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

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3447 SATURDAY, NOVEMBER 23, 1935 Vol. 136

Economics of Plenty*

FEW problems have astonished the modern world so much as the apparent paradox of "poverty in the midst of plenty" yet, as Sir Josiah Stamp pointed out in his Norman Lockyer Lecture to the British Science Guild, delivered on November 13 and entitled "The Calculus of Plenty", the problem is by no means new, for just a hundred years ago, Carlyle could write that "In the midst of plethoric plenty, the people perish". As the years have gone on, the term 'plenty', while still covering the glaring maladjustment of things made, longed for but unused, has gradually widened in content to mean much more. In the last few years, it has become so nebulous and over-suggestive as to be, in Sir Josiah Stamp's words, almost an intellectual menace. The conception for which it stands, however, is in all conscience, he said, serious enough, though we should not be overawed or confused by it. The rigorous analytical examination to which Sir Josiah subjected the term 'plenty' in the course of his lecture provides an important contribution to the elucidation of the various problems involved, which only too often are lumped together to the confusion of clear thinking. Adopting a main threefold classification with various sub-heads, he classified 'plenty' as first that of physical or scientific potentiality ; secondly, as that of unused or unmarketed production ; and thirdly, that of unused capacity.

The plenty of potentiality is mainly a conception of the engineer and man of science, and it was developed to its greatest extent by the exponents of technocracy, who have left a sinister trail of dreams and pseudo-statistics over the whole field of thought and inquiry. Generally speaking, it expresses the facts of output in terms of reduced man-power for a given output. But the crude figures of engineering potentiality need to be qualified before the net figures of economic potentiality are deduced. It may well be that on the manufacturing side all the attendant supplies and processes cannot be speeded up to correspond, or the full and even load postulated may not really be available. Further, even supposing a considerably lower price is possible for the larger quantities available, after allowing for every production difficulty, it is not certain that the amount will be taken by the public at that price or even at any price. It might be a boon to make 100 fire grates with the ease with which one is now made, and yet not really a greater boon in any realistic sense to make 1,000 for every one now. Technical possibility has to be considered against a background of economic and psychological relativity. A further serious limitation will arise if in fact there are only one or two of the new machines in existence, and the bulk of supply comes from older equipment. In this event, the alleged plenty does not actually exist, nor is it actually potential ; it is only hypothetically or ultimately potential.

The current concept of plenty popularly linked in almost causative association with poverty is fed from three main sources : the concept of things not hitherto made but now capable of being made, the concept of things already made and standing unused, and the concept of things that have not but could have been made.

Large dynamic ideas are scientifically dangerous if they remain unmeasured. Technological and scientific conceptions of plenty are capable of measurement and quantitative statement, but an accepted technique for this purpose is still lacking,

* The Calculus of Plenty. By Sir Josiah Stamp. (The Norman Lockyer Lecture, 1935.) Pp. 35. (London : British Science Guild, 1935.) 1s.

and no recognised units of productivity have yet been devised which are capable of being fairly aggregated and compared. The problem, however, goes much further than the mere measurement of plenty, since successive increments of productivity of apparent equality in measurement may have different values in practice. It may be, for example, that an invention can only be brought into full use gradually ; fuller utilisation of unused capacity may involve greater proportionate expense for each unit, or increased supplies may only be demanded if the price is reduced.

The technocrats made grossly excessive claims about the potentialities of science and invention, nearly always stated quantitatively, and with great apparent exactness, thus conveying an impression of realisable plenty were it not for someone's stupidity or the faults of society. Some of the processes of technocratic computation, it would seem, assumed that machinery would be kept working 24 hours a day, or that what was true for an isolated process was true for a whole industry.

The gross possible theoretical or technical capacity based on engineering ideas has to be brought down to the more important economic capacity in several stages. First there is the operating margin. A 100 per cent use is in practice unattainable ; a part amounting to something like 20 per cent must serve as a reserve for breakdown, repairs, irregularity of supplies, etc.

Secondly, there is unco-ordinated surplus capacity, since industries are not so perfectly integrated as to make possible a flow of production which will keep all stages fully employed. An intensified demand may quickly bring out some limiting factor. Allied to this, there is seasonal surplus capacity, and plant cannot be deemed to have a yearly capacity equal to its seasonal capacity multiplied by the full term.

Thirdly, it is possible that two industries may have surplus capacity technically equal yet vastly different in practical potentiality. For example, people might be desiring radio sets more and more and pianos less and less, and not generally both. Abundant purchasing power means much greater demand for the one, very slight extra demand for the other. Clearly potential 'plenty' cannot be regarded as the aggregate of these two unused sets of plant. Further, the advance of science and invention may render certain productive units obsolescent, or capital may be invested in production which is economically misplaced.

Consideration must also be given to the demand side. Suppose there is an efficient up-to-date plant for the production of a certain article which is only 70 per cent utilised, but which could be fully utilised without difficulty. Then we could only call the 30 per cent "plenty in the midst of poverty" if additional employment or spending power enhances total demand at the former price, so that an enhanced total supply produced at the same cost is marketed. But if increased spending power gives a relatively less increased demand for this article and the increased supply is at a relatively higher cost, we certainly could not.

The destruction of actually produced wealth when men are in need strikes the imagination much more than mere unused capacity ; it seems so wanton. But this, as Sir Josiah Stamp pointed out, is by no means entirely a modern phenomenon, for the throwing overboard of Eastern produce to maintain the price of the remainder has in a former century been the producers' strike against an elastic demand schedule.

Stocks 'carried over' have not all the same quality. A glut of plums in Worcestershire not worth the cost of picking and getting to market is not effectively 'plenty', though if there is a canning factory then it may well be plenty. Here, of course, the demand schedule for canned fruit is quite another thing than that for fresh fruit. Then there is obviously a 'quality of position', for a surplus of tons of produce in Australia can well be different from tons in Smithfield. Perhaps the best-known example of the actual destruction of 'plenty' is the recent burning of coffee in Brazil, but not everybody has realised that the probable cause of the whole episode was an attempt on the part of producers, not merely to maintain prices but even to raise them. The excess supply of wheat of late years seems enormous when stated absolutely in bushels, but if it is measured in relation to total consumption, namely, 2·05 per cent, it becomes quite reasonable.

Sir Josiah Stamp also discussed the measurement of invention 'plenty'. Often innovations take a long time to get fully adopted if their margin of advantage is not revolutionary. The laboratory case may be proved up to the hilt, the engineer may be positive but the capital market is slow in moving ; and, in Sir Josiah's view, there is no reason to suppose that socially-owned capital would be more progressive and risk-taking than privately-subscribed capital, so as to reduce the lag between an idea and its practical development.

Woman: Past and Present

Woman: an Historical, Gynaecological and Anthropological Compendium

By Hermann Heinrich Ploss, Max Bartels and Paul Bartels. Edited by Eric John Dingwall. Vol. 1. Pp. xiii+655. Vol. 2. Pp. xii+822. Vol. 3. Pp. viii+543. (London: William Heinemann (Medical Books), Ltd., 1935.) 3 vols., £8 8*s*. 0*d*. net.

FOR fifty years the various editions of "Das Weib" have had a considerable reputation on the Continent, in Great Britain and in the United States. The later editors revised and enlarged the book originally written by Dr. H. H. Ploss and added numerous new illustrations, and it has thus become a unique compilation on womankind. Hitherto there has been no English translation, but now English students can study with ease the accumulated data of the eleventh edition. This work, however, is not a mere translation, as the English editor, Dr. E. J. Dingwall, has made corrections and added supplementary matter, thus bringing it up to date so far as was possible. This laborious task has been performed in a most praiseworthy manner, and we have also to thank him for the very extensive bibliography. A noticeable feature of the work is the excellence of the illustrations, which are more than a thousand in number, but some of them could easily have been dispensed with. Loaded paper is used throughout on account of the illustrations and this makes the volumes uncomfortably heavy to hold; vol. 2 weighs nearly 6 lb.

This is a really remarkable compendium of the very voluminous literature that deals directly or incidentally with what appertains to women. The information is culled from ancient and modern authors and from the records of travellers and trained investigators among innumerable backward peoples as well as among the backward elements in modern communities. The external and internal anatomy of women is described and illustrated in detail, and sufficient physiological information is given for those who are not physiologists. Matters of interest are provided for those who occupy themselves in the history of medicine and obstetrics; but it is to anthropologists especially that the work will be of value, as it places at their disposal a wealth of material which otherwise it would be impossible for them to acquire. But it is to be feared that the great cost of the work will prevent most anthropologists from procuring it.

The exigencies of space precluded that any one section of the social aspects of womankind could be treated in anything like a complete manner. Probably enough has been given to satisfy ordinary requirements, but many recent field-workers will look in vain for the facts and inferences which are familiar to them. The ethnologist has much provided for him, but he will have to search elsewhere for further details and for other explanations of the significance of what is recorded.

The lengthiest discussion of social practices and institutions is that on the development of the institution of marriage. To the authors, man appears from the very beginning as a gregarious animal, and according to them it is really absurd to assume a monogamous institution in mankind. They go so far as to say that every form of 'marriage' conceivable among human beings occurs among animals and that all of them are dependent upon the care of the offspring. This is not the occasion to add to the unnumbered discussions of the origin of marriage or (as the authors hold) the priority of matriarchy to patriarchy and similar topics. Many modern ethnologists regard these subjects from a different point of view, or look upon them as being unprofitable to discuss.

The authors have very little to say concerning certain social and legal aspects of the position of women in a community. Much has been written, for example, about men's dread of contamination from women and about the various methods adopted to prevent or nullify it. This attitude certainly exists, but it is also well recognised that a man pays very little attention to restriction when he desires a woman. Individuals frequently break away from the standardised pattern of behaviour in regard to social barriers to marriage, forbidden degrees of relationship and the like. Irregular marriages are so frequent in some communities that there is a definite mechanism for socialising them, as it is recognised that strict adherence to custom is impossible in certain circumstances and it is necessary to regularise and establish the position of the children in society—which is one of the main functions of marriage. Common-sense usually prevails in primitive communities in a conflict between theoretical morality and what actually takes place.

Further, certain social practices in connexion with young women are best understood if those persons are regarded as property—more especially corresponding to property in trees. An essential idea of property is work done, and in many places a man who plants a fruit tree owns it and its

usufruct in perpetuity irrespective of who happens to own the land on which it is planted. The parents of a girl have had to do work in rearing her; when she marries, this work is usually recognised in payment by the groom or his group, or by the groom working for her parents. The loss of a woman to a group is also the loss of her prospective children; thus the groom may have to pay for the rearing of the girl and also for her usufruct, and these payments may extend over a number of years. This conception of property applies to the rape of an unmarried girl, which is described as a theft from the father or guardian, and that of a married woman from her husband. The transference of ownership is ratified not only to the husband or to his group by gifts, such as *lobola*, or whatever term may be used for this transaction, but also by bodily markings, a ring, adornment or other means. The recognition of ownership is in rare cases enforced by a chastity belt. The idea of property is, however, only one of the sentiments connected with marriage.

The method adopted in this work is of great value for those interested in comparisons and distributions, but it necessarily precludes any precise or even general conceptions concerning the place of woman in the life of communities. Woman is cut out of the picture. Those who desire to learn how women's activities and emotions are related to the functioning of particular communities must consult such books as "The Sexual Life of Savages in North-Western Melanesia" by B. Malinowski, who deals in a very thorough way with the Trobriand Islanders of Papua, and in "The Sorcerers of Dobu" by R. F. Fortune, who shows in another Papuan island the working of a society in which the wife and her village dominate the husband, who is always an alien. Dr. Margaret Mead illustrates the functioning of the very unpleasant family life of the people of Manus, Admiralty Islands, in her wrongly entitled book "Growing up in New Guinea", and in her "Coming of Age in Samoa" she gives a picture of a very different kind of family life. It is not fair to criticise authors for not doing what is outside the limits they have set themselves, but within these limits they have produced a work of great value.

A. C. HADDON.

Insect Morphology

Principles of Insect Morphology

By R. E. Snodgrass. (McGraw-Hill Publications in the Zoological Sciences.) Pp. ix+667. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 36*s*. net.

THE author of this book ranks as the foremost American worker on insect morphology. His contributions on the subject are notable for their clarity and originality of thought, and the appearance of a volume, embodying his ideas in comprehensive form, is sure of a hearty welcome. In its preparation, Mr. Snodgrass has incorporated the results of much first-hand study with those of many recent investigators in the same field. He has produced an outstanding book wherein knowledge of facts is combined with that of function and, at the same time, theoretical conceptions of the origins and relationships of organs and parts are not overlooked.

The book is divided into nineteen chapters, each concluding with a glossary of the special terms used: the definitions are exact, and should help to eliminate prevailing ambiguities of terminology. The general subject of morphology is opened with a short chapter on arthropod organisation as a background, while the fundamentals of insect structure are reviewed from the development point of view. The body-wall and its derivatives are dealt with at length, and a clear exposition of the physico-chemical properties of chitin is included. The subject of sclerites and segmentation forms another chapter, which is followed by one on the general morphology of arthropod limbs. In this connexion, the author follows Störmer (1933) in rejecting the view that trilobite limbs are truly biramous, the so-called exopodite being interpreted as an epipodite. Mr. Snodgrass stresses the fact that 'biramous' limbs are peculiar to Crustacea, and that there is also no sound evidence of their occurrence in any Tracheata. In the chapters dealing with the structure of different body-regions, and their appendages, lucid explanations of their morphology are given, while the usually neglected subject of myology comes in for adequate treatment. The application of this latter aspect to the interpretation of the labium has clarified the prevailing inaccuracies of nomenclature.

The chapter on wings and flight is of special interest in that the author expresses original views on the anal group of veins and on the relations of the chief veins to the articular sclerites: the subject of wing regions also comes in for special discussion.

Under the title of 'Organs of Ingestion', the mouth-parts of individual orders and their larvæ are described at length, together with their musculature and methods of functioning. The various internal organs and systems are discussed in separate chapters.

In dealing with the nervous system, the author takes due account of the extensive work of Hanström in regarding the proto- and deuto-cerebral ganglia of the brain as secondary differentiations of an original prostomial archicerebrum, the tritocerebrum being interpreted as the first ganglionic centre of the ventral nerve cord. The histology of the nerve centres is very fully treated in the light of recent neurological research. In coming to the sense organs, the account, although adequate in most respects, says little of the tympanal organs of Lepidoptera, and no mention seems to be made of the halteres of Diptera or of the modern conception of general stimulation organs.

The final chapter on the genitalia is a full and well-illustrated treatment of a complex subject. The book concludes with twenty-two pages of up-to-date bibliography. In a short notice little more than an indication of the scope of this work is possible, but it remains to be emphasised that it is a really sound scientific treatise of first-rate importance, which no worker on the subject can afford to neglect. A. D. IMMS.

