April meeting of the Optical Society Mr. F. Twyman described an instrument for testing camera lenses. The method depends on interference, and permits of the measurement, in wave-lengths of the light used, of the deviation from sphericity of the whole of the wave-surface transmitted by a lens from a point source behind it. This is secured by mounting the lens under test so that it can be rotated about a line at right angles to its axis passing through its second principal point. The apparatus brings the beam which has traversed the lens into interference with one which has travelled a fixed distance, as in the case of a Michelson interferometer. The isochromatic lines of the interference pattern then correspond to equal deviations from sphericity of the transmitted wave surface. The instrument affords a most severe test, and defects of lenses by first-class makers have been found by its means.

THE report of the council presented at the annual meeting of the Illuminating Engineering Society on May 31 contains evidence of further useful work, new

joint committees in co-operation with various other bodies having been formed to study special problems arising from recent discussions. Amongst the subjects thus dealt with are photometry, motor-headlights, and the lighting of kinema studios. It is also remarked as gratifying that international co-operation in connection with illumination is being resumed. A session of the International Illumination Commission, the first since the outbreak of war, is being held in Paris in July, and such questions as motor-headlights, "artificial daylight," and regulations for industrial lighting will be discussed. Following the formal business at the annual meeting Mr. J. S. Dow read a paper on "The Use of Artificial Light as an Aid to various Games and Sports." An account of the lighting of various covered tennis courts was given, and it was suggested that even the artificial illumination of football and cricket grounds and golf links, though admittedly presenting considerable difficulties, might be accomplished in the future.

WE have received from Messrs. C. Baker, High Holborn, a descriptive pamphlet of a universal geometric slide photomicrographic apparatus made by them from the design of Mr. J. E. Barnard and originally described by him in 1911. The base is designed on the girder principle to obtain rigidity, and the portion carrying the microscope is constructed to swing out so that the object may be searched. The camera, a half-plate one, has a 3-ft. extension. The upper surface of the base carries two parallel metal rods, and the camera slides on these by two V-grooves on one and a plane surface on the other, the latter being intermediate in position between the V-grooves. The principle of the geometric slide is thus obtained, the apparatus being supported practically on three points forming the apices of a triangle, while alignment is maintained by the V-grooves. It may be clamped down in any position, and by means of a spindle running in bearings along the centre of the casting, which actuates a pulley "belted" to the fine adjustment with a thin cord, focussing may be carried out at any position. All subsidiary apparatus, including the illuminant, is similarly carried on geometric slides. The price of the apparatus is 33*l.*, or with arc lamp and some subsidiary apparatus about 40*l.*

THE April issue of the *Whitehall Gazette* contains an interesting article on the fraudulent proceedings that were practised to avoid service when conscription was in force in this country. Some claimed exemption on the ground that they were suffering from consumption, but declined to provide sputum there and then, promising to send samples. The samples forwarded did contain tubercle bacilli, but they were dead, and the specimens were found to be artificial concoctions. A good many forged passports were produced by Russians who remained in this country. In some cases a passport belonging to another would have the written details bleached out by chemical means and the desired name, etc., inserted. Sometimes the date of birth of the man's own passport might be put back ten years. These forgeries were detected by the change in reflecting power of the surface of the paper caused by the removal of the size

by the bleaching agent or by the attempt to replace it, by the spreading of the ink caused by the removal of the size, by the restoration to visibility by chemical means of the bleached-out writings, by the finding of the bleached inscriptions by photography under suitably coloured lights, and so on. The article is illustrated with excellent photographs and reproductions of photographs.

ON May 10, at the Institute of Petroleum Technologists, Prof. P. Carmody (late Government analyst, Trinidad) read a paper on "Trinidad as a Key to the Origin of Petroleum." Prior to the meeting the title of the paper had created much interest and curiosity, especially among those members who have had professional experience in the island, but unfortunately both the paper and subsequent discussion were scientifically somewhat disappointing. The author's main contention was that in a comparatively small area, within reasonable access of Europe, and under conditions of life peculiarly satisfactory for a tropical island, there exist all the requisite natural factors for an exhaustive research into the origin of petroleum, as yet a little understood problem: the solution of which must perforce have far-reaching scientific and economic results. The natural factors referred to include the occurrence of varied forms of solid, liquid, and gaseous hydrocarbon compounds within the rocks of the island, and in illustration of his idea the author gave a brief description of these, supplemented with a large number of chemical and physical

data obtained during the course of some thirty years' work in the Government laboratory. There is obvious value in the publication of such data by one whose long experience entitles him to speak with authority, but the *raison d'être* of the paper suffered much from the somewhat narrow view taken as to the origin of oil, viz. its derivation entirely from vegetable matter, i.e. cellulose. On this assumption, and in view of the many known oil occurrences wherein marine organisms have unquestionably been involved, it is doubtful whether Trinidad does indeed constitute the desired "key," and whether, as the president remarked later, the existence of all these forms of petroleum is not a disadvantage rather than an aid to the solution of the problem.

PROF. R. S. TROUP, of the forestry department of the University of Oxford, has written for publication by the Oxford University Press a work in three volumes on "The Silviculture of Indian Trees." The first volume, dealing with Dilleniaceæ to Leguminosæ—Papilionaceæ, is promised for appearance by an early date.

A FULL report of the meeting held on May 30 by the National Union of Scientific Workers on "The Administration of Scientific Work," of which a short account was given in last week's NATURE, p. 439, will appear in the next issue of the union's Journal. Copies may be obtained from the Secretary, N.U.S.W., 25 Victoria Street, S.W.1, at the end of this month (post free 6d.).

Our Astronomical Column.

COMETS.—Reid's comet is rapidly fading, but should be within reach of moderate instruments for another month. An extension of the ephemeris from Ebell's elements for Greenwich midnight is therefore given:

R.A.			N. Decl.			R.A.			N. Decl.			
h.	m.	s.	°	'	"	h.	m.	s.	°	'	"	
June 9	8	8	33	51	38	June 29	8	17	41	43	31	
	13	8	10	41	49	July 3	8	19	16	42	21	
	17	8	12	37	47		7	8	20	49	41	18
	21	8	14	24	46		11	8	22	19	40	19
	25	8	16	3	44		15	8	23	46	39	24

Values of $\log r$, $\log \Delta$: June 13, 0.0665, 0.2311; June 25, 0.1054, 0.3035; July 7, 0.1459, 0.3543.

The following observation of Pons-Winnecke's comet was obtained at Greenwich: G.M.T. June 2d. 10h. 57m. 38s.; apparent right ascension, 20h. 37m. 15.85s.; apparent north declination, $37^\circ 12' 45.8''$. The position deduced from Crawford and Levy's second elements is right ascension 20h. 38m. 5s., north declination $37^\circ 3'$. The elements are therefore fairly near the truth.

The comet now appears large and diffused owing to its small distance from the earth. It will be nearest to both earth and sun on June 12.

Mr. G. Merton obtained an observation of Dubiago's comet on June 1. He states that its position agreed closely with the ephemeris given in NATURE of May 26.

NOVA CYGNI III. (1920).—Mr. Denning writes that he observed this object on June 5 at 10h. 40m. G.M.T. with a $6\frac{1}{2}$ -in. refractor. He estimated the magnitude to be 9.6, so that the star's light would appear to have declined very slightly during the last $7\frac{1}{2}$ months. It will be remembered that the magnitude of the star decreased from 1.8 to 8.5 during the 2 days from

August 24 to October 6, 1920, so that the average decline of light was 0.16 per day. Since about the middle of October, however, the nova appears to have maintained its brightness in a rather unexpected way.

COLLISION OF STAR AND NEBULA.—Prof. Ernest W. Brown contributes a paper on this subject to the April issue of the *Astrophysical Journal*. Taking the star as origin and the line of relative motion as the Z-axis, particles of the nebula equidistant from this axis would all be deflected into similar hyperbolic orbits meeting in a point on the axis. There would thus be numerous collisions of particles along the axis which would generate a fan-shaped nebula with its apex towards the star. Another nebulous envelope surrounding the star would be formed by collisions of particles with the star or its appendages. The nebula is supposed to be non-gaseous at the start, being composed of widely scattered particles.

