NATURE

SATURDAY, MARCH 15, 1924.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

NO. 2837, VOL. 113]

The Development Commission.[1]

THE periodical reports of the Development Commissioners, in so far as they are concerned with scientific research, possess an especial interest. Historically, the institution of the Development Fund was the first recognition by the State that the best chance of rehabilitating our outworn industries lay in the organised promotion of scientific research. It was fitting that this recognition should first be given to such vital industries as those concerned with the nation's food supply—agriculture and fisheries. It is, perhaps, not sufficiently recognised that the organisation of State aid for industrial research in Great Britain is still in the experimental, or evolutionary, stage. Fundamentally, the Development Commission is a purely advisory body : whereas subsequent authorities, such as the Department of Scientific and Industrial Research and the Medical Research Council, have been endowed with varying degrees of executive powers ; and the last-mentioned bodies differ *inter se*, also, in the degree in which laymen control executive and administrative decisions in relation to matters in which expert scientific knowledge is requisite.

There is another direction in which the experimental aspect of the relations between the State and science may be emphasised, and that lies in the extent to which research in pure science is aided. It is true, historically, that the great discoveries of science which have subsequently led to industrial expansion related to what is now known as pure science. When made, these discoveries, in lay opinion, would not have been regarded as "results" justifying the expenditure of the taxpayers' money in their further exploitation. Who could have foreseen that the severely academic researches of Clerk Maxwell would, in time, give birth to that wonderful means of entertainment and instruction—"broadcasting"? It is perhaps permissible to say, therefore, that the grant of State money to what may be styled *ad hoc* research, in so far as it tends to exclude, or to minimise the importance of, "pure" scientific research, is not an unmixed blessing.

Using the report under notice, as the authors proclaim it to be, as a "Directory to the activities of the Stations aided by the Development Fund," one can indicate some of the difficulties which hamper the scientific worker who endeavours to solve the "farmer's problems." The ultimate problem of the industrialist must always be—does this or that pay? This question often presents almost insuperable difficulties. Not only is it remote from the ordinary interests of the

[1] Development Commission. Thirteenth Report of the Development Commissioners for the Year ended the 31st March 1923. Pp. v+136. London: H.M. Stationery Office, 1923.) 4s. net.

scientific worker, but it also involves a consideration of the ever-fluctuating values of materials and labour, a subject which, in these post-War days, does not lend itself to scientific treatment. Owing to the superadded variations of soil, climate, and markets, in the case of agriculture, this difficulty is more pronounced. Thus, on an early page of the report we find that an Institution is "investigating the precise effects of electrical discharges on plants and the possibility of adopting electrocultural methods *commercially*." On the other hand, in reading the long list of publications issued by the workers of the Rothamsted Laboratory, one notices a number of papers on subjects which, so far as can be judged by their titles, relate to matters of fundamental scientific importance rather than of directly practical interest.

Turning to matters of less speculative interest, one finds indications of that careful attention to questions of principle which always distinguishes the reports of this department. In general outline, agricultural research follows a carefully-thought-out scheme, or plan, of which one unique feature is the provision of a link between research and the practitioners for whose benefit it is undertaken. There is now a staff of thirty-five investigators of the second order, "Advisory Officers," specialists who are called in to assist when problems arise which require investigation or a specialist's knowledge of scientific results.

It would be impossible to notice, in any detail, the multitude of topics of scientific interest which this report brings to the surface. They can be discussed more appropriately in reviews of the various scientific periodicals in which specific publication of results takes place. In regard to the finance of the Fund, some comments perhaps may be made. The original conception, due to Mr. Lloyd George, was to create a Fund from which moneys could be expended without subjection to the annual scrutiny of Parliament with its inevitable clamour for "results." It would appear that the Old Fund has now been exhausted, and that so far as the upkeep of existing schemes is concerned, the Commissioners are dependent on an annual Parliamentary Grant limited to actual requirements. But there is now a Special Fund created by the grant of 850,000*l.* under the Corn Production (Repeal) Act, 1921. In the year 1922–23 the expenditure from the Old Fund amounted to 289,246*l.* and from the Special Fund 110,056*l.*, and the latter now has a balance of 748,843*l.* It would appear that the Commissioners have successfully conquered the antinomy created by the fact that while they are enjoined by the Treasury to practise Geddesian economy with the Old Fund, they can open the purse-strings of the Special Fund without reproach!

Science for the People.

(1) *Atoms and Electrons.* By J. W. N. Sullivan. (People's Library.) Pp. 188. (London and Toronto: Hodder and Stoughton, Ltd., 1923.) 2*s.* 6*d.* net.

(2) *The Atom and the Bohr Theory of its Structure: an Elementary Presentation.* By H. A. Kramers and Helge Holst. Translated from the Danish by R. B. Lindsay and Rachel T. Lindsay. Pp. xiii + 210. (London, Copenhagen and Christiania: Gyldendal, 1923.) 10*s.* 6*d.* net.

SCIENCE is steadily becoming severely specialised. The proportion of amateurs (in the restricted sense of the word) among original workers of all ranks decreases slowly but surely. The average "educated" man of to-day knows less and cares less about the natural world in which he lives than did the average "educated" man of the Victorian era. A scientific event, such as an eclipse of the sun, which in the 'seventies claimed day after day several columns of newspaper space, is now dismissed in a few short paragraphs. When, as occasionally happens, science emerges for a brief interval above the welter of political and commercial intrigue, it is by virtue either of some achievement which may be used for practical ends, such as wireless telephony, or of some sensational development, like the theory of relativity, which provides entertainment and a passing relief from the stress of more attractive matters. The keen, active interest of the amateur in science for its own sake, though happily still conspicuous in some quarters, is unmistakably on the wane.

This is a tendency which must arouse deep concern in the minds of all true lovers of science. The causes are probably very intricate, and are not to be found in any one direction. The rapid multiplication of human interests, the increasing complexity of scientific conceptions, the popularising of other departments of thought, the quickened sense of urgent responsibility for social evils—these and many other factors doubtless contribute in greater or less measure to the comparative neglect of pure science as an instrument of culture. The appearance of the two books under consideration turns our thoughts to another possible factor: have our expositors lost the power of inspiring enthusiasm in their readers for the subjects to which they themselves are devoted? To some extent we believe they have, though for clearness of expression and accuracy in matters of detail, some modern popular scientific treatises could scarcely be improved upon. The occasion is perhaps opportune to set on record a few principles which we believe to be particularly applicable to the circumstances of our own time. The inspiration of genius, which more than compensates

for the lack of such principles, is independent of time.

The problem of popular exposition has assuredly never been so difficult as it is now. When a diffuse nebula was found to be a gas and not a collection of stars, it was easy to say so; people could appreciate the fact and wonder at it. But when one of the greatest advances of a decade arises from the idea that radiation involves the unimaginable transformation of the "negative energy" of orbital revolution into electromagnetic oscillations in an ether which may not exist—how is one to say so in a manner "understanded of the people"? It seems that the time has come when popular science can no longer be a repetition of esoteric science in simple language. He who would make plain the progress of science must adopt one form of exposition for the specialist and another for the general reader.

A work of science must be presented as a work of Art, which indeed it is; it has a technique for the student and a soul for the amateur. The ordinary man is not enlightened by being told the principles of transformation from one set of axes to another in a space-time system, however clearly those principles are expressed. What is of importance to him is the fact that Nature includes such transformations as a physical possibility. It is not necessary to see a man's skeleton in order to understand the qualities of his heart, nor is it necessary to track every step of science in order to see the direction in which it is moving.

It is, we believe, the general tendency of modern writers to say too much for popular consumption. In a science advancing so rapidly as is physics at the present time, many conceptions are formed which have the character of tools rather than that of a finished product. They are necessary only until clearer knowledge is obtained, after which they will pass out of sight. Such, for example, are the idea of a "warped space," and the present models of the arrangement of electronic orbits in atoms. Necessary factors as these conceptions undoubtedly are to the progress of science, we believe it to be a mistake to lay them before the general reader in carefully selected language, embellished with necessarily imperfect verbal illustrations. For his purpose, the mastery of such notions, even if it could be achieved, would not be worth the effort expended. Worst of all, they are not likely to inspire him with a determination to pursue the matter for himself. He has scarcely worked them into his consciousness when they are discarded and other conceptions take their places. Far better is it to suppress them altogether and to present, in language as true and vivid as possible, the more general principles and the broader lines of research which characterise the present age.

It is not our intention in the foregoing paragraphs to suggest a method of evading difficulties. We are not concerned with making science easy of comprehension, though we are concerned with making it intelligible. Science, especially in these days, is a sealed book to those who will not or cannot think. Science made intelligible is, we believe, a worthy aim, for which many sacrifices might well be made: science made easy can only be science made unscientific. Nor is there any need to avoid subtleties of reasoning. The "man in the street" is not a babe, to be fed with milk in anticipation of the time when he will be ready for meat. His intellect and powers of reasoning may be quite as robust as those of the man of science, only they have developed in other directions. His science should be no less manly than that of the specialist, but it should be more general and simple in the true sense of the word. In satisfying or creating his need, there should be no regrets for the details and fine shades of difference which must be left outside.

Statements at which a scientific critic would cavil should not be shunned if they convey the truth. We do not wish to justify verbal inaccuracy in general, though there may be particular instances in which we would uphold it, but we would decidedly look with less disfavour on a verbal inaccuracy which conveyed the true spirit of the matter than on a correct statement which had twisted itself into an almost unintelligible form in order to save the writer from the criticism of scientific purists for whom his work was not intended. From this point of view, it is scarcely reasonable to submit a work, professedly of a popular nature, to a critical and detailed review.

Most certainly would we prefer such an inaccuracy to a false step in reasoning, whatever the advantages to which it may lead. Thus, when Mr. Sullivan, in one of the books before us, defines the C.G.S. unit of force as "that force which gives to a mass of one gramme a velocity of one centimetre per second in a second," we hold that, although the statement lacks much in precision, to say the least of it, he is perfectly justified in making it, because it will be properly understood by those for whom he is writing. But when, having on p. 27 stated that "atoms are indivisible in the sense that less than one of them *cannot* take part in *any* chemical reaction," he proceeds on p. 30 to derive atomic weights from the assumption that "the smallest part of an element which *takes* part in any *known* chemical reaction is called an atom," we cannot allow our admiration of the clearness of the succeeding argument to temper our condemnation of the fault which he has committed. He has sinned against logic, and logic is not a monopoly of the specialist; it is universal, and its universality should be respected.

It is unfortunate that these remarks should have been elicited by the two books named above, for they are among the very best of their type. Though to some extent they come under the general criticism we have ventured to make, yet they have qualities which many will consider to outweigh by far any defects which they might have. Mr. Sullivan has written a very lucid and accurate little book which covers sufficient ground to make it almost a handy reference work to modern physical ideas. The reader is first introduced to atoms and molecules as units, and to their outstanding physical and chemical properties. Following a discussion of the constituents of the atom as revealed by cathode rays and radio-activity, and a short account of X-rays, the Rutherford atomic model is described, and notes on isotopes and the restricted theory of relativity are given. The author then shows how classical mechanics fails to explain atomic processes, and introduces the quantum theory, after which the Bohr atom, with a considerable amount of evidence for and deduction from it, claims attention. The book concludes with a discussion of the arrangement of electrons in atoms, including Bohr's recent suggestions with regard to the structure of the heavier elements and the explanation of the periodic table. The book is very interesting, very clear, and the information given is quite trustworthy.

The work of Drs. Kramers and Holst, to which Sir Ernest Rutherford contributes a short introduction, covers almost the same ground as that of Mr. Sullivan, but the method of treatment is different. Instead of an exposition in which each topic has an equal intrinsic interest, we have a discussion in every part of which the spirit of the Bohr theory walks abroad. The authors wrote the earlier chapters—which nevertheless are clearly and adequately expressed—with a far-away look in their eyes, and it would be truer to say that they live with and chat about the Bohr theory than that they formally describe it. No previous knowledge, however, is required on the part of the reader. Successful as the authors are in producing an interesting and valuable book, we cannot but feel that an attempt to explain the meaning of "quantum numbers" in non-technical language is an efflux of enthusiasm which must necessarily end in failure. The attempt, however, has the advantage of making the book extremely valuable to the not inconsiderable number of physicists who feel the need of a general and authoritative account of the latest speculations on these matters. A word of praise is due to the translators for the service they have rendered to English-speaking people and for the manner in which their task has been performed: our only complaint—a serious one—is that they have not included an index.

Organic Chemistry.

(1) *Organic Chemistry for Advanced Students.* By Prof. J. B. Cohen. Fourth edition. Part 1: Reactions. Pp. viii+423. Part 2: Structure. Pp. vii+461. Part 3: Synthesis. Pp. vii+412. (London: E. Arnold and Co., 1923.) 18*s.* net per volume.

(2) *Systematic Organic Chemistry: Modern Methods of Preparation and Estimation.* By William M. Cumming, I. Vance Hopper, and T. Sherlock Wheeler. Pp. xxii+535. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 25*s.* net.

(1) PROF. COHEN'S work is well known to all serious students of organic chemistry, and for some years has been the best résumé of modern theories and advances in that branch. The last few years have seen important discoveries and a considerable change in outlook towards this subject, and a new edition of "Organic Chemistry for Advanced Students" is very welcome. The work of revision has been very thorough and the volumes have grown considerably; the publishers are therefore to be congratulated on issuing them at the old price, though this has involved some slight irregularity in the appearance of the pages, obviously caused by the avoidance of the heavy expense of resetting the whole work. One cannot but feel that the consideration for the pocket of the student is justified, particularly as clearness has been in no way sacrificed, and only the fussy will bewail that the ensemble is not quite perfect in a volume which is meant for use rather than for ornament.

As indications of the increased scope of the work, one may mention the inclusion of the work of Thorpe and his school on spiro-compounds, on Baeyer's strain theory and on the glutaconic acids; the application of the Lewis-Langmuir theory to organic compounds, with a clear expression of the views of Lapworth and Robinson on alternate polarities; the work of Sir William Bragg and his collaborators on the crystal structure of organic compounds, and that of Baly and Heilbron on photo-catalysis. These are but a few of the new subjects touched upon.

It seems almost improper for one whose love for organic chemistry was first stimulated by the first edition of this book to offer criticism, but one cannot help feeling that the gradual departure in successive editions from the original intention has, in some respects, spoilt the value of the book, especially to undergraduates in the honours schools of chemistry. The author in the first edition explained that the book was based on his own lectures to honours students; the second edition, according to the author's preface, was not intended to be a book of reference, but this reservation no longer appears and the volumes are becoming

overcrowded with detail and correspondingly difficult to read. Revision in the way of elimination and selection of material seems to be needed. As examples, it may be quoted that consideration of the relation between constitution and colour occupies no less than fifty-four pages, much more than the importance of this subject justifies. In the section on reactions the number of examples given is often too many, whilst Zincke's reaction is scarcely worth mention and Kolbe's electrolysis of the fatty acids is mainly of historical interest. Even some of the new work is not presented in quite a true perspective, and it is doubtful whether the polarity theories of various kinds have sufficiently emerged from the nebulous condition to be presented to students without some reservation.

The growth of other branches of chemistry and of organic chemistry itself is putting an almost impossible strain on the memories of students. Those responsible for the training of undergraduates are realising that it is becoming imperative to eliminate detail as much as possible, together with unimportant side-issues, and to concentrate on the really fundamental phenomena of chemistry. In so far as the author has departed from the original happy inspiration of producing a readable volume, the new edition is somewhat disappointing. The many excellencies of the work are too well known to require recapitulation, and one must be grateful to Prof. Cohen for his labour. He has done much for the advancement of British chemistry by making the British student independent of those foreign works which lack the impartiality which he shows. It is difficult to see how any student reading for honours in chemistry can deny himself the advantage of possessing Prof. Cohen's book, which presents a review of organic chemistry unobtainable short of reading through hundreds of original papers and monographs.

(2) This volume is a text-book of practical organic chemistry conceived on somewhat novel lines, but, though the design is excellent, the execution leaves much to be desired. The errors begin early in the book; in the list of abbreviations, *Chimie* is spelt with two "e's," the *Phil. Mag.* is described as the "Magazine of the Philosophical Society (London)," and *analytische* is spelt without the "i."

Part 1 deals with general hints on manipulation and methods, but it may be urged that thirteen lines devoted to the use of the library are quite inadequate. The hint that if the student's yield differs by more than 10 per cent. from that stated, the cause should be sought and the experiment repeated, is excellent advice, but there might be occasions when repetition was unnecessary; for example, in the preparation of benzaldehyde described on p. 224 by the Etard reaction, the yield given is 1000 per cent. of that calculated on the toluene employed, and more than 1100 per cent. on the chromyl chloride used. It is rather surprising to find it stated that concentrated sulphuric acid, phosphorus pentoxide, and solid potassium hydroxide are equal in drying power. In the few lines devoted to pumps for vacuum distillation, no mention is made of the latest types of mercury pumps, whilst the statement that the lowest pressure obtainable with a water pump is the vapour pressure of the water at the particular temperature is not strictly accurate; neither is it correct to say that if the melting point of two substances melting at the same temperature is not depressed on mixing them, they are one and the same compound. The figures are not always satisfactorily drawn; for example, in Fig. 16, the apparatus for continuous distillation is out of scale, and the boiling flask would be empty long before the receiver was full enough for water to flow back via the side tube.

In Part 2 details are given of a large number of interesting preparations, but here again mistakes occur, and although the methods of preparation are supposed to be modern, this is not always the case; for example, the best methods of preparation of diazomethane, benzene-sulphonic acid, and methyl iodide are not described. In the preparation of benzantialdoxime, the hydrochloride does not separate from the alkaline solution, and the description of the action of dehydrating agents on isomeric oximes is quite misleading. Some of the descriptions suggest that the authors have not had practical experience of the preparations; it is expecting too much to obtain an almost theoretical yield of benzsynaldoxime by the method given, and those who have had experience of the small scale preparation of *p*-phenetidine will be sceptical of obtaining a satisfactory product from ten grams of *p*-nitrophenetol; it is noteworthy that no yield is given in this case. The use of a corked conical flask for the preparation of acetamide from ethyl acetate and ammonia is distinctly dangerous; flasks of this shape will not stand pressure, and the present writer has not infrequently known them to burst in similar circumstances, sometimes with unfortunate results to the experimenter.

Part 3 deals with quantitative analysis and is somewhat freer from mistakes, though methyl orange is prescribed as indicator for back titration in the estimation of esters by hydrolysis. In Part 4 a number of inorganic reagents and preparations are described, and the book concludes with qualitative tests for the commoner organic acids, alkaloids and carbohydrates. The osazone method for distinguishing the sugars is not described, and as the compounds mentioned are but few, and no general method of qualitative analysis is indicated, the chapter serves no useful purpose.

L I

Man's Antiquity and Origin.

Fossil Men: Elements of Human Palæontology. By Prof. Marcellin Boule. Translated from the French, with an Introduction, by Jessie Elliot Ritchie and Dr. James Ritchie. Pp. xxvii+504. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1923.) 36*s.* net.

THE translators of Prof. M. Boule's standard treatise, "Les Hommes fossiles," have accomplished their task exceedingly well. They worked from the first edition, which has been already reviewed in our pages (NATURE, May 12, 1921, p. 322), and the translation was already standing in page proof when Prof. Boule brought out a second edition. By references inserted in the text, and by the addition of an appendix the translators have made all the additional matter of the second edition available for English readers.

A close study of "Fossil Men" in its English dress confirms the high opinion formed on reading it in the original. In his new edition Prof. Boule has taken the opportunity to alter or modify former expressions of opinion. In the earlier edition he did not hesitate to assign the lower jaw found at Piltdown to an extinct form of chimpanzee; he is now almost prepared to admit that it may be part of Piltdown man. Since the appearance of the first edition M. l'Abbé Breuil has been convinced that Mr. Reid Moir and Sir Ray Lankester are right in regarding certain flints found beneath Pliocene (Red Crag) deposits in Suffolk as being of human workmanship. This conversion has clearly had some influence on Prof. Boule, but he "cannot share the opinion of certain of my fellow-workers, more enthusiastic than critical, that they (these new observations) definitely settle the question."

Amongst other additions made to the second edition and included in this translation are (1) a description of the lower jaw of a child found in the famous Pleistocene deposits at Ehringsdorf near Weimar in 1916, and attributed by Prof. Boule to the period of Acheulean culture; (2) a child's skull from the Mousterian beds at La Quina, described in 1921 by Dr. Henri Martin; (3) the remarkable ivory statuette of a very fat lady, found last year in a cave in the south-west of France. Prof. Boule describes this latest discovery of palæolithic art as queen of the Aurignacian Venuses; (4) the Rhodesian skull is described, and its mixture of Neanderthal and Australian features duly noted. Indeed, from a reviewer's point of view it was fortunate that Dr. and Mrs. Ritchie had proceeded so far with their task before Prof. Boule's new edition appeared, for the appendix of additions makes an excellent summary of recent discoveries relating to the prehistory of man.

Our Bookshelf.

On the Application of the Quantum Theory to Atomic Structure. By Niels Bohr. Part 1: The Fundamental Postulates of the Quantum Theory. (Proceedings of the Cambridge Philosophical Society: Supplement.) Pp. 42. (Cambridge: At the University Press, 1924.) 3*s.* 6*d.* net.

ENGLISH readers will welcome this authoritative account by Prof. Bohr of the application of his theory to atomic structure. The essay has been translated from the *Zeitschrift für Physik* by L. F. Curtiss with the author's concurrence. It follows the third of the three essays contained in "The Theory of Spectra and Atomic Constitution," published in 1922, and forms the first of a new series expounding systematically the problems of atomic structure.

The three chapters deal with the fundamental postulates of the quantum theory. The first postulate is concerned with the so-called "stationary states" for an isolated atomic system. The fixation of these states for simply and multiply periodic systems is a problem of no little difficulty, which has gradually advanced by contributions from a great number of authors. In the presence of an external conservative field of force further difficulties are met with, but a simple analytical treatment is here given in which Prof. Bohr has had the co-operation of Dr. Kramers. When an atom is affected by radiation, or when we consider a collision between two atoms, it is necessary to introduce further conditions such as the adiabatic principle of Ehrenfest. The significance of this principle is extraordinarily great, since it leads to the elucidation and development of formal methods for fixing the stationary states. The "weights" to be attributed to these states in the calculation of the probability may be determined by a method also due to Ehrenfest.

Chap. ii. takes up the radiation problem, starting with a statement of Bohr's frequency relation, which is to be applied to every emission and every absorption of radiation. The fact that the laws of the classical theory are suitable for the description of the phenomena in a limited region is explained by the Correspondence Principle. This principle throws light on the fixation of the stationary states, and may afford a formal interpretation of the continuous spectrum.

In chap. iii. the formal nature of the theory is discussed and reference is made to Einstein's hypothesis of light-quanta and to Whittaker's quantum mechanism. The principles mentioned above are to be regarded purely as laws of the quantum theory, which give us a hope in the future of a consistent theory capable of reproducing the characteristic advantages of the newer conceptions and at the same time of being regarded as a rational generalisation of classical electrodynamics.

Zum sechsten Erdteil. Die zweite deutsche Südpolar Expedition. Von Dr. Wilhelm Filchner. Pp. xix+410. (Berlin: Verlag Ullstein, 1923.) n.p.

DR. FILCHNER'S account of the German Antarctic Expedition of 1910–12 has been long delayed, but its appearance is welcome, for it adds an important chapter to the story of the exploration of the Weddell Sea. The *Deutschland* essayed to follow up the work of the *Scotia*, and like the *Scotia* was well

equipped for oceanographical work. Dr. Filchner hoped also to set up a winter station in the far south as a base for the exploration of the ice-cap.