A Poet's Picture of Life and Philosophy

The Mystery of the Mahābhārata

By N. V. Thadani. Vol. 1 : A Vision of the Vedas. Pp. lxiv+432. 12 rupees. Vol. 2 : The Systems of Hindu Philosophy and Religion. Pp. xviii+371. 8 rupees. Vol. 3 : The Story and the Essence of the Epic. Pp. lii+462. 8 rupees. Vol. 4 : The Explanation of the Epic, Part 1. Pp. xlvii+378. 8 rupees. Vol. 5 : The Explanation of the Epic, Part 2. Pp. xvi+379–924. 8 rupees. (Karachi : Bharat Publishing House, 1931–1935.) £4 the set.

IT may not be unknown to most readers that the Mahābhārata, or Great Bharatiana (that is, things about the Bharat clan, as the title is usually understood), is to Indian literature what the Iliad is to that of Greece, only immensely longer, the long period of its compilation being of equally indefinite date. The only portion of it with which they are likely to have any direct acquaintance is the episode known as the Bhagavadgītā, or Song of the Blessed One, best known to us in the translations of Edwin Arnold, Dr. L. Barnett and that in the sacred books of the East.

Mr. Thadani, late principal of the Hindu College, and rector of the University of Delhi, agrees with Indologists in seeing in the vast work, of which tradition holds that only a summary—and that being 100,000 lines !—has survived, the hand of many writers (possibly, before that, the voice of many Sayers). But he does not concede that the many are a succession of editors, incorporating new values, altering, dropping out superseded values. He is before all a poet, and has a vision of "a great school of thought which seems to have flourished in India in the past". He does admit that his 'school' will have included results of new knowledge from time to time. But he claims that from first to last the epic has 'unity of design', and that this design was to give a "picture of all systems of philosophy and religion in story-form", and incidentally "an account of the universal history of Man or the human race".

Enough said—at least for present limits of space. I do not recommend the study of these volumes to scholars ; they are too poor in first-hand knowledge and in historic perspective for such. Nor to the serious inquirer at second-hand, and for the same reasons. The account given, among the 'systems', of Buddhism, shows these weaknesses perhaps at their worst—or is it because there I am better able to judge ? But for the literary reader and for the student of racial types in authors, it may prove an interesting (and in style very readable) mine of curious information. Especially perhaps where the venerable cosmic 'egg', as the primary unit of life at the creation, appears in modern dress as 'the cell', and in the theory of Sanskrit as having been deliberately constructed "as a picture of Brahm'anda, that divine egg". A poet runs the great danger of seeing his perspective just like that : "as a picture", and often an ancient picture at that. I mean one in which the time-quality is either represented merely as background, or all as in the foreground. A book which can set out to give a picture of the history of man, by way of 'systems' of religion and philosophy, without any mention in its index—and it is one of forty pages !—of man's will and man's becoming, can scarcely contain even the rudiments of that history, of that real nature.

C. A. F. RHYS DAVIDS.

A Neglected Aspect of the Calculus of Variations

Variationsrechnung und partielle Differentialgleichungen erster Ordnung
Von Prof. Constantin Carathéodory. Pp. xi+407. (Leipzig und Berlin: B. G. Teubner, 1935.) 22 gold marks.

THE work of Euler and Lagrange in the middle of the eighteenth century proved that the essence of theoretical mechanics lay in the calculus of variations, which was itself something that included not only all mechanics but also much else besides. Mechanics is a class of partial differential equations; the calculus of variations corresponds to a similar but bigger class, whose essential properties differ only in detail from those of the former class. Jacobi in particular stressed, in 1836, the intimate relation that subsists between systems of partial differential equations of the first order and equations arising out of the calculus of variations.

There for the next forty years the matter rested; no doubt for lack of some of those essential principles which were in that period changing from fluidity to solidity, there is small evidence of development in the direction to which Jacobi's researches seemed to point. Then in 1879 appeared the work of Weierstrass, which gave the calculus of variations its independence from its first parent, mechanics, an independence which it maintained only until it was adopted by the new and comprehensive calculus of functionals.

From the time of Weierstrass the evolution of the general theory of the calculus of variations proceeded in directions which appeared to loosen the primal association with partial differential equations, an association which, though noticed in a casual manner from time to time, all but disappeared from sight. Thus those landmarks of the period, the textbooks of Bolza (1909) and Hadamard (1910), tend away from, rather than towards, the Jacobian point of view (though Hadamard clearly realised that there was still much to be revealed), whereas the more recent and more highly specialised books—that of Morse (1934) may be quoted as a distinguished example—pass still further away.

In his preface to the book now before us, Carathéodory tells how he has been endeavouring for many years to pick up the threads of the connexion between the calculus of variations and partial differential equations left by Jacobi and his pupils. The old-fashioned theories of partial differential equations proved inadequate for this purpose because they were evolved with the view of forcing the equation to disgorge a solution—or at least the skeleton of one—and were often in the nature of artifices the scope of which was limited and power unreliable. That moderately complete knowledge of the essential nature of a solution which has now been gained, together with the modern weapons of mathematics, such as the tensor calculus, provide an equipment both necessary and effective for weaving new matter into the older fabric.

In order that an adequate account of the theory of partial differential equations, refined and recast in moulds of precision, should be always at hand, the author has devoted the first ten chapters (163 pages) of his book to developing this theory. With as great a generality as is possible without making the existence theorems somewhat repulsive, yet at the same time without imposing tiresome restrictions on the work he is leading up to, the author establishes the basic theory of characteristics, canonical transformations of systems of equations, contact transformations and the Pfaff problem. Though it was designed as a necessary preliminary to the second half of the book, and indeed serves that end to perfection, it is actually an account remarkable in itself for lucidity and completeness.

Apart from an introductory chapter on maxima and minima in the ordinary sense, the second part of the book is devoted to founding the theory of the calculus of variations on the basis that has been mentioned. But though the basic association with partial differential equations is emphasised throughout, the link is not stressed to breaking point. Except in the examples by which the author illuminates the theory and puts its powers to the test, everything is stated in terms of many-dimensional space. Incidentally, the examples—they have an index of thirty entries to themselves—are extraordinarily interesting, and made all the more valuable by some clear and striking diagrams. Naturally the limits of space imposed upon the author have restricted the scope of the work, excluding discontinuous solutions and other topics to which the contributions of Carathéodory himself have been considerable. But the essence is there—in places perhaps a little concentrated, but never turbid. In brief, the author treats of the simple and the parametric variation problems, the second variation, the boundary problem, closed extremals and the Lagrange problem. An extensive bibliography is accompanied by ample indications to sources of information about those topics which are not contained in the text. In sum, this book is indispensable. E. L. I.

Die wichtigsten Lagerstätten der "Nicht-Erze"
Von Prof. Dr. O. Stutzer. Band 6 : Die Lagerstätten der Edelsteine und Schmucksteine. Von Prof. Dr. O. Stutzer und Dr. W. Fr. Eppler. Pp. xvii+567. (Berlin : Gebrüder Borntraeger, 1935.) 43.50 gold marks.

IN this book, the first section, which is an enlarged and rewritten version of an earlier work by Dr. Stutzer, gives an interesting account of the diamond fields of the world, plentifully illustrated with maps, diagrams and photographs. Statistical tables are given, and these emphasise the enormous extent of the diamond industry, accounting for more than 90 per cent of the world's trade in precious stones. In 1929, the total production reached nearly eight million carats, more than half of which came from pipes and gravels in the Union of South Africa.

The second and slightly larger section, written by Dr. Eppler, is entirely new, and provides a useful survey of all the more important sources of the precious and semi-precious stones, arranged according to their chemical composition. The section concludes with a long chapter on amber (much in favour in Germany just now) and a note on jet. The treatment of each species consists of a brief summary of its chief mineralogical characters, followed by a description of the geology of the most important deposits, and a note on the commercial aspect of its production. Pyrites, which is extensively used in cheap jewellery as 'marcasite', receives no mention, nor do sphene, andalusite, or phenakite—while on the other hand, such rarities as benitoite and euclase are included in this section.

Although not free from minor errors, omissions and misprints, the book can be recommended as a most useful monograph on the subject. B. W. A.

Hydrographie
Von Prof. Dr. Friedrich Schaffernak. Pp. ix+438. (Wien und Berlin : Julius Springer, 1935.) 46.50 gold marks.

PROF. SCHAFFERNAK, from the store of his knowledge and experience as an exponent of the principles of hydrography at the Technical High School of Vienna, has compiled a textbook on the subject which should be extremely useful to students, as also to others who are engaged in observational and experimental work of this nature. The volume is divided into three main parts, the first of which deals with the taking and assembling of hydrographical, meteorological and morphological observations, including rainfall, water-levels and discharges of rivers and streams ; the second with statistics in an analytical and graphical form ; and the third with a consideration of important special problems and their solution.

There is a fully illustrated description of the various instruments and appliances which are used in connexion with the field work of hydrology, and a variety of information concerning the taking and classification of readings ; while the mathematical side also receives attention. The illustrations and diagrams are clear and easily intelligible, and there is a serviceable index. B. C.

Head, Heart and Hands in Human Evolution
By Dr. R. R. Marett. Pp. 303. (London : Hutchinson and Co. (Publishers), Ltd., 1935.) 10*s*. 6*d*. net.

IN this volume Dr. Marett has brought together a number of addresses, lectures and essays, ranging from three presidential addresses to the Sociological Institute in 1933–35, and the Donellan Lecture delivered at Trinity College, Dublin, in 1933, to a number of miscellaneous papers, including contributions to publications of a popular or semi-popular character. Notwithstanding their varied character and purpose, they have a certain unity, which is suggested by the author's choice of a title. Between them all they cover the sum of human activities, through which man expresses himself as a member of a society, as a being in relation to a spiritual world, and as an exploiter of his material environment, whether for the practical needs of everyday life or for the expression of an æsthetic impulse.

Dr. Marett is an evolutionist in so far as that term is applicable to the consideration of man's cultural development ; but he is too expert in handling philosophical categories to allow himself to be entrapped into the crudities which are attributed, not always justly, to that school. In the first of his addresses to the Sociological Institute he is careful to expound the distinction which is to be drawn between the implications of the biological terms 'evolution' and 'progress' in cultural development. On the other hand, he shows that the evolutionary position in anthropology conforms to the requirements of the biological concept in that, rightly understood, it neither postulates, nor claims to find in the evidence, the unilateral progression which is said to be its characteristic defect.

Civilisation and the Growth of Law :
a Study of the Relations between Men's Ideas about the Universe and the Institutions of Law and Government. By Dr. William A. Robson. Pp. xv+354. (London : Macmillan and Co., Ltd., 1935.) 12*s*. 6*d*. net.

DR. ROBSON traces the growth of 'law' from its origin as an observed order in early societies and as conformity to the will of a ruler, divine, or of divine quality, to that of modern times, in which natural law as the ordered process of natural phenomena stood over against human law, which enforced obedience to a rule of conduct to be observed in any given community. He shows how the institutions of government have been influenced successively by magic, superstition, religion and science. The modern scientific outlook, however, he holds, has produced a profound modification in the conception of the character of natural laws as based upon objective reality. Hence he seeks to show that the gap between natural law and human law may now be bridged in a synthesis —the human mind, which formulates them—in other words, in the creative powers of the human intellect. Dr. Robson has written a stimulating book, which prompts a re-examination of certain fundamental sociological and juristic conceptions in the same way as it is now necessary in the light of modern theory to examine fundamental concepts of natural science.

Heavier-than-Air Aircraft:
a Brief Outline of the History and Development of Mechanical Flight with reference to the National Aeronautical Collection, and a Catalogue of the Exhibits. By M. J. B. Davy. (Board of Education, Science Museum: Handbook of the Collections illustrating Aeronautics, 1.) Second edition (revised and enlarged). Pp. 125+26 plates. (London: H.M. Stationery Office, 1935.) 2*s*. 6*d*. net.

THE second edition of this handbook contains an outline of the history and development of mechanical flight from the beginning to the present day, with special reference to the National Aeronautical Collection, and a complete catalogue of the exhibits at South Kensington.

The National Aeronautical Collection, which was founded as a historical exhibit in 1919, has enlarged rapidly since that date, and is now probably the most comprehensive exhibition of its sort in the world, and one of the most popular of the collections at the Science Museum. Much original historic apparatus has been acquired, and the collection is certainly richer in this respect than any abroad. It includes the gliders of Lilienthal, Pilcher, Chanute and Weiss; the original Wright aeroplane which made the first flights in 1903, the Vickers-Vimy aeroplane which made the first crossing of the Atlantic by air in 1919, the Supermarine Rolls-Royce Seaplane S.6.B., which secured the Schneider Trophy for Great Britain and created a world speed record of 407·5 miles an hour. A note on the development of air transport to the year 1934 is included in this edition, and some new illustrations have been added. The catalogue portion includes the additions to the Collection which have been made since 1929.

The Chemical Formulary:
a Condensed Collection of Valuable, Timely, Practical Formulæ for making Thousands of Products in all Fields of Industry. Editor-in-Chief: H. Bennett. Vol. 1. Pp. x+604. Vol. 2. Pp. ix+570. (London: Chapman and Hall, Ltd., 1933–1935.) 25*s*. net each vol.

THESE two volumes consist of numerous receipts for the manufacture of a wide range of materials dealt with under such varying headings as adhesives, alloys and metals, food products, explosives, ceramics, insecticides, plastic materials, etc., to waterproofing of materials. The information used in compiling these books has been obtained from a variety of sources, including industry and patent literature, and has been carefully considered by a board of editors drawn from a large number of educational institutions and industrial firms.

Although correct quantities may be used, much depends upon the method of compounding and other factors if the best results are to be obtained, and so experimental work or consultation with other workers in a similar field may be necessary. Nevertheless, the contents of these volumes supply much useful information on how various products can be obtained, and are therefore very suitable works of reference to both the educationist and the industrialist.

Wasserbauliche Strömungslehre
Von Dr. Paul Neményi. Pp. viii+275. (Leipzig: Johann Ambrosius Barth, 1933.) 28 gold marks.

DURING the past twenty years, a complete change of outlook has occurred in all subjects involving the mechanics of fluid motion. In the main, this is due to intensive aeronautical research originating in the War period. Almost without exception, writers of textbooks of hydraulics have ignored this advance and have merely rearranged and expanded the older material. Dr. Neményi, on the contrary, almost creates a new subject. The scope and arrangement are new, and much of the subject matter is ably abstracted from recent original papers.

Written primarily for the civil engineer, or perhaps rather for the advanced student, it is for the most part an exposition of the fundamental principles of flow, classified under a variety of boundary conditions. Mathematical treatment is occasionally used, but only where the matter really warrants it. Ample references, however, are given to the original papers where the full treatments can be found.

Some idea of the scope may be given by the following random selection from chapter headings: river-bed and silt movements, ice in relation to the river problem, underground water, jets and sprays, the layout of a laboratory for hydraulic model testing. All are fully illustrated by photographs, curves and line diagrams.

As this work is likely to have far-reaching influence, it is to be hoped that the author will be able to arrange for an English translation.

Hand- und Jahrbuch der chemischen Physik
Herausgegeben von A. Eucken und K. L. Wolf. Band 6: Elektrizität und Materie. Abschnitt 1B: Dielektrische Polarisation. Von O. Fuchs und K. L. Wolf. Pp. x+237–460+12. (Leipzig: Akademische Verlagsbuchhandlung G.m.b.H., 1935.) 27 gold marks.