Hubble's variable nebula round the star R Monocerotis is discussed in detail, and it is shown that its form agrees closely with that indicated by the theory. It is suggested that the variations in the light of the fan-shaped appendage may arise from irregularities in the density of the nebula that the star is supposed to be traversing. It is shown that Prof. Slipher's observation that the stellar envelope and the fan-shaped appendage have identical spectra is in accord with the hypothesis, for both would arise from the gas resulting from collisions of the nebular particles. Slipher and Lampland's further statement that the spectra resemble those of novæ in their early stages suggests to Prof. Brown that a similar explanation may be available for the phenomena of novæ.

The Edinburgh Meeting of the British Association.

THE preliminary programme and invitation circular for the eighty-ninth annual meeting of the British Association, to be held in Edinburgh on September 7-14, is now ready for distribution. Members of the Association will receive it shortly if it has not already reached them; others who propose to attend the meeting may obtain a copy on application to the Assistant Secretary of the Association, Burlington House, London, W.1. The circular, which is more comprehensive than has been customary, contains more than a merely preliminary programme, for many of the definitive arrangements for the meeting are set forth and a time-table of the principal engagements is appended. The circular is a pamphlet of sixteen pages with a three-leaf cover. One leaf, detachable at a perforation, provides two reply forms—one for intimation of attendance and the other for intimation of the member's local address—and, in order to assist the organisation of the meeting, members who propose to be present are requested to complete and return these forms at their earliest convenience. On another cover is a useful map of central Edinburgh, on which are indicated the principal buildings, especially those to be used for the meetings, the railway stations, the 'bus and tram routes, and the principal hotels.

A prefatory note on Edinburgh is followed by the announcements regarding conditions of membership and railway communications. In the latter we note that the general officers of the Association have made, and will continue to make, every endeavour to secure a reduction of return fares for members attending the meeting, but up to the present they have been unable to obtain this concession from the railway authorities, and, failing the issue of a further intimation, it must be assumed that the concession formerly customary cannot be given this year. Enclosed in the circular is a printed slip directing attention to a proposal to run motor coaches from London (following routes *via* Oxford and Cambridge) and from Bristol, Liverpool, and other towns north of these, to convey members to Edinburgh, and back again if so desired. The fares would be approximately two-thirds of those charged by the railways in each case. The motor coaches would leave London and points south of Liverpool on September 5, completing the journey to Edinburgh in two days, and arrangements would be made for hotel accommodation *en route*. From Liverpool, Manchester, Leeds, and points north thereof the journey to Edinburgh would be made in one day—September 6. Passengers' luggage would be collected and delivered, each passenger being allowed 56 lb. free of charge. This enterprising project can be realised only

if the transport company has a guarantee as to the number of members who would be prepared to avail themselves of it, and members are therefore requested to state on their intimation forms if they would make use of the motor service.

The programme gives the titles of the addresses, discourses, and principal discussions. The presidential address by Sir Edward Thorpe will deal with some aspects and problems of post-war science pure and applied. The evening discourses are on subjects especially appropriate to a meeting in Edinburgh. Prof. C. E. Inglis will make a comparison of the Forth and Quebec bridges, showing the evolution of cantilever-bridge construction during the past thirty years; and Prof. W. A. Herdman will give an account of the important part played by Edinburgh in the progress and development of the science of oceanography.

The sectional presidents' addresses will cover a wide range of subjects; for example, the laboratory of the living organism, the boundaries of physiology, experimental geology, evolution, the theory of descent in relation to the early history of plants, the study of native races, consciousness and the unconscious, the place of music in a liberal education, water-power, the principles by which wages are determined, and agricultural economics. Several of these addresses are to be introductory to discussions. The president of the Conference of Delegates of Corresponding Societies is to give an address, followed by a discussion, on "Science and Citizenship." Arrangements have been made for a number of joint sectional discussions, and the following are announced as the respective subjects: The structure of molecules, the age of the earth, biochemistry, the proposed mid-Scotland canal, the origin of the Scottish people, and vocational training and tests. The times of the sectional presidential addresses and of the principal discussions have been arranged so that those on cognate subjects are not held at the same hour; for instance, the addresses are distributed over the Thursday, Friday, and Monday mornings, and not more than two are at the same hour.

From this summary it will be evident that the arrangements for the meeting are in an advanced stage, and we understand that this is also the case in regard to the programme of papers to be presented to the various sections.

The forthcoming meeting in Edinburgh—restored to its pre-war length of a full week—promises to be one of great scientific interest and value, and all well-wishers of the Association are looking forward to a full resumption of the activity and influence of the Association.

The Royal Observatory, Greenwich.

THE visitation of the Royal Observatory took place on June 4, when the report of the Astronomer Royal, which covers the year ended on May 10, was presented. The report states that strenuous efforts are being made with the transit circle to complete the present catalogue, which embraces some two thousand stars of the list prepared by Dr. Backlund and Mr. Hough; the aim of that list was to obtain a convenient number of reference stars uniformly distributed over the sky. These observations will be concluded at the end of this year, after which observations will be commenced of all stars down to magnitude 8.0 between N. declination 32° and 64° . It will be remembered that stars down to magnitude 9.0

between declination 64° and 90° , and also between 24° and 32° , have recently been observed at Greenwich. The catalogue of the last-named region was distributed during 1920; it includes the determination of the proper motions of 12,000 stars.

The mean error of the longitude of the sun, as given in the Nautical Almanac, is $-1\frac{1}{2}''$; that of the moon is $-13''$, which is deduced from observations on 114 nights. Eight occultations of stars by the moon were observed, and also both phases of the solar eclipse of April 8.

The 28-in. equatorial has undergone extensive repairs by Messrs. Cooke; observations of double stars have now been resumed. The working catalogue

has been drawn up with the idea of avoiding overlapping of observation and of including stars the orbit determination of which is hopeful. Many orbits of binaries have recently been computed by Mr. Jackson, who has also, together with Mr. Furner, published an investigation showing that the mean mass of binary systems is double that of the sun. Working on this assumption, hypothetical parallaxes have been deduced for several hundreds of stars. The observations with the 28-in. equatorial since 1893 have been collected into a volume, which is nearly ready for publication; it also contains the orbits found by Mr. Jackson, and notes on the relative motion in cases where orbits cannot yet be determined.

The programme of parallax determination with the 26-in. equatorial is being continued. The plan of taking double exposures on the same plate at six-month intervals has been dropped; each plate is now developed after exposure. Fiducial plates of each field are prepared by making rulings with a diamond in the positions of the parallax star and reference stars; all the plates are compared in succession with the appropriate fiducial plate. Forty-nine parallaxes have thus been deduced in the year, the number of plates measured being 829; the probable error of a determination is 0.009".

There are two extensive investigations in progress with the aid of diffraction gratings. The grating employed with the astrographic equatorial gives a first diffracted image 2.83 magnitudes fainter than the principal image. By successive steps it is possible to compare the magnitudes of all stars within the range of the instrument. The magnitudes of the stars in the Harvard polar sequence are being re-determined. The results obtained so far confirm the Harvard scale for the fainter stars, and the Mount Wilson one for the brighter.

The grating on the 30-in. reflector is being used to obtain the effective wave-length, and hence to infer the spectral type, of the stars in the Greenwich astrographic zone (declination 64° to 90°). An exposure of seven minutes suffices to give satisfactory results for

stars of magnitude 10.5. Effective wave-lengths have already been determined for 550 stars within 3° of the Pole, the mean probable error being 10 angstroms.

The astrographic equatorial will shortly be dismantled in preparation for its removal to Christmas Island for next year's eclipse. Sir Howard Grubb and Sons are making an equatorial mounting for use there, as the *coelostat* method proved unsatisfactory in 1919 for a problem involving such great precision as the investigation of the Einstein bending of light. Mr. Jones and Mr. Melotte will start for Christmas Island early next year, and remain six months on the island. The fact of having an astrographic equatorial close to the equator will be utilised for taking series of photographs for the purpose of comparing the magnitude scales of northern and southern zones.