After some preliminary work on the east of South Georgia a spring voyage was made to the little-known South Sandwich group. Heavy seas prevented a landing, but some useful observations were made. On the return of the ship to South Georgia the voyage into the Weddell Sea was begun. Without any great difficulty a high latitude was reached, and Luitpold Land was discovered between lat. 76° and 78° S. This is clearly an extension of Coats Land: the link between the two was discovered by Shackleton three years later. An ice-barrier, called now the Weddell barrier, was found in lat. 78° S. The expedition followed its edge in a north-westerly direction for about 100 miles. Pack-ice barred further progress. This barrier would appear to be comparable with the Ross barrier, but the Germans did not penetrate to the south. Several ice-free nunataks, some ten to fifteen miles from the edge of the ice-cap, unfortunately were not visited. Their examination would have thrown light on the structure of Coats Land.

Considerable space is occupied with an explanation of the failure to find a suitable site for winter quarters and the disaster that befell the hut built on barrier ice in Vahsel Bay. Eventually the plan of wintering was abandoned, and the ship stood northward. Beset in the pack, she drifted to the north during the winter, an experience comparable with that of Shackleton's *Endurance*, but was released uninjured in the spring and returned to South Georgia. The book gives a good account of the oceanographical work, which was important, and is well illustrated with photographs and maps. R. N. R. B.

The Chemistry of Paints, Pigments and Varnishes. By J. Gauld Bearn. Pp. x+277+11 plates. (London: Ernest Benn, Ltd., 1923.) 30*s.* net.

MR. BEARN states in the preface to his book that it is addressed to works managers, students, those engaged in the industry, analysts, and architects. Clearly such a wide field could not be covered satisfactorily in one volume, although each type of reader will find in it something of interest and value. The inevitable result of this ambitious programme is that the analytical and manufacturing details are too sketchy to be of much service to specialists, and the student will find too much of the book taken up by elementary chemistry, the nomenclature of which is generally antiquated and not used consistently. Although the author warns us on p. 214 not to confuse "benzene" with "benzine," yet he does so himself throughout the book. The size of the volume is unnecessarily increased by dividing the text into numerous small paragraphs, sometimes mere sentences, and there is much repetition. Thus, on p. 29 we are told no less than three times that barytes is an "ideal adulterant" for white lead, and this is repeated in other places. The style on the whole is good and concise, but far too many errors have been overlooked in the proof-reading. Such statements as that amyl alcohol "rotates the flame of polarisation" should not have escaped even a casual reader, yet they are numerous. Many of the line drawings of chemical apparatus are incorrect and show immediately obvious faults. Thus, the Schrötter apparatus on p. 32 has no outlet for gas, the Soxhlet apparatus on p. 22 would not work, and the Liebig's condenser on p. 197 is fitted up in the way all students are taught not to adopt. The half-tone illustrations are well produced but teach nothing as to the working of the plant. Mr. Bearn's book is presumably intended to be useful to business men not connected with the industry, and to give a bird's-eye view of the subject.

Volumes moléculaires: Applications. Par Prof. A. Leduc. Pp. 120. (Paris: Gaston Doin, 1923.) 8 francs.

DURING the past thirty-two years, Prof. Leduc has conducted extensive researches on the physical properties of gases, based on experiments of a high order of exactitude. These researches are contained in memoirs published in the *Annales de Chimie et de Physique* and in the *Journal de Physique*. The present publication is a brief summary of the main results, and deals with such topics as atomic weights, dissociation, internal pressure, the velocity of sound in mixtures of gases and vapours, specific heats, etc. The calculations are based on a modified form of Boyle's Law, and on a form of the reduced equation of state of a gas slightly different from that of Van der Waals and also from the more complicated form of Clausius. The author uses the "*principle of corresponding states*" enunciated by himself in 1892, namely, that "in corresponding states, the relative molecular volumes of all gases are equal": the relative molecular volume is the quantity Mpv/RT, where M is the mass of gas having pressure p and volume v at absolute temperature T, and R is the usual universal constant. S. B.

Chance, Love, and Logic: Philosophical Essays. By the late Charles S. Peirce. Edited with an Introduction by Morris R. Cohen. With a Supplementary Essay on the Pragmatism of Peirce by John Dewey. (International Library of Psychology, Philosophy, and Scientific Method.) Pp. xxxiii+318. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1923.) 12*s.* 6*d.* net.

THIS is a manufactured book with a misleading title. The author, who died a few years ago (the book does not contain a biographical notice), was a distinguished mathematician who contributed numerous articles of a general and popular philosophic interest, mostly book reviews, to the journals of his time. Neither the selection of the essays in the volume nor the title of the volume were in any way whatever intended by the author for the form they have received.

Die Atome. Von Prof. Jean Perrin. Mit Autorisation der Verfassers Deutsch; herausgegeben von Prof. Dr. A. Lottermoser. Dritte erweiterte Auflage. Pp. xx+213. (Dresden und Leipzig: Theodor Steinkopff, 1923.) 5*s.*

ALL that need be said of this German translation of Prof. Perrin's book is that it is less complete than the new English translation which was reviewed in NATURE of July 14, 1923, p. 52, and has therefore nothing to recommend it to English readers.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Hafnium Content of some Historical Zirconium Preparations.

THE investigation of a very great number of ores containing zirconium has revealed the presence of hafnium without exception. (Comp. the December issue of the Journ. Chem. Soc., 1923.) The hafnium content, which could be readily estimated by quantitative X-ray spectroscopy as devised by Coster (*Chem. News*, 127. 65, 1923), was found to vary greatly for different ores as described in detail in the paper referred to. For the larger number of ores investigated, the hafnium content varied between 2 and 6 per cent. For certain zirconium ores the hafnium content, however, was only 1 per cent. or less, while for a few very rare ores, referred to below, hafnium is present in even larger amount than zirconium.

On account of the extraordinary similarity of the properties of these elements, the separation of hafnium from zirconium is more difficult, perhaps, than the separation of any two other known elements. Accordingly we should anticipate that every sample of zirconium hitherto prepared would prove to be a mixture of zirconium and hafnium. This conclusion has been fully borne out by the investigation of a large number of zirconium samples prepared by well-known chemists. By great courtesy from different sides we have been enabled to examine samples prepared, among others, by Julius Thomsen, the famous thermochemist, Rammelsberg, the well-known mineral chemist, Nordenskjöld, Lindström, and Weibull, all known experts on the chemistry of zirconium. All these samples contained hafnium in different amounts, depending in most cases not so much on the different chemical treatment as on the ore from which they were prepared.

Especially the investigation of preparations made by Marignac, certainly after Berzelius the greatest authority on the chemistry of zirconium, gave results of exceptionally high interest. To disprove the correctness of the statement of Svanberg (1845) and Sjögren (1852) that zirconium is a mixture of different elements (a statement which has—as we know to-day—nothing to do with the presence of hafnium in zirconium), he prepared from hyacinth from Ceylon the compound K_2ZrF_6, determined its solubility in water, crystallised it afterwards several times and repeated the solubility measurements. Should zirconium be a mixture of different elements, the corresponding double fluorides would exhibit different solubilities and the complexity of zirconium would be revealed by the solubility measurements. Marignac, in carrying out the experiment, found no such difference and concluded accordingly that zirconium was not a mixture of different elements. Through the great courtesy of Prof. K. Freudenberg in Karlsruhe we came into possession not only of K_2ZrF_6 prepared by Marignac, but also of a whole collection of double fluorides of zirconium prepared by this investigator and including: $(NH_4)_2ZrF_6$; $ZnZrF_6+6H_2O$; $Cd_2ZrF_8+6H_2O$; $MnZrF_6+5H_2O$; $Cu_2ZrF_8+12H_2O$; $Cu_3Zr_2F_{14}+16H_2O$; $NiZrF_6+6H_2O$; $Ni_2ZrF_8+12N_2O$; $K_2NiZr_2F_{12}+8H_2O$.

The origin of these samples is highly interesting. On September 3, 4, and 5, 1860, some of the greatest chemists of the last century assembled in Karlsruhe to discuss the controversial views on chemical formulæ as mainly advocated by Berzelius's followers on one side and by those of Gerhard on the other. We find thus in the list of members, among others, the names of Baeyer, Bunsen, Cannizzaro, Dumas, Kekulé, Marignac, Mendeléeff, Stas, Strecker, Thenard, Weltzien, Wurtz, and so on. The Congress was arranged by Weltzien, Wurtz, and Kekulé. Weltzien was at this time professor of chemistry in the Technical High School of Karlsruhe; he was a man of the world with far-reaching international connexions and also an intimate personal friend of Marignac.

When coming to the Congress, Marignac presented his friend with the unique collection of his preparations. The famous petroleum expert, Prof. Engler, a pupil, assistant and successor of Weltzien, heard the latter often relate the history of this Congress and of Marignac's preparations. It is to him and his successor in the chair of chemistry, Prof. Freudenberg, that the writer owes the above description. The investigation of Marignac's samples revealed the presence of 1 per cent. hafnium in his K_2ZrF_6, and a hafnium content varying between 5 per cent. and ½ per cent. in the other preparations. Hyacinths as used by him contain in general about 5 per cent. hafnium. When crystallising these compounds the hafnium would accumulate in the mother liquor, and when preparing his crystallised compounds Marignac lost accordingly a part of the hafnium originally present, retaining only 1 per cent. in the case of K_2ZrF_6, and in the extreme case of $(HN_4)_2ZrF_6$ only ½ per cent. In most other cases the greater part of the hafnium content was retained in the crystallised preparations.

Quite apart from a small difference in the molecular solubilities of K_2ZrF_6 and K_2HfF_6, the presence of 1 per cent. of hafnium in zirconium, due to the great difference in the atomic weight of these elements, means a difference in the solubility of 0·2 per cent. when measured by the weight of the salt present in solution as done by Marignac. Even when starting with an original material containing 5 per cent. hafnium and obtaining by crystallisation a material of 1 per cent. hafnium, he would thus find a difference in the solubilities not greater than 1 per cent. Solubility data given by him claim only an accuracy of ¼ per cent.; furthermore, the high temperature coefficient of the solubility (5 per cent. per degree) must have influenced the accuracy of his results very unfavourably. By carrying out the same experiment with the ammonium compound instead of the potassium salt, he could possibly have detected hafnium, the difference in the molecular solubilities of the two salts being here somewhat greater.

Even in the last case the practically complete separation is, however, only effected through a large number of crystallisations. In fact, crystallisation of the ammonium zirconium double fluoride was found by us to be far the most effective method for the separation of hafnium from zirconium, although even by this method a practically complete separation can only be effected through a very large number of crystallisations (comp. *Chem. News*, 127. 353, 1923). The partial separation obtained by Marignac, as revealed by our examination of his samples, bears witness to his ingenious intuition in finding out by far the most effective method of separation and to the extraordinary care with which his unique samples were prepared.

The separation of hafnium from all other elements, including those of the rare earth group, raises no difficulties. Apart from our experiences, this result is clearly borne out by the latest results of Ed. and G. Urbain (*Comp. rend.* 178. 265, 1924), who

measured the atomic weight of zirconium prepared from different minerals, some of which contained considerable amounts of rare earth elements, and found the atomic weight of zirconium in the last cases somewhat higher and ascribed this as due to the presence of hafnium in zirconium, which by purification from the rare earth elements remained together with zirconium. The fact emphasised by Urbain, that zirconium ores which are especially rich in hafnium often also contain considerable amounts of rare earth elements, receives a simple explanation when we assume that these minerals have undergone great transformations in geological times whereby a considerable shift in the Hf/Zr ratio as originally present in the fluid earth material could be effected. In fact, such transformations are indicated by the marked abundance of other elements like rare earths in these minerals compared with the common zirconium minerals less rich in hafnium. This was already pointed out by Goldschmidt and Thomasen, when, quite soon after our discovery of hafnium in zirconium minerals, they found in alvit and malacon an especially abundant source for the new element. In certain rare minerals containing only small amounts of zirconium and a large number of other elements we have recently detected even a larger amount of hafnium than zirconium.

By means of the mentioned samples of K_2ZrF_6, Marignac also performed his well-known determination of the atomic weight of zirconium, and the value found by him coincides practically with the value now accepted by the International Committee for Atomic Weights. It is of very great interest that, in spite of the fact that Marignac's sample contained 1 per cent. hafnium, the atomic weight found by him is not too high, probably even somewhat too low. By a curious coincidence the error due to the presence of hafnium and corresponding to roughly 1 unit in the atomic weight was compensated by errors involved in the methods used. Through the courtesy of Prof. Smith in Lund the writer was able to examine samples used by Weibull in his determination of the atomic weight of zirconium by means of the sulphate method. The value found by him was 89·6, or 1 unit less than the international value, in spite of the presence of more than 5 per cent. hafnium in his preparation. This result particularly suggests doubts as to the efficiency of the older methods used in determining the atomic weight of zirconium. The only atomic weight determination of this element carried out by means of modern methods, as worked out in Th. W. Richards' laboratory, has been performed by Venable and Bell. These authors used zirconium prepared from zirconia from North Carolina, which has a low hafnium content, and found in spite of this a higher value than any earlier investigator, namely 91·8. In fact the untrustworthiness of all the earlier methods is the only explanation why the presence of another element of twice the atomic weight of zirconium was not discovered by means of atomic weight determinations.

The discovery of hafnium could of course also have been made by specific gravity measurements of zirconium oxide of different origins. Such measurements have in fact been carried out repeatedly. Thus Nordenskjöld compared the density of ZrO_2 isolated from catapleit, zirconia from Espouilly, and eudialyt. Although he made preparations of zirconium oxide also from alvit, Nordenskjöld unfortunately did not determine the density of his preparation from this mineral rich in hafnium, to compare with catapleit, which has a smaller amount of hafnium relative to zirconium than any other mineral investigated by us. Through the great kindness of Profs. Aminoff and Benedicks in Stockholm we came in possession of a minute sample of Nordenskjöld's ZrO_2 prepared from alvit. The X-ray investigation revealed the presence of 7 per cent. hafnium in this sample. The difference in the densities of ZrO_2 from alvit and from catapleit should therefore amount to 0·3 units, which is amply sufficient to indicate the presence of a constituent of high atomic weight in the zirconium oxide prepared from the former mineral. A detailed discussion of the results communicated in this letter will be shortly published in a joint paper with Mr. V. Thal-Jantzen in the Proceedings of the Chemical Society.

G. HEVESY.

Universitetets Institut for teoretisk Fysik,
Copenhagen,
February 9.

Problems of River Pollution.

THE letter by Dr. Orton and Prof. Lewis (NATURE, February 16, p. 236), urging the necessity for continuous fundamental research on the constitution and biological character of streams, as a background for the study of problems of river pollution, will appeal to all, in virtue of its breadth of treatment and logical argument—but to none so strongly as to the biological worker already concerned with a special problem of river pollution. Such problems are many and varied, but undoubtedly the solution of any one of them requires at the outset a clear concept of the conditions of life in streams in general, and in unpolluted streams of the home district in particular.

It is, indeed, unfortunate that there has been in Great Britain so great a neglect of the systematic ecological study of fresh-water biology, and of the biology of running waters in particular, upon which such a concept might be based. As it is, the experimental worker who sets out to investigate a particular problem of river pollution is somewhat in the position of a man who must become an expert in the science and art of poultry-keeping before he can have an egg for breakfast; before he can attack his problem directly, he must first devote himself to what, for a single worker, may well be a lifelong study—that of the occurrence and distribution of local fresh-water species; next, he must amass data concerning the general and particular characteristics, hydrographical and chemical, of the streams, polluted and non-polluted, of his district; and third, for the sake of perspective, he must collate his facts with others of parallel nature obtained from another district. Finally, after perhaps years of preliminary study, he comes, faint yet pursuing, to the direct attack—that is, if an unkind Fate have not already removed him from the scene of all these endeavours.

I speak feelingly, and not without experience. So long ago as the year 1919, desiring to investigate a local problem (that of pollution of rivers by lead-mining), I found myself faced with such a prospect. Previous observations of a scientific character on the constitution and population of local rivers did not exist; of fresh-water fauna, barring *Limnæa pereger* and *L. truncatula*, not one single species had ever been recorded for the district; although local anglers had accumulated some information as to the occurrence of trout in non-polluted waters, such could scarcely be classed as scientific data, nor had any been interested in the distribution of invertebrate species, even such as take definite rank as "fish food." Here was, at any rate, a clear field for the investigator; but a method must be evolved. It is because that method, used since 1919, and found

to be practicable and profitable, follows so closely along the lines indicated by Dr. Orton and Prof. Lewis (although, alas, practice has often fallen far short of the ideal), that I venture to invite attention to it here, as a practical illustration of the thesis developed by these writers, although a more detailed account of the investigations will shortly appear elsewhere (*Annals of Applied Biology*).

The method, in outline, is as follows :

(1) General and comparative study of the fauna of *all* streams of the district, and of some of its pools. (Some attention was also paid to flora, but "Scientia longa, vita brevis");

(2) Study of the streams themselves under the following heads :

(*a*) Geology and physical geography of the basin, and general nature of the course of the stream ;

(*b*) Hydrogen-ion concentration of the waters.

(*c*) Chemistry of waters and river sludges, with especial reference to lead-content, dissolved and solid ;

(3) Collation of fauna-lists for different streams with data from group (2) ;

(4) Comparison with a neighbouring district ;

(5) Direct experimentation, based upon circumstantial evidence obtained from (1), (2), (3), and (4).

The order is almost strictly chronological, and not until 1923 was the "circumstantial evidence" judged sufficiently complete to justify expenditure of time upon experimental work, nor have results obtained since then indicated that any portion of the earlier study might have been foregone : on the contrary, it might with advantage have been carried further, had time permitted. On the other hand, three or four years might have been saved, had there been available preliminary data of the kind the systematic collection of which is urged by Dr. Orton and Prof. Lewis.

Another point raised by these authors is of great practical importance : the necessity for collaboration by specialists in different branches of science. It has not been my privilege to enjoy such collaboration, and the work has suffered correspondingly, although it owes much to friendly advice as well as to paid service : the latter is not always easily obtained, and, for the majority of biological workers desiring to take up ecological studies, the difficulty of securing collaboration is a very real and pressing one—a point well deserving the consideration especially of "those bodies interested in fostering fundamental researches of any kind."

K. CARPENTER.
Department of Zoology,
University College of Wales, Aberystwyth,
February 18.

Three Biological Principles observed in Speech Inscriptions.

IN the disease known as general paralysis the mental side consists of a gradually progressive disintegration of the mind. There is often a time very early in the progress of the disease when no mental defect can be found and no speech peculiarity can be detected, but yet when certain bodily signs are sufficiently prominent to render a diagnosis certain. Speech inscriptions in such cases always show an interesting abnormality.

The inscriptions are made by speaking into a tube that leads to a membrane the movements of which are enlarged and recorded on a moving surface. An inscription of "*pa-pa-pa-*" repeated a number of times shows a series of straight lines each of which is ended by a sharp upward jerk followed by small waves. Each straight line registers the time during which the lips are closed for the *p*. The upward jerk registers the puff of air that issues as the lips are opened. The waves register the vibrations of the vowel.

In an inscription from a normal voice the straight lines are nearly equal in length and the upward jerks about equal in height. In a case of general paralysis both the straight lines and the upward jerks are irregular. The difference can be expressed numerically. Ten successive straight lines are measured. Then the difference of each line from the average is noted as its variation. The average variation gives an index of the irregularity. For example, a normal record on one occasion gave an average variation of 0·6 mm. for an average straight line of 14·6 mm. ; that is, 4 per cent. A record from a paralytic showed an average variation of 16 per cent.

At the early stage of the disease here under consideration the sounds are correctly formed. If the paralytic could only stick to the same type he would have no speech defect. The trouble is that he wavers from his type. This defect I have termed "asaphia."

Records of this kind show the interplay of three forces. One is eusaphia, or the impulse to speak properly according to type. A second is antisaphia, or the force that opposes the impulse to proper speech. The third is anasaphia, or the impulse to correct the defect.

It can be observed regularly that the paralytic makes a special effort to speak correctly into the apparatus or when questioned. He feels or fears his defect and exerts his will to correction (anasaphia). This sometimes goes so far that the paralytic speaks as perfectly as a trained elocutionist. As soon as he is off his guard, however, the defect appears.

The extra effort of anasaphia in opposing antisaphia causes fatigue, and the defect increases as the test is prolonged. The record of the paralytic referred to above as having an average variation of 16 per cent. showed an average variation of 37 per cent. a few minutes later. It is not difficult to observe in the early cases the interplay of the three forces, namely, the impulse to do as others do, an opposing force, and an attempt to correct the defect.

Using the terms to apply not merely to speech but to all forms of mental activity, we have eusaphia as the impulse to conform to the type of what is considered right, antisaphia as the opposing force, and anasaphia as the impulse to correction.

There is here a close resemblance to Freud's tripartite division of the soul (*Das Ich und das Es*). According to Freud the main part of the soul consists of the It, whose chief impulse is to obtain peace ; this it can do only by getting away from life by dying ; it is characterised, therefore, by the will to die. Experience of the outer world develops out of the It a different part of the soul, the I, or the Self. The I wants to live and enjoy. Still further there develops the Super-I or the Super-Self, or Conscience, whose function it is to sit in judgment on the acts of the Self. It is to be remembered that the It and much of the Self are unconscious.

To live requires adaptation to the environment. The will to live implies the impulse to conformity to type. It may well be that eusaphia is a manifestation of the will to live. To resist the environment means ultimately death to the organism. The will to resist would be certainly a part of the (unconscious) will to die. The ethical impulse to correction, anasaphia, is part of a larger impulse to correction ; this is a fundamental biological factor of which Freud's Conscience may form a part.

The speech of epileptics shows a peculiarity in the

melody. The melody of the spoken words rises and falls according to the emotion to be expressed. Quite independent of the emotional rise and fall there is always in the speech melody of normal persons a continual fluctuation in pitch that gives it a flexible and pleasant character. In the speech of epileptics these small fluctuations are absent. Even when the melody rises and falls in the speech of an insane epileptic the same thing is observed. Flexibility in speech means friendliness and adaptability to the environment; the inflexibility of epileptics is a sign of resistance to the environment. The nature of idiopathic epilepsy is thus shown to be a constitutional obstinacy to adaptation to the environment. Speech inscriptions in other nerve diseases give analogous results.

A wider consideration shows that all voluntary activity involves these three forces: (1) the impulse to adaptation to the circumstances; (2) the impulse to oppose the circumstances; and (3) the impulse to correct the opposition. Indeed it may be said that these are three of the driving processes of living organisms.

Successful adaptation means life; opposition to the environment means death; the impulse to correction of the defective adaptation means sensitiveness to a fault and desire for repair. These three forces may well be termed the will to live, the will to die, and the will to correct.

E. W. SCRIPTURE.

University of Vienna.

Measurement of Photographic Records.

IN the course of work on the instantaneous photography of vibrating strings I have found the following device for obtaining a graph-paper effect on the negatives very useful. As a similar device may be of service to other workers I give the particulars and an example of the type of result obtained (Fig. 1). A

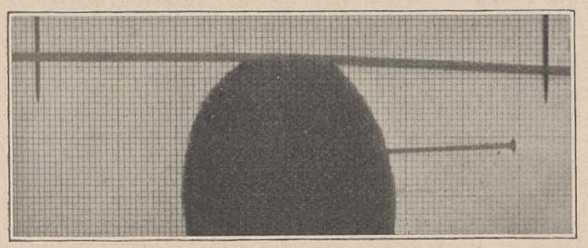

FIG. 1.—Instantaneous photograph with superposed grid-plate to facilitate measurement.

piece of good quality engraved graph-paper is photographed with a camera such as is used for making lantern-slides, and a print of this negative is made on to a photographic plate, the result being opaque lines on clear glass. This "grid-plate" is then placed in front of the photographic plate to be used, so that the two gelatin surfaces are in contact. The print obtained from the final negative then shows the graph-paper effect, and fairly accurate measurements can be directly read off from the print itself. Care must be taken to focus with the grid-plate in position.