THE subject of "Dielectric Polarisation" acquired a new interest and importance, to chemists as well as to physicists, when Debye in 1912 showed how the dipole moment of a gas could be deduced from the temperature coefficient of the dielectric constant, and J. J. Thomson in 1914 showed how, either by this method or by comparing the dielectric constant with the square of the refractive index, gases could be divided into two classes, according as their molecules do or do not possess a permanent dipole moment. Subsequent years have been marked by intense activity in correlating dipole moments with molecular structure, and especially with the configuration of molecules in space of three dimensions. In this way, many physico-chemical problems have already been definitely solved, and other subjects, such as the principle of free rotation, have been illustrated and elucidated. A monograph of 234 pages, with more than 60 figures, is supplemented by a table containing all the previously determined dipole moments, with references to 319 papers in which the data in question are recorded.

Some Geological Aspects of Recent Research on Coal*

By Prof. H. G. A. Hickling

I BELIEVE that coal is not only in itself worthy of more attention at the hands of the geologist than it has been generally accorded, but also is likely to repay that attention by shedding light on some of the major problems of geological science. Later, I shall revert to the conception of coal as a metamorphic rock. The idea is ancient, but the data necessary for its establishment and more precise definition have been lacking. Perhaps they are now to hand. If that be so, we have in this familiar rock an indicator of crustal conditions far more delicate than any of the index minerals of the metamorphic petrologist; so delicate indeed, that should it come within range of even the lowest grade of metamorphism, as usually understood, it is completely shrivelled up and leaves only a trace of graphite as witness of its former self.

Structure of Coal

So far back as 1831, Henry Witham had prepared microscopic sections in which he had seen plant structure, and in January 1833, a paper was read before the Geological Society of London, by William Hutton, based on the examination of a considerable collection of thin sections. It was, unfortunately, published in brief abstract only, but the original manuscript, at present in my possession, shows that he had observed most of the features which were noted by later observers until very recent times. This was the first serious attempt to determine the structures of the different kinds of coal, and little advance was made in this matter for more than half a century.

The modern period of coal petrology is clearly the offspring of the palæobotanical research on petrified coal which culminated at the close of the nineteenth century. This work gave us a precise knowledge of the structure of the plants which formed the Carboniferous coals, and a clear picture of the condition of some of the coal peats at the time of their deposition. It was inevitable that this should be followed by more determined attempts to see these structures in the coal itself, and was equally natural that such attempts should be made quite independently by a number of workers.

The 'Uniform Brown Substance'

Before the time of Witham and Hutton, coal was often regarded as a deposit from 'solution' in water—as a kind of vegetable 'extract', which might consequently be expected to possess a distinctive composition, independently of the materials from which it was derived. The earlier microscopic observations at once limited this idea by demonstrating the presence of plant remains which retained their organised structure; but Hutton directed attention especially to a 'uniform brown substance' as the dominating constituent of the commoner types of coal. This clearly appealed to many observers as the essential feature, and many references to the 'coal substance' seem to be more or less clearly identified with it. The foremost question in coal petrology has been, in fact, the nature of this brown substance—in particular, as to whether it is, in more modern phrase, a colloidal precipitate, or whether it represents actual fragments of plant material. Since it forms probably quite 75 per cent of all our common coal, this question is of the first importance.

All recent workers have directed attention largely to this dominating material. E. C. Jeffrey named it 'lignitoid material'. He regards it as representing pieces of plant tissue, largely woody, in which all trace of the original organisation has been destroyed by decay. Thiessen differed from Jeffrey chiefly in his belief that the structure of the original plant material is rarely quite obliterated, and that it can nearly always be detected if the sections and the microscopic technique be sufficiently good. He named the material 'anthraxylon'.

In 1919, Dr. Marie Stopes essayed a classification of the types of coal substance which can be distinguished by eye in an ordinary bituminous seam. While earlier writers had usually been content to describe the coal as divisible into 'bright' and 'dull' layers, together with occasional bands of 'mineral charcoal' or 'mother of coal', she directed attention to the additional fact that the 'bright' coal might be separated into two portions. The general mass of the bright substance has a just perceptible fine lamination which gives it a silky sheen; but interbanded with it are many thin layers which at once strike the eye by the mirror-like reflection from their perfect cleavage surfaces. She applied distinctive *names* to the different types of laminæ, adopting the French *fusain* to replace the questionable English term 'mineral charcoal', and devising corresponding terms for the other types of coal: *durain* for the true dull bands; *clarain* for the ordinary silky

* From the presidential address to Section C (Geology) of the British Association, delivered at Norwich on September 6.

bright coal; and *vitrain* for the brilliant glassy-looking substance.

Turning to the microscopic characters of these types of coal, she observed that the clarain bands were mainly composed of this uniform brown substance, finely interspersed with other ingredients, and often showing its original plant structure; while vitrain consisted entirely of similar material, free from admixture with other substances, but seemed to show no trace of structure. The development of technique during the past decade has shown, however, that this latter distinction was apparent only. In direct proportion as the methods of preparing thin sections or of etching coal surfaces have been improved, an ever-increasing proportion of the 'uniform brown substance' of the bright coal has been shown to retain the structure of the plants of which it is composed.

Nature of the 'Uniform Brown Substance'

Thus the 'uniform brown substance' for the most part, at least, represents portions of plant tissue with their organised structures exquisitely preserved; and there are those who regard it as made up entirely of such fragments, each of which now consists only of the remains of the organic substance of which that particular plant fragment was originally composed. The alternative view is that a large part of the substance of the original vegetation was reduced by early decay to the condition of a true fluid, some of which was absorbed into those plant fragments which retained their organisation, while other portions of the fluid may have solidified as a truly structureless gel, and acted as a cement to the whole mass. Whatever may be the amount of truth in this latter hypothesis—and there is considerable evidence that material which must have been absorbed in a fluid condition is present in some cases—it is absolutely unquestionable that the plant remains which now form this translucent coal substance have been rendered jelly-like, whether by their own decay or by absorption of extraneous material. In nearly all cases, cell-walls which were clearly rigid have been flattened and folded without rupture. Often the entire tissue has been contorted into the most fantastic forms but still remains unbroken.

In any case there is little reason for supposing that the essential nature of this substance is very different whether the plant-structure be discernible or not; all our evidence points to a remarkable general uniformity. Its ash-content is always found to be amazingly low. Not only is it a mere fraction of that present in the rest of the coal substance, but it is much below that in any average aggregate of modern plant materials. There is no reason for supposing that the vegetation of the coal-forests was abnormal in its content of inorganic matter, so we must presume either that the inorganic content of this part of the coal has been reduced, by leaching out, or that there has been a very large addition of pure organic substance. Further, this material shows extremely little variation in its organic composition, as compared with the other constituents of the coal. While the hydrogen content, for example, in the different ingredients of a single block of bituminous coal may be found to range from $3\frac{1}{2}$ to 8 per cent, the variation among samples of vitrain from the same block will rarely exceed a twentieth of that amount. It is because most coals consist mainly of this substance that they differ so little from one another. Prof. Wheeler and his colleagues have shown that it is mainly composed of ulmin compounds.

In the absence, hitherto, of any generally accepted name to denote this most important of all coal constituents, I propose for the present to adopt the term recently suggested by Dr. Stopes and call it *vitrinite*.

Other Components of Coal

We must now take stock of the other materials which go to the make-up of an ordinary coal seam. Though they are subsidiary in amount to the vitrinite in most portions of the seam, it is the character and varying quantity of these other materials which primarily differentiate the quality of the coals.

Most conspicuous and familiar is the 'mineral charcoal' or fusain. This illustrates at once the fact that in some cases the mode of preservation of the plant-substance may be of greater import than its original nature. The fusain is usually woody tissue, clearly identical originally with much of that which has been converted into vitrinite. But how different in its present form! Devoid of any organic substance in its cell-cavities; every cell-wall so brittle as to break at a touch; always extremely low in its content of hydrogen and oxygen, and correspondingly high in carbon. Physically and chemically it stands in the strongest possible contrast. On account of its porous nature, it has commonly formed the receptacle for much of the mineral matter which has been deposited from solution in the coal, and is consequently a great carrier of ash. Quite moderate variation in the amount of fusain in the coal has important effects on its utility for various purposes.

The next group of coal components may for the purpose of this review be designated the 'high-hydrogen' group—the outer coatings of stems, leaves and spores which are characterised by an accumulation of waxes, fats, resins and allied substances. They differ so strikingly in chemical

properties from the rest of the coal that by the roughest chemical treatment the remainder of the coal can be broken down while the spore-coats and cuticles are left little altered. They are then seen under the microscope to differ in structure little, if at all, from their condition in a living plant. Their obvious relative indestructibility has resulted in their accumulation in the coal in quantities much in excess of their natural proportion—in extreme cases, even to the total exclusion of other materials.

Associated with the cuticles and spores in respect of chemical peculiarities and durability, but differing somewhat in the manner of distribution in the coal, are the resinous secretions of the plants. Since the resins were originally contained in the wood or bark, they are found largely in the vitrinite of the coal. On the other hand, they are often found in local aggregations among the more disintegrated plant debris, in such a manner as to suggest that the aggregates may represent the resinous content of a tissue which has, for the rest, been almost entirely destroyed.

There is one other distinctive ingredient in most ordinary coal seams, characterised by its minute state of fragmentation. It forms a kind of paste made up of particles of 1 or 2 microns or less in diameter. Obviously it represents quite a distinct stage in the degradation of the plant material; and there is some indication that it has distinctive chemical peculiarities. It is of very dense colour, and is consequently opaque except in the thinnest sections. It is essentially characteristic of the dull coals. So far it lacks a generally recognised title and has been merely described as the 'residuum'. Dr. Stopes would christen it 'micronite'.

'Sapropelic Coals'

The foregoing account of the components of coal deals with those to be found in our normal bituminous coals of Carboniferous age. So far as my knowledge extends, the account does not require material modification in reference to the coals or lignites of other ages. But there are other types of coal, particularly the cannels and bogheads, which have a widely different structure and at least one very different component material; namely, the microscopic oil-bearing algæ. In the last few years these organisms have been carefully re-examined by Zalessky, by Thiessen, by P. Bertrand, and by my own colleague Dr. Temperley, who have not only demonstrated their structure in greater detail, but also have established their essential similarity (and possible identity) with the living oil-alga *Botryococcus braunii*. This constituent of the cannels affords the most striking of all examples of the effect of original materials on the composition of the coals. As the algal content increases, so the percentage of hydrogen in the coal rises, from about 6·0 per cent in those without algæ up to more than 12 per cent in the purest algal bogheads.

(*To be continued.*)

Birkbeck College

Past, Present and Future

THE successful inauguration of the appeal for the rebuilding of Birkbeck College, originally the London Mechanics Institution (see NATURE, Nov. 16, p. 787), will be welcomed universally by students of science. The College, established at a meeting of 'mechanics' held in the Crown and Anchor Tavern in the Strand on December 2, 1823, had as its original purpose to provide scientific education for the skilled craftsmen who were the aristocracy of the Industrial Revolution. That the objective was education and not mere technical training is proved by the motto of the Mechanics Institutes established throughout the country: "To make a man a better mechanic we must make the mechanic a better man".

In the early days, as Mr. Ramsay MacDonald, a former student of the College, has said, their science was simple and stimulating. "Its revelations were both startling and fresh; the controversies it roused were popular and the prospects it opened were inspiring." The opposition encountered by Birkbeck was essentially opposition to scientific training. "What is wanted," said Bell's *Weekly Messenger*, "is practical mechanics—instruction in trades . . . Science, in the very nature of things, must be confined to a few"; and the *St. James' Chronicle* asserted that "a scheme more completely adapted for the destruction of this empire could not have been invented by the author of evil himself. . .". Carlyle, in "Sartor Resartus", denounced its students as "professed Enemies of Wonder", cackling "like true Old-Roman geese and goslings round their Capitol, on any alarm, or on none"; as illuminated sceptics guiding people with rattle and lantern when the sun is shining. He resented "that progress of Science which is to destroy mystery".

Science has withstood these attacks and has captured some of the strongholds of the older culture. Birkbeck College can claim to have acted as *éclaireur* to the "march of mind" and to recapitulate the history of scientific instruction in Great Britain; this proud claim should ensure the success of its appeal.

The College, as we have said, stands for education in a broad sense, but it stands also for another great principle—part-time education. Hundreds of examples of the value of part-time education could be cited from the records of the College, but the one selected by the Archbishop of Canterbury in his speech at the Mansion House meeting is of outstanding interest. Sidney Gilchrist Thomas (1850–85), a police court clerk, attended George Chaloner's chemistry class in the College. The lecturer remarked that "the man who eliminates phosphorus by means of the Bessemer converter will make his fortune". From 1860 onwards, Sir Henry Bessemer and many others had studied this problem, a problem of great economic importance, since its solution would render available vast deposits of iron ore in England, Germany and the United States. Gilchrist Thomas solved the problem and received the promised guerdon. This wealth was not, however, the incentive to the discovery, for his biographer states that "he held 'advanced' political and social views and had he lived he had intended to devote his fortune to the alleviation of the lives of the workers". The money was spent in philanthropic objects after his early death. "A rare young man", as Gladstone observed! Let it be added that the scientific equipment provided at the College at this period was of the simplest. The room, said Bernard H. Becker in "Scientific London" (1874), might (were it not devoted to the use of science) be designated the back kitchen. A couple of glaring 'butcher's lights' illuminated a rough deal table from behind which Mr. Chaloner expounded the properties of carbonic acid gas. But he added, —and this sounds the keynote of the history of the College—"the lecturer and the audience evidently mean business".

In recent years, the College has catered for two groups of students who are to be found in large numbers in London and the surrounding districts. The first consists largely of teachers, civil servants, technical chemists and others who have missed the usual university training and are willing to give their evenings to working for a degree. The second group comprises graduates in arts and science of London and other universities who have a keen desire to pursue post-graduate studies and research. For many years the lecture rooms and laboratories have been seriously overcrowded by both types, and each year a number of keen and deserving students has been refused admission owing to limitations of space.

New buildings and more space are urgently needed to enable the College to serve effectively the needs of the present generation. When the College was founded in 1823, two men in every three and nine women in every ten could neither read nor write. When it was rebuilt in 1883, elementary education was in its infancy. To-day the mesh of the scholarship net is so fine that the time is not far distant when all who are fitted for university education will be provided for in the ordinary course.

What then is Birkbeck's future? It has provided adult education in fundamental subjects; it has led its students along the paths of the polytechnic, and inspired them to scale the academic heights by degrees—now it has entered upon a greater role —the provision of opportunities for research for those whose everyday occupations are in other fields.