The Reid and Pons-Winnecke comets have been observed both visually and photographically on several nights. The first photograph of the latter was secured within a few hours of the receipt of Prof. Barnard's telegram announcing his detection of the comet.

The usual magnetic and meteorological observations have been continued. The mean magnetic declination for 1920 was $14^\circ 8.7'$ W.; it is diminishing by $9\frac{1}{2}'$ annually, which will bring it to zero about the close of the century. The chief magnetic disturbance was from March 22 to 25, 1920, being associated with a large group of sun-spots. The mean temperature for the first four months of 1921 was the highest for that period during the last eighty years, January being 7.5° above the average. The rainfall was 18.77 in., being 5.47 in. below the average of seventy-five years. July and September alone were above the average.

The Astronomer Royal refers to the success attained by Mr. Bowyer in the mechanical registration of wireless signals on a siphon recorder. Signals are received from the Eiffel Tower, Nauen, Annapolis, Darien, Bordeaux, and Lyons; some special series were sent from Lyons for the determination of Australian longitudes. These were recorded both at Greenwich and in Australia.

A. C. D. C.

The Chinese Earthquake of December 16, 1920.

By DR. C. DAVISON.

A PRELIMINARY report on the destructive Chinese earthquake of December 16 last has been prepared by Father E. Gherzi, and is published by the Zi-ka-wei Observatory. Though brief, it is of considerable interest, as it is the first scientific account that we have received of this great earthquake. The report is based on the letters received from correspondents of the observatory (nearly all missionaries), on articles in Chinese and other newspapers, and on the seismograms provided by the Wiechert astatic pendulum (mass 1200 kg.) at the observatory.

The first shock registered there occurred on November 16, others on December 1, 6, and 10, and possibly three early on December 16. The primary waves of the great shock arrived on that day at 12h. 9m. 16s., and the secondary waves at 12h. 11m. 45s. In less than two minutes later one of the recording levers was dismantled, and after $3\frac{1}{2}$ minutes more the other passed off the paper and was put out of action. Such as it is, the seismogram shows that the epicentre was about 1400 km. from Zi-ka-wei, and that the time at the origin was 12h. 6m. 5s. (G.M.T.).

The area most strongly shaken lies in the provinces of Kansu and Shensi, in the north-west of the country, in which are situated the origins of the most dis-

astrous of Chinese earthquakes. From the somewhat scanty materials at his disposal, Father Gherzi has constructed the probable courses of the isoseismal lines, using the Mercalli scale. The curves of chief interest are those of degrees 10 and 11. The former surrounds all the places at which the destruction of buildings was total or nearly so. It includes the towns of Pingliang, Kingchow, Kuyuan, and Tsingning-chow, and covers a district about 180 miles long, 60 miles wide, and more than 8000 square miles in area. Its longer axis is directed N.N.W. and S.S.E., and is roughly parallel to the axes of the great crust-folds of this region. Assuming this isoseismal to be drawn correctly, it follows that the position of the epicentre is about 35.8° N., 106.2° E.

As in all earthquakes of the first magnitude, the duration of the shock was considerable—according to one observer, who measured it, certainly three minutes. Throughout all this time the shock seemed to vary but little in intensity, though becoming slightly stronger near the middle. The effects of the shock were aggravated by the structure of the country—the rock in the central area being capped by a thick bed of loess, through which the streams have worn ravines with nearly vertical sides. Roads are said to be cut up

by fissures in which houses have disappeared, and are blocked by avalanches which have fallen from the ravines. Father Gherzi estimates the loss of life at more than 40,000, by no means a large figure for an earthquake of this character. Probably the real number will never be known, as it is a custom in this district for families to live in caves hollowed out in the loess along the river-sides, which in many cases were blocked by the fall of avalanches.

The isoseismal 4, which forms the boundary of the known disturbed area, is incomplete towards the west. Its mean radius, in the portion drawn, is about a thousand miles. Thus the disturbed area probably contains more than three million square miles, and is perhaps not much inferior in extent to the whole of Europe. At the present time the largest disturbed areas known to us are those of the Assam earthquake of 1897 (about $1\frac{1}{4}$ million square miles), the Kangra earthquake of 1905 (nearly 2 million square miles), and the Charleston earthquake of 1886 (about 2,800,000 square miles). The last area is, however, bounded by an isoseismal line of intensity 2. If the corresponding isoseismal could have been drawn for the Chinese earthquake, the figure given above for its disturbed area would have to be multiplied several times. In any case it is clear that we are dealing with a shock which, if not the greatest, is certainly one of the greatest, known to us since earthquakes began to be studied.

Since the foregoing was written, a report by a small party of foreign travellers has appeared in the *Times* of June 4. Though the travellers were unable to examine the whole of the central region, they state that the shock was felt principally within an area of 15,000 square miles, bounded approximately by the parallels of 35° and 37° and the meridians of 105° and 107° , thus agreeing with the result deduced from Father Gherzi's map. The loss of life, however, is estimated at a far higher figure than that given above. "The prefectural Taoyin of Pingliang puts the total loss of life at 180,000, or one-third of the whole population; 30,000 perished at Kuyuan. Haicheng appears to have been almost completely buried by the surrounding hills tumbling in upon it, about 70,000 people being entombed." Such a total has but rarely been approached, and only twice, I believe, surpassed. The number of deaths due to the Messina earthquake of 1908 cannot fall far short of 100,000. In the Indian earthquake of 893 180,000 persons are said to have perished; in the Japanese earthquake of 1703, 200,000; and in the Indian earthquake of 1737 the reported number rises to a maximum of 300,000.

Stereochemistry.

AT the seventh Indian Science Congress Prof. B. K. Singh, who presided over the chemistry section, delivered an address on "Recent Advances in Stereochemistry," which has since been published in pamphlet form.

After reviewing the early development of the subject by Pasteur, the theory of the asymmetric carbon of van't Hoff and Le Bel, and the later researches on asymmetric nitrogen, sulphur, and selenium by Pope, Peachey, and others, Prof. Singh proceeds to discuss the more obscure relations subsisting between the amount of rotation and the constitution of the active substances. In this connection he touched on the work of Pickard and Kenyon, the main outcome of whose researches was to indicate a sudden rise of rotation produced at the end of a chain of five or a multiple of five carbon atoms—a phenomenon which was explained by the proximity of the first and fifth

carbon atoms in the chain. Reference was also made to the work of H. O. Jones on the activity of quaternary ammonium bases containing different radicals and certain generalisations which followed. The influence of conjugation, as illustrated by the work of Rupe, and the abnormally high rotations produced in the derivatives of amino-camphor were also reviewed. This was followed by a reference to the relation of optical activity to position isomerism, with a discussion of Frankland's theory.

Prof. Singh, who has himself contributed certain observations on the subject, comes to the conclusion that neither Frankland's theory nor what he terms "Cohen's rule" accords with the facts; but omits to point out that both his own and Frankland's observations are made with dissolved substances in which the solvent may, and frequently does, modify the rotation, whereas Cohen and his co-workers purposely avoided the use of any solvent. Finally, the address dealt with those mysterious changes of rotation known as "the Walden inversion," which are effected by certain reagents, when one constituent of an asymmetric group undergoes replacement. The earlier theories based upon change of structure due to the reagent have since been shown to be untenable in the light of the work of Senter and Drew, who find that with the same reagent different solvents may produce a similar inversion.

J. B. C.

University and Educational Intelligence.

BIRMINGHAM.—At the meeting of the Council of the University held on Wednesday, June 1, Mr. Walter H. Moberly was appointed to the chair of philosophy to succeed Prof. J. H. Muirhead, who is retiring from the chair in September next. Mr. Moberly is dean, fellow, and tutor of Lincoln College, Oxford, and one of the best known of the younger teachers of political and social philosophy in the Philosophy and History School of that University. His experience of municipal administration as a member of the Oxford City Council and his work with the Workers' Educational Association should contribute to make him a fitting successor to Prof. J. H. Muirhead.