In taking prints from films the grid-plate can be conveniently substituted for the clear glass of the printing frame.

A further use for the device is in making rapid and fairly accurate measurements on negatives or lantern slides and on graphs or illustrations such as occur in books and research papers which may not be defaced. The grid-plate is placed on the figure to be measured and, if needed, an electric lamp may be placed behind. By this means a tedious setting of the figure before a microscope or cathetometer is avoided. In some cases figures other than a system of rectangular co-ordinates might be more useful for the original grid-plate.

An objection to the use in some cases of the grid-plate upon the sensitive plate is the extra absorption of light. This difficulty could no doubt be eliminated by a method which I understand is used in making photographic charts of the heavens. A "réseau" is impressed upon the photographic plate *before* exposure to the sky so that the stars and the squares appear at the same time upon the negative. The advantage of the use of the grid at the same time that the photograph is taken lies in the convenience of setting the grid accurately and firmly in some desired position relative to the object, after which the photographic plate may be placed without accurate setting in contact with the grid.

WM. H. GEORGE.

Physics Research Lab.,
University College,
Nottingham.

Colour Vision Nomenclature: Defatigue and Enhancement.

WHEN the development of any subject necessitates the introduction of new terminology, it is specially desirable that unity regarding the use of terms should be ensured if possible.

In colour vision, the use of the term "fatigue" is well known. By continued incidence of light upon the retina, the intensity of the sensation produced gradually falls off from its initial value although the incident light retains its intensity unimpaired. This gradual diminution in strength constitutes the process of fatigue. In accordance with Fechner's law, expressed in its integrated form, the intensity of the sensation, S, is given by the relation

$$S = \log \frac{x}{x_0},$$

where x is the constant intensity of the stimulus, including if necessary the equivalent of the self light, and x_0 is its "threshold value." Since the sensation falls off in magnitude as x_0 increases, I have suggested that x_0 may be taken as the measure of fatigue, or that the increase of x_0 may be used to express the increase of fatigue. If we are ever to attain to quantitative treatment of the effect, some such expression must be adopted.

Conversely, the opposite process, decrease of x_0, corresponds to increase of sensation, as, for example, when the eye recovers from the effect of precedent stronger illumination. So I have used the term "defatigue" to indicate this process.

Now both processes may arise in either of two ways, direct or induced. Fatigue may gradually decay on the removal of the exciting stimulus, or it may be overcome by a positive action arising from a different stimulus, for example, that of light incident on a different portion of the retina. Prof. Frank Allen has, in recent noteworthy work (*Journ. Op. Soc. Amer.*, Aug. and Nov. 1923), shown that reflex action gives rise to increase of sensation in the latter manner, and he introduces the term "enhancement" to denote the process. He points out that I use the word defatigue in the same sense, and thinks it preferable to use the word enhancement instead.

I entirely agree with his use of the term enhancement to indicate the positive reflex effect; but I meant the use of the term defatigue to be wider in its application. Both terms seem to be required. For, when x_0 diminishes with time, its rate of variation may depend on two quantities, one expressing

the uninterrupted rate of decay of fatigue when the stimulus is removed, the other expressing the enhancement due to reflex (and perhaps also direct) action. I do not specially like the word defatigue, but have not succeeded in finding one which seems to be better. If a better one were suggested, I would at once concur in its use. But the great desirability is universality in the employment of terms.

W. PEDDIE.

University of St. Andrews,
February 27.

The Structure of the Great Rift Valley.

IN the issue of NATURE for October 6, 1923, which reached me at the end of the year, Prof. J. W. Gregory gives an admirable résumé of our knowledge of the Great Rift Valley. May I, in this connexion, be afforded space in order to contribute a few remarks upon the subject?

Prof. Gregory states, quite correctly, that my view (compression hypothesis) is based on general considerations, and that I do not appear to have seen any reversed faults along the Rift Valley. Nor am I in a position to dispute the statement that "all the numerous faults that have been recognised in the Great Rift Valley series are normal." But one would like to know why the western fault of the Gulf of Suez has now been so drawn, the more so as in a generalised section across the region of the Egyptian oil-fields published by W. H. Emmons (after Hume) in his "Geology of Petroleum," 1921, p. 550, only two faults are shown; these are both—according to the section as drawn—primary Rift faults, and both are shown as reversed.

For my part, I have never seen any faults that can be interpreted as original (primary) Rift Valley fractures, but I know of many that are certainly secondary—that is to say, consequent upon the subsidence of a rift block—and they are, of necessity, normal.

Recent work in Bunyoro, Toro, and Ankole has brought out the following points:

1. The Rift Valleys (at any rate in the districts mentioned above) are beyond all doubt tectonic structures.

2. There has been differential movement between the valley sides and the valley bottoms (rift blocks).

3. The last great movement took place in human times, and affected the topography of the whole Protectorate.

4. There are three belts of volcanic activity in the Toro-Ankole area. They are coincident with lines of very ancient (pre-Rift) faulting, but the extrusions are part of the Rift Valley history, during which volcanicity manifested itself at least twice. The first phase is evidenced by a thick series of subaqueous volcanic tuffs, and the second by explosion craters blown through the tuffs. The volcanic belts run across the high land that separates Lake George from Lake Albert, and in directions more or less at right angles to the long axis of the Rift Valleys. They butt up against Ruwenzori. There is no evidence to show that they mark lines of subsidence or of upheaval.

5. The Lake Albert rift-block, the Toro highlands, Ruwenzori, part of Bunyoro and Ankole have suffered from pivotal movements which provide evidence of a general rise of the country to the south of Toro and a general subsidence to the north of it. The southern part of Ruwenzori has taken part in this rise.

6. Where the rift-block of Lake Albert sinks deepest the valley sides close in.

The position, at present, as I see it, is as follows:

(*a*) The great Kenyan and Uganda-Congo upfolds are in all probability compressional structures.

(*b*) The Rift Valleys (at any rate so far as we know them in Uganda) are quite certainly tectonic structures.

(*c*) The main "featuring" of the Great Rift Valley was brought about by the subsidence of the rift-blocks.

(*d*) The original Rift features have been generally obscured by secondary (normal) faulting on a very large scale, consequent upon the subsidence of the rift-blocks.

(*e*) Prof. J. W. Gregory's explanation of the origin of the Great Rift Valley (by tension) is an hypothesis; so is mine (compression hypothesis). Either may be subsequently proved to be right, partially true or wrong. Nothing but detailed work in a great many places along the Great Rift Valley system can establish the truth.

(*f*) Should it chance that compression is ultimately found to be the essential factor in the formation of the Uganda rifts, it does not follow rigorously that the same explanation holds for the rest of the Great Rift Valley; but upon those who maintain that the Uganda rift valleys are peculiar in origin lies the onus of proof.

E. J. WAYLAND.

Entebbe, Uganda, January 3.

THE difference as to the faults between the figure in NATURE of October 6 and that in Prof. Emmons's book is that he copied the original section of 1916, whereas the figure in NATURE gives the modified section published by the Geological Survey of Egypt in its Petroleum Research Bulletin No. X. Dr. Hume's letter published in NATURE of January 12, 1924, confirms the later section. Mr. E. J. Wayland's summary of the recent progress in the investigation of the Rift Valley in the Uganda Protectorate is of great value, and he and his colleagues are to be congratulated on their interesting results. The fifth point he mentions agrees with the pivotal movements on east and west axes in the eastern branch of the Rift Valley in Kenya Colony. The results already announced indicate that Mr. Wayland's full report on the geology of the Rift Valley in the Uganda Protectorate will be a most important contribution to African geology. J. W. GREGORY.

The Temperature of Reversing Layers of Stars.

FOLLOWING the well-known treatment of the problem by Schwarzchild (1906), it has become conventional to estimate the temperature, T', of the outer atmosphere of a star as of the order $T_1/2^{\frac{1}{4}}$, or about 0·85 T_1, where T_1 is the effective temperature of the surface (practically, the surface of the photosphere) as given by application of Stefan's law to the total energy radiation. This result presupposes that the stellar atmosphere can be treated as "grey," that is, as having an absorption coefficient which is the same for all wave-lengths. Milne has published (Mon. Not. R.A.S., 82, 368, 1922) an approximate mathematical discussion which indicates that when the atmospheric absorption-coefficient varies with the wave-length, the value of T' may fall as low as $\frac{1}{2}T_1$, or rise as high as T_1. The equation upon which he bases his treatment postulates that the outflowing radiation may be taken as approximately black. For stellar reversing layers this assumption seems unjustified, in consideration of the sharply selective opacity indicated by the existence of Fraunhofer lines. The radiation is indeed deficient in the very wave-lengths in which the gas may be expected to absorb and radiate most strongly. That the general,

as compared with the sharply selective, opacity of the upper reversing layer in the sun is negligible, is shown by the existence of the bright line flash spectrum.

It has been stated by various observers that the light-intensity at the centre of strong Fraunhofer lines is of the order one-tenth or one-twentieth that of the neighbouring continuous background. This fact is opposed to the conclusion that the temperature of the region where the lines are produced is as high as 0·85 that of the photosphere. For whether the dark lines are caused by selective absorption or by a combination of absorption and selective scattering, examination of the equations of transfer of radiant energy through a gas indicates that the intensity at the centre of a line should not be less than that of black-body radiation of the same frequency, and corresponding to a temperature equal to that of the uppermost region in the stellar atmosphere effective in producing the line.

In this connexion, conversation with Prof. H. N. Russell has resulted in working out the following illustrative argument. About a given small region in the reversing layer place (in imagination) a complete opaque enclosing surface, maintained at the temperature which normally exists in the given region. Then the radiation emergent through a small aperture in the upper side of the enclosing surface will be black-body radiation corresponding to that temperature. For a given wave-length concerned in a Fraunhofer line, the opacity is large, and this radiation will come partly from the gas, and partly from the back of the enclosure. Now suppose the enclosure removed. The rôle formerly played by the back of the enclosure is then played by some deeper and hotter layer of the atmosphere. (For wave-lengths not concerned in Fraunhofer lines the said deeper layer is the photosphere.) Thus the total flux of energy through the gas in the given region is no smaller than before; and in consequence the rate of scattering will be at least as great. Since the temperature is by hypothesis unchanged, the rate of radiation of the gas in the region is unaltered by the removal of the enclosure. Therefore the whole brightness for the given wave-length will increase if it changes at all.

In the case of the sun, taking the effective temperature of the photosphere as 6000°, and that of the reversing layer as 0·85 of this, or 5100°, the ratio of the intensity at the centre of the dark line to the intensity of the neighbouring continuous background, should be for the D lines about 0·50 (assuming Planck's formula). To reduce the calculated ratio to the observed value, say, 0·10, the effective temperature of the reversing layer for these lines required by the Planck formula is about 4000°.

A good correlation has been found by Dr. St. John (Mt. Wilson Contributions, No. 88, 1914) between the intensities of Fraunhofer lines in the solar spectrum and the heights above the photosphere to which the corresponding chemical elements extend, as given by observations of the flash spectrum at eclipse. The less intense Fraunhofer lines are produced altogether in the lower regions, where the temperatures may be supposed nearer that of the photosphere. It is probable that these data indicate a greater temperature-gradient in the solar atmosphere than is predicted by the conventional "grey body" mathematical treatments.

It is obvious that further physical, mathematical, and observational studies of the problem of estimating temperatures in stellar reversing layers are to be desired. In particular, quantitative data are required concerning the variation from centre to limb of the sun of the intensity in Fraunhofer lines and relating such intensities to effective heights. There would seem to be a possibility of determining the temperature-gradient from such observations. The evidence outlined above indicates (1) that lower average temperatures should be adopted, say of the order 0·7 rather than 0·85 of the photospheric temperature; and (2) that the equilibrium may depart correspondingly further from the isothermal condition.

JOHN Q. STEWART.
Princeton University Observatory,
February 8.

Auto-obituaries.

IT sometimes happens that an obituary notice in NATURE arouses much criticism, and it is seldom that one does not hear that some one else "could have done it much better." The point arose at one of the dinners which George Murray Smith used to give to the contributors to the "Dictionary of National Biography." I remember Dr. Creighton, Bishop of London, remarking, in a speech, that as we were all more or less entitled to a place in that Walhalla, the question could scarcely help arising in our minds as we conversed with our neighbours at table: "Shall I do *you*, or will you do *me*?" Why not invite all the leading scientific workers whose deaths you are looking forward to recording in NATURE to write their own obituary notices? Such auto-obituaries would be most useful to your post-mortem panegyrists.

F.R.S.

[Obviously, such autobiographies as are suggested by our correspondent would be purely records of what the writers considered to be the chief events or achievements of their careers. Obituary notices in NATURE are, however, usually personal appreciations of the scientific significances of the lives and work of departed friends, and such independent testimonies, even when not effusively favourable, are of far greater interest than any auto-surveys ever possibly could be.—EDITOR, NATURE.]

The Phosphorescence of Fused Transparent Silica.

THE phenomenon mentioned by Chapman and Davies in NATURE of March 1, p. 309, is certainly a most striking accompaniment of the discharge in tubes of fused silica, but we doubt the correctness of their interpretation.

We have recently been using such tubes for discharges in the halogens, hydrogen and the hydrogen halides, and in one case, on warming the tube after three days, we were surprised to find the phosphorescence burst out in broad daylight. One of us, however, had noticed some years ago the phosphorescence of fused silica which had been exposed to the light from an aluminium spark, and had attributed it to the fact that silica begins to absorb strongly in the neighbourhood of the strong aluminium lines at 186 and 176 $\mu\mu$.

The colour of the phosphorescence differs, under otherwise identical conditions, with the specimen of silica, and is probably due to minute traces of impurity; we have had green and pale violet from different parts of a tube made from two tubes joined together, though the discharge was identical in both parts.

In the case of hydrogen, the radiation absorbed is probably the Lyman series; the radiation for fluorine and chlorine has been photographed by Millikan; a strong line we get at 206 $\mu\mu$ in the case of iodine may turn out to be the first of a series ending at 155 $\mu\mu$, corresponding to the ionisation potential of that gas.

E. B. LUDLAM.
W. WEST.

Dept. of Chemistry,
University of Edinburgh.

The Human Brain.[1]

By Prof. G. ELLIOT SMITH, F.R.S.

THE human brain is the instrument of the high powers of intelligence that distinguish man from all other living creatures. The secret of man's most distinctive attribute is hidden in the texture of his brain, and perhaps will never be fully revealed. Yet from time to time, with the growth of knowledge and the discovery of new methods of approach, we can profitably return to this greatest of all biological problems and get new glimpses of the factors that have made man what he is. Two considerations make the present time appropriate for taking stock of the state of our knowledge of these matters. The emergence of a clearer understanding of the sequence of structural changes in the brain and body of man's ancestors enables us to interpret the physiological factors involved in the widening and deepening of the intellectual powers and to appreciate the conditions essential for the attainment of such mental growth. In the second place, the new points of view regarding the functions of the cerebral cortex that have emerged from Dr. Henry Head's suggestive clinical investigations prompt one to examine the brain anew and endeavour to integrate the results of his brilliant analysis with those revealed in the study of the evolution of the brain. Whether or not it is yet possible fully to correlate the facts and conclusions of these two disciplines into one coherent body of doctrine, it is well worth while to make the attempt to do so, if for no other reason than to direct attention to new problems that call for solution.

In the history of organisms endowed with the power of voluntary movement, which necessarily involves the ability to choose between conflicting impulses, the fundamental condition of progress is the attainment of quickness of appropriate response. The evolution of the nervous system is the means employed to enable increasingly complex and more completely adapted muscular actions to be performed with promptitude and precision. Mammals differ from all other living creatures, not excluding even birds, in having acquired a true neopallium, which is an instrument of almost unlimited potentialities for the cultivation of skilled movements of increasing degrees of complexity and adaptation to diverse circumstances. In man these potentialities achieve their highest expression. The human cerebral cortex provides the vital mechanism that can be fashioned by education to initiate and control an almost endless variety and complexity of muscular actions. It is able to perform these functions in virtue of the fulness of the information it obtains from a variety of sense-organs and the efficiency of the amazing machinery in the central nervous system for integrating the effects of these afferent currents and for controlling increasingly complex combinations of groups of muscles. But even more important still is the ability of the neopallium, by some means which is quite unknown, to record the results of past experience and to put the influence of such knowledge at the service of the muscular system. This provides the means whereby behaviour can be modified in the light of knowledge, but also enables a high degree of automatism to be acquired by training, which is perhaps the most essential factor in the attainment of high degrees of skill.

The acquisition of these extensive powers plays a fundamental part in the development of the physiological dispositions which are expressed in intellectual operations. In fact, in a somewhat different sense from what Prof. Pear had in mind when he coined the phrase, one can support the claim for "the intellectual respectability of muscular skill." In the evolution of man the attainment of increasingly skilled movement involved the growth of mind.

Before proceeding to interpret and give precision to these phrases, it will be profitable to glance for a moment at certain incidents in the past history of controversies regarding the human brain. When one considers how fundamental is the interpretation of the human brain for the understanding of the distinctive attributes of mankind, it is remarkable how little has been done to solve its important problems. By this I do not mean to suggest that the volume of the writings concerning them is small. What, however, is impressive is the fact that the vast stream of books and memoirs has brought us so few indications of any serious attempt to probe into the really vital issues regarding the way in which the brain has acquired its highest powers. It is barely a century since the knowledge of the structure and function of the brain had reached the stage that permitted really profitable discussion of its distinctive attributes in the human being. The great revolution in attitude was effected by Gall, whose services in the advancement of science are now almost completely disguised by the notoriety associated with his name as the inventor of what afterwards became known as phrenology. Yet it would not be wholly true to say of Gall what Shakespeare put into the mouth of Mark Antony when he said of Cæsar:

> The evil that men do lives after them;
> The good is oft interred with their bones.

The evil part of Gall's teaching has undoubtedly lived after him: but the good attained what Huxley long ago called "the euthanasia of scientific work": it has been accepted as part of our heritage of knowledge, even though the credit due to Gall for a great reform has for most of his successors been "interred with his bones." It was he who destroyed the ancient speculations concerning vital spirits dwelling in the ventricles of the brain. He proved that the white substance was fibrous, and introduced the method of exposing fibre-tracts by dissection to demonstrate the connexions within the nervous system. He directed attention to the real significance of the grey matter. He was the first to give the correct account of the connexions of the optic tracts. The discussions arising out of his claims for cerebral localisation provided the stimulus which was responsible for a profound revolution in cerebral physiology, even in spite of the fact that he was so incensed by the attacks of the physiologists as to deny the value of experiment. In his own lifetime it was the anatomical facts so easily susceptible of confirmation that were most violently assailed by his critics:

[1] Discourse delivered at the Royal Institution on Friday, February 22.

hence the speculative and untenable part of the doctrines usually associated with his name escaped criticism and "lived after him." But his really great discoveries became tacitly absorbed into the great body of knowledge at the time when in later decades men were hot in pursuit of the fallacies of "phrenology." Although it was not until more than thirty years after Gall's death that the localisation of function in the cerebral cortex began to be seriously entertained, chiefly under the influence of Hughlings Jackson and Broca, much valuable work was accomplished in the first half of the nineteenth century.

Even before 1828 (when Gall died), attempts had been made to discover wherein the brain of man could be differentiated from those of other mammals. Curiously enough the remarkable claim (which Sir Richard Owen revived in 1857) was made that the human brain was distinguished by the presence of a hippocampus minor; but in 1827 Serres disposed of this assumption, as Huxley and Flower did in 1862, by showing that "the hippocampus minor is not distinctive of man, as hitherto has been supposed, for it is present in the apes and seals."[2] It is an amazing episode in the history of this subject that Owen should have resuscitated a fallacy which had been so utterly demolished as this claim had been; but the incident was not without its uses, for it stimulated Huxley to revise the anatomy of the occipital end of the cerebral hemisphere and so prepared the way for the particular line of research with the latest results of which this address is, in the main, concerned. Incidentally, also, it inspired Charles Kingsley to write in "Water Babies" one of the most ironical parodies of a scientific discussion in the English language.

If, however, Serres demolished this claim for one distinctive peculiarity of man's brain, he set up three others which have little, if any, better justification. For, he wrote, "man alone possesses a tonsillar lobule in his cerebellum, striæ medullares in his fourth ventricle and salient and distinct corpora mammillaria on the base of his brain." The most arresting episodes in the history of the subject during the last hundred years have been the setting up of a series of similar false claims and their subsequent refutation. Nor, unfortunately, is this comedy of errors yet done; although the nature of the supposed distinctions is undergoing a change.

Of the large series of supposed distinctive features of the human brain that have been extensively cited during the last half century, I shall refer here only to one directly relevant to the serious argument, which I must now set forth, based upon the further investigation of the area surrounding the sulcus which Huxley labelled "calcarine."

Upon the lateral aspect of the cerebral hemisphere in most of the apes there is a furrow which was supposed to be so peculiarly distinctive of these Primates that it was labelled the *Affenspalte* or ape-fissure. More than twenty years ago its presence was demonstrated in the human brain, and as its old name was clearly inappropriate the new designation, *sulcus lunatus*, in reference to the semilunar form it usually assumes, was given to it.

[2] E. R. A. Serres, "Anatomie comparée du Cerveau," Paris, 1827, t. ii. p. 583.

The identification of this furrow was established by the study of the distinctive texture of the cortical area responsible for its presence, now called the *area striata*, in reference to its most obtrusive feature, the stria of Gennari. This led to the measurement of the extent of the area striata, in which the optic radiations end; and the discovery that the visual receptive territory is just as extensive in the brains of many monkeys, even small macaques, as it is in those of men. This investigation led to the realisation of the important part played by the early cultivation of vision as the dominant sense in man's ancestors, and pointed to the necessity for a detailed study of how and why this particular trend in evolution should have led to results of such vast significance as the emergence of the human mind. I do not propose to discuss the early phases of this process again, for I sketched the general results in a lecture delivered in the Royal Institution four years ago, and have from time to time recorded the subsequent progress of the investigation elsewhere.[3] I am concerned, here, only with the last phase in this evolutionary story; but as this is essentially the culmination of a process that has been working with amazing consistency since the commencement of the Tertiary Epoch, and, in fact, from a still earlier time, the essence of the argument is implicit in the direction which was given to the course of brain-development at the birth of the Primates.

Man has emerged as the result of the continuous exploitation throughout the Tertiary period of the vast possibilities which the reliance upon vision as the guiding sense created for a mammal that had not lost the plasticity of its hands by too early specialisation. Under the guidance of vision the hands were able to acquire skill in action and incidentally to become the instruments of an increasingly sensitive tactile discrimination, which again reacted upon the motor mechanisms and made possible the attainment of yet higher degrees of muscular skill. But this in turn reacted upon the control of ocular movements and prepared the way for the acquisition of stereoscopic vision and a fuller understanding of the world and the nature of the things and activities in it. For the cultivation of manual dexterity was effected by means of the development of certain cortical mechanisms; and the facility in the performance of skilled movements once acquired was not a monopoly of the hands but was at the service of all muscles. Skilful use of the hands was impossible without the appropriate posturing of the whole body. High co-ordination of hand movements and high co-ordination of movements localised elsewhere in the body must go together. The sudden extension of the range of conjugate movements of the eyes and the attainment of more precise and effective convergence were results that accrued from this fuller cultivation of muscular skill. They were brought about as the result of the expansion of the prefrontal cortex, which provided the controlling instrument, and also by the building up in the midbrain of the mechanism for automatically regulating the complex co-ordinations necessary to move the two eyes in association in any direction.