Schmidt and the Eels

Danish Eel Investigations during Twenty-five Years

ON June 22, sixty miles west of Ringkjöbing, Jutland, the research ship *Dana*, built by the British Admiralty during the War and sold to the Danish Government in 1921, was sunk in collision with a German trawler in a fog. Happily there was no loss of life; but, with her, was lost all her scientific equipment and the material of her latest cruises. Johannes Schmidt, who made the *Dana* famous, had died all too soon, a comparatively young man, on February 21, 1933. When his ship went down, it was as if a chapter of oceanographical history came to an end. The little brochure "Danish Eel Investigations During Twenty-five Years, 1905–1930", recently issued by the Carlsberg Foundation, Copenhagen, may be regarded as the epilogue to the story.

There is nothing new in this publication. The text is taken from Schmidt's report of his famous voyage round the world. It was his intention that the report, written in Danish, should be done into

FIG. 1. Chart of Indo-Malaya showing distribution of the eel (in black). Shallow water (less than 200 metres deep) is shaded and deep water and land areas are white. Note that eels do not occur off coasts facing shallow water regions (Sumatra, Java, Borneo, Siam, etc.)

English, or at least French. That intention was not fulfilled, but Schmidt's summary record of the Danish eel investigations, of which he had been the leader since 1905, has been lifted out of the report and published in English. The record is illustrated and expanded by the addition of figures, with appropriate text, from others of Schmidt's papers, and the brochure concludes with a list of Schmidt's papers on eel investigations and a brief record, with illustrative charts, of his various eel expeditions. Three of the illustrations are reproduced herewith by courtesy of the Carlsberg Foundation.

For those who followed Schmidt's voyages as they took place, this paper is an interesting summary of their results, as regards eels, and of his conclusions from them. To the student approaching the question for the first time, it will be a stimulating introduction to what Schmidt describes as "the Eel question", and a useful guide to the literature. One cannot read it without a feeling of deep regret that he did not live to pursue the subject further and to check his own conclusions, as we may be sure that he would have done if he had not been cut off in his prime.

As a summary statement of the facts and Schmidt's interpretation of them, this document is a masterpiece of compression. Schmidt believed that he had successfully identified every species of the genus *Anguilla*. Besides the two Atlantic species —the European and the North American—he was sure of six species in the countries bordering the Indian Ocean, and "about twelve in the countries by the Pacific", of which some were common to both oceans. Actually, only ten non-Atlantic species are named in the paper, but this reflects the summary character of the statement. The main fact that emerges from his investigations is that all the fresh-water eels without exception require for spawning waters of great depth and high salinity. This fact is illustrated by charts,

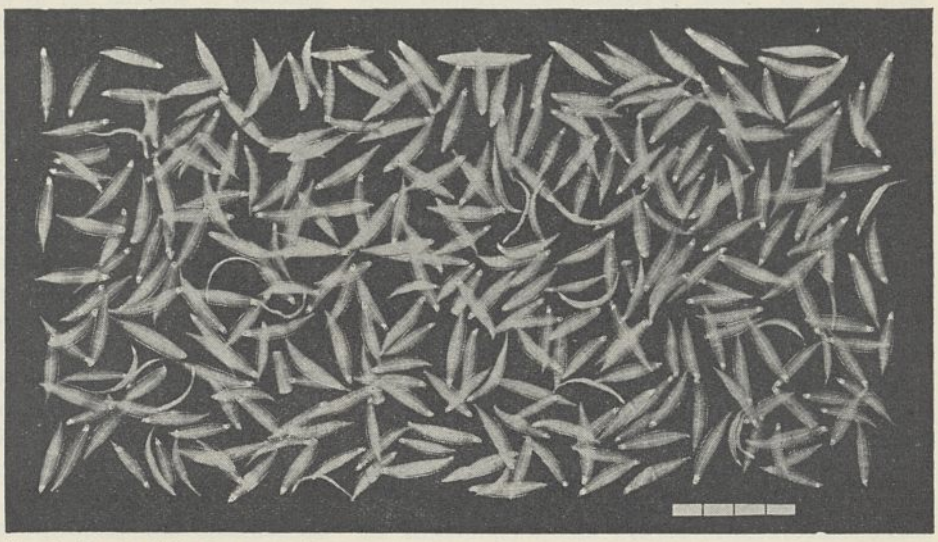


FIG. 2. Larvæ of the European eel from the Sargasso Sea. Note the small size and the uniformity of the larvæ. Scale shows centimetres.

which demonstrate in truly remarkable fashion how the concentrations of small larval eels are found in the deepest waters and how, even among the islands of Indo-Malaya, eels are not found at all on the coasts facing extensive areas of shallow water (Fig. 1).

Another important fact is that, just as the larval period of the North American eel, which has a less distance to travel, is appreciably shorter than that of the European eel, so the eels of Indo-Malaya, which Schmidt studied most intensively of the Pacific species, are still more rapidly metamorphosed. Although some of them reach a very much greater size than the European eel, their larvæ, both in the earliest and in the latest stages, are much smaller. Moreover, whereas in the Sargasso Sea a haul of eel larvæ will be all small and practically identical in size (Fig. 2), in the Mentawei Deep, west of and at no great distance from Sumatra, which is the spawning area of three species, they are found together at all stages of development, and, nearer to the coast, the larger larvæ and the elvers are found freely intermingled (Fig. 3).

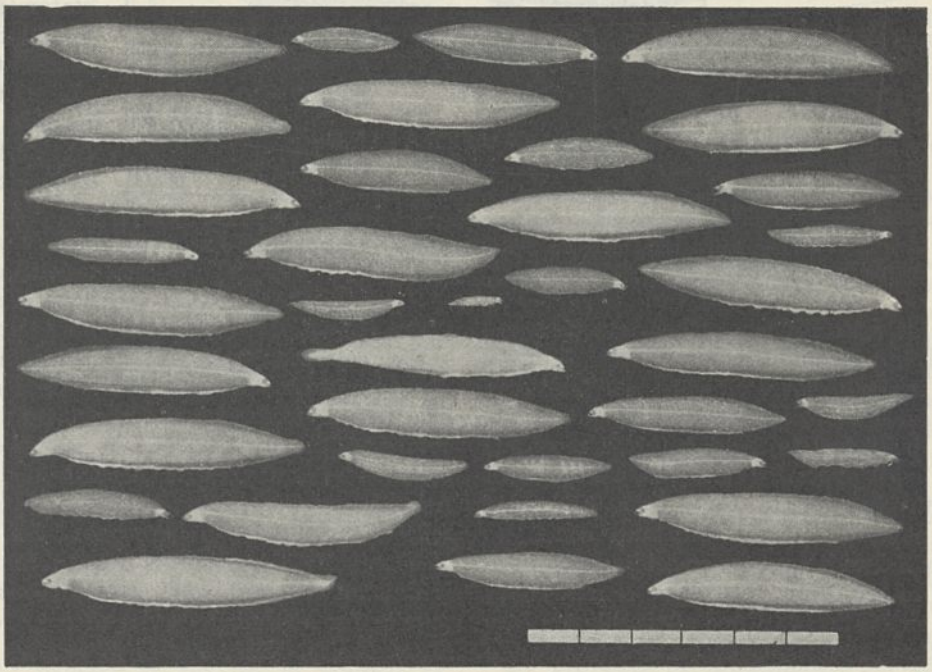


FIG. 3. Larvæ of freshwater eels from the Mentawei Deep, west of Sumatra. All stages of development are present. Scale shows centimetres.

Schmidt's most remarkable conclusion is that not only are all the fresh-water eels of tropical origin, but also that "the most westerly equatorial Pacific is the domicile of the Eel genus from which it has distributed itself over those parts of the world where conditions are favourable for it to thrive". Considering that no eels are found on the east or west coast of South America, and none on the west coast of Africa, it is difficult to reconcile with this conclusion the distribution, as proved by Schmidt, of the European and the North American eel, unless, indeed, one glances back in imagination over the ages to some remote, cataclysmic change of the earth's crust and of the distribution of the oceans.

One may hesitate to accept without question such a far-reaching conclusion, but one cannot read this paper without renewed admiration for Schmidt's genius. In particular, the thoroughness with which he did his work, and the forethought with which he laid his plans are remarkable. From 1922 onwards, thousands of eels from all parts of the world were examined at Copenhagen, with the view of obtaining information as to the distribution of each species and such knowledge of the adult eels as would facilitate the recognition of their larval forms. In 1926, Schmidt himself visited Australia, New Zealand and Tahiti, for the purpose of completing his records. Not until he was satisfied that he had thoroughly charted the distribution of the eels in fresh water did he embark upon his round-the-world expedition, the chief purpose of which was to chart their spawning places in the sea, and thus, while elucidating their life-history, to throw a new light on the European species, chiefly distinguished from its relations of the Pacific and Indian Oceans by its amazing instinct for travel.

Obituary

Prof. J. Goodman

JOHN GOODMAN, who died on October 28, was born on May 1, 1862, at Royston, Herts, receiving his school education at Gravesend and Cambridge. His engineering training followed the orthodox lines of that period—a long apprenticeship of five and a half years, followed by a spell of two years as an assistant to the chief engineer. During this period, by attendance on evening courses and private study, he acquired such a sound knowledge of the scientific principles upon which engineering is based that he was able in 1885 to win a Whitworth scholarship, and entered University College, London, when the chair of engineering was held by Sir Alexander B. W. Kennedy, and in 1886 he became an assistant to his professor.

A short period of service as chief assistant in the Broadway Testing Works, Westminster, was closed by Goodman's appointment in 1890, at the early age of twenty-eight years, to the chair of civil and mechanical engineering at the Yorkshire College, Leeds (now the University of Leeds), in succession to Prof. Archibald Barr, who had been appointed to the chair of engineering at Glasgow. Goodman held this chair for thirty-two years, and, when he resigned in 1922, was made emeritus professor, and was given special accommodation in the University Engineering Laboratories to enable him to carry on the research work which had always been such an important feature of his university work.

Prof. Goodman was an ideal engineering professor, a fluent, lucid lecturer, able always to maintain the interest of his students, and much beloved by them for his deep interest in the social side of their university careers, and by the special efforts he always made to assist them in securing a start in the practical side of their profession. His output of research work was remarkable in view of the amount of teaching work he undertook ; the results of these researches, very largely in the field of lubrication of bearings, on the design of roller bearings, on anti-friction metals, and the stresses in crane hooks, etc., were published in numerous papers in the *Transactions* of the Institutions of Civil and Mechanical Engineers. The Institution of Civil Engineers, to which he was elected in 1887, becoming a full member in 1900, awarded him a Miller scholarship and a Telford premium ; he became a full member of the Institution of Mechanical Engineers in 1890. Apart from these papers dealing entirely with the results of research work, Goodman was the author of a well-known textbook—"Mechanics applied to Engineering"—which has gone through several editions, and has been recognised as a standard work for the young engineering student.

During the Great War, Goodman was attached to the Royal Air Force with the rank of major, and did valuable work in the field of aircraft construction. He was never married. T. H. B.

Sir Temistocle Zammit, C.M.G.

WE regret to record the death, which occurred on November 2 at the age of seventy-one years, of Sir Temistocle Zammit, formerly rector of the University of Malta.

Temistocle Zammit was born in Malta in 1864 and educated at the local university, where he took the degree of M.D. in 1889. Entering the service of the Government of the island as an analyst, he became a member of the commission appointed by the Colonial Office and the Royal Society to investigate malaria. In 1904 he represented the Government on the Mediterranean Fever Commission, and in the following year became professor of chemistry in his University. To him was due the discovery which led to the recognition of the organisms of Malta fever in the blood of the native goat, and in 1908 he became a member of the Commission appointed to combat this disease. For the remainder of his life, such time as could be spared from his other pre-occupations was given to research in this direction. From 1920 until 1926 he was rector of the University. He was a member of the Council of Government and of the Executive Council of Malta. He received the Mary Kingsley Medal of the Liverpool School of Tropical Medicine in recognition of his services in medical research.

While Zammit's services to medical science were widely recognised among members of his own profession, he was far more widely known as an archæologist, more especially for his contributions to our understanding of the obscure archæological problems in the prehistory of Gozo and his native island. After he had been appointed curator of the Malta Museum in 1903, he discovered and excavated the neolithic temples of Tarxien and Imgiar, and took in hand and completed the excavations already begun in the other subterranean temples of Malta. In 1926, after his retirement from the rectorship of the University, he became director of the enlarged Museum Department, and brought together and arranged a remarkable exhibit of Stone Age antiquities such as is unsurpassed elsewhere. It is entirely owing to his enthusiasm and knowledge that the antiquities of Malta have been made more accessible and more easily intelligible to the visitor to the island, whether archæologist or layman, than in any other European centre of archæological interest. Under his editorship, the official publications of the Department became a valuable source of first-hand information. He was the author of "Malta, the Island and its History" (1926) and "The Neolithic Temples of Tarxien" (1930), indispensable to the student of the early history of the Mediterranean.

The honorary degree of D.Litt. was conferred on Zammit by the University of Oxford in 1920. He was made a C.M.G. in 1911 and knighted in 1930. He was also an honorary fellow of the Royal Anthropological Institute.

News and Views

Nobel Prize for Physics: Prof. J. Chadwick

THE award of the Nobel prize for Physics for 1935 to Prof. James Chadwick and that of Chemistry for 1935 to M. and Mme. Joliot-Curie are associated with two of the most important discoveries of recent years, that of the neutron and of artificial radioactivity. Prof. Chadwick worked in Lord Rutherford's laboratory, and M. and Mme. Joliot-Curie in that of Mme. Curie, and it will be felt by all how fitting it is that these two latest awards should be connected in this way with the two great founders of nuclear physics. In 1919, Prof. Chadwick went with Lord Rutherford to Cambridge from Manchester, where he had taken his degree and worked before the War. His first research in the Cavendish Laboratory, on the scattering of α-particles, still remains one of the most important direct determinations of the nuclear charge of the elements. Then for many years he worked in collaboration with Lord Rutherford on the artificial disintegration of the elements by α-particles. These fundamental researches really laid the foundations on which modern nuclear physics is built. The scintillation method of counting the particles was the only certain method available at that time, and further advance was checked by its limitations. Prof. Chadwick was intimately connected with the development of electrical methods of counting, and applied them to a detailed study of the disintegration of some of the light elements. These investigations were of the highest importance since they yielded precise information about the nuclear energy levels.

WHEN M. and Mme. Joliot-Curie reported the anomalous behaviour of certain radiations emitted in the transformation of beryllium by α-particles, Prof. Chadwick was able in a very short time to carry out a brilliant investigation which showed, beyond doubt, that the neutron had at last been detected. The possibility of such a particle had often been discussed, and as early as 1922 experiments were made in the Cavendish Laboratory in the hope of finding something of this nature. In his first communication, Prof. Chadwick gave quite an accurate estimate of the mass of the neutron, and with various collaborators began a thorough investigation of its properties, particularly that of its power to disintegrate other elements. Recently, by investigating the disintegration of the deuteron by γ-rays, he has obtained what is generally accepted as the most dependable value for the mass of the neutron. The importance of the discovery of the neutron may best be realised when it is remembered that it has changed completely and simplified our ideas of the structure of nuclei.