Dr. H. J. W. Tillyard has been appointed to the chair of Russian, and Signorina L. P. di Castelvechio to the Serena chair of Italian. Dr. Tillyard is the first occupant of the chair of Russian in the University—a chair founded on the fund collected for the purpose by the Birmingham Chamber of Commerce. Signorina di Castelvechio is the first professor of Italian to occupy the chair founded on a generous benefaction from Mr. Arthur Serena and on funds collected by the Birmingham Chamber of Commerce. She is the first woman to be appointed to a chair in the University.

The Council has also appointed Mr. E. H. F. Mills, fellow of St. John's College, Cambridge, and secretary of the University Library, Cambridge, to the office of librarian which will shortly be vacant by the retirement of Mr. W. H. Cope.

CAMBRIDGE.—Dr. G. E. Moore, Trinity College, and Mr. W. E. Johnson, King's College, have been re-elected University lecturers in moral science, and Mr. F. Debenham, Gonville and Caius College, has been re-elected University lecturer in surveying and cartography. Mr. J. A. Venn, Trinity College, has been nominated Gilbey lecturer in the history and economics of agriculture. Mr. J. C. Wallace has been elected a junior fellow of Emmanuel College.

Miss F. E. Haines has been elected to a scientific fellowship at Girton College, and Miss M. T. Budden to an associates' fellowship in mathematics at Newnham College.

It is proposed to appoint a committee of nine to manage the low-temperature station for research in biochemistry and biophysics, which is nearing completion. Five members of the committee are to be nominated by the council of the Senate and four by the Department of Scientific and Industrial Research.

The Syndicate to consider possible alterations affecting the Mathematical and Natural Sciences Tripos is to consist of Dr. Fitzpatrick, Sir Joseph Thomson, Prof. H. F. Baker, Sir Ernest Rutherford, and Messrs. W. B. Hardy, A. Hutchinson, W. H. Mills, J. Barcroft, J. F. Cameron, A. Wood, C. G. Darwin, R. H. Fowler, and G. P. Thomson.

Dr. H. Hartridge, King's College, has been appointed senior demonstrator in physiology.

Owing to the continued difficulties of railway travelling, the vote on the admission of women to membership of the University or to titular degrees has been postponed from June 16 to October 20.

The Arnold Gerstenberg studentship will be awarded to the science student of proper standing who writes the best essay on one of the following six subjects:—The Ultimate Data of Physics, Philosophical Aspects of the Theory of Relativity, Mechanical Explanation and the Problems of Biology, The Theory of an "Elan Vital" and Related Conceptions, Heredity and Memory, Instinct and Intelligence.

MANCHESTER.—Dr. Harold Robinson, senior lecturer in physics and assistant director of the physical laboratories, has resigned his appointment as from September 29 next.

The following have been recommended for the degree of Doctor of Science:—Frederick William Attack, William Broadhurst Brierley, Colin Campbell, Robert George Fargher, William Harold Pearsall, and Henry Smith Holden.

IN connection with the department of coal gas and fuel industries of Leeds University a Corbett-Woodall scholarship in gas engineering is being offered. It is of the annual value of 60*l.*, and tenable for three years, with the possible extension to a fourth. Full particulars can be obtained from the registrar of the University. The latest date for receiving applications for the scholarship is June 15.

SUMMER schools for practical work in open-air geography, geology, botany, and allied sciences will be held under the auspices of the Geographical Association at Chamonix (July 28–August 11) and in Snowdonia (August 13–27). The original glacial researches of De Saussure, Forbes, and Tyndall will be retraced in the Chamonix district, and, similarly, Ramsay's work on the ancient glaciers of North Wales will be studied in Snowdonia. Particulars of the arrangements may be obtained by sending a stamped addressed envelope to Mr. H. Valentine Davis, "Noddfa," Wistaston, Crewe.

THE Bulletin of the National Research Council for March (vol. ii., part 1, No. 9) contains a classified statement compiled by the Research Information Service of the funds available in 1920 in the United States for the encouragement of scientific research. The publication falls into seven sections, of which the first is introductory, and sections ii. to vi. contain lists of the medals, prizes, fellowships, etc., in connection with which specific mention is made of research. In section ii. the various medals and prizes are brought together; section iii. deals with grants for research; section iv. with institution funds for research; and section v. with the fellowships and scholarships available for research workers. In every case reference is made to the awarding body, the nature of the research for which the award is made, the frequency of award,

and usually the monetary value. Section vi. consists of an index to the subjects in which funds for research are available; while section vii. forms an index to the various institutions which make awards and to the funds from which grants for research are allotted. A truly remarkable amount of information from widely scattered sources is thus brought together conveniently in a single publication.

THE programme of the Summer School of Civics, to be held this year at Guildford, Surrey, from July 30 to August 13, offers opportunities for good all-round social study. The courses of lectures to be given fall into three groups. In the first come those on geography, descriptive economics, primitive and present-day institutions, and anthropology; through these the student will be given a condensed view of community life at the present day. In the second group are the courses which develop a theory of community life, e.g. those on social biology, psychology, philosophy, etc. In the third group come the courses on the principles and practice of civics, social education, public administration, and economic problems. A special course for teachers on modern developments in education will also be given. Informal discussions will be, as formerly, a great feature of the school's work, and there will be exhibitions of civics, rustic surveys, housing and town-planning schemes, and excursions in Guildford and the neighbourhood. Mr. A. Farquharson will be responsible for the general direction of the school, and a number of well-known lecturers have offered their services. The inaugural lecture will be given by Prof. Patrick Geddes, professor of sociology and civics in the University of Bombay, and special lectures on psycho-analysis are being given by Miss Barbara Low. Full particulars of the school may be obtained from Miss Margaret Tatton, secretary, Civic Education League, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

ONE of the prime features of the Education Act of 1918 was that establishing day continuation schools for young persons entering upon employment at fourteen years of age. Immediate provision was to be made by the various local education authorities for education during working hours for such young persons for seven or eight hours weekly for forty weeks of each of two following years. Many large firms in the North of England, chiefly textile and engineering, took advantage of the provision so made and established for their own employees classes of a liberal character during working hours. Some education authorities, of which Manchester is a notable example, also established facilities for continued day education. The London County Council was one of the very few authorities which adopted the Act, and the Board of Education thereupon named an appointed day in the terms of the Act. The Education Committee of the L.C.C., among its other activities, made large provision for the means of continued day education, which received a gratifying response. It is therefore a matter of much surprise that the Education Committee of the Council resolved on May 9, and confirmed at a meeting held on June 1, that the Council's interim scheme adopted on May 4 of last year be amended so as to provide for the continued day education of employed young persons up to 15 years of age only. The reason given for this decision is that the cost of continued education for two years under the Act is too great in face of the growing unwillingness of the people to pay increased rates. Apart from the serious injury to the young persons concerned, it is a proposal of very doubtful legality, and it is to be hoped that the recommendation to the Council, which was carried by a majority of only one, will be summarily rejected.

Calendar of Scientific Pioneers.

June 9, 1875. Gérard Paul Deshayes died.—A founder of the Geological Society of France, Deshayes was distinguished for his study of the fossil mollusca of the Paris basin. He assisted Lyell in the classification of the Tertiary system into Eocene, Miocene, and Pliocene.

June 10, 1836. André Marie Ampère died.—A teacher first at Bourg and Lyons, Ampère in 1805 became a professor at the Ecole Polytechnique, and in 1824 was appointed to the chair of experimental physics in the Collège de France. Like Oersted, Faraday, and Henry, he was a pioneer in the science of electrodynamics, which he developed with mathematical skill. His "Observations Electro-dynamiques" appeared in 1822 and his "Théorie des Phénomènes Electro-dynamiques" in 1830.

June 10, 1858. Robert Brown died.—Beginning life as an assistant surgeon in a Scottish regiment, through Banks Brown in 1801 went to Australia with Flinders in the *Investigator*, and four years later returned with a collection of 4000 plants. He was afterwards placed in charge of Banks's collections and became botanical keeper at the British Museum. The foremost botanist of his day, his works embrace not only systematic botany, but also plant anatomy and physiology. Humboldt called him "facile princeps botanicorum."