The attainment of stereoscopic vision enormously enhanced the value of the information acquired by

[3] See, for example, the "Study of Man," NATURE, September 22, 1923.

the eyes. The development of maculæ luteæ made possible the fuller appreciation of the details, the texture and the colour, of objects seen; and in association with the increased precision of muscular control enabled the eyes to follow the outlines of objects and appreciate better their exact size, shape and position in space. But this completer vision of objects in the outside world stimulated a curiosity to examine and handle them and so led to a yet further cultivation of skill in movement and an enhancement of tactile discrimination. This higher skill was attainable because the powers of stereoscopic vision conferred more accurate control on the hands than was possible before it was at their service.

Thus the fuller cultivation of the results of the visual powers provides a new stimulus and new means for enhancing vision itself, and this cycle of developmental changes was repeated again and again in the history of the Primates, at each stage leading to a further enhancement of muscular skill and visual acuity.

It is of fundamental importance to remember that one result of this continued handling of objects is the attainment of a fuller understanding of the nature of the objects seen and of the forces that are operating. The closer correlation of the information gained by vision and touch played a leading part in the cultivation of an appreciation of form, which represents the germ of the æsthetic sense. There also emerged the aptitudes to estimate weight and to discriminate between textures.

When these had attained such a degree of exactitude that it became possible for the individual to distinguish sharply one object from another and to appreciate its physical properties and understand something of its significance, the time had arrived when the process of naming it acquired a definite biological value. Man's ancestors were already provided with the muscular instruments for speech and the ability to use them for the emission of a variety of signals, mainly in the nature of cries to express emotional states. Hence, long before the need made itself felt for an instrument to express the names of objects, it was already in being; and all that required to be done was to devise the necessary vocal symbolism to express the visual experience—to give a name to an object seen. Moreover, long before the discovery of articulate speech, the ancestors of modern man were conveying information of an intellectual kind one to another through the visual appreciation of the meaning of gestures and facial expressions. With the introduction of an auditory symbolism man continued to do what he had done previously in a manner less precise and less capable of intellectual elaboration.

Thus the acquisition of speech was based primarily upon the fuller understanding of the world around the ancestors of men and the need for names as a sort of shorthand concisely to express the various attributes of a single object and other more complex states of consciousness; but it involved the seeing eye and the understanding ear and the highly skilled muscular act involved in phonation and articulation. In other words, while the expansion of most cortical areas is essential for the interpretation of experience, the special development of territories in the neighbourhood of the areas concerned with the reception of acoustic and visual impulses and with the control of the musculature of the head and neck should be expected.

These localised hypertrophies of the cerebral cortex are, in fact, found in the primitive types of human brain such as are revealed in the endocranial casts of Pithecanthro s, Eoanthropus and the extinct species of the genus Homo.

If the brain of man's nearest relative, the gorilla, be compared with the human brain it will be found that the enormous increase in the cortical territories of the latter affects chiefly three areas, the parietal region (especially that part of it known as the supramarginal and angular convolutions), the prefrontal region and the inferior part of the temporal area. These are the areas that reach their full development last in the human child. They were the most defective parts of the brains the forms and proportions of which can be inferred from the moulds of the brain-cases of Pithecanthropus and Eoanthropus. They are also the parts of the brain injury to which has yielded the most instructive clinical results so far as mental effects are concerned.

Now that the tentative hypothesis to express the known biological facts has been formulated, it is profitable to consider what light is thrown upon the issues by Dr. Head's clinical investigations, more especially by his two great memoirs "Sensation and the Cerebral Cortex" (*Brain*, 1918) and "Speech and the Cerebral Localisation" (*Brain*, 1923).

In the former Dr. Head defines the functions of those parts of the cortex concerned with sensation. Injury to any part of the cortex disturbs attention. The cortex is the repository of past impressions and these sensory dispositions profoundly modify the effect produced by the arrival of fresh impulses. But the sensory cortex is concerned also with the power of appreciating the differences in weight, shape, relative size and texture of objects, and is also responsible for the spatial aspects of sensation.

The facts relating to the evolution of the cerebral cortex in the Primates suggest the explanation of how these abilities, which in their fully developed form are so distinctive of man, have been acquired, by the cultivation and co-operation of vision and touch with the acquisition of skill in movement. The area concerned with sensation derives its power of spatial reference by its connexion with the visual cortex. With reference to the latter, Dr. Rivers has given a clear account of the facts. The physiological basis of localisation in space is the simultaneous stimulation of both retinæ. The perception of form and size depends not merely on the retinal images but also on minute movements of the eyes following the outlines of the object. The acquisition of the ability to extract such information from visual experience obviously depends upon the power to effect the complex conjugate movements of the eyes with the necessary precision.

Perception of form in three dimensions—solidity—depends primarily on the physiological binocular mechanism for relative distance, but is profoundly influenced also by such psychological factors as light and shade and the ability to discriminate between substance and shadow—one of the results of stereoscopic vision.[4]

[4] W. H. R. Rivers, Schäfer's "Text-book of Physiology," vol. ii. p. 1132.

Head has emphasised the fact that sensory experience can only form part of a consecutive consciousness by virtue of the coherence which otherwise isolated incidents receive from the projected aspects of sensation. The activity of the cerebral cortex is essential for giving us our conceptions of coherence both in space and in time. Without the ability to refer the results of our sensations to the outside world—to some definite locality in space—the material stimulus would fail to convey any ideas of size, shape, weight, texture, and intensity.

Appreciation of the nature of the objects and events happening in the outside world are dependent upon certain cortical developments which did not occur until man's immediate ancestors were assuming human qualities. The attainment of the realisation of space and time, and the faculty of recognising objects by their shape, colour, size, and texture, marked the transformation of the ape into a man. For the ability to appreciate these things made it biologically useful for him to devise names for things, and so initiated the development and use of language with all that language implies in vastly increased capacity for thinking in symbols of value to himself and intelligible to others.

By the development of this line of argument, the origin of speech can be brought into logical connexion with the other factors that are expressed in the expansion of the parietal, prefrontal and temporal cortex.

In the primitive human brain, such as the endocranial cast of Pithecanthropus enables us to picture, there is a very pronounced local expansion of the posterior part of the second temporal convolution. This can have only one meaning—the fact that in the earliest known member of the human family there was a sudden expansion of the acoustic territory for the appreciation of some sort of speech.

Primitive speech, apart from mere emotional cries such as all animals endowed with a true sense of hearing emit, no doubt began with imperative verbs differing only in their variety and fuller meaning from instinctive cries. But when names were invented, at first by the definition of a visual experience for which a verbal symbol was devised, it became possible for men to communicate one with the other in sentences of two words after the manner of Alfred Jingle in "Pickwick Papers."

It required a much more elaborate cultivation of the acoustic territories of the cortex before real sentences were devised by the syntactic process of linking together a series of words to express a meaning which was not simply that of the individual words or the combination of them, but so to speak a glorified word with an individuality and a meaning of its own and a rhythm of enunciation somewhat akin to music. As a complement to this power of controlled expression of highly complex acoustic symbols, which is made possible by physiological dispositions in the temporal area, there is a wider understanding of the significance of the symbolism so elaborated, which apparently is made possible by the development of the parietal area (supramarginal convolution). This semantic aspect of speech—the capacity for understanding the deeper significance of words and the wider meaning of the whole sentence—is really part of the process of true comprehension of the aim and purpose of speech, thought and action. It is dependent upon the complete integrity of the cortical connexions linking the tactile with the visual and acoustic areas. The functions of this parietal territory are as significant for the real understanding of events as the prefrontal territories are for the attainment of muscular skill, although in all its activities almost every part of the cortex plays its part.

When man began really to examine the objects around him he did not neglect the study of himself. The knowledge he accumulated of the world included a knowledge of his own body and the estimation of the æsthetic qualities of his fellows, for vision came to acquire an increasing influence in his selection of sexual mates; and it is possible that in the case of the human family Darwin's claim for sexual selection may find much ampler confirmation than most biologists are inclined to attach to it in the case of other organisms. No one can question the appeal of physical beauty to mankind, and it is difficult to believe that an attraction so universal and deep-seated could possibly have been devoid of effect in the process of transmuting the uncouth form of an ape into the graceful figure of a human being.

Man did not examine merely the physical form of himself and mankind in general; he studied the behaviour of his fellows, and by introspection examined his own thoughts and feelings, and constructed his conceptions of time, space and materials. In his attempts to interpret what he saw and learned by experiment, he tried to understand such of the forces of Nature as seemed to affect his welfare. Out of such gropings there emerged the earlier theories of physics and biology, which became stereotyped by tradition. At every stage of his progress toward a fuller enlightenment, such speculations became for the vast majority of mankind a simple device for escape from the necessity of thinking. But if such traditional evasions were a source of comfort to the many they have ever been a hindrance to the real thinker striving after a consistent and really satisfying explanation of natural phenomena and human history.

Atomic Species and their Abundance on the Earth.

By Dr. F. W. ASTON, F.R.S.

THE relative abundance of the different elements has always been of great interest to chemists. Attention was directed to the relation between abundance and atomic number first by Harkins (Jour. Amer. Chem. Soc. 39, p. 856, 1917; also NATURE, April 14, 1921, p. 202), who showed that elements of even atomic number predominated to a very marked degree not only in the earth's crust but also in such extra-terrestrial matter as meteorites. Since there is now available definite information on the constitution, isotopic or otherwise, of so many of the elements, it is of interest to extend this inquiry to individual species

of atoms. The accompanying diagram (Fig. 1) represents the relative abundance of the different types of atoms composing the first 39 elements. Although these number less than half the elements known yet, owing to the great preponderance of the lighter elements in terrestrial matter, they represent a surprisingly large percentage, being more than 99·8 by weight of all such matter available for chemical analysis.

The mass-number of each species of atom, that is to say its whole number atomic weight or the number of protons in its nucleus, is plotted against the logarithm to base 10 of the total number of gram-atoms on the earth. The latter figure is arrived at in the following manner. The earth is assumed for the purposes of this calculation to consist of a lithosphere of mass $5{\cdot}98 \times 10^{27}$ gm. having the average composition of the igneous rocks, a hydrosphere of mass $1{\cdot}45 \times 10^{24}$ gm. of water, and an atmosphere of mass $5{\cdot}29 \times 10^{21}$ gm. of ordinary air. That the unknown interior of the earth has the same chemical composition as the deeper parts of its outer crust is, of course, flagrantly improbable, but to leave it out of the calculation altogether might give the hydrosphere and atmosphere undue prominence. The average chemical composition of the igneous rocks is calculated in gram-atoms from the percentage composition given in the admirable report on the subject by Clarke and Washington (No. 462 Geophysical Laboratory, Washington; May 1922). Ramsay's and Claude's figures are taken for the atmosphere. In the case of a complex element, the proportion of its various isotopes, when not otherwise ascertainable, is estimated from the intensity of their lines on its mass-spectrum. This rough method is sufficient for the diagram, for which no great accuracy is claimed. Only the roughest estimates are available for the percentages of the rarer elements in the igneous rocks.

The number of gram-atoms used is clearly a measure of the total number of atoms; we have only to multiply by Avogadro's number $6{\cdot}06 \times 10^{23}$ to obtain the latter. Thus in the case of oxygen there are on the earth we are considering $1{\cdot}73 \times 10^{26}$ gram-atoms containing very nearly 10^{50} of type O^{16} in all. Of the next most abundant type, Si^{28}, there are about one-third that number. The types belonging to odd and even atomic number are distinguished from each other and a continuous connecting line is drawn. In the case of isobaric pairs this line is duplicated, making the diagram somewhat complicated in the region of krypton. It is of interest to note that the contribution of hydrogen atoms from the sea is barely distinguishable on this diagram, while that of oxygen atoms from the sea and air combined is entirely insignificant.

The preponderance of elements of even atomic number is well shown by the peaks 8 O^{16}, 14 Si^{28}, 20 Ca^{40}, 22 Ti^{48}, 26 Fe^{56}, 38 Sr^{88}, which have an enormous significance on a log scale of this kind. The outstanding importance of atomic weights of type 8n is also brought out clearly. The appearance of more uniform distribution among the odd atomic numbers than among the even ones is probably largely fictitious, and due to the method of calculating the abundance of the inert gases. Attention may be directed to the scarcity of those types which contain an odd number of electrons in the nucleus. These only number 7 out of a total of 69, and 4 of these, including all those of even atomic number, occur below atomic number 8.

The curve was originally drawn in the hope that it might afford some evidence as to the relative stability of nuclei during the evolution of the atoms. In this respect its irregularity is rather disappointing, but consideration of it raises many points of interest. The one with which this article is particularly concerned is perhaps the most obvious of all; that is, the extreme contrast between the range of abundance exhibited among the different isotopes of one element and that shown among the elements themselves; *e.g.* there are only about three Cl^{35} atoms to one Cl^{37} and about two Ga^{69} atoms to one Ga^{71}, yet there are a thousand million times more atoms of chlorine than of gallium. The methods of mass-ray analysis are not yet particu-

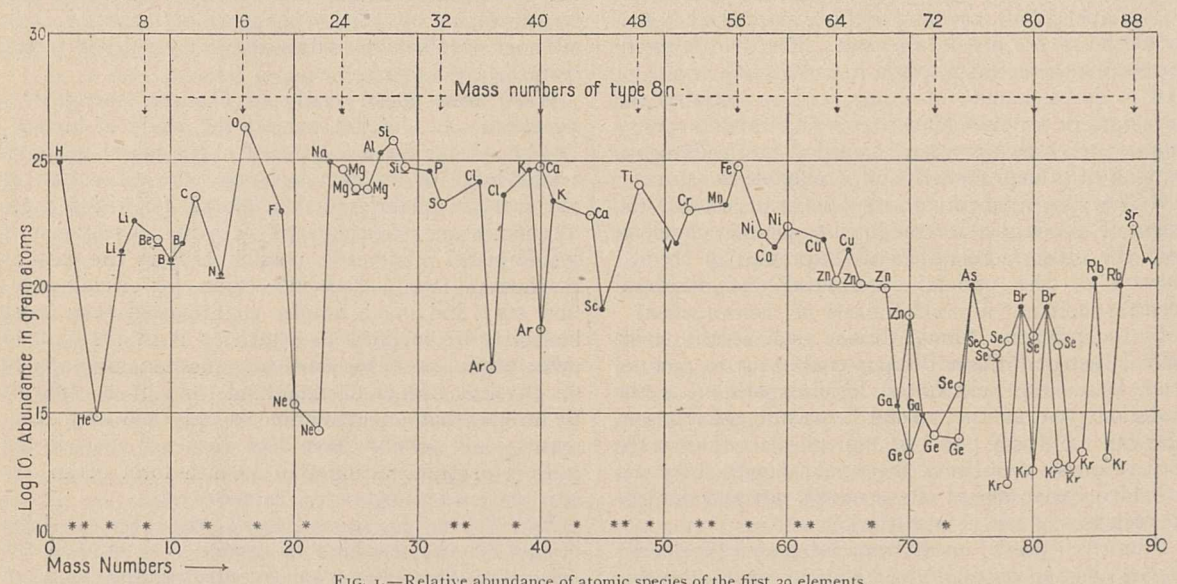

FIG. 1.—Relative abundance of atomic species of the first 39 elements.
○ Even atomic number 41 } Total, 69 species.
● Odd atomic number 28 }
✳ Missing or doubtful mass numbers.

larly suitable for detecting atoms present in small quantities among their isotopes, so that a reasonable figure, neglecting exceptionally favourable cases, for the range of abundance between isotopes is 10^2. That between elements, even on this table, rises to 10^{14}, and if the heavier atoms were included, would be vastly greater.

It is curious to reflect how very few would be the number of types of atom known to us by physical methods of mass determination had no chemical methods of separation and concentration been available. The problem is to assign a reason for this gigantic difference of range. If the limitations of the method of detection are the only factors, then we must conclude that the number of atomic species so far discovered is only a minute fraction of those actually existing. This conclusion is interesting in itself, and has some show of probability in the case of elements of even atomic number which show great differences in isotopic complexity, but it does not seem admissible in the case of the others. Twenty-five elements of odd atomic number have been analysed so far; in ten cases two, and in no case more than two, isotopes have been detected. That this can be ascribed simply to the limit of delicacy of the method of detection seems so exceedingly improbable that it appears safer to adopt the view that the number of existing atomic species and their relative abundance shown in this diagram, though of course incomplete, are not on the whole very far wrong.

If this is so, and there are many other pieces of evidence in its support, then there appear only two possible ways of explaining the difference of range under discussion; either our sample of matter is entirely unrepresentative or the similarity between isotopic atoms must be even deeper than has hitherto been supposed. The first alternative would require that natural chemical separation and concentration had taken place to an enormous extent before the earth, or that part of it we are considering, was formed. The relative abundance of the elements in meteorites, which is not very different from that in terrestrial matter, is all against such an idea. The other and more probable alternative is one of fundamental importance and interest. The close abundance-relation between the members of groups of isotopes is most striking, and particularly is it significant in the pairs of odd atomic number, to which may be added those of antimony and silver, not on this diagram. It cannot be due to the mere identity of net nuclear charge, but must be connected in some other way with the structure of the nucleus and its stability in evolution.

It has been suggested that all atoms of the same element may in general contain an "inner nucleus" in common, and that the stability of the inner nucleus will determine the abundance of the element. Further, that this inner part being formed, outer parts may be added to the nucleus in different ways giving rise to isotopes without altering the stability to a large degree. Experimental evidence in support of this idea is already available. The mass relation between the isotopes of tin is apparently integral to the highest accuracy. The same is true of the isotopes of xenon. But the masses of the principal isotopes of tin are not integrally related to the masses of those of xenon, those of tin being the lighter by a quantity which, under the particular conditions of comparison, cannot possibly be ascribed to error of measurement. This is exactly the state of affairs to be expected if the inner nucleus common to the isotopes of tin is lighter than the inner nucleus common to those of xenon. Much more accurate mass determinations will be required to substantiate this theory, which is admittedly speculative, but it seems to supply the only feasible explanation of the facts.

Obituary.

CAPT. T. H. TIZARD, F.R.S.

CAPT. THOMAS HENRY TIZARD, formerly Assistant Hydrographer of the Navy, died on February 17 in his eighty-fifth year. He was the senior surviving officer of the old navigating branch, and came from an old seafaring family. Born at Weymouth on March 13, 1839, son of Mr. Joseph Tizard, his grandfather commanded an armed merchant vessel at the battle of Copenhagen. Educated at Royal Hospital School, Greenwich, he joined the Navy as master's assistant just seventy years ago, and served in H.M.S. *Dragon* with the Baltic Fleet during the Russian war of 1854–1856, being present at the attack on Fort Gustasvard and also at the bombardment of Sveaborg. After the Russian war, Tizard was appointed to H.M.S. *Indus* on the West Indian station, bearing the flag of Rear-Admiral Sir Houston Stewart, his former captain in the *Dragon*. Promoted to second master in February 1860, he returned to England shortly afterwards. Following the inclination of a mathematical and scientific turn of mind, the surveying service had attractions for him, and he was appointed to H.M. surveying vessel *Rifleman* on the China station. He served in that ship for seven years, during which time he laid the foundation of his subsequent reputation as an accomplished surveyor. The *Rifleman* was largely engaged on the survey of the reefs and shoals abounding in the South China Sea between Singapore and Manilla, and for some three years Tizard had command of the schooner *Saracen*, acting as tender to the *Rifleman*. He was promoted to the rank of master in June 1864, and returned home three years later suffering severely from dysentery.

In 1868–71 Tizard was serving as navigating lieutenant of H.M. surveying vessel *Newport*, commanded by Capt. (later Sir George) Nares on the Mediterranean station, and in September-October 1868 directed the laying of a submarine cable between Malta and Alexandria. The *Newport* was present at the official opening of the Suez Canal in 1869, leading the long procession of ships. During the next three years Tizard was engaged in carrying out a much-needed survey of the Gulf of Suez for the benefit of the vast volume of shipping about to use the new canal route through the Red Sea, a larger vessel, the *Shearwater*, replacing the *Newport*. Whilst serving in the *Shearwater* Tizard conferred a great boon on his brother surveyors by bringing out a "Table of Chords," thereby saving a vast amount of time and arithmetical labour

in the chart-room when plotting. During this time, also, interesting and important observations were made of the surface and under-currents in the Straits of Gibraltar, which set at rest the vexed question of movement of those waters. In all this work Tizard's strong personality and resourcefulness, combined with his intimate knowledge of both the scientific and practical sides of hydrographical surveying, exercised an influence unusual in the case of a subordinate officer.

In 1872 the appointment of Capt. Nares to command the memorable *Challenger* Expedition led to Tizard's transference to the *Challenger* as navigating officer. This afforded him the great opportunity of becoming closely associated with the science of oceanography, then comparatively in its infancy. The benefit to science in many branches resulting from the observations made during the voyage of the *Challenger* from 1872 to 1876 was a grand achievement, and one in which Tizard bore an important and leading part. Promoted to the rank of staff-commander in July 1874, he remained in the *Challenger* until her paying off in 1876, when he was appointed to the *President* for service in the Hydrographic Department of the Admiralty, being employed on the narrative of the voyage and its oceanographical results, together with a contribution to the meteorology of Japan. Little at that time was known about the latter, but from the meteorological records kept for a number of years at each of the lighthouses and lightships a very valuable series of observations had been collected. These observations were tabulated by Tizard, and from the mean monthly results diagrams were constructed showing the yearly curves.

In 1879 Staff-Commander Tizard again resumed active surveying duties afloat, serving in the *Porcupine* on the survey of the coast of England before taking charge of the survey himself the following year. From 1880–82 he was in command of the hired vessel *Knight Errant*, and in the latter year commissioned a new vessel, H.M.S. *Triton*, for surveying work on the east coast of England. During the nine years that he held this command he wrote many papers of scientific value and interest, most of which were published by the Admiralty. One of the earliest of these, on deep-sea explorations in Faeroe Channel in 1882, was read at the Royal Society and the Royal Society of Edinburgh, and in it Tizard showed that his observations established the existence of a continuous ridge across the Faeroe Channel, which was named "Wyville-Thomson Ridge." This ridge separates the cold from the warm area, and had been predicted from the *Challenger's* report so far back as 1876. Tizard thoroughly investigated it by means of cross-sections, at each end of which serial temperatures were observed and diagrams constructed showing the distribution of the temperature from the surface to the bottom, the form of the ridge, etc., besides obtaining a series of dredgings and trawlings on top of and on each side of the ridge.

The fact was also established that there is a regular interchange of the water across the Wyville-Thomson ridge, the Atlantic water flowing north-east into the Arctic basin on the surface and so far down as the ridge permits; whilst over the deepest part of the ridge there is a small outflow of Arctic water into the Atlantic, which, though of infinitely less volume than the water moving north-east, yet appears to be sufficient to enable the bottom water of the Arctic basin, immediately adjacent to the ridge, to retain its coldness.

In 1886 Tizard delivered a lecture at the School of Military Engineering, Chatham, on marine surveying, which was printed in the Professional Papers of the Corps of Royal Engineers.