Nobel Prize for Chemistry: M. and Mme. Joliot-Curie

M. AND MME. JOLIOT-CURIE have long been distinguished for their work in various branches of radioactivity. After the discovery of the positive electron, they made several investigations of its mode of production, and quite early concluded that it could be formed in some manner other than by the action of γ-rays. In particular they observed positive electrons to accompany neutrons in the disintegration of certain light elements by α-rays. Further investigation of this led them to the striking discovery that while the neutrons were emitted simultaneously with the bombardment by the α-particles, the emission of positrons was an entirely separate process occurring after the source of α-particles had been removed. By a variety of experiments, they were able to show that they had formed new radioactive bodies, and in many cases they were able to verify the chemical nature of the substances by using their radioactive properties as an indicator. This is a discovery of fundamental importance, and has provided a new and powerful method of investigating the transmutations of bodies. In the last year this work has been much extended by the proof that the neutron is very effective in forming new radioactive bodies, and both these and all other investigations have only tended to increase the importance of this new phenomenon, which in addition to furnishing many new isotopic species, promises to throw great light on the true nature of radioactivity.

Medal Awards of the Royal Society

HIS MAJESTY THE KING has approved of the awards this year by the president and council of the Royal Society in respect of the two Royal Medals to Prof. C. G. Darwin, Tait professor of natural philosophy in the University of Edinburgh, for his researches in mathematical physics, especially in the quantum mechanics of the electron and in optics, and to Dr. A. Harker, emeritus reader in petrology in the University of Cambridge, in recognition of his distinguished work and influence as a petrologist. The following awards of medals have also been made by the president and council: Copley Medal to Prof. C. T. R. Wilson, emeritus professor of natural philosophy in the University of Cambridge, for his work on the use of clouds in advancing our knowledge of atoms and their properties; Davy Medal to Prof. A. Harden, formerly head of the Department of Biochemistry of the Lister Institute, for his distinguished work in biochemistry and especially for his fundamental discoveries in the chemistry of alcoholic fermentation; Hughes Medal to Dr. C. J. Davisson, of the Bell Telephone Laboratories, New York, for research resulting in the discovery of the physical existence of electron waves through long-continued investigations on the reflection of electrons from the crystal planes of nickel and other metals.

New Officers of the Royal Society

THE following is a list of those recommended by the president and council for election to the Council of the Royal Society at the anniversary meeting on

November 30: *President*, Sir William Bragg; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Frank Smith and Prof. A. V. Hill; *Foreign Secretary*, Prof. A. C. Seward; *Other members of Council*, Prof. E. D. Adrian, Mr. D. L. Chapman, Prof. A. W. Conway, Dr. W. H. Eccles, Prof. A. S. Eve, Prof. L. N. G. Filon, Dr. J. Gray, Sir Daniel Hall, Dr. S. W. Kemp, Sir Patrick Laidlaw, Sir Gerald Lenox-Conyngham, Prof. G. T. Morgan, Prof. R. Robison, Dr. Bernard Smith, Prof. W. Stiles, Mr. W. Trotter.

Dr. P. Kapitza's Apparatus and the U.S.S.R.

A REPORT published on November 19 in the *Cambridge University Reporter* gives an account of a proposed arrangement for the transfer of apparatus from the Royal Society Mond Laboratory at Cambridge to a new laboratory which is being built for Dr. P. Kapitza in the U.S.S.R. It will be remembered that Dr. Kapitza was refused leave to return to England after his visit to Russia in September 1934. In the report of the Committee for the Laboratory, it is pointed out that much of Dr. Kapitza's work in Cambridge had been preliminary to the experiments with strong magnetic fields at the temperature of liquid helium which he was on the point of beginning before he left for Russia, and that members of the Laboratory would not care to take up these experiments if Dr. Kapitza wished to resume work at once in this field. It is therefore suggested that the large generator for the production of strong magnetic fields, together with its associated apparatus, should be sold to the Government of the U.S.S.R. for the use of Dr. Kapitza. The remainder of the apparatus in the Laboratory, including the apparatus for the production of liquid hydrogen and liquid helium, would not be transferred since it is in constant use and will be required for the future work of the laboratory. It is proposed, however, to supply duplicates of this apparatus for transfer to Russia, so that Dr. Kapitza will have equipment identical with that he had developed in Cambridge. With the sum received for this apparatus it is proposed to buy new equipment suitable for the future work of the Laboratory. Such equipment might include a large electromagnet which could be used for nuclear research or for the production of low temperatures by the method of adiabatic demagnetisation.

Prof. Ejnar Hertzsprung

IN connexion with the recent announcement that Prof. Ejnar Hertzsprung, professor of astrophysics in the University of Leyden, and assistant director of the Leyden Observatory, has been appointed director of the Observatory to succeed the late Prof. W. de Sitter, it may be recalled that Prof. Hertzsprung was awarded the Gold Medal of the Royal Astronomical Society in 1929. Prof. Hertzsprung's work covers an extremely wide range of astronomical subjects, and he has contributed to our knowledge in nearly every branch of the science. In particular, he is known for his work on double stars and on the clusters. The mass luminosity relation, the division of the late type stars into giants and dwarfs, and the connexion between absolute magnitude and spectral type (the famous 'seven diagram') are all associated with his name (together with that of Prof. H. N. Russell, of Princeton). He will have as his assistant director at Leyden, Dr. J. Oort, who is also well known in Great Britain, chiefly on account of his work on galactic rotation.

"Everyday Science" and Civil Service Examinations

FOR several years "Everyday Science" has been one of the obligatory subjects of the competitive examinations for the important administrative group of Government services, comprising the Indian and Ceylon Civil, the Foreign Office and Diplomatic, the Consular and Overseas Trade (Intelligence Officer) and Home Civil (Junior Grade of the Administrative Class). We notice with astonishment and regret, therefore, the announcement of the Civil Service Commissioners that, with effect from next year, the subject will be omitted; some *optional* questions on science will be included under the subject "Present Day". The scope of the "Everyday Science" paper, now to be discontinued, is indicated by the following passage: "Such knowledge will be expected as candidates will have who have studied science intelligently at school and have since then kept their eyes open. A liberal choice of questions will be given. Attention should be paid to orderly, effective, and exact expression". The other parts of the obligatory section of the examination are: Essay, English ("to test the understanding of English and the workmanlike use of words"), "Present Day" (being questions on contemporary subjects, social, economic and political, calling for effective and skilful exposition), auxiliary language and viva voce. The inclusion of "Everyday Science" must have exerted an influence on school and college courses, and its omission will be regretted by many who believe in the value of "general science" teaching in schools and hold it to be plainly wrong (to quote the words of Mr. C. M. Bowra in *Time and Tide's* recent university supplement on "More and More of Less and Less") that highly educated men should know next to nothing of the structure of the universe or of their own bodies.

Royal Institution: Legacy of the late Mr. Harry Brown

FROM a statement recently issued by the Managers of the Royal Institution, it is understood that the munificent bequest to the Institution by the late Mr. Harry Brown, of the residue of his estate, reported in April last, is expected to amount to approximately £28,000. This large sum has been given without restriction as to its use, but the Managers hope to apply it mainly to the extension of experimental research, one of the two principal objects of the Institution's work. Shortly after information as to the legacy had been received, the freehold of 19 Albemarle Street, immediately adjoining the Davy Faraday Research Laboratory and the rest of the Institution's buildings, came into the market. With the double object of investing Mr. Brown's legacy and providing for future extensions of the premises, it was resolved to purchase the property. The

purchase has now been completed. For the present, the Institution will use the top two floors of the new house for storage of books and apparatus, releasing valuable accommodation elsewhere for other purposes. It is proposed to let the lower floors, and to devote any income obtained to research purposes. Eventually, as the research activities are enlarged, it may prove necessary to occupy a larger part of the house.

Royal Institution: Reconstruction of the Library

ABOUT April last it was noticed that a sinking had occurred of the ceiling of the Library on the first floor at the Royal Institution, and of the floor of Sir William Bragg's rooms immediately above. The ceiling, which was old and of timber construction, was found to be defective. It was temporarily propped, and at the end of the lecture season a thorough examination was made. An astonishing state of disrepair was discovered. Not only was the heavy timber ceiling defective, but also the brick walls upon which it was supported were cracked and broken in all directions. The examination was carried down to the rooms on the ground floor and here a similar state of affairs was revealed. When in 1799 the Royal Institution was founded, a large town house was purchased and considerably altered to suit its new purpose. Further alterations have been made at intervals. Vulliamy added the Corinthian column front in 1837. In 1930 a large part of the building, including the lecture theatre, was completely reconstructed, but the Library and rooms below it were left untouched. These it has now proved necessary to rebuild, largely, it must be said, due to faulty workmanship in the past, as the various alterations to the structure have been made.

THE reconstruction is now in progress. The defective brickwork of the walls is being replaced, including that of the front wall, which is being worked at from the inside, so that the elevation to Albemarle Street will remain untouched. New fire-resisting floors are to be supported on a steel structure, which is being erected within the walls. The steelwork, the foundations for which are being carried to basement level, will also serve to strengthen the rebuilt walls. When completed, the rooms on the first and second floors will appear much as they were before, but advantage is being taken of the alterations to construct a large new research laboratory in the basement. The work is expected to be completed about April next, and it is understood that it will cost about £12,000.

November Floods

THE past week or so has been characterised by rains and floods of exceptional severity, extending over a widespread area in western Europe, including the Rhone Valley, the Riviera, parts of Switzerland and of Great Britain. At Avignon, in the south of France, a large section of the town was inundated in places to depths of so much as six feet, and the famous Pont d'Avignon has been seriously damaged. At Nîmes, the Rhone reached the record height of 26 feet, and about 125 square miles of the valley were submerged. As an unfortunate consequence of so disastrous a visitation, there has been much distress and several deaths among the inhabitants of Provence and Languedoc. One village, Aurlot, near Marseilles, has been almost destroyed, whilst in various districts, thousands of people have been rendered homeless. Damage has also been reported from Fréjus and Hyères. In Switzerland, wide areas near Geneva have been under two feet of water, and it is stated that no such floods have been recorded since so far back as 1890. The rainfall was particularly persistent and lasted without intermission for sixty hours.

IN Great Britain, inundations of considerable tracts have followed locally unprecedented rainfalls for November, the first seventeen days of the month having yielded about twice the amount of rain normally experienced at a number of places in the south of England. Flooded districts are reported from Swanage in Dorset and many parts of Kent and Sussex, while in the Midlands, the River Trent has overflowed its banks. The Thames valley has also been seriously affected. Presiding at the meeting of the Thames Conservancy Board on November 18, Lord Desborough, the chairman, said that the state of the river was causing some anxiety. The flow was exceeding the 'root figure' (when the river is flowing bank high) by a thousand million gallons daily. The 'root figure' for the discharge of the river is 4,500 million gallons a day measured at Teddington; the comparable November average is 1,486 million gallons a day. The rainfall in the Thames Catchment Area had been quite exceptional for the time of the year. In September, there was a rainfall of 4·59 inches; in October, 4·09 inches and for 17 days of November, 4·11 inches. The total for two and a half months was 12·79 inches. Looking back over previous records, Lord Desborough said he had not been able to trace a similar case. The unexpected and catastrophic occurrence of such floods serves to emphasise the importance of the national inland water survey, so repeatedly advocated in NATURE, and now in the hands of a committee of the Ministry of Health, appointed nearly a year ago, under the chairmanship of Sir Henry Lyons. It is obvious that only by accurate and reliable records of floods can adequate precautionary measures be devised and undertaken so as to remove a serious menace to life and property.

Brauner Memorial Lecture

FROM the time of the founding of the University at Prague in 1347 by Charles IV, Bohemia has been an important centre of learning. Komenský, Purkyně and Mendel all attained fame beyond the frontiers of their country, but the first Czech chemist to gain world-wide recognition was Prof. Bohuslav Brauner, who died on February 14 of this year. He had been a student at Manchester under Sir Henry Roscoe in the 'eighties, and whilst in England began some of his famous researches on the rare earths. He came to acquire an international reputation also by his advocacy of Mendeléeff's Periodic Law, to the

substantiation of which he directed his investigations, especially his redeterminations of atomic weights. He was elected an honorary and foreign fellow of the Chemical Society soon after the Great War, and the Society's Brauner Memorial Lecture was delivered by Dr. S. I. Levy on November 14. Dr. Levy has himself contributed to our knowledge of the rare earth elements and he was able to give a very lucid account of the way in which these very similar and difficultly separable bodies were isolated and identified as pure substances. Brauner's share in this work was very great, and is all the more noteworthy since it was very largely performed in adverse circumstances, for it was not until 1903 that the chemical institute of the Charles University of Prague was erected, largely as a result of Brauner's insistent pleas.

FROM his exhaustive researches, which led, among other things, to the fractionation of didymium into praseodymium, neodymium and samarium, Brauner came to the conclusion that the rare earth elements from lanthanum to lutecium should be placed together in the Periodic Table. Brauner's other contributions to chemistry include his work upon the compounds of cerium and tellurium, concerning the homogeneity of which he was for a long while doubtful. It is interesting to note that some of his atomic weight determinations, even those of forty years ago, remain the accepted standards even to-day. It has perhaps never been generally realised how great his contributions were to the fundamentals of inorganic chemistry. Few of Brauner's original British friends remain. They include Mr. W. Macnab, who came to move the vote of thanks to Dr. Levy, and who recalled how Brauner's fine physique and unconventional, friendly manner always attracted admiration. Reference was made by Dr. G. Druce in seconding the vote of thanks to Brauner's interest in the transcription of Russian names into English, concerning which he had written several times in NATURE, and to the rapid progress in scientific research in many fields at Czechoslovak universities, largely as a result of Brauner's inspiring influence and example.

Anatomy Department of St. Thomas's Hospital

IMPORTANT alterations and additions to the Anatomy Department of St. Thomas's Hospital Medical School, London, have just been completed, and an "At Home" was held in the Department on November 14 when it was visited by representatives of the universities and of various London hospitals. Three new research laboratories and a large radiological laboratory, together with a director's room and an office, are housed in the new block. The dissecting-room has been completely renovated, and a new terrazzo floor has been laid. The museum has been equipped with special lighting arrangements for the exhibition of lantern-slides, X-ray negatives, bottled specimens and models. The X-ray equipment is of the latest pattern, and is completely shock-proof, and will serve not only for the instruction of students in all normal radiological appearances but also for research. An optical bench for photomicrography and for the reduction of X-ray negatives has also been accommodated in the radiological laboratory, adjacent to which is a dark-room. The research laboratories are situated in the upper floor of the new block. They are magnificently lighted, and are furnished throughout with the most modern fittings. The visitors were afforded an opportunity of seeing some of the results of experiments which are being carried out in the Department in the use of the cinematograph for the teaching of anatomy. A composite film comprised portions of films showing respectively a dissection of the forearm, some examples of muscle-nerve paralyses, the surface anatomy of normal shoulder movements and a dissection illustrating the mechanism of the knee-joint. This Department is admirably fitted for the teaching of anatomy by modern methods, with emphasis on the study of living anatomy.