June 10, 1903. Luigi Cremona died.—Distinguished for his work in synthetic geometry, Cremona for thirty years was professor of higher mathematics in the University of Rome. He reorganised the mathematical instruction in Italy, and for a time was Minister of Education.

June 11, 1875. Joseph Winlock died.—For some years superintendent of the American "Nautical Almanac," Winlock in 1865 succeeded G. P. Bond as professor of astronomy and director of the observatory at Harvard.

June 11, 1897. Karl Remegius Fresenius died.—A student at Bonn and then assistant to Liebig, Fresenius from 1845 onwards was professor of chemistry and technology at the Agricultural Institute at Wiesbaden. He made many analytical researches, wrote standard text-books, and in 1862 founded the *Zeitschrift für analytische Chemie*.

June 12, 1885. Henry Charles Fleeming Jenkin died.—The assistant of Lord Kelvin in his important experiments on the resistance and insulation and the making of electric cables, Jenkin afterwards occupied the chairs of engineering in University College, London (1865), and in Edinburgh University (1868).

June 13, 1844. Thomas Charles Hope died.—Hope in 1799 succeeded Black as professor of chemistry in Edinburgh University. Unrivalled as a popular teacher, more than 16,000 students attended his lectures. To him we owe the demonstration that water attains its maximum density at 4° C.

June 14, 1746. Colin Maclaurin died.—Born in 1698, Maclaurin at the age of nineteen became professor of mathematics at Aberdeen. In 1725 he was appointed to the similar chair at Edinburgh. After Newton's death he was recognised as the foremost British mathematician. He died at York, his death being due to his exertions during the Rebellion of '45.

June 14, 1875. Heinrich Louis D'Arrest died.—Of Huguenot descent, D'Arrest was born and educated at Berlin. He assisted Encke, held the chair of mathematics and astronomy at Leipzig, and in 1857 became director of Copenhagen Observatory.

June 14, 1903. Karl Gegenbaur died.—Famous for his work in comparative anatomy, Gegenbaur held the chairs of anatomy at Jena and Heidelberg. His "Elements of Comparative Anatomy" appeared in 1874.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 2.—Prof. C. S. Sherrington, president, in the chair.—Bakerian lecture by Dr. T. M. Lowry and Dr. C. P. Austin: Optical rotatory dispersion. Although no case is known in which Biot's law of inverse squares, $\alpha = k/\lambda^2$, is accurately true, the rotatory dispersion in a very large number of organic compounds can be expressed by the *simple dispersion formula*, $\alpha = k/(\lambda^2 - \lambda_0^2)$, which differs from Biot's formula only in the introduction of a "dispersion constant" λ_0^2 . This formula is a special case of the general formula $\alpha = \sum k_n/(\lambda^2 - \lambda_n^2)$ introduced by Drude as an approximation based upon the electronic theory of radiation and absorption of light. Substances which require more than one term of this equation are said to show *complex rotatory dispersion*. Tartaric acid and its esters give dispersion curves which frequently show an inflexion, a maximum, and a change of sign; they are described as cases of *anomalous rotatory dispersion*. These can be represented by two terms of Drude's equation, while the rotatory dispersion in quartz was represented by a similar equation, in which the dispersion-constant of the negative term was negligible. In order to express recent measurements it is necessary to assume finite values for both dispersion-constants and to introduce a term to express the influence of the infra-red absorptions; this can be taken as a constant. The anomalous dispersion of tartaric acid was attributed by Arndtsen in 1858 to the presence of two modifications of the acid differing in the sign of their rotations and in the magnitude of their dispersions. This view has been confirmed (1) by the proof that the complex rotatory dispersion of the acid and its derivatives can be expressed as the sum of two simple dispersions, and (2) by the discovery of certain "fixed" derivatives of tartaric acid which exhibit simple rotatory dispersion. Attention is directed to some analogies between tartaric acid and nitrocamphor, which give two isomeric compounds in solution.

Zoological Society, May 24.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. C. W. Andrews: The skull of *Dinotherium giganteum* in the British Museum.—Dr. C. F. Sonntag: (1) The comparative anatomy of the tongues of the Mammalia, Families 3 and 4, Cebidæ and Hapalidæ. (2) Some points in the anatomy of the tongues of the Lemuroidea.—Prof. R. Broom: Some new genera and species of anomodont reptiles from the Karroo beds of South Africa.—R. I. Pocock: The external characters of some species of Lutrinæ (otters).

Geological Society, May 25.—Mr. R. D. Oldham, president, in the chair.—G. W. Lamplugh: The junction of Gault and Lower Greensand near Leighton Buzzard (Bedfordshire). The paper, a continuation of one by the author and the late J. F. Walker published in 1903, describes about twenty sections exhibiting the base of the Gault in excavations around Leighton Buzzard. The variable "Basement Beds" of the Gault are "condensed" deposits, falling mainly within the "zone of Ammonites mammillatus" as recognised in northern France. The evidence bears out Jukes-Browne's suggestion of the occurrence of a current-swept strait in this quarter during late Lower Cretaceous times. During the accumulation of the "Basement Beds" a shoal in this strait north of Leighton formed a reef, while the deeper water to the southward gathered a stratum of gritty glauconitic loam and clay with fossiliferous phosphatic nodules. The transitional stages are visible in the sections. The dark clays above the "Basement Beds" belong to the Lower Gault, here reduced to about half its thickness at Folkestone. They rest sharply on the

ironstone "pans" of the reef, but usually pass downward by gritty intercalations into the glauconitic loams. The incoming of the Upper Gault, with keeled ammonites, is shown in three of the sections. A band of corroded phosphatic nodules, like those of the "Junction-Bed" at Folkestone, occurs near the base of the division, and marks a long pause in the sedimentation. This band has yielded many fossils. The palæontology of the deposits is discussed, and is held to be in general agreement with that of the same succession in northern France.

Physical Society, May 27.—Sir W. H. Bragg, president, in the chair.—H. Pealing: The reflection of the X-ray spectrum of palladium from fluorspar. An examination of the odd order spectra reflected from the 100 plane of fluorspar, using palladium X-rays, has been made with the view of testing the Lewis-Langmuir theory of the motion of valency electrons in compounds. Evidence in partial confirmation of the theory has been obtained.—Sir W. H. Bragg: The intensity of X-ray reflection by diamond. The relative intensities of the reflections of monochromatic X-rays by the crystallographic planes of diamond are given. The special difficulties due to the small size of available crystals are discussed. The results lie very closely on smooth curves, indicating that if the outer electrons of the carbon atom lie at any considerable distance from the centre they must be in motion over a wide range, or for some other reason must contribute little to the reflection. The properties of the carbon atom in diamond are based on a tetrahedral form. The tetrahedra point away from any (111) plane in the case of half the atoms, and towards it in the case of the other half. Consecutive 111 planes are not exactly of the same nature, and consequently some slight second-order reflection from the tetrahedral plane might be expected. This effect, though slight, has been found.—Research Staff of the **General Electric Co., Ltd.**: A method for the micro-analysis of gases by the use of the Pirani pressure gauge. A method of analysis of gases at a pressure between 0.61 and 0.001 mm. is described, based on the characteristic vapour-pressure temperature curve of any substance. A gauge such as the Pirani gauge, which will measure the pressures of vapours, as well as of permanent gases, over the range mentioned is used.

MANCHESTER.

Literary and Philosophical Society, February 8.—Sir Henry A. Miers, president, in the chair.—C. W. Duckworth: Note on a unique set of hydrometers.—Prof. G. Unwin: Samuel Oldknow, the first manufacturer of British muslins. An account of Oldknow's records (1782-1812), including the whole process of manufacture.