The report on Tizard's survey of the outer part of the Thames estuary carried out in 1889 contains information on the tidal datums used at various places on the east coast of England and Scotland during the period covered by his survey. Two years later he compiled and published "Notes on the Tidal Datums and Levels on the River Thames and Estuary," thus bringing together in a convenient form for reference full information on tidal datums over a large part of British coasts. In 1890 Tizard published in NATURE an interesting and highly important article on "The Thames Estuary," in which he gave an account of the changes in the channels of the estuary from the commencement of the nineteenth century. He shows these changes to be of two kinds, namely, permanent changes and periodic changes, and illustrates them by a series of diagrams. The formation of the banks of the estuary and the influences operative on them are also dealt with, and the interesting phenomenon of the opening up and disappearance of swatchways, with special reference to Duke of Edinburgh Channel, is discussed. The article deals very fully with questions affecting the estuary of the Thames, and is one of great permanent value to all those whose duty it is to maintain the channels in the estuary of a river of such national importance as the Thames.

In 1891 Staff-Commander Tizard was selected for the position of Assistant Hydrographer of the Navy, and in the same year was elected fellow of the Royal Society in recognition of his contributions to oceanographical knowledge. He served on the Council of the Royal Society from 1902 to 1904.

Tizard attained the rank of staff-captain in February 1889, and was placed on the retired list with the rank of captain in December 1896. In June 1899 he was awarded the honour of a civil C.B. In 1900 he compiled an interesting chronological list of the officers conducting British maritime discoveries and surveys, together with the names of the vessels employed, from the earliest times until 1900.

The question of the feasibility of making an alternative harbour on the eastern side of the Rock of Gibraltar having been raised in the House of Commons, Capt. Tizard was charged to report on the matter, in conjunction with Mr. Shield of the Works Department of the Admiralty, and in April 1902 proceeded to Gibraltar for that purpose. The report was rendered to the Board of Admiralty in June. Capt. Tizard continued to serve at the Admiralty as Assistant Hydrographer until the autumn of 1907, when he was awarded a special pension in recognition of his valuable public services.

After his retirement he continued for some time to write and edit various Admiralty publications, among which "Tides and Tidal Streams of the British Isles" was perhaps the most important; this work he rewrote entirely.

The last, and not the least, public service performed by Tizard was to report and prepare plans to assist the Admiralty Committee, under the chairmanship of Admiral Sir Cyprian Bridge, in 1912, to arrive at a conclusion relative to the tactics employed by Nelson at Trafalgar. The investigation and co-ordination of all records from ships' logs and other sources enabled Tizard to prepare a track chart and three plans, which the Committee in its report states to be "the first and only plans representing any phase of the Battle of Trafalgar which have been exactly drawn to scale, and in which the positions assigned to particular ships in the British Fleet have been settled in accordance with the evidence contained in the logs and journals." A. M. F.

SIR MALCOLM MORRIS, K.C.V.O.

THE sudden death on February 19 of Sir Malcolm Morris, at the age of seventy-four, removes one who for half a century has been identified with the progress of medical science in its widest aspects. His student days were passed at St. Mary's Hospital, and after qualifying and holding a house surgeoncy there, he entered upon general practice in Yorkshire for a brief period. He then proceeded to Berlin and Vienna in order to continue his medical studies, and became interested in dermatology.

After his return to Great Britain, Sir Malcolm Morris was soon appointed clinical assistant to the Blackfriars Skin Hospital, and, later, lecturer on dermatology and surgeon in charge of the skin department, St. Mary's Hospital, where he worked for twenty years. Afterwards, he was for some years dermatologist to the London School of Clinical Medicine, Greenwich. He was one of the first in Great Britain to employ the Finsen light in the treatment of skin affections, and was one of the promoters of the Radium Institute and served on its committee.

Sir Malcolm Morris naturally had his attention directed to those two scourges of mankind, tuberculosis and syphilis. He was one of the first to recognise the importance of Koch's discovery of the tubercle bacillus and, later, of tuberculin, and was Secretary-General of the British Congress of Tuberculosis held in London in 1901 when Koch made his noteworthy pronouncement on the duality of human and bovine tuberculosis. He was also a member of the International Council on Leprosy. As regards syphilis, he recognised the public apathy and conspiracy of silence respecting this disease, and became a strenuous advocate for the appointment of a Royal Commission on Venereal Diseases. He saw his proposal realised in 1913 and served as one of the Commissioners, as well as becoming a vice-president of the National Society for Combating Venereal Diseases, established in 1914.

Other public health questions also interested Sir Malcolm Morris. He was elected president of the Institute of Hygiene in 1917, was a fellow of the Royal Sanitary Institute, and long served on the Council of the Cremation Society of Great Britain. He was created K.C.V.O. in 1908. His published work included a manual of "Diseases of the Skin," which passed through several editions, and "The Story of English Public Health," and he was for a time editor of the *Practitioner* and a director of Cassells, Ltd. He was a man of unbounded energy, a facile speaker, and with keen business acumen, an excellent member of committees. R. T. HEWLETT.

REV. C. J. BALL.

THE death occurred recently of the Rev. Charles James Ball, Rector of Bletchington, Oxford, at the age of seventy-three years. Although his work was known only to a comparatively limited circle, his knowledge of Biblical Hebrew and of the text of the Old Testament was unsurpassed, and he was one of the recognised authorities in Assyriology. His earlier years were spent as classical and Hebrew master at Merchant Taylors School, and after he had been presented to the living of Bletchington in 1899, he was for a time reader of Assyriology in the University of Oxford.

Of Mr. Ball's many contributions to Biblical and Assyriological studies, the most noteworthy was a series entitled "The New Accadian," which appeared in the proceedings of the Society of Biblical Assyriology, the Council of which he joined in 1878. He here endeavoured to show that the Chinese language and writing were derived from the Proto-Babylonian or Sumerian. This series was afterwards expanded into book form and published under the title "Sumerian and Chinese," issued in 1913. Its reception was of a mixed character, partly owing to the fact that Ball's intimate knowledge of the two languages was not equally shared by any other scholar: partly to the fact that his theories were in advance of his time. They are, in fact, still *sub judice*. Equally original was his attempt to trace Semitic triliteral roots to a Sumerian origin, published in the form of contributions to the "Hilprecht Anniversary Volume" and the Proceedings of the British Academy. Although his theory is still not finally accepted, the work of other scholars on lines laid down by Mr. Ball tends to confirm it. In addition he wrote extensively on matters connected with the Old Testament, his work of most lasting value to scholars being "The Hebrew Text of Genesis with Critical Notes" and "The Book of Job, a Revised Text and Version."

THE death is announced of Mrs. Robert Gray, of Edinburgh, who had for many years collected fossils from the Ordovician and Silurian rocks of Girvan, Ayrshire, with great assiduity and skill, and had continued her field labours up to last summer. She was in her ninety-third year. Her collection of more than 40,000 specimens was recently purchased by the Trustees of the British Museum, and contains material described by T. Davidson, Alleyne Nicholson, R. Etheridge fil., Lapworth, Cowper Reed, Bather, W. K. Spencer, and other specialists. In 1903 Mrs. Gray was awarded the Murchison fund of the Geological Society of London.

WE regret to announce the following deaths:

Dr. L. Péringuey, Director of the South African Museum, Cape Town, on February 20.

Prof. H. A. Thomson, professor of surgery in the University of Edinburgh, on March 5, aged fifty-nine.

Current Topics and Events.

GEOLOGISTS and zoologists visiting the British Museum (Natural History) will soon miss the presence of Dr. Arthur Smith Woodward, who is about to retire. It was in 1901 that he succeeded Dr. Henry Woodward as keeper of the Geological Department, which he had joined as an assistant in 1882, and in which his whole career has been passed. He leaves the Department in a state of high efficiency, the collections in many branches reflecting the elegance and accuracy of his own personal work. His chief official publication is the four-volume Catalogue of Fossil Fishes, a task which occupied many years, and evinces not only careful systematic work, but also theoretical deductions of high value, not merely in relation to the fishes, but to the vertebrata generally. Dr. Woodward followed up his catalogue with the "Outlines of Vertebrate Palæontology," which soon became, and has since remained, the leading text-book on the subject. He also collaborated with Mr. Sheborn in the "Catalogue of British Fossil Vertebrata." In connexion with his museum work, Dr. Woodward visited many foreign countries, paying especial attention to the collection of new material, as at Pikermi, in Aragon, and in South America, as well as studying the leading museums of those countries. Few authors have contributed so many papers, and on so wide a range of subjects, to the Geological and Zoological Societies, the *Geological Magazine*, and the Geologists' Association. He has been president of the Geological and Linnean Societies, the Geologists' Association, and Section C (Geology) of the British Association, and has found time for more than twenty years to act as secretary and edit the fine series of volumes issued by the Palæontographical Society, to which he himself contributed the Monograph on the Fishes of the Chalk. His name is associated with many important discoveries among the fossil fishes and reptiles of Great Britain, but two of his most noteworthy researches have been in the Weald, in association with Mr. Dawson. The first of these was the first find of mammalian remains in the Wealden beds, and the second the famous Piltdown skull, which Dr. Woodward placed in a new genus, Eoanthropus, making a prediction with regard to its anatomy which was afterwards verified by the remarkable discovery of the ape-like canine tooth, the existence of which he had anticipated.

AN important and recent bequest to the Natural History Museum is the collection of spiders and other Arachnida formed by the late Mr. H. R. Hogg. Mr. Hogg started the study of this group while living at Macedon in Victoria, and thus became acquainted with the spider fauna of South Australia. Coming to England some thirty years ago to carry on his business in London, he spent most of his spare hours at the Museum, identifying and describing the collection he had brought home. He soon became known as an authority upon the spiders of that quarter of the world, and afterwards he received and worked out numerous consignments that were sent to him not only from Australia, but also from New Zealand, the subantarctic islands, and Austro- and Indo-Malaysia. Although the restrictions of his business prevented him devoting so much time as he wished to the prosecution of his hobby, his painstaking industry resulted in the publication of many papers in the Proceedings of the Zoological Society and in various Asiatic and Australian scientific periodicals. For many years before his death last December, he had been almost the only man in England working at exotic Arachnida, and his loss will be greatly felt by his zoological colleagues and by the numerous personal friends to whom his kindly nature had endeared him. He bequeathed his valuable collection of scientific books to Christ's College, Cambridge, where he was a graduate.

THE Physical Society of London is arranging to celebrate its jubilee on March 20-22, March 21 being the anniversary of the first meeting held, when a paper was read by Prof. J. A. Fleming. All the proceedings will take place at the Institution of Electrical Engineers, the premises having been generously placed at the disposal of the Physical Society for the occasion. A number of distinguished men, including many foreign men of science, have stated their intention of taking part in the celebrations. Amongst these may be mentioned (besides the principal British physicists) MM. le Duc de Broglie, Langevin, Fabry, and Dunoyer (France), M. de Hemptinne (Belgium), Profs. Wien and Zenneck (Germany), Prof. Guye (Switzerland), and Prof. Zeeman (Holland). The afternoon of March 20 will be devoted to the reception of delegates and presentation of addresses (3 P.M.), and to the delivery of the Guthrie lecture (3.45 P.M.) by M. le Duc de Broglie, who will take as his subject "The Photo-electric Effect in the case of High-frequency Radiation, and some Associated Phenomena." For the evening (6 P.M.) a lecture by Sir Richard Paget has been arranged by the Institution of Electrical Engineers on "The Nature of Speech." On March 21 there will be reminiscences by fellows of long standing, including, at the afternoon session, Sir W. Barrett, Prof. J. A. Fleming, Prof. C. V. Boys, and Sir R. Glazebrook, and at the evening session Sir A. Schuster, Sir Oliver Lodge, and Prof. H. E. Armstrong. On Saturday, March 22, a banquet will be held at the Connaught Rooms at 7 P.M. His Royal Highness the Duke of York has graciously consented to be present, and to respond to the toast of the Royal Family. The Prime Minister and Viscount Haldane will also be guests of the Society, and are expected to speak. Each day there will be an exhibition of apparatus, and demonstrations dealing particularly with important apparatus which was described before the Society at its first introduction. A feature of this part of the entertainment will be a demonstration by Prof. C. V. Boys of the making of quartz fibres, which he first showed to the Society thirty-seven years ago. The exhibition will be open from 2.30 to 8.30 P.M. on March 20 and 21, and from 2 to 4 P.M. on March 22

AT the meeting of the Informal Meetings Section of the Institution of Electrical Engineers on February

18, Mr. E. M. Malek gave some very interesting data as to recent hydro-electrical development in France. In 1902 only 200,000 h.p. was being developed from water-power, and in 1906 this had grown to 350,000 h.p. In 1906 powers were given to the Ministry of Public Works to collect data and prepare schemes for the development of natural water-powers. The progress of development was steady until 1914, when it was accelerated by the demand for energy for the manufacture of munitions, and by the shortage of fuel. In 1919, 1,500,000 h.p. was in operation, and it is estimated that by 1925 the total development will amount to 3,000,000 h.p., and by 1935 to 4,000,000 h.p., or about 45 per cent. of the total available water-power of the country. This will represent a saving of some 24,000,000 tons of coal per annum. There are eighty-two power-houses now in operation in France having a capacity of more than 10,000 h.p. Of these, ten are above 50,000 h.p. and two more than 100,000 h.p., while eight further schemes, each to give above 100,000 h.p., are now in hand. The regions of hydraulic power are the east, centre, and south. Between these areas a network of transmission lines is being constructed which will be extended to Paris, to the industrial area of the N.E., and the towns on the north and west coast. These developments are likely to have a very pronounced effect on the growth of industry in France, and especially on that of the metallurgical industry.

SIR OLIVER LODGE communicated to the Society for Psychical Research, at its meeting on March 6, an important paper by Prof. Richet entitled "Pour et contre la survie." Without questioning the alleged facts accepted by the investigators of what are called spiritistic phenomena, Prof. Richet doubts the spiritistic interpretation, because as a physiologist he cannot see how personality can survive the death of the brain. Sir Oliver Lodge dealt with this objection from the purely scientific point of view. The basis of Sir Oliver's spiritistic theory, the ground of his belief in survival, is not religious in the theological meaning, or speculative in the philosophical meaning, but positivistic in the scientific meaning. It may be described as a physical theory of mental activity, or at least as a physical hypothesis of the nature of the relation of mind and brain. He holds that the physical universe, even admitting the new interpretation of physical reality offered by the principle of relativity, gives abundant evidence of the existence of ether, a physical medium which differs in definite and clearly marked characteristics from matter. It is essentially through this medium that all human activity is in fact conducted even when living people in communicating with one another make use of material organisms. It is this fact which holds out to us the scientific possibility of the continuity of psychical existence and the survival of personality. Personality, Sir Oliver holds, is even now and here an ethereal and not a material existence, but in our present life its activity depends on its relation to matter. We are unable to know directly, and we can only vaguely conceive, the conditions of ethereal existence without relation to matter, but everything points to the view that it is not nothing. The theory seems a perfectly reasonable one, and simply depends for its appeal on the amount of direct evidence of a scientific nature which we can collect, and also, of course, on the rationality of the interpretation. The hypothesis has nothing in common with the philosophic argument which Plato puts into the mouth of Socrates in the "Phædo," or with the metaphysical argument of Leibniz that the soul being a simple substance is indestructible.

THE estimates for the Civil Service and Revenue Departments for the year ending March 31, 1925, which have recently been issued (H.M.S.O., 3*d*.), show a total net estimate of 289,874,727*l*., a reduction of 37,338,145*l*. on that for the year 1923–24. Among the items with which we are more intimately concerned, and comparing the estimates with those for 1923–24, we notice that the estimate for the Ministry of Agriculture and Fisheries has been reduced by 2,704,323*l*., and now stands at 2,018,138*l*., a reduction of considerably more than one-half, while that for the Forestry Commission has been increased by 15,000*l*. to 178,000*l*. In Scotland the Board of Agriculture and Fishery Board receive increases of 115,440*l*. and 14,111*l*. respectively, the two estimates being 446,692*l*. and 60,790*l*. Class IV. estimates are of particular interest. The Board of Education estimate is 41,900,000*l*., a reduction of 34,047*l*. only on that for 1923–24; that for the British Museum is 301,793*l*., an increase of 9877*l*. Scientific investigation has been allotted 201,450*l*., an increase of 12,729*l*., while the estimate for the Department of Scientific and Industrial Research has been increased by nearly one-fifth (50,938*l*.), the total being 328,281*l*. The item for universities and colleges, Great Britain, and intermediate education, Wales, has also been augmented slightly (73,770*l*.), the 1924–25 figure being 1,272,970*l*. The estimate for public education in Scotland is 5,773,495*l*., a decrease of 149,500*l*. on the 1923–24 estimate. The Development Fund is allotted 200,000*l*., a decrease of 50,000*l*. on the present year's figures.

THE need for linking the activities of the various organisations of technicians in industry, so as to enable them to co-operate effectively for the purpose of securing that the interests of their members are adequately protected, is now becoming generally recognised. It is felt that, in the past, owing to the fact that technical engineers, chemists, and scientific workers generally have been insufficiently organised, their collective voice has been practically ignored when, *inter alia*, questions of general policy affecting industry have been made the subject of legislative enactment. With the view of remedying this state of affairs, a joint conference of delegates representing several societies of technical engineers and chemists was held recently to consider the matter, the outcome being that a National Council of Technical Staff Associations has been formed. At present only the Electrical Power Engineers' Association, the Society of Technical Engineers, and the Engineer Surveyors' Association are represented on the National Council, but the regulations which have been drawn up are

wide enough to admit all similar organisations to its membership. The National Council aims principally at being an advisory body : its object is to co-ordinate the work and policy of the constituent societies, whilst maintaining adequate safeguards to prevent encroachments on their autonomy. The National Council proposes as a first step to undertake propaganda work with the view of impressing upon technicians generally the desirability of their being organised on a professional basis, and meetings, to be held in large industrial centres for this purpose, are now being arranged ; the first of these will be held at the Milton Hall, Manchester, on March 28. Joint secretaries to the National Council have been appointed, their offices being established at 102 Belgrave Road, London, and 23 King Street West, Manchester.

AT the invitation of the Council of the British Association, a conference of representatives of scientific societies will be held at the rooms of the Society of Antiquaries, Burlington House, on March 21, at 3 P.M., to discuss the need for further protection of sites of historic or scientific interest or of natural beauty against disfigurement or obstruction. Recent experience in connexion with Holmbury Hill, Lulworth Cove, and Avebury indicates that the Ancient Monuments Act is not adequate to secure beyond question monuments which may be irreplaceable, while it does not cover sites in which the scientific or æsthetic interest lies in the locality itself irrespective of any structures or building. Although local learned societies have done much to form public opinion in specific instances when a site is threatened, damage may already have been done before an expression of public disapproval has gathered sufficient force to resist powerful interests such as were concerned in the cases mentioned. It is therefore urgently necessary that the existing Act should be strengthened by a widening of its scope and by a stricter wording, so that it should apply to all such sites, and should provide that when once scheduled they could not be subject to any kind of disturbance except by removal from the schedule as the result of a deliberate decision of Parliament in the interests of the nation.

THROUGH the persevering labours of Mr. R. T. Gunther, of Magdalen College, the extremely valuable collection of early scientific instruments acquired by Mr. Lewis Evans has now found a permanent home in the Old Ashmolean Museum at Oxford. No more appropriate resting-place for this unique series of historic instruments could be found than the building erected by the University in the reign of Charles II. to receive the famous collections of Elias Ashmole, and to serve as a centre for scientific studies in Oxford. The collection is the fruit of thirty years' assiduous devotion on the part of Mr. Evans, and it is quite certain that, if it were dispersed, no such series could ever be got together again. A remarkable feature of the collection is its wealth in early astronomical and mathematical instruments, dated examples of which go back so far as the thirteenth century. For rather more than a year past the collection has been housed as a loan in the Picture Gallery of the Bodleian Library ; now, however, it passes as a gift to the University, and the expenses of its removal to its new quarters will be met by the generous gift of 1000*l.* from the Goldsmiths' Company and of 250*l.* from Sir John R. Findlay, of Balliol College. Mr. Gunther is to be heartily congratulated on the successful issue of his untiring efforts, in the face of some opposition, to ensure the addition of this most interesting series to the permanent treasures of the University.

THE new Aquarium which has been built in the Zoological Society's Gardens at Regent's Park, London, will be opened to fellows of the Society on Saturday, April 5, and to the public on Monday, April 7. The Aquarium is situated below the Mappin Terraces, and has been completed at a cost of approximately 54,000*l.*, including equipment and stocking. It is a crescentic gallery nearly 450 feet long, with tanks on each side, those on the outer side of the crescent being illuminated by daylight or electric light, those on the inner side by electric light bulbs which select the rays so as to produce a daylight effect. There is a fresh-water hall with twenty-five tanks, a sea-water hall with a similar number of tanks, two of which are more than 30 feet long, and a tropical hall with forty tanks, most of them small in size. There are well-lighted service passages behind the tanks from which the cleaning and feeding are carried out. The salt water has been obtained from the Bay of Biscay. It is stored in large reservoirs under the floor of the great hall, and is circulated constantly through the tanks. A well-equipped workroom is attached to the Aquarium for zoological and economic research. The living exhibits already include turtles, cod, soles, plaice, flounders, small sharks and dog-fish, skates, rays, crabs, lobsters, octopuses, and many different kinds of molluscs, worms and anemones, most of the British fresh-water fish, and a large number of rare and brilliantly coloured tropical fish.

MR. EDWARD F. L. WOOD, M.P., and Major A. G. Church, M.P., secretary of the National Union of Scientific Workers, have been appointed members of the Medical Research Council.

IT is announced in *Science* that Dr. Frederic A. Lucas, after serving for twelve years as director of the American Museum of Natural History, has become honorary director, and will act in an advisory capacity. Mr. George H. Sherwood is promoted to the post of acting director for a term of two years.

APPLICATIONS are invited by the Department of Scientific and Industrial Research for an assistantship for experimental work in connexion with timber-drying kilns of the Forest Products Research Board. The applications should be made in writing by March 20, at latest, to the secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1.

MR. R. ANNING-BELL, Royal Academician ; Mr. J. W. Simpson, past president, Royal Institute of

British Architects; and Mr. F. E. Smith, F.R.S., director of Scientific Research, Admiralty, have been elected members of the Athenæum under the provisions of the rule of the club which empowers the annual election by the Committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

THE Lord President of the Council has appointed Mr. F. S. Sinnatt to be assistant director of fuel research as from April 1 next. Mr. Sinnatt is lecturer in fuels in the University of Manchester, Faculty of Technology. He is also director of research to the Lancashire and Cheshire Coal Research Association, and has been in charge of the physical and chemical survey of coal seams which the Association is carrying out for the Fuel Research Board in the Lancashire and Cheshire coalfields.

PROF. V. H. BLACKMAN, of the Imperial College of Science and Technology, will deliver a lecture before the Royal Meteorological Society on March 19 on "Atmospheric Electric Currents, Normal and Abnormal, and their Relation to the Growth of Plants." The subject of the lecture is one that has created much interest of recent years both in Great Britain and abroad, and Prof. Blackman's discourse will bring forward the latest developments in this line of research. Those interested in the subject are invited to attend the meeting, which will be held in the Society's rooms at 49 Cromwell Road, South Kensington, at 7.30 P.M.

REAR-ADMIRAL ALBERT PARKER NIBLACK, U.S. Navy (Retired), has been elected a director of the International Hydrographic Bureau in succession to Capt. S. H. Müller, Royal Norwegian Navy (Retired), who resigned in October 1923. Admiral Niblack has had a long and varied career afloat, and for four years was under the U.S. Coast and Geodetic Survey in Alaska, during which he carried out astronomical determination of latitude and longitude, magnetic and tidal observations, and other scientific work. He has also been responsible for much hydrographic surveying in the Hawaiian Islands, off Costa Rica, and other regions.