Sir James Walker and the University of Edinburgh

To commemorate the services of Sir James Walker, professor of chemistry at the University of Edinburgh from 1908 until 1928, to chemistry in general and to the Chemistry Department of the University of Edinburgh in particular, it is proposed to establish a fund for a Walker Memorial Lecture to be delivered annually by an eminent chemist invited to Edinburgh by the Edinburgh University Chemical Society for that purpose. Sir James Walker, who died in May of this year, was the leading exponent of physical chemistry in Great Britain for nearly fifty years. During the Great War he did valuable work in the manufacture of high explosives, and the new chemical laboratories which he designed and fitted up at Edinburgh are among the foremost, both in equipment and in research activity, in Great Britain. The Chemical Society of the University of Edinburgh enjoys the distinction of being the oldest chemical society in the world, since it has recently been established that it existed as far back as 1785 under the sponsorship of Joseph Black. It is felt that a yearly meeting at which the student members of this body may have the opportunity of making direct contact with the researches of distinguished investigators in chemistry from other universities will provide a most stimulating permanent memorial of the labours of Sir James Walker for the advancement of the science in Edinburgh and elsewhere. Former students of Sir James Walker and any others who may wish to assist in the project are invited to send contributions to Mr. J. E. Rocca, honorary secretary of the Edinburgh University Chemical Society, King's Buildings, West Mains Road, Edinburgh.

Memorial to Viscount Grey of Fallodon

LORD ARMSTRONG, president of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, has issued an appeal for subscriptions towards a permanent 'North Country' memorial to commemorate the life of Viscount Grey. It is proposed to place a tablet to the memory of the great statesman and bird-lover in the Hancock Museum and to found a trust fund, the income of which will be applied to the endowment of the Museum. This

is a purpose which Lord Grey himself would have applauded, for he took much interest in the Museum, and was concerned about the upkeep of the many valuable and historically interesting collections which it contains. The Museum itself was built in 1884 to house the natural history collections of the Society, and with subsequent additions it has cost approximately £45,000. But the cost of upkeep and staffing is more than the Society can bear, even although the membership is now greater than at any time during the hundred and six years of the Society's existence. A sum of £1,000 has been promised anonymously if three other donors are each prepared to subscribe a similar amount, but it is to the generosity of the many lovers of Nature, and particularly those of the north of England, that Lord Armstrong and the Society look for the safeguarding of the Museum and its collections.

Explorations in Ellesmere Island

THE Oxford University Arctic Expedition of 1934–35 under Dr. N. Humphreys was forced to winter at Etah in north-western Greenland instead of on Ellesmere Island; but during the summer of this year they split up into small parties, each accompanied by Eskimo, and explored various parts of the north and centre of Ellesmere Island. Three articles on their work have appeared recently in *The Times*. An attempt to cross the Grinnell Land ice-sheet failed, but a crossing was made to the south by the narrow isthmus between Flager and Bay fjords, thus linking up with Isachsen's former work on the west coast. A more important journey was made in Grant Land from Fort Conger, Greely's camp of half a century ago, via Lake Hazen to the lofty United States Range. From a summit of 9,000 ft. there was a good view clear to the north. The country seems to be entirely mountainous and difficult to cross. The lofty ranges to the northward were named the British Empire range. They appear to flank the northern side of Ellesmere Island, and their relation to the Challenger Mountains farther west, discovered in 1876 by Aldrich, will be of interest when revealed. These mountains are probably related to the Caledonian foldings of northern Greenland. A third party carried out some surveys in Scoresby Bay, which hitherto had been inadequately examined. The expedition returned to England in October bringing large collections.

Organisation of the Coal Industry

SIR HAROLD HARTLEY, addressing the Institution of Chemical Engineers on October 20 on "Our Nation's Coal Resources", surveyed the changes which, during the last twenty-five years, have so profoundly affected the prosperity of the British coal industry. He pointed out the need which has been disclosed for the National Coal Survey undertaken by the Fuel Research Board, and stated that the value of the work of the Survey is becoming more obvious as it progresses. He advocates extending the Survey to examine the suitability of coals for the different industrial purposes, so as to discover where need for conservation exists. Fuel economy in utilisation and other circumstances have reduced the production of coal; but methods of mining have made great progress, and both circumstances reduce the number of mine workers. Methods of transportation and distribution have not kept pace with the improvement with the methods of mining. Sir Harold condemned the widespread ownership of private waggons as a burden on cost of distribution and advocated a unification of interests at least up to the point at which coal is to be transferred to the consumer. A rational system of grading should replace trade practice of selling by description. Intensified research on the fundamental nature of coal was urged, and indeed the factors which seem to Sir Harold most promising are more research and better organisation. The latter may be unpalatable to some individualists, but seems to be inevitable.

The Press and the Post Office

IN the course of an address to the Post Office Telegraph and Telephone Society given at King George V Hall, St. Martin's le Grand, London, on November 18, by Mr. J. H. Brebner, press officer of the Post Office, it was emphasised that the development of the Press has been closely allied to the progress of the Post Office. The Post Office can claim a great share in the development of newspapers, for from its establishment, six postal officials entitled 'clerks of the roads' were the first newsagents in Great Britain, and were solely responsible for the distribution of newspapers to all parts of the United Kingdom. These 'clerks of the roads' derived some £8,000 a year from the sale of newspapers, £6,000 of which was used by the Post Office for the payment of pensions and increases of salaries to Post Office servants who were inadequately paid. At the beginning of the nineteenth century, the private telegraph companies maintained a press bureau which supplied the newspapers with general news. The newspapers, however, desired to organise their own press agencies on the ground that they were the better judges of the news the public required. Since the telegraph companies would not give up their press bureau, the newspaper proprietors joined the growing agitation for the nationalisation of the telegraph system. The Electric Telegraphs Bill was passed in 1868, and the State accordingly acquired the telegraphs. A special 'News Division' was created at the Central Telegraph Office, London, and was maintained until 1930, when the extended use of the telephone by the Press, and the leased telegraph lines to press agencies and newspapers, rendered this section with its special press wires unnecessary. The Press has taken full advantage of each step in the progress of communications brought about by the Post Office, and the rapid development of the telephone service, since its acquisition by the State in 1912, has enabled the speedier transmission of news not only from all parts of Great Britain, but also to and from all parts of the world.

Imperial Chemical Industries, Ltd.

MR. JUSTICE EVE has allowed the petition of Imperial Chemical Industries, Ltd., to confirm a

reduction of capital from £95,000,000 to £89,565,859, the petition being opposed by a committee representing more than 13,000 holders of Deferred shares. In evidence, Sir Albert Wyon, chartered accountant, agreed that the company is spending large sums of money on research which have yielded valuable returns. These returns appear in the accounts in the shape of increased revenue. In this connexion, it is of interest to recall that, when this great combine was formed, NATURE, in a leading article (January 29, 1927, p. 149), stressed its importance from the point of view of scientific research: "Of special interest, fully recognised by the promoters of the trust, is the question whether it will be possible to improve methods and results in scientific research. The record of the constituent companies in this respect is creditable enough, and the work they accomplished during the War earned the gratitude of the nation. But combination must tend towards greater economy and greater efficiency."

Cornish Engines Preservation Fund

CORNWALL occupies a unique place in the industrial history of Great Britain, owing to its contributions to the advancement of mining and the development of the steam engine. The natural pride Cornishmen take in the achievements of the inventors and engineers of the county has found expression in various ways, and a scheme has now been set on foot for preserving, before it is too late, some of the few remaining Cornish beam engines. At a meeting held at Murdock House, Redruth, on October 15, a committee was formed to further the scheme, and an appeal has been made for funds for the purchase of a winding engine at Levant Mine, designed nearly a century ago by Francis Mitchell, and probably constructed at Copperhouse Foundry, Hayle. The engine, which is of the beam type, has a cylinder 24 in. in diameter with a stroke of 4 ft. As the mine, after a life of 110 years, has been closed down, the engine can be purchased at scrap value and arrangement can be made for its preservation *in situ* with a right of way to it, the total sum required for the purchase of the engine, repairs to the engine house and for maintenance being estimated at £300. The honorary secretaries to the committee are Mr. W. T. Hooper, of Falmouth Observatory, and Mr. W. A. Michell, Couch Lane, Redruth, while the honorary treasurer is Mr. H. Michell, of Barclays Bank, Falmouth, to whom subscriptions should be sent.

Quarterly List of Scientific Books

THE Association of Special Libraries and Information Bureaux, 16 Russell Square, London, W.C.1, has recently issued a book list which is the first of a series of quarterly recommendations of recently published scientific and technical books (10*s*. 6*d*. a year for non-members). The main object of the list is to provide public and other libraries with a selected list of recent scientific and technical books, and the list has been compiled with the assistance of more than sixty specialist organisations which are able to assess the relative merits of new publications in their own fields. Only books in the English language, and, with few exceptions, those published in the last six months, have been included. No attempt has been made to introduce detailed classification, the books being listed under broad main headings, such as General Science and Technology; Chemistry and Chemical Technology; Physics; Metallurgy; Medicine, Public Health and Nutrition; Communications and Transport, etc. The books are further sub-divided into those suitable for general readers, books of an intermediate character or suitable as textbooks for students, advanced or highly technical books, and dictionaries, directories or encyclopædias and the like. The lists should thus be of real value to specialist, as well as to public, librarians, in dealing with the difficult problem of book selection, particularly in fields of which the librarian himself has no special knowledge.

Maimonides

DR. M. GASTER delivered a lecture on "Maimonides and his Works" at a meeting on November 14 of the Royal Asiatic Society in conjunction with the Society for Old Testament Study. He said that Maimonides was a man of strong faith which deeply influenced his activity. Fully conversant with the Hebrew and Arabic literature of the time, he displayed a threefold activity. First, his legal activity consisted in compiling for the first time a comprehensive code of laws which has remained the basis of Judaism to this very day, and prevented it from splitting up into sects. Secondly, his medical activity was intended to prove, besides furthering and stimulating medical research, that there is no incompatibility between science and faith; indeed, that they assist one another. Thirdly, his philosophical activity was intended to reconcile the tenets of faith with philosophic speculation. He endeavoured to answer some of the fundamental problems of human life, such as the existence of God, the problem of creation, the relation between God and man, revelation, sin and evil, punishment and reward, and immortality. With slight modification, the answers which he gave retain their value even at the present time.

Sir John McLennan, K.B.E., F.R.S.

IN the obituary notice of Sir John McLennan published in NATURE of October 19 (p. 633), it was stated that he went from Toronto to Cambridge with an 1851 Exhibition Scholarship. Prof. A. S. Eve now informs us that this statement is not correct. Dr. E. F. Burton, who succeeded Sir John at Toronto, has written: "Although most of the men who were at the Cavendish with Dr. McLennan held 1851 Exhibition Scholarships, he did not have one himself. As a matter of fact, he resigned his position at Toronto in order to go abroad entirely at his own expense. It was in the nature of a gamble for him at that time as his resources were very meagre, but he realised that this was the only possible course to take if he wanted to work in what was then modern physics. He was undoubtedly moved to do this by the meeting of the British Association for the Advancement of Science in Toronto in 1897, as it was just after this that he went to England."

Midland Section of the Institute of Physics

THE second Local Section of the Institute of Physics to be formed in Great Britain was inaugurated at a meeting held at the University of Birmingham on Friday, November 15. Prof. S. W. J. Smith was elected chairman, and Dr. J. H. Mitchell, of the British Thomson-Houston Research Laboratory, local honorary secretary, from whom further details may be obtained. The inaugural lecture was given by Dr. J. D. Cockcroft, of the Cavendish Laboratory, Cambridge, who took as his subject "Recent Work on Nuclear Transmutations". It is proposed to hold the meetings of this new Section in Rugby and Leicester and possibly other towns in the Midlands during the session.

Forthcoming Eclipse of the Sun in U.S.S.R.

THE Academy of Sciences of the U.S.S.R. has issued a report ("Bulletin de la Commission pour les recherches du Soleil", 13) by Profs. Gerasimovič and Ščerbakova, dealing with the circumstances of the forthcoming total solar eclipse. The eclipse will take place on June 19, 1936, and the line of totality crosses the U.S.S.R. from the North Caucasus, over the Volga steppes, and over Siberia to the far eastern provinces. The track passes over both Omsk and Tomsk, which are of course large cities which will offer facilities to observers. In the present report, an account is given of the meteorological data which have been specially collected since 1933 at various stations along the track of totality, in order that prospective observers of the eclipse may have the best choice of stations likely to enjoy clear weather on the day of the eclipse.

Astronomical Spectrography

MESSRS. HILGER'S new catalogue of astronomical spectrographs and spectroscopes shows that this firm is maintaining its reputation for keeping abreast with the latest developments. Among the major instruments which it has recently constructed are the 3-prism spectrograph for the 36-in. reflector at the Royal Observatory, Edinburgh, and the spectrograph for the 74-in. reflector at Toronto. The first of these follows the general design of that at the Dominion Observatory, Vancouver, but contains many improvements; the second is designed for radial velocity work with a single prism and has a special mounting designed to reduce flexure to a minimum. The firm has also made a slitless spectrograph for the Royal Observatory, Greenwich, following a design of Mr. C. R. Davidson. Messrs. Hilger now offer as standard productions a spectroscope for observing solar prominences designed by Mr. J. Evershed, and a direct-vision constant deviation monochromator recently designed by Prof. H. H. Plaskett.

Announcements

PROF. F. G. DONNAN, professor of chemistry in the University of London and director of the Chemical Laboratories, University College, London, has been elected a foreign member of the Division for Chemistry of the Royal Physiographical Society of Lund (Sweden).

DR. C. E. K. MEES, vice-president in charge of research and development in the Eastman Kodak Co., Rochester, U.S.A., will deliver six Christmas Lectures "adapted to a juvenile auditory" at the Royal Institution on Saturdays, Tuesdays and Thursdays, commencing on December 28. The subject of Dr. Mees's lectures will be "Photography". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

A DISCUSSION on "Ice Ages", arranged by the Royal Meteorological Society and the Royal Astronomical Society, will be held on January 31 at 4.30 in the rooms of the Royal Astronomical Society, Burlington House, London, W.1. The discussion will be opened by Sir George Simpson.

THE Empire's Airway Exhibition at the Science Museum, South Kensington, organised by Imperial Airways, Ltd., will be opened by the Secretary of State for Air in the lecture theatre of the Museum at 11 a.m. on Thursday, December 5. The chair will be taken by Sir Eric Geddes.

THE Exhibition of Kinematography at the Royal Photographic Society, 35 Russell Square, W.C.1, is to remain open to the public until Saturday, November 30. The exhibition is mainly devoted to 'stills' from films. Some very fine photography is shown. A certain amount of apparatus is shown, notably that for recording and reproducing sound with 16 mm. picture film.

THE National Trust has accepted from the Viscountess Rhondda and the Dowager Viscountess Rhondda some 2,130 acres of the Sugar Loaf, just north of Abergavenny. This magnificent hill, which is well known in South Wales and Monmouth, is at the south end of the Black Mountains and rises to a height of nearly 2,000 feet.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A technical officer, an assistant (grade II) and assistants (grade III) for work in wireless equipment at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Nov. 29).