Literary and Philosophical Society and the Faraday Society (Joint Meeting), February 11.—Prof. A. W. Porter, president of the Faraday Society, in the chair.—Dr. A. Ferguson: Studies in capillarity. Part i.: Some general considerations, and a discussion of the methods of measuring interfacial tensions. The importance of accurate measurements of surface tensions, in view of the development of colloid physics, is becoming increasingly manifest, and a systematic determination of capillary constants is urgently needed. In this paper the "genetic" relations of various methods for the measurement of surface tensions are discussed. A critical comparison of these shows that among the most promising methods for systematic use are those depending on the measurement of (1) large bubbles or drops, (2) the maximum pressure required to release a bubble of air from the end of a capillary tube immersed in the liquid, and

(3) the maximum pull on an anchor ring which is immersed in the liquid and slowly withdrawn. Dealing with the ascent of a liquid in a capillary tube, it is shown that where a^2 is the specific cohesion and h the height to which the liquid rises in a tube of radius r , the equation

$$2a^2 = rh(1 + rh/3 - 0.1288 r^2/h^2)$$

is adequate for all requirements. Methods are proposed for the measurement of the surface tensions of such liquids as molten metals, and the problem of the accurate measurement of interfacial tensions is discussed.—Dr. A. Ferguson and P. E. Dowson: Studies in capillarity. Part ii.: A modification of the capillary tube method for the measurement of surface tensions. A modification of the usual method is proposed in which the meniscus is forced down to the end of the capillary immersed vertically in the liquid, and the pressure required to effect this is measured on a separate manometer. Apart from small corrections, the difference in level of the surfaces of the liquid in the gauge is equal to the heights to which the same liquid would rise in the capillary tube employed. By using a specially light liquid in the gauge this difference may therefore be magnified. But any manometer of sufficient delicacy may be used and the use of a cathetometer avoided. Thus the differential manometer or a simple sloping-tube manometer will give accurate results by ordinary naked-eye estimations. Temperature control becomes relatively simple, and the temperature of the meniscus may be estimated by means of a thermo-junction placed close to the end of the tube. Calibration of the capillary is unnecessary, for measurements are always made with the meniscus in one definite position—at the end of the tube.

DUBLIN.

Royal Dublin Society, May 24.—Dr. F. E. Hackett in the chair.—Prof. T. Johnson and Miss J. G. Gilmore: The occurrence of *Dewalquea* in the core of the bore made at Washing Bay, Co. Tyrone. This bore, made to tap a concealed coalfield if possible, had to be abandoned owing to the unexpected thickness of the bed of Lough Neagh Clay encountered (1106 ft. instead of 250 ft.), and from other causes. Plant-remains were obtained, especially at a depth of 870-930 ft., above the lithomarg or basalt. The hellebore-like foliage of *Dewalquea* was found represented by three new species, *D. hibernica*, *D. fraxinifolia*, and *D. denticulata*, of which particulars are given. The authors restored the leaves and found peltate scales, like those of *Engelhardtia*, present. They regard *Dewalquea* as an ancient member of the Juglandaceæ. It is recorded from the Cretaceous of America and Europe, also from Belgium (Lower Eocene) and Italy (Oligocene). The plant-beds at Washing Bay are probably Upper Oligocene.—The late Prof. J. A. McClelland and J. J. McHenry: Uncharged nuclei produced in moist air by ultra-violet light and other sources. The uncharged nuclei produced in moist air by ultra-violet light were given an electric charge through the agency of uranium. Their number and size could then be readily found under varying conditions. It is concluded that they are minute drops of water, and that they probably owe their formation to the production of hydrogen peroxide. The nuclei produced by heating glass were also studied. Moderate heating caused a temporary evolution of nuclei, attributed to surface impurities absorbed from the atmosphere. Strong heating caused a continuous evolution, attributed to disintegration of the glass. Similar effects were observed with metals.—H. G. Becker: A simple apparatus for observing the rate of reaction between gases and liquids, and the determination thereby of

the effect of stirring on the rate of solution of oxygen in water. The principle is similar to that already described elsewhere by Dr. Adeney, and consists in enclosing the liquid with a known volume of gas in a space connected to a manometer and observing the change of pressure due to absorption. Experiments made on the effect of stirring on the rate of absorption of oxygen from the air showed that the rate of solution is enormously increased even by gentle stirring of the liquid, and with more vigorous stirring tends to the maximum value already found by a different method. The experiments form a link between conditions occurring in Nature and those obtaining in the method previously described by Adeney and Becker in the society's Proceedings.

PARIS.

Academy of Sciences, May 17.—M. Georges Lemoine in the chair.—A. Denjoy: The calculation of the coefficients of any convergent trigonometrical series the sum of which is given.—G. Dumas: The tramiag contours.—M. Bratu: Series the general term of which tends towards zero.—G. Valiron: Integral functions of finite order.—J. Le Roux: The theory of relativity and the secular movement of the perihelion of Mercury.—B. Lyot: The aurora borealis of May 14-15, 1921, and the simultaneous magnetic phenomena. Intense magnetic disturbances commenced twenty hours before the passage of an important group of sun-spots across the central meridian, and this passage was followed by a remarkable aurora borealis.—J. Guillaume: Observation of Pons-Winnecke's comet (1921b) made with the equatorial of the Observatory of Lyons. Position on May 10 is given. The comet is roughly circular, with a faint central condensation. Magnitude about 11.5.—G. Vavon and J. Detrie: The transformation of phenol into cyclohexanol. A study of the addition of hydrogen to phenol, with platinum as the catalyst. It is shown that cyclohexanone is formed as an intermediate product.—T. Martinet and P. Coisset: The action of chloraloxim on the aromatic amines; the synthesis of isatins. When the oxime of chloral condenses with aromatic amines the chlorine, and not the aldehydic oxygen, reacts. The product of the condensation treated with hot sulphuric acid yields isatin. Starting with various substituted amines, the corresponding substituted isatins can be readily prepared.—M. Lespieau: The action of 2:3-dibromopropylene upon isopropylmagnesium bromide.—MM. Delépine, Fleury, and Ville: Researches on $\beta\beta$ -dichloroethyl sulphide. The material prepared from ethylene and chlorides of sulphur contains various impurities. These give some sulphur as sulphuric acid on oxidation, and only from 60 to 70 per cent. of the chlorine is removed by hydrolysis with water at 80° C. The pure material gives no sulphuric acid on oxidation, and the whole of the chlorine is removed by hydrolysis.—R. Fosse and G. Laude: Syntheses of cyanic acid and of urea by the oxidation of ketones, acids, and amines in the presence of ammonia.—G. Arambourg: The ichthyological fauna of the Sahelian of the Oran region.—A. Magnan: The ratio of the wing surface to the caudal surface in birds.—F. Ladreyt: Histological and histochemical researches on the pigimentary atrophy of the liver.—A. Weber: Researches on the toxicity of the internal medium of Batrachians towards their eggs.—V. Galippe and Mme. G. Souffland: Researches on the presence in meteorites, hard stones, minerals, quartz, granite, basalt, volcanic ashes, and lava of "organites" susceptible of reviving, and on their resistance to high temperatures.—E. Chatton and R. Courrier: A trypanosome of the bat,

Vesperugo pipistrellus. Hypothesis relative to the etiology of endemic goitre. In Lower Alsace about 10 per cent. of these bats are infected with a trypanosome resembling *Schistotrypanum Cruzi*, but smaller. The suggestion is made that this organism may possibly be the cause of endemic goitre.—A. Sartory and P. Bailly: The agglutinating power of thorium sulphate on the spores of *Aspergillus fumigatus*. An emulsion of the spores was clarified by solutions of thorium sulphate, the maximum effect being produced at concentrations between 0.001 and 0.0005. Concentrated solutions do not agglutinate the spores.—G. Marinesco and E. Craciun: Lesions of the nervous system in exanthematic typhus and their relations with neuritis.—C. Lebaillly: The preservation of the aphthous virus by cold.

ROME.