THE annual general meeting of the Chemical Society will be held at Burlington House on Thursday, March 27, at 4 P.M., when the president, Prof. W. P. Wynne, will deliver his presidential address, and the presentation of the Longstaff medal for 1924 will be made to Prof. F. G. Donnan. An informal dinner of fellows and their guests will be held at the Hotel Cecil, Strand, the same evening, at 7 for 7.30 P.M. Tickets, price 7s. each, are obtainable from the Assistant Secretary, Mr. S. E. Carr, the Chemical Society, Burlington House, Piccadilly, W.1.

THE following Committee has been appointed by the Ministry of Agriculture to investigate foot-and-mouth disease: Sir Charles Sherrington (chairman), Dr. J. A. Arkwright, Prof. W. Bulloch, Prof. J. B. Buxton, Capt. S. R. Douglas, Mr. S. H. Caiger, Sir John McFadyean, Prof. C. J. Martin, Prof. Robert Muir, Sir Stewart Stockman, Mr. H. G. Richardson and Mr. W. G. Wragg (secretaries). By its terms of reference, the Committee is to initiate, direct, and conduct investigations into foot-and-mouth disease, either in Great Britain or elsewhere, with the view of discovering means whereby the invasion of the disease may be rendered less harmful to agriculture.

THE Toronto meeting of the British Association, to be opened on Wednesday, August 6, with the presidential address by Sir David Bruce, will be distinguished by a number of discussions in which members of two sections will join. Among the subjects of these joint discussions are:—soil population, physiological and psychological factors of muscular efficiency in industry, optical stress determination, vitamins, crystal structure, mental differences of race, chromosomes and species, and colloid chemistry. On the evening of Friday, August 8, Sir Thomas Holland will give a discourse on the formation and destruction of mineral deposits, and an afternoon lecture will be delivered by Sir Ernest Rutherford on Tuesday, August 12, on the subject of atomic disintegration.

H.M. THE KING has been pleased to approve the award of the Royal medals of the Royal Geographical Society as follows: Founder's medal to Ahmed Hassanein Bey for his journey in 1923 to Kufra and Darfur; Patron's medal to Commander Frank Wild for his long services to Antarctic exploration. The Council has made the following awards: Victoria medal to Mr. J. F. Hayford, formerly of the United States Coast and Geodetic Survey, for his establishment of the theory of isostasy; Murchison grant to Mr. J. H. Reynolds for his work on the 1/million map and for the Permanent Committee on Geographical Names; Back grant to Mr. M. C. Lester for his geographical work in Graham Land; Cuthbert Peek grant to Mr. F. Kingdon Ward to assist him in his present journey in Tibet; and Gill memorial to Major A. L. Holt for his surveys in Arabia.

AT the annual general meeting of the Institute of Chemistry of Great Britain and Ireland, held on March 3, Mr. A. Chaston Chapman, the retiring president, delivered an address, and the following officers were elected: *President*, Prof. G. G. Henderson; *Vice-Presidents*, Prof. E. C. C. Baly, Mr. A. Chaston Chapman, Mr. A. More, Dr. T. Slater Price, Prof. A. Smithells, and Dr. E. W. Voelcker; *Hon. Treasurer*, Mr. P. H. Kirkaldy; *General Members of Council*, Mr. L. Archbutt, Dr. E. F. Armstrong, Mr. E. R. Bolton, Prof. A. A. Boon, Dr. F. D. Chattaway, Mr. R. L. Collett, Dr. H. G. Colman, Mr. J. Evans, Dr. R. H. Greaves, Prof. A. J. Hale, Mr. G. N, Huntly, Prof. W. H. Lewis, Mr. W. McD. Mackey, Dr. H. McCombie, Dr. R. S. Morrell, Mr. G. H. Perry. Prof. J. C. Philip, Dr. R. H. Pickard, Mr. B. D. Porritt, Prof. F. L. Pyman, Mr. W. D. Rogers, Mr. H. Silvester, Dr. A. Slator, Prof. J. F. Thorpe, Dr. J. F. Tocher, Dr. D. F. Twiss, Prof. F. J. Wilson; *District Members of Council*, Dr. L. Dobbin (Edinburgh and East of Scotland), Mr. H. J. Evans (Liverpool and North-west Coast), Dr. W. R. Fearon (Irish Free State), Dr. W. H. Gibson (Northern Ireland), Mr. C. A. F. Hastilow (Birmingham and Midlands), Mr. E. M. Hawkins (London and South-eastern Counties), Mr. R. D. Littlefield (Bristol and South-western

Counties), Mr. S. E. Melling (Manchester and District), Dr. L. G. Paul (North-east Coast and Yorkshire), Mr. C. A. Seyler (Wales and the County of Monmouthshire), and Mr. J. H. Young (Glasgow and West of Scotland); *Censors*, Mr. A. Chaston Chapman, Sir Herbert Jackson, Prof. G. T. Morgan, and Sir Robert Robertson.

DR. PAUL RIVET publishes a bibliography of current Americanist literature in vol. xv. of the Journal de la Société des Américanistes de Paris. It extends to ninety pages, of which forty are occupied by entries relating to physical anthropology, archæology, ethnology, and linguistics. Dr. Rivet asks that authors should send him copies of their contributions to the subject. It is no doubt the failure to comply with this request that is responsible for the omission of work published in Britain from the bibliography. This is unfortunate, as British contributions to Americanist studies, though few in number, are as a whole of some importance.

THE London County Council has recently issued a second edition of Mr. Milligan's Handbook to the cases illustrating adaptations for locomotion in animals, a series that forms a characteristic and attractive feature in the Horniman Museum at Forest Hill. Apart from the cases, this booklet of 40 pages serves as a useful summary, clear and correct so far as it goes, though it cannot hope to be complete. The omission of any reference to crabs under "Climbing" is doubtless due to the lack of a suitable specimen. Under "Creeping" allusion might be made to the use which some sea-urchins make of their jaws. In making the transition from "Parachuting" to "Flying," would it not be of interest to mention Archæopteryx?

AMONG a number of items of local or of general interest, the Transactions and Proceedings of the Torquay Natural History Society for 1922–23 (vol. iv. part 1) contains a most instructive and illuminating article from the pen of Dr. R. C. L. Perkins on "The Control of Injurious Insects in the Hawaiian Islands by their Natural Enemies." The economic value of the study of entomology has in recent years received something of the recognition that is its due. But it cannot be denied that there are yet wider fields for its application. Articles such as this of Dr. Perkins perform a useful function in setting before the layman the facts and the outlines of the methods adopted in combating insect pests. They thus help to enlist the aid of public opinion in support of work on which an important part of the food supply of the world depends.

ERRATUM.—Letter on "Continental Drift and the Stressing of Africa," E. J. Wayland, December 29, 1923, p. 939, col. 1, line 27, for *features* read *fractures*.

Our Astronomical Column.

COMET OR MINOR PLANET?—An object of uncertain nature (either comet or minor planet) of magnitude 11 was discovered by Stroobant at Uccle Observatory (Brussels) on March 5 at $7^h\ 26{\cdot}5^m$ G.M.T.; Right Ascension $2^h\ 42^m\ 28^s$, daily motion $+1^m\ 20^s$. North Declination 16° 44′, daily motion +10′. Its closeness to the ecliptic and moderate rate of motion make its planetary nature quite probable; but the discoverer's uncertainty as to its nature suggests some appearance of nebulosity.

THE PLANET SATURN.—Mr. W. F. Denning writes: "The belted aspect of the globe of Saturn, and the occasional spots and irregular markings observed, show that disturbances occur on this planet of somewhat similar character to those which frequently present themselves on Jupiter. The much smaller diameter of Saturn, however, renders certain of the phenomena beyond our recognition. At somewhat rare intervals, as in 1903, the disc of this planet becomes the seat of extensive changes, and it is then that its period of rotation may be ascertained with considerable accuracy. In 1795 William Herschel found the period $10^h\ 16^m$, while in 1877 Asaph Hall, at Washington, determined it to be $10^h\ 14^m\ 24^s$ from an equatorial white spot which, however, remained visible only a short period.

In 1903 the writer computed the period as $10^h\ 37^m\ 52^s$ from a number of white and dark spots which remained visible during the last half of that year. This is $23\frac{1}{2}$ minutes longer than the period found nearly half a century ago.

Saturn now rises at about 10 P.M., and may be well observed during the morning hours. It will soon be favourably placed for telescopic study during the evening hours, as it rises 4 minutes earlier every night. Observers should examine critically the planet's globe for signs of a repetition of the disturbances which occasioned the irregular markings detected in past years."

DISTANCES OF STARS.—E. A. Kreiken has published a memoir on "The distance of the stars in the Scutum group, and other Galactic regions," which is dedicated to the memory of Prof. Kapteyn, since it is largely based on his methods. The colours of the stars, or rather the effective wave-lengths of the light we receive from them, are found by the distances between the first order spectra that are produced by a coarse grating in front of the telescope tube. The stars go down to magnitude 14·9; the table below shows that the colour-index is a minimum about magnitude 11·5.

Mag.	Mean Colour.	No. of Stars.
Brighter than 8·9	+0·70	2
8·9 to 9·9	+0·37	3
9·9 ,, 10·9	+0·21	20
10·9 ,, 11·9	+0·16	36
11·9 ,, 12·9	+0·34	101
12·9 ,, 13·9	+0·46	480
13·9 ,, 14·9	+0·60	604

The spectral type is deduced from the colour-index by the following table, based on the work of Miss Cannon and K. Schwarzschild: Bo −0·25, B5 −0·16, Ao −0·04, Fo +0·30, Go +0·65, Ko +0·90, Mo +1·50. The distance of the cloud is separately deduced from stars of different spectral type from formulæ using the luminosity frequency curves for each type.

Stars of type Bo to B5 indicate 1800 parsecs for the distance (printed 3600 but altered by hand by the author); B5 to B9 give 1300 parsecs; Ao to A9 1400 parsecs (4600 light-years), the latter being adopted as having the highest weight, but the agreement of the others is sufficiently good.

The star-density in the cloud is found to be five times the average value for the same galactic latitude.

Research Items.

THE BRONZE AGE IN ESSEX.—A useful descriptive catalogue by Mr. Charles H. Butcher of the Essex Bronze Age implements and tools in the Colchester Museum inaugurates a series of Borough of Colchester Museum Publications. From the general character of the Bronze Age finds in Essex it would seem that this area retained its neolithic influences until a comparatively late date, and that the period contemporary with the barrows and burial mounds was of short duration. The greater proportion of the Bronze Age belongs to the period when founding was universal, and the socketed axes, leaf-shaped swords, and bronze spear-heads were in use. Evidences of continental influence are marked, especially in types of winged axes, rare in Britain, but commoner on the Continent, and curved tanged knives resembling those commonly found in Switzerland. These come from a hoard found at Grays Thurrock, as does also a halberd blade of hitherto unrecorded type. Of a number of hoards found in the county, this was the most remarkable, as it was the largest, the number of pieces being 298, and including socketed axes, leaf-shaped spear-heads, leaf-shaped swords, tanged and socketed knives, part of a mould, and 68 lumps of copper and bronze.

PRE-COLUMBIAN RUINS IN NEW MEXICO.—A prehistoric ruin in the Chama Valley, New Mexico, excavated by Mr. J. A. Jeancon, is described in a bulletin recently issued by the Bureau of American Ethnology. This ruin, known as "Po-shu-puinge," meaning "Calabash at the end of the ridge village," is undoubtedly pre-Spanish. The pottery discovered was of good quality and great variety. According to Indian tradition the village was formerly a great centre of trade in pottery and other artefacts. A great number of objects in stone and bone were found, including axes, knives, spear-heads, mortars and pestles, scrapers, bone dirks, flutes, awls, needles, and beads. Squares and oblongs of pottery were possibly tallies for some such game as is still played by Indians of the south-west. Seeds of squash, pumpkin, and gourd were found, as well as charred corn. Traditional evidence indicates that the people of the village came originally from some country to the north, and that it was their custom to kill their male enemies but to assimilate the captured women and children into the tribe. This would account for the presence of foreign types of pottery. Apparently the village was deserted very suddenly, the ancient inhabitants being driven out and vanishing completely, so far as is known.

PLAGUE INVESTIGATIONS IN EGYPT.—A report on plague investigations in Egypt by Dr. G. F. Petrie and Major R. E. Todd, assisted by Dr. R. Skander and Dr. F. Hilmy, has been issued from the Ministry of the Interior, Egypt, Department of Public Health (Government Press, Cairo, 1923). A brief history of plague in Egypt from the seventh century is given. The present series of epidemics dates from 1899, when plague broke out in Alexandria, the exact mode of its importation being, however, unknown. The subsequent history is one of a generalised dispersion of the infection throughout the country. The total number of cases notified from 1899 to the end of 1919 is 14,783. The second section of the report deals with the species of rodents trapped in the houses, etc., and with their insect parasites. Of the 67,000 rodents captured, nearly 40,000 were *Rattus rattus* and about 25,000 were *Acomys cahirinus* (the Cairo spiny mouse). *Xenopsylla cheopis* was the predominant flea. The exceptional severity of the epidemic in 1911 on one of the estates specially investigated is explained by the remarkable degree of infestation of the back-to-back mud houses with *X. cheopis*. The relation of climate to bubonic plague is discussed, and a chapter is devoted to pneumonic plague, the prevention of which is likewise dependent in the last resort upon the extinction of plague in rodents. In the concluding pages emphasis is rightly laid upon the need for the enlightenment of the majority of the community if progress is to be made in the control of plague.

EUGLENA IN TADPOLES.—Prof. R. W. Hegner describes (*Biol. Bull.*, xlv., 1923, pp. 162-180) three species of Euglena from the intestine and rectum of frog- and toad-tadpoles. All three possess green chromatophores and red stigmas. A comparison of two sets of tadpoles of *Rana pipiens* from adjoining ponds, one set much retarded in growth and heavily infected with species A, and the other of normal growth, lightly infected or not at all, indicates that the dwarfing of the former may have been due to the presence of the euglenas. Tadpoles of *R. pipiens* containing very few specimens of species A were fed on the highly infected intestine of other tadpoles of the same species and became more heavily infected. The author thinks that the usual method of infection is not by ingesting such trophic forms of Euglena, but that a resistant, over-wintering form of species A probably exists by means of which the new broods of tadpoles become infected in the spring. Attempts to cultivate species A outside the tadpole failed, and the author concludes that the trophozoites are incapable of living and reproducing outside their host. Attempts were made to infect tadpoles of *Rana pipiens* with three species of free-living euglenoids, but without success. Apparently the species which inhabit the intestine and rectum of the tadpoles possess a resistance to the digestive juices which is not present in free-living euglenoids. Species A is also a regular inhabitant of the intestine and rectum of tadpoles of *Rana clamitans* and *Bufo lentiginosus americanus*, and can be transferred with food from tadpoles of one species to those of another. Prof. Hegner hopes to continue work on these organisms, which present excellent material for the study of the evolution of parasitism.

THE SILURIAN STRATA AND OSTRACODA OF MARYLAND.—The Geological Survey of Maryland has added to its handsomely published and weighty series of volumes a monograph on the Silurian (Gotlandian) system of the State, by Charles K. Swartz and other members of its staff (Baltimore, 1923). E. O. Ulrich and R. S. Bassler contribute an essay (pp. 233-270) on corresponding deposits throughout N. America, in which older and newer classifications are usefully explained. Their palæogeographic maps may be compared with the effective but less detailed series given by A. W. Grabau ("Textbook of Geology," part 2, p. 326, etc.), who concisely points out the interest in earlier Palæozoic times of the Appalachian region, which was liable to incursions of marine faunas from the north, from the Atlantic, stretching across to Britain, and from the south. Maryland lies well on the meeting-ground, and its later series, with the eurypterid zones of Wills Creek, herald the incoming of a continental Devonian type. Some of the beds contain little but ostracods, and E. O. Ulrich and R. S. Bassler furnish an account of Palæozoic types in general, in which several new genera are established and new methods of study are described. The distribution of ostracod shells across continental deposits from desiccating

pools by the action of the wind is well referred to. The volume contains 67 plates of fossils, and the existence of an Atlantic fauna adds to its interest for the numerous workers on Silurian stratigraphy in the British Isles. Those who seek especially for graptolites will, however, meet with disappointment.

WEATHER IN THE HIGHER ATMOSPHERE.—The U.S. *Monthly Weather Review* for last September contains an article on "The Law of Pressure Ratios and its Application to the Charting of Isobars in the Lower Levels of the Troposphere," by Mr. C. Le Roy Meisinger of the U.S. Weather Bureau. An attempt is made by the author to develop the preparation of free-air pressure maps to which he has devoted so much attention; the previous discussion in Supplement No. 21 of *Monthly Weather Review* was noticed in NATURE for June 9, 1923, p. 788. Previous efforts by the author to establish isobaric charts for the levels 1 or 2 kilometres (to 6500 ft.) above sea-level were in a way successful. The attempt is now made, by the aid of these together with the precisely measured surface pressure, to learn something about the pressure distribution at a higher level. Pressure ratios have been formed between the pressures at 1 and 2 kilometres above sea-level and between pressures at the surface and some selected higher level, those selected being 3, 4, and 5 kilometres (to 16,400 ft.) above sea. It is asserted that regardless of the level to which the computations refer, the accuracy is just about as satisfactory at the high level as at 2 km. level; this is of considerable importance to the law of pressure ratios. Computations for high levels at the aerological stations are compared with the results by means of kites at those levels. The computed and observed results at 3 and 4 kilometre levels show a remarkably good agreement. The determination of constants for non-aerological stations is thoroughly explained and the application to map drawing is well illustrated, several specimen pressure maps being given for sea-level and for 2, 3, and 4 kilometres above sea-level. A praiseworthy attempt is made to associate the wind direction and speed with the pressure at different levels. The discussion is useful for aviation and is of importance in weather forecasting.

MERCURY STANDARD CELLS.—The solubility of finely divided substances depends on the size of the individual particles. It follows, therefore, that standard cells set up with mercurous sulphate sufficiently finely divided should have abnormally high electromotive forces. Vosburgh and Eppley (Jour. Amer. Chem. Soc., January 1924) have tested this conclusion experimentally and found it to be correct. The order of the E.M.F. increase is from 40 to 100 millivolts. When Weston cells are being set up to determine the value of the international volt, it is important that the mercurous sulphate be sufficiently large grained. Digestion of the latter with a boiling solution of sulphuric acid is recommended as a wise, but somewhat untrustworthy, precaution.

GASES AT HIGH PRESSURE.—The issue of the Proceedings of the American Academy of Arts and Sciences for January contains the results of an investigation of the compressibilities of five gases at extremely high pressures which has been carried out by Prof. P. W. Bridgman, of Harvard, with the aid of the Rumford Fund. Hydrogen, helium, nitrogen, ammonia, and argon at 30°, 65°, and 95° C., and at pressures between 3000 and 15,000 atmospheres, were investigated, and the results are given in the form of tables and curves. In all cases, at pressures of the order of 6000 to 8000 atmospheres, the compressed gas has about the same compressibility as a liquid at atmospheric pressure, and the volume shows no sign of approaching a limit asymptotically. The product of pressure and volume continues to increase up to the highest pressures at a rate which diminishes a little as the pressure increases. The volumes for pressures exceeding 5000 atmospheres are less than the minimum volumes for infinite pressure as given by the b term of Van der Waals' equation. A four constant formula suggested recently by Becker agrees better with the experimental results.

THE β-RAYS OF URANIUM-X_1.—Dr. C. D. Ellis writes to us with reference to the article under this heading which appeared in NATURE of February 23. The article was intended merely to give an abstract of the paper by Fräulein Dr. Lise Meitner, quoted in it, without any particular expression of opinion on one side of the subject or the other. Dr. Ellis, however, regarded it as "an authoritative statement of one side of a controversy" though "the question under discussion is still unsettled." On this account he directs attention to two papers in the February number of the Proceedings of the Royal Society, which were not seen by the writer of the above article before it was published, in which Dr. Ellis and Mr. H. W. B. Skinner have described in detail the present state of the opposite point of view, and have replied to previous papers by Dr. Meitner. These papers describe some remarkable experimental results on radium B and radium C, magnificent radiographs of the B-ray spectra of RaC and of RaB+RaC having been obtained. From the observed energy relations between the lines the frequencies of a set of γ-rays, which are assumed to produce them, are deduced; and the values obtained are regarded as having confirmed strongly the conclusion that the rays are due to transitions between stationary states in the nucleus; diagrams of the probable nuclear levels of RaB and RaC are given; the two sets show striking similarities, which fact is considered to be of great importance. Owing to a printer's error, the masculine personal pronoun was made use of in the article of February 23 in referring to Fräulein Meitner.

ELECTRIC CONDUCTIVITY OF CRYSTALS.—Herr F. v. Rautenfeld has measured the conductivity of rock salt at temperatures between 650° and 793° C., and of Iceland spar between 230° and 550° C., by means of alternating currents (*Annalen der Physik*, Nov. 1923). For the first substance he finds the relation between the conductivity κ and the temperature t to be $\kappa = 0{\cdot}152 \times 10^{-9} e^{0{\cdot}0287t}$, while for Iceland spar a different law holds, $\kappa = 0{\cdot}01995 \times e^{-5756{\cdot}5/T}$, where T is the absolute temperature. In both cases contact with the crystal was obtained by dusting the ground faces with platinum black and pressing flat platinum electrodes against them. F. Braun and, independently, F. Noack have determined the relation between the conductivity in different directions through rock salt, and v. Rautenfeld has measured plates cut perpendicular to the principal axis of Iceland spar, in the direction of cleavage, and parallel to the principal axis. The last gave somewhat uncertain values, but they were smaller than those obtained with either of the first-named plates. The first of the three plates gave the largest values, and the second approximately the geometrical mean between the first and the third. Herr v. Rautenfeld concludes that the conductivity in different directions does not depend greatly on whether atoms of the same kind, or atoms of different kinds, succeed each other in the directions concerned, but possibly more on their mobility sideways. The experiments cannot be considered to explain the mechanism of conductivity in such crystals.

Neanderthal Man in Malta.

AT a meeting of the Royal Anthropological Institute on March 4, the president, Prof. C. G. Seligman, in the chair, a paper by Sir Arthur Keith on "The Discovery of Neanderthal Man in Malta, with an account of the Survey of the Cave in which the evidence was found (Ghar Dalam), by Mr. George Sinclair," was presented by Dr. A. Burkitt, of the University of Sydney, in the absence of the author. The discovery was made in 1917 by Mr. G. Despott, curator of the Malta Natural History Museum, who in digging a trench across the deposits on the floor of Ghar Dalam found two human teeth of a remarkable character. They lay in the second stratum of the cave—a deposit of red cave earth, which varies in depth from 6 to 8 feet. Over the cave earth is a superficial stratum varying from 1½ to 2½ feet in depth and of neolithic date, while under the cave earth is the third stratum, a bone breccia 3 feet in thickness, made up chiefly of rolled fragments of fossil bones belonging to two species of hippopotamus and three species of extinct elephants. The two teeth were found 1½ feet and 2½ feet deep in the red cave earth with remains of stag, elephant (*E. Mnaidrensis*), and hippopotamus (*H. pentlandi*). These bones and the teeth were in the same state of fossilisation. At the same levels and mingled with the above were found chards of neolithic pottery, teeth, and also other remains of neolithic man. Men of the neolithic period and of later dates had lived in the cave and wrought some degree of confusion in the upper levels of the cave earth. In spite of extensive excavations carried out under the auspices of the British Association, no trace of the culture of palæolithic man has been found—neither of the Mousterian period, which is that of Neanderthal man, nor of the later Aurignacian period. All that can be assigned with certainty to palæolithic man are the two molar teeth.