A University lecturer and a University demonstrator in biochemistry in the University of Cambridge—Sir F. G. Hopkins, Sir William Dunn Institute of Biochemistry, Cambridge (Dec. 7).

A research assistant to the Animal Diseases Research Association—The Secretary, Moredun Institute, Gilmerton, Midlothian (Dec. 20).

A Jacksonian professor of natural philosophy in the University of Cambridge—The Vice-Chancellor (Dec. 31).

A head of the silk section of the British Cotton Industry Research Association—Dr. R. H. Pickard, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 837.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Intensity Variations in the Channel of the Return Lightning Stroke

PHOTOGRAPHY of lightning strokes with the Boys camera has shown that each separate stroke is of a dual nature, consisting of a leader and a return portion. It has been shown that the return stroke travels from ground to cloud, passing outwards along the branches when it reaches branching points of the leader. The charge on the leader branches passes in this manner to ground. It has also been shown that there is a marked diminution in the intensity of the light emitted from the main channel after the return stroke has passed a prominent branch.

The photographs also permit of the study of the manner in which the intensity at any point in the channel varies with time. It is found that this intensity at the ground end of the channel fluctuates in such a manner as to indicate a series of component discharges, all apparently passing upwards. A maximum number of six such components in the return stroke has been observed, but the components of high order are weak and not always clearly seen.

The time intervals between successive component discharges are indicated in the following table:

Component	1	2	3	4	5	6
Separation from first appearance of luminosity in return channel (microseconds)	0	7 to 75	37 to 370	110 to 580	510 to 2,100	815
Cases observed		25	21	7	3	1

The ratio of the intensities of the different components has been obtained by photometric analysis of photographs specially taken with this purpose in view. Component 2 is of the same order of intensity as component 1. In a few cases it is found that at a point above a prominent branch it is actually more intense than component 1. Between component 1 and 2 the luminosity of the channel falls to less than half its previous value. If the intensity of component 1 is taken as unity, that of component 3 is of the order of 1/10 and that of component 4 of the order of 1/200. The subsequent components are too feeble for a satisfactory determination of their intensities.

There is some evidence that the second, and sometimes also the third, component is related to the existence of the charge distributed along the branches. In a number of cases the time intervals between 1 and 2 is of the same order as that required for 1 to reach the start of a prominent branch. Component 2 thus starts at the moment that this branch charge is beginning to disappear, suggesting that it is associated with the induced charge bound on the surface of the earth beneath the branch.

Where prominent branches do not exist, as in the case of strokes after the first, the second component in the return portion does not start until the first has reached the cloud.

The influence of these components upon the wave-form of the atmospheric radiated from a lightning flash is being investigated.

Our thanks are due to the Lightning Research Committee of the South African Institute of Electrical Engineers for permission to publish this report.

D. J. MALAN.
B. F. J. SCHONLAND.
University of Cape Town.
H. COLLENS.
Victoria Falls and Transvaal Power Co.,
Johannesburg.

Radioactivity of some Rare Earths induced by Neutron Bombardment*

WE have studied the radioactivity produced by bombardment with slow neutrons in those elements of the rare earth group where the results of other workers are not in agreement.

The results are summarised below.

Compound	Half-period	Quantity used	Initial activity
Neodymium oxide	35 min. ± 5 min.	2 gm.	8 impulses per min.
Gadolinium oxalate	6·4 hr. ±0·3 hr.	14 gm.	16 ,, ,,
Dysprosium oxalate	2·5 hr. ±0·1 hr.	1 gm.	strong
Erbium oxide	5·8 min. ±0·2 min.	25 gm.	6 impulses per min.
	2·7 hr. ±0·2 hr.	25 gm.	very strong
Holmium oxide	2·6 hr.	0·01 gm.	very weak
Lutecium oxalate	3·6 hr. ±0·4 hr.	1 gm.	35 impulses per min.

The source of neutrons consisted of 500 mgm. of radium intimately mixed with 2 gm. of beryllium. The irradiation was carried out inside a block of paraffin wax 30 cm. high and 30 cm. in diameter.

The half-period of dysprosium and the long period of erbium were determined by means of an ionisation chamber and quadrant electrometer; this is a convenient method where strong activities of fairly slow decay are concerned. The remaining half-periods were found by means of a Geiger-Müller β-ray counter, with aluminium walls 0·2 mm. thick.

It was not possible to compare accurately the relative intensities of excitation, on account of the differences in the quantities and geometrical arrangements of the specimens of the rare earths. Nevertheless, an idea of the relative intensities can be gained from the additional information given in the table.

The half-period of 6·4 hr. obtained for gadolinium is in fair agreement with the value 8 hr. reported by Hevesy and Hilde Levi[1]. The half-period, 3·6 hr., of lutecium is close to the value 4 hr. given by Marsh and Sugden[2]. The short period of erbium reported by the latter authors has been carefully investigated

* Sir John McLennan died on October 9, but the observations here recorded were made with the joint author, Mr. W. H. Rann.—Editor, NATURE.

and found to be 5·8 min. The 2·6-hr. period observed in the case of erbium is probably due to traces of the strongly active element holmium, as was suggested by Marsh and Sugden[2].

Our thanks are due to the Union Minière du Haut Katanga for the loan of the radium used, and also to Messrs. Adam Hilger, Ltd., for the loan of a specimen of neodymium oxide.

J. C. McLennan.
W. H. Rann.

Radium Beam Therapy Research
at the Radium Institute,
16 Ridinghouse Street,
London, W.1.

[1] Hevesy and Hilde Levi, NATURE, **136**, 103, July 20, 1935.
[2] Marsh and Sugden, NATURE, **136**, 102, July 20, 1935.

'Extra' Electron Diffraction Rings

Dr. G. I. Finch and A. G. Quarrell[1] have reported many 'extra' rings in electron diffraction patterns from thin metal foils containing preferentially oriented crystals. At first they attributed these to diffraction from two-dimensional gratings made up of the atoms in the crystallographic faces through which electrons might leave the foil. In a later comprehensive paper, Finch, Quarrell and Wilman[2] have stated that the extra rings do not appear unless the metal foil is contaminated; the earlier explanation has been abandoned. In this later paper are given, however, the results of the calculations concerning diffraction by atoms in exit faces. This note is concerned solely with the results of such calculations.

It is worth pointing out that the extra diffraction rings cannot be explained in the manner first proposed. The case is one of face-centred cubic crystals oriented with a (110) direction parallel to the primary beam and to the surface normal. It was first proposed[1] that atoms in (111) and (120) exit faces were responsible for the extra diffraction rings. In the later paper[2], the exit faces were described as (110) and (120). The previous designation of an exit plane as (111) was clearly an oversight or typographical error, as it can be shown that a (111) plane of atoms would give rise to all the Debye-Scherrer rings for the oriented crystals, and to no extra rings.

In regard to scattering by atoms in a (120) plane when the primary beam direction is (110), one can show that there will result diffraction cones about the primary beam direction, the semi-apex angles of which are approximately equal to:

$$\frac{\lambda}{a_0}\sqrt{\frac{1}{9}(11\,h_1^2 - 8\,h_1 h_2 + 8\,h_2^2)}.$$

Here λ represents the wave-length, a_0 the length of the edge of the unit cube of the face-centred structure, and h_1 and h_2 are any positive or negative whole numbers. The radical has the following series of values: 0·94; 1·11; $\sqrt{3}$; 1·89; $\sqrt{4}$; etc. The integers 3 and 4 correspond, of course, to the first two Debye-Scherrer rings. The extra rings corresponding to the other values are not those calculated by Finch, Quarrell and Wilman[2], and they do not agree with the extra rings observed.

L. H. Germer.

Bell Telephone Laboratories,
New York, N.Y.
Sept. 12.

[1] NATURE, **135**, 183; 1935.
[2] *Trans. Faraday Soc.*, **31**, 1074; September 1935.

The observed ring radii are given in the table below, col. 1, and the ring radii we attributed to scattering from a (110) exit face [(111) is obviously an error] in col. 2. In cols. 3, 4 and 5 are set forth the values calculated by Finch, Quarrell and Wilman, and by Germer using his approximate and accurate expressions respectively.

Table

1	2	3	4	5
0·99	1·00	0·98	0·94	0·9407
1·10	—	1·11	1·11	1·105
—	—	1·12	—	1·107
1·40	1·41	—	—	—
1·65	—	—	—	—
1·73	1·73	1·73	1·73	1·727
—	—	—	—	1·729
1·76	—	1·76	—	—
1·78	—	1·78	—	—
—	—	—	1·89	1·877
—	—	1·95	—	—
2·00	2·00	2·00	2·00	2·001

Germer's results are the more accurate; we evidently placed too much reliance on four-figure tables in working out results involving small angles. We had, however, to consider more than one plane and so preferred the more direct method of calculation indicated in our paper.

I may add that, even before the experimental discovery of the real origin of 'extra' rings, the 'exit face' idea had lost much in attraction when it was realised that any and every 'extra' ring could be accounted for by postulating a suitable exit face.

G. I. Finch.

Imperial College of Science and Technology,
London, S.W.7.

Pigments of the Bull Frog Retina

The substances and processes found in the retina and pigment epithelium of the bull frog, *Rana catesbiana*, are identical with those in species of frogs

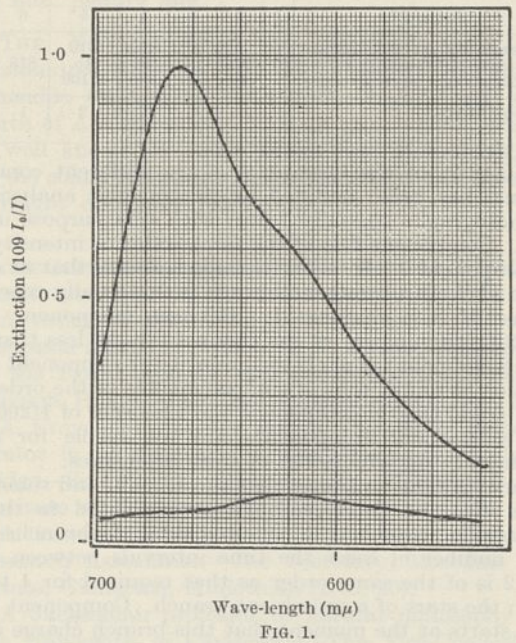


Fig. 1.

previously examined[1]. The retina contains varying amounts of the carotenoids retinene and vitamin A. Retinene is yellow, and when mixed with antimony trichloride reagent yields a sharp absorption band at

662–666 mμ. (In the hand spectroscope this band has invariably appeared to be at about 655 mμ, the position originally given.) Vitamin A is colourless in comparable concentrations, and in the antimony trichloride test yields a band at 612–615 mμ (crude extracts).

Dark-adapted retinas contain only a trace of vitamin A, which can be extracted in the dark with benzine without injury to the visual purple (Fig. 1, lower curve*). Afterwards, the same retinas may be re-extracted with benzine in bright light. Light bleaches visual purple to 'visual yellow', after which benzine readily extracts a large quantity of retinene (Fig. 1, upper curve). The destruction of visual purple in the dark with chloroform also liberates retinene (Fig. 2, upper series). Visual yellow appears

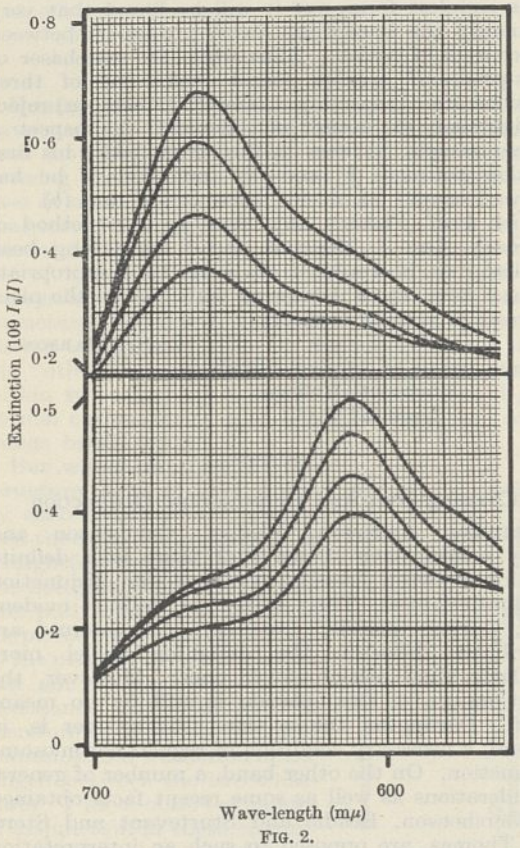
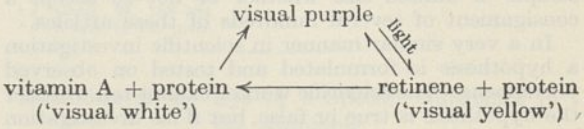


FIG. 2.

to be simply free retinene, liberated by light—or by chemical treatment—in the destruction of visual purple. (At the time of writing the previous report, I believed retinene to be bound complexly in visual yellow as it is in visual purple, a legitimate interpretation of the data then available.)

The retinene of bleached ('visual yellow') retinas is converted quantitatively to vitamin A by a thermal process which occupies about an hour in either light or darkness at 25° C. During this interval, the retinas fade from yellow to colourlessness. The lower curves of Fig. 2 show this change. They were obtained with retinas symmetrical with those which yielded the upper series, but had been bleached in bright light and allowed to fade for about an hour at 22° C. before being extracted.

In the isolated retina, vitamin A is the final product of the bleaching and fading reactions. In the intact eye, however, the vitamin is resynthesised to visual purple. This process completes the visual cycle, represented partly by the scheme:



Isolated bull frog retinas which have been bleached and wholly faded contain about 2·3 γ per eye of vitamin A. Retinas light-adapted *in vivo* contain only about 0·8 γ of the vitamin. This loss of vitamin A in the active retina probably accounts for the dependence of the visual purple system in some animals upon a continuous supply of vitamin A in the diet.

The combined pigment epithelium and choroid layer of the bull frog eye contain about 2 γ of xanthophyll and about 9 γ of vitamin A, at least 80 per cent of which are located in the pigment epithelium alone. An incomplete extract of these tissues also contained about 1·3 γ per eye of flavine, similar to that found by von Euler and Adler[2] in the eyes of several mammals and fishes.

Details of this work will appear in the *Journal of General Physiology*.

GEORGE WALD.

Biological Laboratories,
Harvard University,
Cambridge, Mass.

[1] G. Wald, NATURE, **134**, 65; 1934. *J. Gen. Physiol.*, **19**, 1935 36, in press.
[2] H. von Euler and E. Adler, *Z. physiol. Chem.*, **223**, 105; **228**, 1; 1934.

* Figs. 1 and 2 show spectra of antimony trichloride reactions with bull frog retinal extracts. They were measured at the Massachusetts Institute of Technology with a recording photoelectric spectrophotometer (Hardy, A. C., *J. Opt. Soc. Amer.*, **25**, 306; 1935). The curves were drawn by the instrument, and have been merely mounted and photographed. The lower curve of Fig. 1 was drawn 5mμ too high in wave-length, due to a fault in calibration which was corrected before the upper curve was recorded. Each series of spectra in Fig. 2 presents successive measurements of a single antimony trichloride test, and ollows the fading of the blue colour produced in this reaction.