Reale Accademia nazionale dei Lincei, March 6.—V. Volterra, vice-president, in the chair.—Paper by a fellow:—Col. G. A. Crocco: Utilisable energy of the wind. The variability of winds, coupled with the fact that the energy varies as the cube of the velocity, has hitherto prevented this source of energy from being put to much practical use. Referring to accumulators, the author considers that recent researches on thermal accumulators offer an opportunity for storing this energy in a form adapted for heating purposes at a moderate cost. Regarding the installation of generators, the author suggests the construction of barrages fixed in such localities as a gap between mountains, where the prevailing wind is more or less constant in direction. It is also pointed out that after passing an obstacle the wind soon almost recovers its original velocity, so that by fixing several installations one behind the other it is possible to utilise the energy contained in a considerable height of air.—Papers communicated through fellows:—M. Picone: Potential of a double surface layer. This extract from a letter to Prof. Levi Civita deals with a proof that the potential of a magnetic shell has finite, definite value of the surface of the shell except at a singular point.—Prof. A. Lo Surdo: A spectroscope with catoptric grating. This arrangement consists of a number of reflecting laminae of equal thickness overlapping each other by the same amount, their edges thus resembling a flight of steps, by reflection from which a diffraction spectrum is formed of a beam of light incident normally to the laminae.—Prof. G. Magrini: Preliminary notice of the Italian expedition for exploring the seas of the Levant. This expedition formed the part assigned to Italy in carrying out the programme arranged in 1919 under the auspices of the International Commission for the Scientific Exploration of the Mediterranean. For this purpose the *Tremiti*, of 500 tons, was equipped, the fundamental problem to be investigated being the distribution and cause of the currents in the Bosphorus and the Dardanelles.—Dr. C. Perrier: The true nature of Rosasite, ii.—G. Stefanini: Geology of Cyrenaica: i., Eocene strata. An examination of literature and materials, considered especially in relation to the previous researches of Prof. J. W. Gregory (Quart. Journ. Geol. Soc., vol. lxxvii., 1911).—A notice of the life and work of the late Prof. P. A. Saccardo, read on February 6 by Prof. O. Mattiolo, occupies twelve pages at the end of the number of the *Atti* containing the previous papers.

March 20.—F. D'Ovidio, president, in the chair.—Papers by fellows:—F. Severi: Theory of simple integrals of the first species belonging to an algebraic surface, i.—C. De Stefani: Ligurian fossil sponges, v. Mulino di San Giovanni, Biscazza, Casa Buzzano,

Caffarella.—G. **Pellizzari**: Transition from guanidine to cyanoamide, and from diguanide to dicyanodiamide.—Papers communicated through fellows:—C. **Burali-Forti**: Real numbers and magnitudes, i.—A. **Artom**: Apparatus for directional radio-mechanics. The currents from two receivers at right angles (or at any other angle) operate on two separate galvanometer coils, fixed at a similar angle to the receivers, in such a way that the deviation of the galvanometer needle depends on the difference of intensity of the currents generated in the coils, and its position thus indicates the direction from which the radio-telegraphic waves are received. The apparatus admits of several modifications.—The present number of the *Atti* contains obituary notices read at the preceding meeting (March 6) by Prof. R. Pirotta on the late Prof. G. Cuboni, and by Prof. Cerulli on the late Prof. Giovanni Celoria.

NEW SOUTH WALES.

Linnean Society, March 30.—Mr. J. J. Fletcher, president, in the chair.—J. J. **Fletcher**: Presidential address. The work of the society during the past year was reviewed and reference made to recent important events of scientific interest, including the establishment of the Australian National Research Council and of the Commonwealth Institute of Science and Industry; the first Pan-Pacific Science Conference; and the resumption of regular meetings of the Australasian Association for the Advancement of Science. The last part of the address referred to the Macleay Museum of the Sydney University, founded by Sir William Macleay. The history of the formation of the Macleay collections was related. In conclusion, the University of Sydney, which is joint trustee with the society for the museum, was criticised for neglect of its trust. Changes made in the building have caused the disruption of the Macleay collections, so that they no longer form an exposition of the fauna of Australia.—Mr. G. A. Waterhouse, elected president for the year 1921–22, then took the chair.—E. W. **Ferguson**: Revision of the Amycterides (Coleoptera). Part vi., *Acantholophus*. A detailed historical account is given, together with a critical revision of the genus and of the species referred to it. The genus is divided into two sections; in the first, the head is separated from the rostrum by the intercrystal ridge, the prothorax is produced above, and ocular lobes are present; in the second the head is separated from the rostrum by a transverse impression, the prothorax is subtruncate above, and ocular lobes are absent. Fifty-nine species, ten of them new, are referred to the genus.—Dr. R. **Greig-Smith**: The high-temperature organism of fermenting tan bark. Part i. The fermentation of spent wattle-bark in the corrosion of white lead is caused by a stout, rod-shaped bacterium having a terminal spore. Its optimum laboratory temperature is 60° C.; in the corroding stacks the temperature may rise to 80°. Raw spent wattle-bark requires preliminary treatment. As conditions which oxidise tannin substances favour the fermentation of the raw bark, it is probable that the residual tannins inhibit fermentation.

Books Received.

Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat. By Prof. H. S. Carslaw. Second edition, completely revised. Vol. i.: Fourier's Series and Integrals. Pp. xi+323. (London: Macmillan and Co., Ltd.) 30s. net.

The Fine Cotton Spinners' and Doublers' Association. NO. 2693, VOL. 107]

tion, Ltd., Manchester: Experimental Department. A Method for Measuring the Length of Cotton Hairs. By Dr. W. Lawrence Balls. Pp. 62. (London: Macmillan and Co., Ltd.) 3s. 6d. net.

The Purple Sapphire and other Posthumous Papers. Selected from the Unofficial Records of the University of Cosmopoli by Christopher Blayre. Pp. x+210. (London: P. Allan and Co.) 7s. 6d. net.

The Scientific Papers of the Hon. Henry Cavendish, F.R.S. Vol. i.: The Electrical Researches. Edited by Prof. J. Clerk Maxwell, revised by Sir Joseph Larmor. Pp. xxviii+452. Vol. ii.: Chemical and Dynamical. Edited by Sir Edward Thorpe. Pp. xii+496+vi plates. (Cambridge: At the University Press.) 6l. net the 2 vols.

The Salvaging of Civilization. By H. G. Wells. Pp. v+202. (London: Cassell and Co., Ltd.) 7s. 6d. net.

Festschrift der Kaiser Wilhelm Gesellschaft zur Förderung der Wissenschaften zu ihrem Zehnjährigen Jubiläum Dargebracht von ihren Instituten. Pp. iv+282. (Berlin: J. Springer.) 100 marks.

The Psychology of Day-Dreams. By Dr. J. Varendonck. Pp. 367. (London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co.) 18s. net.

The Case-Hardening of Steel. By Harry Brearley. Second edition. Pp. xi+207. (London: Longmans, Green and Co.) 16s. net.

Factory Chemistry: Preparatory to Courses in Metallurgy and Metallography. By Wm. H. Hawkes. Pp. vii+59. (London: Longmans, Green and Co.) 4s. 6d. net.

The Correspondence of Commerce. By A. Risdon Palmer. (Pitman's Commerce Series.) Pp. xii+159. (London: Sir I. Pitman and Sons, Ltd.) 6s. net.

Ameboid Movement. By Prof. Asa A. Schaeffer. Pp. vii+156. (Princeton: University Press; London: Oxford University Press.) 10s. 6d. net.

Medical Research Council and Department of Scientific and Industrial Research: Reports of the Industrial Fatigue Research Board. No. 13: A Statistical Study of Labour Turnover in Munition and other Factories. (General Series, No. 4.) Pp. 92. (London: H.M. Stationery Office.) 3s. net.

Einführung in die Theoretische Physik mit besonderer Berücksichtigung ihrer Modernen Probleme. By Prof. Arthur Haas. Zweiter Band. Erste und Zweite auflage. Pp. vi+286. (Berlin and Leipzig: Walter de Gruyter and Co.) 12s. 6d.

Vorlesungen über die Theorie der Wärmestrahlung. By Prof. Max Planck. Vierte auflage. Pp. xi+224. (Leipzig: J. A. Barth.) 36 marks.

Elemente der Theoretischen Physik. By Prof. C. Christiansen and Prof. Johs. J. C. Müller. Vierte auflage. Pp. xxiv+680. (Leipzig: J. A. Barth.) 80 marks.