Through the courtesy of the Rector of the University of Malta, Prof. T. Zammit, Sir Arthur Keith was given an opportunity of examining all the teeth found in the floor of the cave. In the condition of fossilisation and in their morphological characters, the two molars differ altogether from the other human teeth, and in size and form are duplicates of molar teeth found in Jersey and at Krapina in Croatia, which are undoubtedly those of Neanderthal man. Teeth possessing such characters have never been seen in the jaws of men of the modern type; they are known only in that anomalous Neanderthal type or species which became extinct in Europe in the last phase of the so-called ice-age. So far, the remains of Neanderthal man have been discovered in only one locality of southern Europe—Gibraltar. Mr. Despott's discovery in Malta carries the type into the old land bridge which—in Pleistocene times—united Tunis to Italy.

The two molars represent the second and third of the upper series of the right side, and although found 7 feet apart, undoubtedly belong to the same set—that of a young man, for the crown of the second is unworn and the third incompletely developed, and must have been in process of eruption. Mr. Sinclair obtained 2250 teeth of neolithic Maltese, of the same date as those buried in the hypogeum at Hal-Safleini, and a close examination of this collection shows no trace of taurodontism, this being the special feature which distinguishes the two fossil molar teeth.

The survey throws a new light on the age and order of the deposits of Ghar Dalam, and makes possible a comparison with the famous palæolithic deposits in the caves of Grimaldi, at Mentone. The original rock floor of Ghar Dalam lies at the same level above the Mediterranean as do some of the original floors of the caves of Grimaldi. On this floor at Grimaldi are the deposits of a raised sea-beach belonging to the Monastirian series of the Mediterranean shores. The rolled stratum of bone breccia in Ghar Dalam apparently also represents this old raised beach. Over the old beach at Grimaldi are deposits of the Mousterian and Aurignacian periods of culture. We may therefore infer that the deposit of cave earth in Ghar Dalam, which contained the Neanderthal teeth, the remains of *Hippopotamus pentlandi* and *Elephas Mnaidrensis*, also represents a pleistocene deposit of a corresponding date. It will thus be seen that the red cave earth represents the geological horizon at which Neanderthal man should appear.

The West Indian Agricultural Conference.

THE ninth West Indian Agricultural Conference was successfully held at Kingston, Jamaica, under the auspices of the Imperial Department of Agriculture on January 28–February 1, Sir Francis Watts, Imperial Commissioner of Agriculture, being the president.

The last conference was held in Trinidad in January 1912, and it will be remembered that the former conference in Jamaica in 1907 was abruptly terminated on the opening day by the disastrous earthquake which destroyed the greater part of Kingston and seriously damaged other parts of the island.

The conference was attended by delegates from Jamaica, Trinidad, British Guiana, Barbados, Grenada, the Leeward Islands, British Honduras, the Bahamas, Bermuda, and by members of the staff and of the governing body of the Imperial College of Tropical Agriculture, Trinidad, and three delegates from England, who were present at the request of the Secretary of State for the Colonies. These were Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew; Dr. S. A. Neave, Assistant Director of the Imperial Bureau of Entomology; and Mr. S. P. Wiltshire, of the Imperial Bureau of Mycology. In addition to the official delegates, Sir Arthur Shipley, chairman of the governing body of the Imperial College of Tropical Agriculture, Trinidad, was also present at the conference, and took part in its deliberations.

The conference was opened by His Excellency the Governor of Jamaica, and after his speech the president delivered his address, which dealt with the present position of the more important agricultural industries in the West Indies. He outlined some of the directions in which investigation and research were needed, and pointed out the way in which such work could be carried out at the newly established college in Trinidad. Subsequent papers by members of the professorial staff of the College on the research work that is being undertaken—on breeding experiments with bananas in connexion with the Panama disease; on the fertilisation of cacao; on cotton, both as regards genetical work and its insect pests; and on the sugar cane and its diseases—showed the methods by which these many problems are being investigated at the Imperial College, and indicated that the results already achieved give good promise of final success in their solution.

On the second day of the conference the proceedings were opened by the Director of the Royal Botanic Gardens, Kew, with a paper dealing with the Imperial aspects of tropical agriculture, in which he pointed out the need of maintaining the connexion of the Colonial Departments with a central institution or institutions at home, and outlined the directions in which the home authorities could assist those working in the Tropics. Dr. Neave and Mr. Wiltshire followed with papers concerning the work of the Imperial Bureaux of Entomology and Mycology respectively, in which they were able to demonstrate very clearly the services these two institutions are able to render to agriculturists and others throughout the Empire.

Important papers were also contributed by the Assistant-Director of Agriculture, Trinidad, on cacao experimental work, especially with reference to budding, grafting, and selecting, and on the red-ring disease of coconuts, of which he was the discoverer.

Other papers of interest dealt with agricultural education and the need of a more definite system of training children for agricultural work which would lead on to the final training at the agricultural college and so produce an efficient class of cultivators, overseers, etc. Commercial problems of agriculture in Jamaica were very ably dealt with by Mr. R. S. Gamble, chairman of the Jamaica Chamber of Commerce, who pointed out how intimately the agricultural interests of the island are connected with the question of supply and demand, and emphasised, by citing local examples, the folly of over-production in some specialised industry.

During the conference the delegates paid a visit to Hope Gardens and the Agricultural Station, where the Director of Agriculture, Mr. H. H. Cousins, demonstrated the results of his very successful cattle-breeding experiments, and the methods of tick control initiated by him, which have proved of very great benefit to the island.

The conference may be said to have demonstrated especially how vital are the agricultural problems awaiting solution which hitherto have been very largely disregarded. It also served to show, from some of the papers presented, that nowhere can these problems be more successfully faced than at an Imperial College of Agriculture situated in the Tropics.

The Association of Technical Institutions.

THE annual general meeting of the Association of Technical Institutions was held on February 29–March 1 at the Clothworkers' Hall, Mincing Lane, London, E.C. Lord Emmott was elected president for 1924, and the following officers were also appointed: Mr. F. Wilkinson, to be vice-chairman of the Council; Mr. W. Calderwood, to be honorary treasurer; and Principal H. Schofield, of Loughborough College, to be honorary secretary.

Lord Emmott, who discussed educational policy in his presidential address, stated that he believes members of Parliament and the electorate are willing to provide what is necessary for education, provided they are assured that educational policy is based on sound lines and is likely to produce good results. But to cripple trade and industry by an unbearable pressure of taxation, even for so vital a matter as education, would be a policy which would defeat its own ends. The present policy of the Board of Education and the very principle of centralised control in education was criticised, and Lord Emmott stated that, in his opinion, the Board of Education ought to be (*a*) a centre of research work on all educational problems, and (*b*) a real source of light and leading to local authorities, managers of schools, and the teaching profession in general.

Referring to higher technical study and research work, Lord Emmott expressed the hope that those concerned with the organisation of this branch of education will continue to cultivate the closest possible relations with manufacturers and commercial business firms. The main defect of our system of education is that it is too remote from the facts of life.

Principal Coles, of the Technical College, Cardiff, read a paper on "non-resident" students, *i.e.* those who reside outside the area controlled by the Local Education Authority maintaining the Institution. The question of the apportionment of so much of the cost of instruction as is not covered by fees is one which has become exceedingly complicated, and the present position was described by Principal Coles as chaotic. A colossal amount of work has been involved in preparing and sifting statistics, and educational efficiency has been prejudiced by friction: the finding of a generally applicable solution of the problem has become a matter of real urgency. For institutions providing senior full-time departments needing much expensive equipment, many of which draw a large proportion of "foreign" students, the question is a vital one.

Among all the institutions included in Principal Coles's tabular statement, Loughborough College is pre-eminent in respect of the percentage of non-resident full-time senior students, and it is therefore interesting to note the Loughborough solution of the problem: "We have fixed the fees at such an amount that with the proceeds of a penny rate from the County we are self-supporting; we then adopt the policy of assisting our own students, *i.e.* those from the County area; by adopting this system not only do we not mind what is the origin of our students, but we prefer that the L.E.A. from whose area students come should assist us through the student himself."

Mr. Dempster Smith, of the College of Technology, Manchester, who dealt with "Industrial Administration," maintained the proposition, long ago accepted in the United States, "where the Universities act as the gates to business," that the post of works manager calls for professional training no less than do the duties of a lawyer or physician. He then proceeded to answer the questions, When should such training begin? What part of the technical or works training should be cut out? What should be the nature and duration of the training? The answer to the first question is—on the completion of the technical training when the student has a thorough appreciation of what is involved; to the second—nothing. The answer to the third question is in the form of a specimen one-year "post-graduation" course syllabus. In the Manchester College of Technology, all students reading for degrees in engineering or textile technology take a course in the industrial administration department during their last year, and provision is also made for full-time courses in industrial administration for graduates and associates. The growth of interest in the subject has been marked by the foundation in 1920 of the Institute of Industrial Administration, which has arranged to hold examinations in 1924 and succeeding years.

At the present time, when building difficulties are a matter of national concern, the views of those

responsible for the direction of the education of craftsmen should be of special interest. The paper on "Technical Education for the Building Trades," by Mr. A. R. Sage, Principal of the L.C.C. School of Building, read before the Association, gives the views of one who, as a colleague of the late Mr. H. Richards, one of the pioneers of building trade education, has been associated with this problem for many years.

Much discussion just now centres round the question of apprenticeship in these trades, to the discouragement of which the serious diminution of operatives is said to be due, and suitable craft education would appear to be a possible solution for reducing the time taken to acquire proficiency while simultaneously providing a continuance of general education. Mr. Sage takes a wide view of the subject, and rightly lays stress on the importance of general education and the teaching of principles underlying the crafts, giving manual dexterity a very subsidiary place. With his claim that knowledge of the reasons for craft processes will not only bring interest into tasks otherwise monotonous, but will also lead to the improvement of processes, all will agree, and while some will be found to question the desirability of attempting professional training in a technical school, few will deny that immense benefit will accrue to the professional student from attending classes designed for future craftsmen. A plea was made for greater support and interest on the part of employers of labour, who in many cases have apparently a very imperfect knowledge of what a modern school of building means. The outline of curricula suggested for students at various stages of the career should be of value to all interested in this branch of education.

Prices of Government Publications.

MANY protests have recently been made against the prohibitive prices of British Government publications, the old basis of charge—one halfpenny for a sheet of four pages—having been greatly increased by the Coalition Government. The present prices vary from 30 or 40 to about 800 per cent. above the pre-War charges; and, consequently, a large amount of valuable official information does not reach the public for whom it is intended. This is in direct opposition to the policy pursued since the year 1836, when the House of Commons accepted the following resolution of a Special Committee on Printed Papers: "That the Parliamentary Papers and Reports printed for the use of the House should be rendered accessible to the public by purchase, at the lowest price they can be furnished, and that a sufficient number of extra copies shall be printed for that purpose." From that time until about the middle of the War period, facilities were provided for the wide distribution of such papers and reports.

Up to the year 1917 a complete set of the "Papers of Both Houses of Parliament" could be purchased for an annual subscription of 20*l.*; the largest public libraries purchased such sets, while other libraries, in which complete sets were regarded as unnecessary, were able to purchase important papers at proportionate rates, if they could not be obtained gratis. All public libraries were able in pre-War days to requisition a considerable number of official publications from the Stationery Office, but the free list has been enormously reduced, the last annual Treasury grant to the Stationery Office for this purpose being the totally inadequate sum of 250*l.*

The present subscription for a "complete set of papers" is 36*l.*, but in reality the cost is several times this sum, because many papers have been removed from the "Parliamentary List," and are now called Stationery Office publications, and must be purchased separately.

It is to be remembered that the statistical and research work of the various Departments of the Government is done, at considerable cost to the nation, with the direct object of communicating the results of their investigations to the public. Further, as a minimum number of certain official documents must be printed and circulated for the benefit of members of Parliament and Government Departments, the initial cost of issuing them should not be chargeable to the purchasers; the purchasers should be charged only the extra cost of the additional copies printed.

These official publications are usually of the greatest value to the public, dealing as they do with every phase of national life: industry, agriculture, commerce, science and technology, education and other allied subjects, central and local administration, legislation, foreign and colonial relations, etc. It is therefore of the greatest importance that efforts should be made to secure the greatest publicity to material of national value accumulated by the State Departments; and so the question of obtaining cheap official publications is one worthy of the immediate attention of the Treasury.

The Library Association, representing all the public libraries of the United Kingdom, and through them the public at large, has urged for a long time past the necessity for easy access by the public to Government publications, and the Association views with grave concern the present serious position. A few months ago, its Council appointed a Special Committee (of which Mr. G. A. Stephen, the City Librarian of Norwich, is the honorary secretary) to consider the conditions under which the Parliamentary and Stationery Office publications are now priced and distributed to the public, and that Committee recently made representations to the Treasury in the hope that the situation might be relieved.

On Tuesday, March 4, the matter was raised in the House of Commons. Mr. Ernest Simon (Member for the Withington Division of Manchester) asked the Chancellor of the Exchequer whether he was prepared to make a substantial reduction in the prices or to give specially favourable terms to public libraries; and Mr. Percy Alden (Member for South Tottenham) asked the Chancellor whether he had received an appeal from the Council of the Library Association on the subject of the distribution and cost of Parliamentary publications, and whether, in view of the importance of such publications to industrial workers and students of sociology, he would consider the advisability of reducing the annual subscription to the former annual payment. In reply, Mr. W. Graham (Financial Secretary to the Treasury) said: "My right hon. friend has had the appeal under consideration and has decided, in lieu of the existing arrangements under which a few publications are presented annually to some public libraries, other supplies being charged at full price, to authorise the Stationery Office to supply any Government publications in future at half the published price, or half the subscription price for a class of publications, as desired. The arrangement will apply to all public free libraries in Great Britain maintained out of the rates, and the offer is also extended to universities and university colleges in receipt of assistance from the University Grants Committee. In all cases the supply is subject to the condition that the publications are not to be resold."

University and Educational Intelligence.

BIRMINGHAM.—At the annual general meeting of the Court of Governors, a report of the Principal for the session 1922–23 was presented. There had been a marked diminution in the number of students. For this there were three evident causes: first, the inflation due to ex-Service students has passed away; secondly, circumstances have not been normal: "To any one really behind the scenes the result of the economic depression both on the students who can just manage and on the many who are debarred from a university course is unmistakably and pathetically clear. And the reduction in spending power necessarily affects the provincial Universities more severely than it does Oxford and Cambridge." Thirdly, "Government 'economy,' with its repercussion on the expenditure of Local Authorities, must not be forgotten. The reduction of grants and the suspension of State scholarships put the finishing touch to the limiting causes." The number of students reading for higher degrees has, however, been well maintained, and the percentage of such students on the total number shows a very marked increase as compared with the percentage either of 1913–14 or 1919–1920. The Report of the Joint Standing Committee for Research shows that a large volume of research work has been done in all departments. The most urgently needed development in the Faculty of Science is the transference of the Biological Departments from Mason College to Edgbaston, and it is hoped that the present session will see this long-delayed transfer to Edgbaston actually under way. The relief that a new block would provide will not be confined to science. Arts and medicine urgently need further and better accommodation, which would be available in the quarters vacated by the transferred departments. Chairs in biochemistry and geography are also greatly to be desired. In conclusion, the Principal pleaded for many more scholarships: "Scholarships are a bounty on brains and work. It is my conviction that our nation will find that bounties on brain and work, through the discipline of mind and character, that is the secret gift of a liberal education, are the best of all national investments, particularly for the situation with which our nation is confronted." The balance-sheet for the year shows the remarkable fact that the expenditure has been slightly exceeded by income.

Mr. E. P. Willoughby has been appointed to the James Watt research fellowship for 1924.

Dr. Percy T. Hughes has been reappointed lecturer in mental diseases for a further period of three years.

Prof. Eijkman of Utrecht has been invited to visit the University to lecture on hygiene and microbiology.

The University will be represented at the Universities' Bureau Conference at the British Empire Exhibition by the Principal, Vice-Principal, Treasurer, and the Dean of the Faculty of Science. Dr. John Robertson will represent the University at the Imperial Social Hygiene Congress.

CAMBRIDGE.—Smith's Prizes have been awarded to T. M. Cherry, Trinity College, for an essay "On the Differential Equations of Dynamics," and to W. J. Webber, Trinity College, for an essay on "Some Applications of the Theory of Integration." An essay on "Interference of Light" by E. D. van Rest, Peterhouse, is honourably mentioned.

An election to a scientific research fellowship at Girton College in mathematical, physical, and natural sciences, including chemistry, electricity, engineering, botany, geology, medicine, agriculture, etc., will take place shortly. The election is for three years in the first instance, with the possibility of being renewed annually for not more than three years. The yearly value of the fellowship is 300*l*. Applications for the fellowship must be sent to the Secretary of the College on or before March 31.

LONDON.—A free public lecture on "The Pathogenesis of Certain Nutritional Disorders" will be delivered (in English) by Prof. E. Gorter, of the University of Leyden, at the Hospital for Sick Children, Gt. Ormond Street, W.C.1, on Wednesday, March 19, at 5 o'clock. No tickets will be required.

OXFORD.—On March 4, the decree for allocating a further space of the University Park, not exceeding nine acres, for the extension of the Science Departments received the final approval of Convocation. The space thus set apart will include the site for the new department of pathology. On the same day a decree passed Congregation accepting the offer of the Rockfeller Trustees of the sum of 75,000*l*. towards the building and equipment of a Department of Biochemistry on condition that the University contributes to the same purpose a guaranteed annual sum of not less than 1250*l*. This decree will be submitted for the final approval of Convocation, which it will no doubt receive in due course. Convocation has also gratefully accepted the offer by Mr. Lewis Evans of his valuable collection of early scientific instruments and books connected therewith, and the offer of 1000*l*. by the Worshipful Company of Goldsmiths, and of 250*l*. by Sir John R. Findlay, of Balliol College, towards the incidental expenses of housing the Lewis collection in the Old Ashmolean Museum.

THE Kingston correspondent of the *Times* states that a movement is afoot in Jamaica to promote an appeal to the Secretary of State in favour of founding a West Indian University at Jamaica. It is proposed to solicit Imperial assistance for the scheme.

THE Council of the Royal College of Veterinary Surgeons will on April 11 elect two examiners in chemistry and elementary physics, biology, elementary zoology and botany for the first year's course for the diploma of M.R.C.V.S. Applications must be received by the Secretary of the College, 10 Red Lion Square, W.C.1, by March 28 at latest.

MEMBERS and friends of Leplay House will this year visit Budapest at Easter. The University of Budapest will receive the party officially, and will arrange a course of lectures on Hungary and Hungarian problems by leading lecturers. An interesting programme has been drawn up by Dr. A. Kriztics, of the University, which includes not only visits to the principal institutions in the city, but will enable members to see a large part of the country, its agriculture, its industrial centres, and its historic cities. In the list of places to be visited are Esztergom, Lake Balaton, and the great Hungarian Plain.

THE Ministry of Agriculture and Fisheries announces that under the scheme for awarding scholarships and maintenance grants for the sons and daughters of agricultural workmen and others, a number of scholarships in agriculture, horticulture, and so on, at universities, agricultural colleges, and farm institutes, are being offered for award this year. The scholarships are of three kinds, enabling the holders to attend degree courses, diploma courses, or short courses respectively. Information regarding the scholarship scheme may be obtained from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, or from the County Authorities for Agricultural Education at the offices of County Councils. Applications should be forwarded to the County Authority for Agricultural Education not later than April 30.

Early Science at the Royal Society.

March 9, 1663. Sir Robert Moray mentioned, that his majesty had the curiosity of weighing himself very frequently, in order to observe the several emanations of his body before and after sleep, tennis, riding abroad, dinner and supper; and that he had found, that he weighed less after tennis by two pounds three ounces (but his majesty drinking two draughts of liquor after play, made up his weight) after dinner, more by four pounds and an half.

March 10, 1669. An experiment was made in the artificial tin-arm of Dr. Goddard's contrivance, to find whether pulsation was made by an intumesence of the artery, or not? And it was found by several trials, that as the pulse beat, so the water rose in the glass-cane adapted to the said tin-arm: And this was found to hold in many pulsations, even to forty strokes; but the water was observed to ascend unequally in the glass.

March 11, 1668. There were dissected some oisters; and because the function of many parts of them were not yet known, Dr. King was desired to produce at his first conveniency a live oister, and lay open all the parts thereof, to the end that those, that are well known, might give light to those that are not so.

1674. The person, who should have made a discourse this day, being by urgent occasions detained from the Society, there was read out of the Register a discourse formerly given in by Mr. Boyle, about shining flesh.—This gave occasion to some hints for a general hypothesis for explaining the nature of light.

March 12, 1672. There was read a Latin letter of Dr. John Baptista Gornia, physician to the grand duke of Tuscany, dated at Florence, containing the writer's opinion concerning the disease, of which Dr. Wilkins, bishop of Chester, died.

1673. Dr. Grew produced two intire microscopical observations, about the texture of a piece of a trunk of a walnut-tree, and of one of the trunks of a hazel-nut.

March 14, 1665. Mr. Daniel Coxe gave some account how he was employed in examining the nature and figure of all sorts of salts, intimating that he conceived, that the origin of all salts was sea-salt. It being demanded, how then, and by what he distinguished salt? it was answered, by the alteration of the figure caused by the addition or mixture of something else.—He was urged to go on vigorously on so noble a subject.

1666. Sir Theodore de Vaux produced a paper containing a description of the tallow-chandlers' trade, and the ways of making candles with the pith of rushes, and of making candles in moulds, and cheap candles for poor men to burn.

1682. An account being given of Dr. Plot's having examined some earths sent by Mr. Flamstead, which the Dr. found to be different marls, Sir William Petty took occasion from hence to move, that the *criteria* or distinguishing qualities of several natural things might be so agreed on, that there might be no ambiguity in the terms. He enquired particularly what was the notion of marl, fullers-earth, clay, etc.? The words *considerably bigger* having been used in some things, Sir William Petty cautioned that no word might be used but what marks either number, weight, or measure.

March 15, 1676. Mr. Oldenburg produced a letter sent to him by an anonymous member, concerning Mr. Henry Bond's book "Longitude found," which, being read, it was ordered that Mr. Colwell should be desired to ask Mr. Bond, how he came to know the difference of longitude between London and Waygatz to be fifty-eight degrees.

Societies and Academies.

LONDON.

Royal Society, March 6.—E. D. **Adrian** and Sybil **Cooper**: The electric response in reflex contractions of spinal and decerebrate preparations. Records have been made of the reflex action currents in the tibialis anticus and vasto-crureus of spinal and decerebrate animals. The reflex contractions were produced by electric stimuli applied to the popliteal nerve. In the flexion reflex of the spinal preparation the electric response consists of a regular series of "primary" waves having the same frequency as the stimuli. If the stimuli are very strong and their frequency below 50 a second, small "secondary" waves may appear. In the decerebrate flexion reflex the secondary waves are usually present so long as the frequency of stimulation is low. In the decerebrate crossed extension reflex the secondary waves are still more conspicuous, and may be completely absent. These results agree with the observations of Liddell and Sherrington on the reflex mechanical response. The secondary waves are not due to proprioceptor impulses from the contracting muscle, for they persist after injections of novocain into the muscle.—A. **Fleming**: A comparison of the activities of antiseptics on bacteria and on leucocytes. Leucocytes which have been allowed to emigrate from a blood clot on to the walls of a capillary tube, or defibrinated blood containing its full quantum of leucocytes, exercise a powerful bactericidal action on staphylococci. When antiseptic solutions are brought into contact with such leucocytes or blood, the destructive action of the antiseptic on the leucocytes is much more marked than it is on the bacteria. When added to infected blood in certain concentrations, most of the antiseptics permit the development of almost all the bacteria implanted, although the blood without any antiseptic will destroy from 90 to 100 per cent. of the added cocci.