Moderne Magnetik. By Felix Auerbach. Pp. viii+304. (Leipzig: J. A. Barth.) 48 marks.

Stanford University Publications: University Series. Mathematics and Astronomy, vol. i. No. 1: Primitive Groups. By Prof. W. A. Manning. Part i. Pp. 108. (California: Stanford University.) 1.25 dollars.

Die Theorie der Allotropie. By Prof. A. Smits. Pp. xvi+500. (Leipzig: J. A. Barth.) 100 marks.

Etudes élémentaires de Météorologie Pratique. By Albert Baldit. Pp. ix+347. (Paris: Gauthier-Villars et Cie.) 15 francs net.

La forme et le Mouvement. Essai de Dynamique de la Vie. By Georges Bohn. Pp. 175. (Paris: E. Flammarion.) 4.50 francs net.

Petrographic Methods and Calculations, with some Examples of Results Achieved. By Dr. Arthur Holmes. Pp. xix+515+iv plates. (London: T. Murby and Co.) 31s. 6d. net.

Diary of Societies.

THURSDAY, JUNE 9.

INSTITUTE OF MINING ENGINEERS (at Geological Society), at 11.—Third Report of the Committee on "The Control of Atmospheric Conditions in Hot and Deep Mines."—J. P. Rees: Observations of Temperature and Moisture in Deep Coal-mines.—Prof. H. Briggs: Characteristics of Outbursts of Gas in Mines.—H. C. Harrison: The Use and Distribution of Shale-dust in Mines. The following papers, which have already appeared in the Transactions, will be discussed:—A. E. Beet and A. E. Findley: The Better Utilisation of Coking Slack.—J. I. Graham: The Normal Occurrence of Carbon Monoxide in Coal-mines.—T. L. Galloway: An Improved Method of Determining the Relative Directions of Two Reference-lines or Bases for Mining Surveys.—E. Bury, W. Broadbridge, and A. Hutchinson: Froth Flotation as Applied to the Washing of Industrial Coal.

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital), at 4.30.—Dr. H. Head: Release of Function in the Nervous System. ROYAL SOCIETY, at 4.30.—Prof. C. S. Sherrington: Break-shock Reflexes and "Supramaximal" Contraction-response of Mammalian Nerve-muscle to Single-shock Stimuli.—R. J. Ludford and J. B. Gatenby: Dietyokinesis in Germ Cells, or the Distribution of the Golgi Apparatus during Cell Division.—Dr. F. W. Edridge-Green: The Effect of Red Fatigue on the White Equation.—E. Ponder: A Method for Investigating the Hæmolytic Activity of Chemical Substances.—W. H. Pearsall: The Development of Vegetation in the English Lakes, considered in Relation to the General Evolution of Glacial Lakes and Rock Basins.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—M. J. Conran: Curvature and Torsion in Elliptic Space.—J. L. S. Hatton: The Inscribed, Circumscribed, and Self-conjugate Polygons of Two Conics.—M. J. M. Hill: The Differential Equations of the First Order derivable from an Irreducible Algebraic Primitive.—F. S. Macaulay: Note on the Resultant of a Number of Polynomials of the Same Degree.—Lt.-Col. A. Cunningham: The Congruence $2^{p-1} \equiv 0 \pmod{p^2}$.—T. Stuart: Diophantine Equations.—G. H. Hardy: A Chapter from Ramanujan's Note-book.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. L. Golla: The Objective Study of Neurosis (Croonian Lecture). ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—H. S. Goodhart-Rendel: Some Fashions in Architecture. OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—H. Lee: Achromatism.—W. L. Custance: Demonstration of the *Société Gènevoise* Universal Measuring Machine. PAINT AND VARNISH SOCIETY (at St. Bride's Institute), at 7.30.—C. A. Klein: The Need for Science and Common Sense in the Practical Testing of Paints.

FRIDAY, JUNE 10.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir George Curtis: The Development of Bombay.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rev. J. G. Hagen: The Origin of Temporary Stars and of Planetary Nebulæ.—S. D. Tscherny: Results of Observations of Sun-spots and Faculæ, 1916-1920, made at the Observatory, Rostov-on-Don.—A. A. Rambaut: Parallaxes of 516 Stars, from Photographs taken at the Radcliffe Observatory, Oxford.—E. A. Milne: Radiative Equilibrium: The Effect of a Strong Absorption Line.—W. M. Smart: Proper Motions of Stars in the Pleiades.—Rev. A. L. Cortie: The Sun-spot Group and the Magnetic Disturbances, 1921 May 8-21.—F. Sargent: Remarkable Spot on the South Equatorial Belt of Jupiter.—Rev. T. E. R. Phillips: Micrometrical Measures of Double Stars.—Royal Observatory, Greenwich: Note on the Measurement of Groups of Sun-spots.—Royal Observatory, Greenwich: Observations of Comets *a* 1921 (Reid); *b* 1921 (Pons-Winnecke); *c* 1921 (Dubiago).

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Sir Ernest Rutherford: The Stability of Atoms (Lecture). ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. G. Webster: Absolute Measurements of Sound.

TUESDAY, JUNE 14.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. L. Golla: The Objective Study of Neurosis (Croonian Lecture).

WEDNESDAY, JUNE 15.

ROYAL METEOROLOGICAL SOCIETY, at 5.—G. M. B. Dobson: Causes of Errors in Forecasting Pressure Gradients and Wind.—R. F. Granger: The Physical Structure of Cloud-Form in the Lower Atmosphere.—N. A. Comissopulos and J. Wadsworth: Variability of Temperature over North America and Europe during the Ten Years, 1900-1909.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Prof. F. J. Cheshire: A Selection from the Abbe Letters.—Dr. C. F. Sonntag: Some Points in the Histology of the Three-Toed Sloth.—F. Chapman: Ostracoda, Foraminifera, and Some Organisms related to Calcosiphæra, from the Devonian of Germany.—G. T. Harris: Note on Mounting in Glycerine Jelly.

THURSDAY, JUNE 16.

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital), at 4.30.—Prof. W. Bulloch: Use and Abuse of Scientific Medical Literature.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Prof. H. B. Dixon, Dr. C. Campbell, and Dr. A. Parker: The Velocity of Sound in Gases at High Temperatures, and the Ratio of the Specific Heats.—Prof. J. R. Partington: The Ratio of the Specific Heats of Air and of Carbon Dioxide.—Dr. A. B. Wood and Dr. F. B. Young: "Light Body" Hydrophones and the Directional Properties of Microphones.—Dr. A. B. Wood and Dr. F. B. Young: The Acous-

tic Disturbances produced by Small Bodies in Plane Waves transmitted through Water, with Special Reference to the Single Plate Direction Finder.—M. A. Giblett: Some Problems connected with Evaporation from Large Expanse of Water.—F. C. Toy: The Photographic Efficiency of Heterogeneous Light.

LINNEAN SOCIETY, at 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. L. Golla: The Objective Study of Neurosis (Croonian Lecture).

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Prof. B. Moore: The Natural Photo-synthetic Processes on Land and in Sea and Air, and their Relation to the Origin and Preservation of Life upon the Earth (Hugo Müller Lecture).

RÖNTGEN SOCIETY (at University College), at 8.15.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.15.—Lecture.

ROYAL SOCIETY OF MEDICINE (General Meeting), at 8.30.—Sir Thomas Horder, Dr. A. F. Hurst, Sir Berkeley Moynihan, Sir Humphry Rolleston, and Others: The Problem of the Private Clinic System in Great Britain.

FRIDAY, JUNE 17.

ROYAL ASTRONOMICAL SOCIETY, Geophysical Discussion, at 5.—Changes of Level in the British Isles, opened by H. L. P. Jolly, followed by Col. Sir C. F. Close and O. G. S. Crawford. Chairman: Col. Sir G. Lenox-Conyngham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—J. C. Warburg: Foregrounds.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8.15.—Dr. C. Addison: The Part of the State in the Prevention of Disease (Cavendish Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir J. J. Thomson: Chemical Combination and the Structure of the Molecule.

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