Faraday Society, February 18.—Sir Robert Robertson, president, in the chair.—A. P. **Laurie**: Suggestions for a magnetic theory of valency. If we assume an atom of the Langmuir type and also assume that the electrons themselves can be regarded as small electro-magnetic units produced by movement in an orbit much smaller than the diameter of the atom, a magnetic field is produced which would result, on the approach of two atoms, in the moving out of the two units so as to take up a position combining the two atoms together. The figure thus produced is really a section through a molecule in which the atoms have combined according to one of the suggestions made by Bohr. This method is, therefore, a simple one for dealing statically with a molecule of the Bohr type. The method of combination can be applied to the problem of the formation of water polymeres and hydration of ions.—T. Martin **Lowry**: The electronic theory of valency. Pt. IV. The origin of acidity. The increasing acidity of the hydrides from CH_4 to FH or from SiH_4 to ClH is attributed to a progressive diminution in the size of the orbits of the electrons by which the protons are linked to the central nucleus. Acylous atoms such as chlorine tend to diminish the size of the orbits of electrons which they share with another atom, and this effect can be transmitted to other orbits of the same quantum-number in the latter atom. In this way the transmission of acidity through a chain of atoms can be interpreted by means of a dynamic, instead of a static, model. Conversely, basylous groups must expand the orbits of electrons which

they share with other atoms. Thus an unsubstituted hydrocarbon chain should act as a neutral radical in carboxylic acids, since orbits shared by two carbon atoms will be of normal dimensions. Hydrogen directly attached to an atom of sulphur, phosphorus, etc., is more acylous than an alkyl radical because it allows for a greater contraction of the orbits; but even a proton is less acylous than the "lone pairs" of electrons in acids such as FH and ClH, since contraction is probably at a maximum in orbits which are entirely unshared.—E. **Hatschek** and R. H. **Humphry**: On certain differences between sols and gels of agar. Agar sols and gels containing 3 per cent. and more of agar show marked optical differences, inasmuch as the sols are clear in transmitted and reflected light, while the gels, though clear in transmitted light, show marked opalescence in reflected light. Owing to the lateral scattering of light, the gels also appear darker in transmitted light than the corresponding sols. The opalescence does not decrease when the gels are kept for several days at a temperature of 62° C., *i.e.* about midway between the setting and melting point. The conductivity of agar gels containing electrolyte is greater, for both direct and alternating current, than that of the corresponding sols, the difference increasing with increasing concentration of agar, and it is greater for alternating current than for direct current, the difference being slightly greater than that between the alternating and direct current conductivities of aqueous electrolyte solution of the same concentration without agar.—D. C. **Henry** and V. A. **Morris**: The influence of anions in the coagulation of a negative colloidal sol. The coagulating power of an electrolyte for a lyophobe sol is largely determined by the nature of the ion of opposite sign to the colloidal particle, but is also influenced by the ion of the same sign, which exerts a stabilising action. Experiments have been carried out on the coagulating powers for a (negative) gold sol of a series of salts of the same cation (sodium), with the object of determining the relative stabilising powers of the different anions. If the logarithms of the electrolyte concentrations and the corresponding coagulation times are plotted, the curves obtained are either linear or of small curvature. The results indicate the following sequence of stabilising power of various anions when associated with sodium ion in the coagulation of a gold sol: oxalate > HPO_4'' > CO_3'' > OH', citrate > HCO_3' > Br', I', acetate, valerate > butyrate, CNS' > SO_4'' > Cl', benzoate.—E. B. R. **Prideaux** and W. E. **Crooks**: The diffusion potentials and ionic mobilities of benzoates and salicylates, and their modification by a membrane of parchment paper. Diffusion potentials are generally increased by the interposition of animal, vegetable, and artificial membranes. This is attributed to a decrease in the transport number of the slower ion. On this view the slower ion is proportionately more impeded yet neither is completely unable to pass, as in the case of the true semipermeable membranes. In the cases considered, the potentials are not permanent, since the electrical double layer slowly moves towards the side of lower concentration. But these membrane potentials, unlike diffusion potentials, can be restored to their original values by stirring on each side of the solutions, if the volumes of these are large relatively to the area of the membrane and the rate of diffusion is slow. These potentials are best treated as modified diffusion potentials, and recent quantitative measurements on sodium benzoate gave results in accordance with the theory.

Aristotelian Society, March 3.—Prof. T. P. Nunn, president, in the chair.—L. A. **Reid**: Creative morality. Goodness manifests itself in social conduct, and must therefore be defined in terms wider than the social whole. It is the personal expression in social material of value experienced. As the artist creates beauty in the stuff of colours, sounds, words, so real goodness is created in the stuff of character and conduct. Creative activity cannot be reduced to terms of instinctive activity. It is the response awakened in man upon the felt cognition of intrinsic value, a cognition which takes place at the higher levels of human consciousness, where man is able to contemplate objects as they are in themselves and not as they are merely in relation to his needs. The supreme good for man is to realise value, *i.e.* to experience it and to create concrete values in different materials not of moral conduct only but of art as well. The supreme good is not a moral good alone.

DUBLIN.

Royal Irish Academy, February 11.—Prof. Sydney Young, president, in the chair.—W. McF. **Orr**: Integrals and series of generalised Fourier-type in associated-Legendre-functions. An arbitrary Dirichlet function can be expressed in the form $\Sigma_r C_r P_{m-r}^{m}(\cos\theta)$, where m is any given number, real or complex, and the values of r are positive integers, including zero. (When $m+\frac{1}{2}$ is a positive integer terms of another type occur.) Fourier analysis as applied to a physical problem involving associated L-functions is also proved valid. This problem has as analogue, in the much easier case of trigonometric functions, the solution from $x=a$ to $x=b$ of the equation

$$f_2(d/dt)dy/dx + f_0/(d/dt)y = 0,$$

subject to the end-conditions

$$A_1(d/dt)dy/dx + A_0/(d/dt)y = 0, \text{ at } x=a,$$
$$B_1(d/dt)dy/dx + B_0/(d/dt)y = 0, \text{ at } x=b,$$

f_0, f_2, A_0, A_1, B_0, B_1 being any polynomials whatever, and for arbitrary initial data. This problem and the corresponding one for Bessel functions are thus considered included. In these examples the initial y must have first and second differential coefficients; but the initial form of the solution furnishes expansions (not one unique expansion) of the initial y, which are valid for any Dirichlet function. The method is that of contour integration.—J. **Algar**, F. **Fogarty**, and H. **Ryan**: Dichromone and dibenzyldichromone. The study of vegetable colouring matters during the past twenty-five years has shown that many of them are related in structure and may be referred to the same parent type. Flavone, flavanone, flavonol, and chromone possess a very similar structure, and amongst derivatives of these four substances may be found many of the best known of the natural dyes. Ryan and O'Neill have already prepared substances related to these colouring matters which may be regarded as derivatives of diflavone and of diflavanone. Two syntheses of dichromone, a compound which is the parent substance of diflavone, are now described, together with a synthesis of dibenzyldichromone.—H. **Ryan** and N. **Cullinane**: Some derivatives of stilbene. 2 : 4 - Dinitrostilbene (from 2 : 4 - dinitrotoluene and benzaldehyde), on reduction with ammonium sulphide, was converted into 2-nitro-4-aminostilbene, the diazo-derivative of which, on being boiled with alcohol, gave 2-nitrostilbene. The latter compound was reduced by means of stannous chloride to 2-aminostilbene, which on diazotisation and treatment with alcohol and copper bronze yielded stilbene. 2 : 4-Dinitro-4′-methoxystilbene (from 2 : 4-dinitrotoluene and anisaldehyde) was converted by means of stannous chloride into 4-nitro-2-amino-4′-methoxy-

stilbene. This substance exists in two chromo-isomeric modifications, yellow and red, the red form being the more stable. The amine sulphate, on treatment with amyl nitrite, gave 4-nitro-4′-methoxystilbene-2-diazonium sulphate. 2 : 4 : 6-Trinitrostilbene (from 2 : 4 : 6-trinitrotoluene and benzaldehyde) was reduced by stannous chloride to 4 : 6-dinitro-2-aminostilbene, and the sulphate of this compound was diazotised by means of amyl nitrite, giving 4 : 6-dinitrostilbene-2-diazonium sulphate.

Royal Dublin Society, February 26.—Prof. E. A. Werner and later Dr. A. G. G. Leonard in the chair.—E. J. **Sheehy**: A note on the effect of the accessory food factors on the quantity of milk and butter fat. The fact that certain internal secretions, such as pituitrin or the substances liberated into the blood during pregnancy, have an influence on the activity of the mammary gland, suggested the possibility of a comparable effect on the mammary gland by the accessory food factors. Experiments were conducted on lactating goats by feeding a ration complete in all respects, except the vitamin, the effect of which was to be tested, and, after a suitable period, by adding this factor without otherwise changing the ration. Negative results were obtained with vitamins A and B. Vitamin C was not tested.—E. A. **Werner** and W. R. **Fearon**: A demonstration of some new reactions of cyanic acid.

EDINBURGH.

Royal Society, March 3.—G. W. **Tyrrell**: The geology of Prince Charles Foreland, Spitsbergen. Prince Charles Foreland consists chiefly of the Hecla Hook formation (Cambro-Ordovician), which has been folded in an orogenic belt continuous with the great Caledonian fold-mountain zone of Scotland and Scandinavia. The rocks are grouped lithologically into three divisions which have suffered different types of movement and metamorphism. Cataclastic structures are exceptionally well displayed in the rocks. A narrow area of Tertiary rocks occurs along the eastern coast of the island. These have been step-faulted to the east towards Foreland Sound; and as reciprocal structures are found on the opposite mainland side, Foreland Sound is a down-faulted trough or graben drowned by the sea.—J. **Cooper**: Investigation of the banded structure of a Fifeshire coal seam. The proportions of definite bands of the five-feet seam of Fifeshire cannot be accepted as an index of position. Determination of the other characteristics of the bands, namely, the coking quality, volatile and ash contents, was discussed from an economic point of view, while the presence of intrusive igneous rock in a coalfield was also dealt with as regards its influence on the properties of adjacent coal seams.

PARIS.

Academy of Sciences, February 18.—M. Guillaume Bigourdan in the chair.—Daniel **Berthelot**: Remarks on the communication of M. Bochet entitled "On the law of corresponding states of Van der Waals." The facts pointed out by M. Bochet are not new, and his criticism is regarded as unjustified. A résumé of work bearing on this question published during the last thirty years is given.—Paul **Dienes**: Tensorial determinants and the geometry of tensors.—H. **Germay**: The integration, by successive approximations, of partial differential equations.—M. **Soula**: The functions defined by Dirichlet's series.—Maurice **Roy**: The acceleration of waves of shock in perfect gases.—A. **Véronnet**: The adiabatic equilibrium of a gaseous star.—L. **Décombe**: Is the notion of entropy really extremely abstract?—M. **Volmar**: Photolysis and the law of photochemical equivalence. Photolysis obeys the law of photochemical equivalence: for each function it requires the intervention of radiations of well-determined wave-length corresponding to the maximum absorption.—Marius **Picon**: The hydrates of sodium thiosulphate. The author's experiments are not in agreement with the conclusions of Young and Burke: instead of twelve hydrates forming five groups proposed by the latter, the author concludes that there are only two groups.—N. **Perrakis**: The influence of the neighbourhood of the critical state of miscibility on volumes. Diagrams of experimental results obtained with the systems *o*-cresol-ethyl alcohol, phenylether-ethyl alcohol. The deformation of curves showing variations of volume as a function of the molecular concentrations of mixtures may be due to the proximity of the critical state of miscibility, and not, as has been in some cases assumed, to the existence of definite chemical combinations.—A. **Tian**: The measurement of the intensity of small sources of heat: the use of a compensation microcalorimeter. The temperature difference between the calorimeter and its jacket is measured with a sensitive thermocouple, and in certain cases reduced to zero by use of the Peltier effect in another couple. The stability of temperature of the jacket is important in measurements carried out over a long period of time, and this is secured by the use of multiple jackets.—W. **Kuhn**: The influence of temperature on the decomposition of ammonia by ultra-violet light. The photochemical decomposition of ammonia increases with the temperature, a rise of 100° C. corresponding with an increase of velocity of 50 per cent. This velocity increase does not obey the law of Arrhenius; probably there are several intermediate reactions between NH_3 and $N_2 + 3H_2$. Between 30 mm. and 300 mm. of mercury, the velocity is independent of the pressure.—V. **Auger** and Mlle. L. **Odinot**: The cobalt and nickel carried down by tin precipitated in the state of stannic sulphide.—H. **Gault** and Brindaban Chandra **Mukerji**: The determination of the copper indices of cellulose materials. Application of the Fontès-Thivolle molybdo-manganimetric method.—**Cornillot**: The constitution of phthalonic acid.—Léon **Bertrand** and Léonce **Joleaud**: The cretaceous and tertiary movements and the volcanic manifestations in the western part of Madagascar.—Ch. **Maurain**: Magnetic measurements in Brittany.—E. **Tabesse**: Magnetic measurements in Brittany (Ille-et-Vilaine and Loire-Inférieure).—G. **Truffaut** and N. **Bezssonoff**: The most favourable form of nitrogen for the higher plants. From the results of experiments extending over four years, it is concluded that mixtures containing nitrogen as urea show a marked superiority as nitrogen manures over ammonia salts, nitrates, and cyanamide.—Lucien **Daniel**: The coexistence of starch and inulin in certain Compositæ.—E. **Poyarkoff**: Contribution to the theory of the action of the lysines of the serum.—L. **Mazé**: The manufacture of Cantal cheese and the means of realising the purity of the lactic fermentation which ensures normal ripening.—Edm. **Sergent** and H. **Rougebilf**: The dissemination of yeasts in vineyards by insects; mutual action between yeasts and Drosophila. Contrasting the theories of carriage of yeast spores by dust and by insects, all the experiments favour the latter view.—A. **Peyron**: The importance of the myo-epithelial layer of the galactophore canals in the development of tumours of the mammary gland in the dog.

Official Publications Received.

Madras Fisheries Department. A Statistical Study of Young Fishes from Silavatturai Lagoon, Tuticorin. By Dr. R. H. Whitehouse. (Report No. 3 of 1923, Madras Fisheries Bulletin, Vol. 17.) Pp. 49-103. 1.4 rupees. The Anatomy of the Chank (*Turbinella pyrum*). By S. T. Moses. (Report No. 4 of 1923, Madras Fisheries Bulletin, Vol. 17.) Pp. 105-107. 5 annas. (Madras: Government Press.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards. No. 478: Redetermination of Secondary Standards of Wave Length from the new International Iron Arc. By W. F. Meggers, C. C. Kiess, and Keivin Burns. Pp. 263-272. No. 479: Interferometer Measurements of the Longer Waves in the Iron Arc Spectrum. By W. F. Meggers and C. C. Kiess. Pp. 273-280. (Washington: Government Printing Office.) 5 cents each.

University Grants Committee. Returns from Universities and University Colleges in Receipt of Treasury Grant, 1922-23. Pp. 22. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

Journal of the Chemical Society. Supplementary Number, containing Title-pages, Contents, and Indexes, 1923, Vols. 123 and 124 (Parts 1 and 2). Pp. 3443-3519+xxxi+ii. S93-ii.1312+20. (London: Gurney and Jackson.)

Department of Scientific and Industrial Research: Advisory Council. Third and Final Report of the Mine Rescue Apparatus Research Committee. Pp. vi+32. (London: H.M. Stationery Office.) 1*s.* net.

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1922-23. Vol. 67, Part 2. Pp. 73-139+xliv+viii. (Manchester: 36 George Street.) 12*s.*

Agricultural Progress: the Journal of the Agricultural Education Association. Pp. 118. (London: Ernest Benn, Ltd.) 5*s.* net.

International Air Congress, London, 1923: Report. Edited for the Committee by Lieut.-Col. W. Lockwood Marsh. Pp. 981. (London: Royal Aeronautical Society.)

Errata.—The publisher of the last four volumes in the list of "Official Publications Received" in the issue for March 1 should have been given as the Carnegie Institution of Washington, and not the Smithsonian Institution.

Diary of Societies.

SATURDAY, MARCH 15.

BRITISH MYCOLOGICAL SOCIETY (in Botany Lecture Theatre, University College), at 11 A.M.—Miss M. Brett: Conditions of Sclerotia Formation in a Species of Aspergillus.—A. D. Cotton: Some Results of the Ministry of Agriculture's Plant Disease Survey.—Dr. J. Peklo: The Work of Kruis and Satava on Normal and Reduced Forms of Yeast and Alternation of Generations.—Miss E. J. Welsford: Diseases of Clove.

GEOLOGISTS' ASSOCIATION (at Geology Department, King's College), at 2.30.—Prof. W. T. Gordon, assisted by A. K. Wells, S. W. Wooldridge, and A. J. Bull: Demonstrations on Minerals, Rocks and Fossils, including the Rocks collected on the Arran Excursion.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Properties of Gases in High and Low Vacua (2).

MONDAY, MARCH 17.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Col. H. St. J. L. Winterbotham and others: Discussion on the Choice of a Grid for British Maps.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—L. Gaster, J. S. Dow, and others: Discussion on Illuminating Engineering: its Application and Value to the Electrical Industry.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. Bagenal: Planning for Musical Requirements.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. C. Pellizzi: The Problem of Religion for the Italian Idealists.

TUESDAY, MARCH 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Lt.-Col. G. Liston: The Plague (Milroy Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. W. Chambers: Civilisation and Literature of the Anglo-Saxon Period (2).

ROYAL STATISTICAL SOCIETY, at 5.15.—A. W. Flux: The Census of Production.

MINERALOGICAL SOCIETY, at 5.30.—Dr. L. J. Spencer: Allopalladium from British Guiana.—W. Campbell Smith: A Serpentine-like Mineral from Burgenland, Austria.—H. C. G. Vincent: Chemical Analyses of Granite from Dufton, Westmorland, and of Mica from Burma.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions made to the Society's Menagerie during the month of February 1924.—G. Summers: Exhibition of Cinematograph Films of Animal-Life in Spitsbergen.—Dr. L. Hill: The Atmospheric Conditions at the Zoological Gardens, London.—W. J. Phillipps: A New Genus of Ribbon-Fishes.—B. N. Schwanwitsch: The Ground-Plan of Wing Pattern in Nymphalids and certain other Families of the Rhopalocerous Lepidoptera.—Dr. F. Wood Jones: The Status of the Kangaroo Island Kangaroo (*Macropus fuliginosus*).

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. H. Remfry: The Interaction in Bridgework of the Deck System on the Main Girders, and the Consequent Modification of Stresses therein.—Prof. C. E. Inglis: Theory of Transverse Oscillations in Girders and its Relation to Live-load and Impact Allowances.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—G. W. Johnson: The Development of the Marine Steam Turbine.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. C. Dollman: The Appreciation of the Beautiful.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prof. F. G. Parsons: A Comparison of Cranial Contours.

WEDNESDAY, MARCH 19.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—A. J. Hill: The Work of a Mechanical Engineer's Office (Lecture).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Prof. V. H. Blackman: Atmospheric Electric Currents, Normal and Abnormal, and their Relation to the Growth of Plants (Lecture).

ROYAL MICROSCOPICAL SOCIETY, at 7.45.—Prof. W. T. Gordon: Fossil Plants.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Miss Evelyn Fox: Practical Aspects of the Association's Work.

ROYAL SOCIETY OF ARTS, at 8.—R. L. Robinson: The Forests and Timber Supply of North America.

THURSDAY, MARCH 20.

PHYSICAL SOCIETY OF LONDON (Jubilee Celebrations) (at Institution of Electrical Engineers), at 3.45.—Le Duc de Broglie: The Photo-electric Effect in the Case of High-frequency Radiation, and some Associated Phenomena (Ninth Guthrie Lecture).

ROYAL SOCIETY, at 4.30.—Sir Charles Sherrington and E. G. T. Liddell: Reflexes in Response to Stretch. (Myotatic Reflexes.)—R. Campbell Thompson: The Plants of the Assyrian Medical Tablets.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. D. S. M. Watson: Evolution To-day (1).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—W. S. Farren: The Work of the Aeronautical Research Committee's Panel on Scale Effect.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Annual Meeting.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—E. Cammaerts: Education in England and Belgium compared.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Sir Richard Paget, Bart.: The Nature and Reproduction of Speech Sounds (Vowels) (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting) (at Watergate House, Adelphi), at 7.30.—H. E. Merritt: Brake Shoe Design.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers, Inc.), at 8.—Open Discussion.

CHEMICAL SOCIETY, at 8.—P. C. Austin and V. A. Carpenter: Rotatory Dispersion of Derivatives of Tartaric Acid. Part I. Methylene Derivatives.—Prof. T. M. Lowry and J. O. Cutter: The Rotatory Dispersive Power of Organic Compounds. Part XV. The Molecular Weight of Ethyl Tartrate and the Origin of Anomalous Rotatory Dispersion in Tartaric Acid and its Derivatives.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting at the Royal Army Medical College, Grosvenor Road), at 8.15.—Demonstrations by Lieut.-Cols. S. P. James, W. P. Macarthur, H. Marrian Perry, Drs. J. G. Thomson, Broughton-Alcock, and C. M. Wenyon; I. M. Puri and L. G. Saunders.—Dr. A. Balfour: Cinematograph Film, illustrating the Etiology, Spread, and Prevention of Malaria.

FRIDAY, MARCH 21.

PHYSICAL SOCIETY OF LONDON (Jubilee Celebrations) (at Institution of Electrical Engineers), at 4.—Sir William Barrett, Prof. J. A. Fleming, Prof. C. V. Boys, Sir Richard Glazebrook.—At 6.—Sir Arthur Schuster, Sir Oliver Lodge, Prof. H. E. Armstrong, Dr. C. Chree.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—O. Rothfeld: Progress of Co-operative Banking in India.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. H. Patchell: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. Richmond: My Experiences in Venice.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—P. Parrish: Sulphuric Acid Plants, New and Old; Constructional Details and Working.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—G. P. Garbett and others: Discussion on The Use of Light for Outdoor Advertisements.—Miss M. Partridge and others: Discussion on The Use of Light in Shops, in Show-windows and for Display Purposes.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Frederick Keeble: The Plant Commonwealth and its Government.

SATURDAY, MARCH 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Properties of Gases in High and Low Vacua (3).

PUBLIC LECTURES.

SATURDAY, MARCH 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. N. Bromehead: Links between Geology and Art.

WEDNESDAY, MARCH 19.

INSTITUTE OF HYGIENE (Devonshire Street), at 3.30.—Dr. Ethel Bentham: The Health of the Domestic Servant.

HOSPITAL FOR SICK CHILDREN (Gt. Ormond Street), at 5.—Prof. E. Gorter: The Pathogenesis of Certain Nutritional Disorders (in English).

UNIVERSITY COLLEGE, at 6.—Dr. P. Stocks: Influence of Social Status and Physical Development on the Characters of the Blood.

FRIDAY, MARCH 21.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. J. S. Phillimore: The Prospect in the Humanities.

SATURDAY, MARCH 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Natural History of Subterranean Animals.