Statistical Tests

THE discussion in these columns which has followed Mr. Buchanan-Wollaston's letter in NATURE of August 3 tempts me, as yet a third member of University College, London, to try to express my views on an interesting, but evidently controversial, subject. Others besides myself have, I know, welcomed a reminder from the author of the "Grammar of Science" that, in the fullest sense of the terms, we are concerned not with the truth or falsehood of a hypothesis, but with the extent to which it graduates our observations of Nature. I fancy that if Mr. Buchanan-Wollaston were to consider specific examples he might find it a little difficult to substantiate the statement, made in his letter in NATURE of November 2, that hypothetical frequency distributions are of two radically different kinds. If I understand him correctly, he suggests, for example, that the Normal curve sometimes falls into one category, sometimes into the other. But can he really maintain that this distribution curve with its infinite limits for the variable is ever anything but a graduation formula ?

Yet I agree that it is difficult to speak of all statistical analysis in terms of graduation. In

scientific research as well as in the affairs of every-day life, we are continually faced with situations where a decision must be made on incomplete data determining which of two alternative courses of action is to be followed. Since we may decide on course *A* when, with more complete information, we should have followed course *B*, and vice versa, two different faulty decisions may be made having very different consequences. A practical example is that of the large-scale purchaser of a certain mass-produced article, who has to decide after the inspection of a sample of limited size whether or not to accept a consignment of several hundreds of these articles.

In a very similar manner in scientific investigation a hypothesis is formulated and tested on observed phenomena. The scientific worker cannot tell whether the hypothesis is true or false, but if his investigation is to continue he must either accept the hypothesis provisionally as useful to him, or reject it as of no use and seek for an alternative hypothesis. Either decision may be one which he would not have made had much fuller information been available at the time, and in this sense may again be spoken of as liable to error.

The tools of statistical analysis have been fashioned to help the experimenter in this process of testing a hypothesis, and, as with all tools, their parts and uses must be described in a technical terminology. Further, as in other branches of applied mathematics, it is necessary to construct a precise but simplified model which we believe will represent the world that we observe with sufficient accuracy to provide us with useful results. Here there is freedom of choice.

Let me illustrate one method of approach by taking the case of a biochemist who is instructed to investigate, by experiments carried out on rabbits, whether there is any difference in regard to a certain reaction, between a new and cheaper form of insulin and an older standard form. Owing to the different response of individual rabbits even to the same treatment, it is the mean difference between effects that must be considered. Further, while no statistical test applied to a limited number of observations can be expected to detect very small differences, the test to be used should be one which is as sensitive as possible to the existence of a real difference, and yet will be unlikely to suggest a difference which is not there.

On the assumption that some decision, whether provisional or final, regarding the adoption of the cheaper insulin is to be based on the result of the experiment, the biochemist will probably report either that (*a*) there appears to be a difference, or that (*b*) he can detect no significant difference. In a purely formal sense, it is convenient to speak of these statements, leading to different decisions regarding further action, as (*a*) that of rejecting the statistical hypothesis that there is no difference in mean effect, and (*b*) that of accepting this hypothesis, and this is the sense in which these terms are used below. Further, it follows that statement (*a*) may have been made when more extensive experiments would show that the apparent difference was purely a chance sampling result, statement (*b*) when such experiments would establish a real difference. Thus again in formal language it is convenient to speak of a decision based on incomplete data as liable to two types of error.

In one case a cheaper form of insulin may be put on one side, at any rate temporarily, in the belief that it is of inferior quality, where fuller experiment would have shown that this was not the case. The statistical hypothesis tested has been rejected when it is true and an error of the first kind has been made. In the second case a cheaper insulin is advocated which in fact has not the properties of the older standard. The statistical hypothesis tested has been accepted when it is not true, and an error of the second kind has been made.

In any given problem it is impossible to say whether a hypothesis is true or false, but it is possible to assess the efficiency of statistical tests by the manner which, on repeated application, they control these two forms of error. Further, it does not alter the essential features of this approach if, as Mr. Buchanan-Wollaston points out in his second letter, it may often be desirable to allow for a third verdict, that of "not proven". I have stated the problem in its simplest form, yet it will be found that very frequently the immediate decision does lie between *two* courses of action. Thus while the purchaser of mass-produced articles might make one of three decisions after inspecting a sample, namely, (*a*) reject consignment, (*b*) accept consignment, (*c*) inspect a further sample, he does in fact often make his first decision between (*b*) and (*c*) and then, if he has followed course (*c*), decide between (*a*) and (*b*).

With Prof. Fisher's objections to our method of approach, Dr. J. Neyman and I have long been familiar, but it would, I am sure, be inappropriate to enter here into a discussion with him on the place of errors in statistical theory.

E. S. PEARSON.

Department of Applied Statistics,
University College,
London, W.C.1.

Crossing-Over and Chromosome Disjunction

BRIDGES, Anderson, Mather, Gershenson and many others have shown that there is a definite relation between crossing-over and the disjunction of chromosomes. Their work has made it evident that, during meiosis, crossover chromosomes are distributed between the daughter nuclei more regularly than non-crossover ones. However, the exact nature of this relation is still by no means clear. Darlington thinks that crossing-over is, in general, a necessary condition of regular chromosome disjunction. On the other hand, a number of general considerations as well as some recent facts obtained by Gershenson, Beadle and Sturtevant and Stone and Thomas, are opposed to such an interpretation in the case of *Drosophila*.

In order to decide the latter question, I undertook an experiment in collaboration with Miss Helene Pogossiants, in which, by using certain rearranged chromosomes, it seemed possible to obtain somewhat more conclusive results than in previous work. Crossing-over and non-disjunction were studied in females of *Drosophila melanogaster* carrying an *X*-chromosome with the *ClB* inversion and another *X*-chromosome (translocation X–IV or 'Bar-Stone'), most of the genetically active part of which was translocated to the fourth chromosome. Data on single crossing-over in the non-inverted region and the number of recovered double crossovers in the inverted region enabled us to conclude, with a high degree of certainty, that single crossing-over in the latter region (undetectable by direct methods) is very low. Possible undetected crossing-over in the

genetically inert parts of the *X*-chromosomes could influence only the disjunction of the *ClB* chromosome and the right (non-translocated) part of the other *X*-chromosome, as the left part, translocated to chromosome 4, does not carry any of the inert region of the *X*-chromosome. Non-disjunction of the left part of this *X*-chromosome and the *ClB* chromosome is much lower than would be expected if Darlington's hypothesis applies to *Drosophila*, and seems therefore to show that regular disjunction of chromosomes is not absolutely conditioned by crossing-over.

It seems clear that both crossing-over and chromosome disjunction are dependent on a third, more general factor, possibly on the intensity with which the conjugation of chromosomes takes place.

S. GERSHENSON.

Institute of Genetics,
Academy of Sciences,
Moscow.

DOBZHANSKY[1], Gershenson (above) and others have concluded that the disjunction of chromosomes does not depend directly on the occurrence of crossing-over between them, as I assume to be the case in all homozygous organisms[2]. They maintain that some "other factor" is concerned in their experiments. But these experiments have necessarily made use of hybridity, without which genetical tests are impossible; and the particular kind of hybridity (structural hybridity) they have used is bound to have a complicated effect on disjunction. It is itself the "other factor". Thus reciprocal crossing-over within two relatively inverted segments should give normal chromosomes with normal disjunction, other things being equal.

But when we consider the structure of the bivalent given by such crossing-over, we see that the disjunction expected in straightforward bivalents will not necessarily follow (Fig. 1). The pull which is to separate the paired chromatids is parallel to the plane of their association and not perpendicular to it. Resistance to separation is therefore not a certain constant minimum, but a function of the length between the two chiasmata. I have observed failure of disjunction in these circumstances in an inversion heterozygote in *Stenobothrus parallelus*. Other kinds of crossing-over in dislocated segments give rise to lagging, interlocking and irregular breakage. It is not therefore surprising that Grüneberg[3] finds the 'non-disjunction' that has previously been attributed to non-pairing and random segregation is often due to loss of both partners.

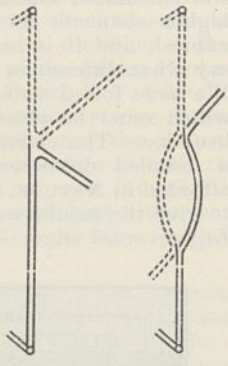


FIG. 1. The structure of bivalents with single (left) and double reciprocal crossing-over (right) between relatively inverted segments of homologous chromosomes.

This is merely one example of the special complications arising in structural hybrids. They have been described by Richardson for inversion hybrids and by myself for interchange hybrids in articles in the press[4]. They show the danger of arguing from the assumptions involved in an abstracted formal use of the terms "chromosome", "non-disjunction" and even "crossing-over" by the geneticist. They also show the difficulty the geneticist is faced with in dealing with the highly selected viable progeny of structural hybrids, a difficulty which can only be overcome by a close collaboration between those who are breeding the hybrids and those who are studying the structures found at meiosis in comparable material[2].

C. D. DARLINGTON.

John Innes Horticultural Institution,
London,
S.W.19.

[1] *Z.I.A.V.*, **64**, 269–309.
[2] *J. Genet.*, **31**, 185–212.
[3] *J. Genet.*, **31**, 163–184.
[4] *J. Genet.*, in the press.

Induction of the Eye by a Specific Substance in the Amphibia

IT is known that in the axial mesoderm of the Amphibia, the capacity to induce individual organs varies from anterior to posterior, each organ having its 'induction field'[1]. After the discovery of inducing substances it is natural to consider whether the existence of these fields may be explained by the localised distribution of specific substances which determine their properties.

If this suggestion were found to be true in the case of any one organ, one could generalise and assume that it is true for other organs as well. The following investigation deals with the eye; if the development of this organ is determined by the presence of a specific substance, the diffusion of this substance from a dead eye must induce, in the ectoderm of an early gastrula, only eyes or eyes with the adjacent region of brain. Accordingly, optic vesicles were removed from *Axolotl* or *Triton taeniatus* in the tail-bud stage, killed by treatment with boiling water or alcohol, and implanted in the blastocœls of early gastrulæ of *T. taeniatus* or enveloped in flaps of presumptive ectoderm of that species. Eyes were induced in 100 per cent of the positive cases, either in whole embryos or in explants. In whole embryos induction was found to be independent of the level of the host. They were usually connected with a mass of brain tissue, which might be smaller than the eye; in some cases, several eyes were formed together. The eyes were normally shaped; and the retinal part of the eye was capable of inducing a lens from the host ectoderm, if it came in contact with it.

The conclusions which may be drawn from these facts are as follows: (1) The agent which induces the primary embryonic axis is not unspecific as regards the region of axis which is induced; possibly it includes a mixture of specific substances or entirely consists of such specific substances. (2) The regional differences within the primary embryonic axis are determined by the corresponding distribution of specific formative substances. (3) Polarity in the system of ectomesoderm[2] is possibly determined by a similar distribution of substances from pole to pole. The phenomenon of regulation must be accounted for by the assumption that these substances follow the principle of polar distribution, and that after a disturbance of the system the previous distribution of the substances is restored.

G. LOPASHOV.

Institute of Experimental Biology,
Woronzowo Pole 6,
Moscow 120.
Oct. 4.

[1] Holtfreter, *Joh. Arch. Entw.-mech.*, **127**; 1933.
[2] Lopashov, G., *Biol. Zentrbl.* (in press).

First Appearance of Red-eye in the wild *Gammarus chevreuxi*, Sexton

In a letter to NATURE[1], we were able to show that heterozygosity existed in the wild stock of this species —eggs from an outside mating, hatched some days later in the laboratory, gave 2 red-eyed recessives in a brood of 11 young.

Although dredging had been carried on at frequent intervals since 1912, and heterozygosity in the wild stock had been suspected for eleven years past, this was the first definite proof obtained, and it was again noted that no red-eyed had yet been found in the open. We have now to record its first appearance. In the dredging brought in on October 22 and examined for eye colour, one *red-eyed* was found amongst 2,000 black-eyed animals.

E. W. SEXTON.
Marine Biological Laboratory, A. R. CLARK.
Plymouth. G. M. SPOONER.
Oct. 30.

[1] Sexton and Clark, "New Developments in *Gammarus chevreuxi*, Sexton". NATURE, **133**, 27; 1934.

Hyperfine Structure and the Gross Structure Analysis of the Spectrum of Doubly Ionised Antimony

THE hyperfine structure of two doublets of the spectrum Sb III has recently been investigated by me at the Reichsanstalt, Berlin. The structures were diffuse, but each line was resolved clearly as a doublet. The wave-lengths, classification[1] and the observed hyperfine structure separations in cm.$^{-1}$ are given below.

Wave-length	Classification	$\Delta\nu$
4265·09	$6s\ ^2S_{1/2} - 6p\ ^2P_{3/2}$	1·27
4591·89	$6s\ ^2S_{1/2} - 6p\ ^2P_{1/2}$	1·40
4352·16	$5s\,5p^2\ ^2S_{1/2} - 6p\ ^2P_{3/2}$	0·45
4692·91	$5s\,5p^2\ ^2S_{1/2} - 6p\ ^2P_{1/2}$	0·55

Taking the nuclear spin-moments of the two antimony isotopes as $5/2.h/2\pi$ and the ratio of their $g(I)$ factors as 1·37[2], and using the graphical method of Fisher and Goudsmit[3], the splitting factor of the $6s\ ^2S$ term for Sb^{121} could be estimated to about 0·53 ν. Applying the formulæ given by Goudsmit[4], the magnetic moment of the nucleus Sb^{121} could be calculated to be about 7·2 proton-magnetons. From my data[5] on the structure of the lines of the first spark spectrum, Goudsmit[4] has deduced a value 2·7 for the magnetic moment of Sb^{121}, compared with which the value obtained above is much too large. The reason for this is to be found in the incorrect analysis of the gross structure. If the $6s\ ^2S$ and the $5s\,5p^2\ ^2S$ terms are interchanged, the calculated value of the magnetic moment comes out to be 2·7, in quite good agreement with the value quoted above. Thus of the two ^2S terms, the deeper should arise from the configuration $5s\,5p^2$ and the higher from the configuration $5s^2\ 6s$. This would assign to the $5s\,5p^2$ term a much larger splitting than that of the $6s$ term, which is not unexpected.

The two terms are very close together, their values differing only by 469 cm.$^{-1}$. The pair λλ 4352, 4693 is decidedly the stronger of the two, and it is more likely that the weaker pair should involve the double electron transition $5s\,5p^2 \leftarrow 5s^2\ 6p$, and this is in accord with the suggested modification. A comparison of the values of the two terms in the isoelectronic spectra of In I, Sn II, Sb III and Se IV shows that the change suggested is quite consistent. In the corresponding case of As III, however, the pair of shorter wave-lengths is the stronger; it is therefore likely that the $5s\ ^2S$ term is deeper than $4s\,4p^2\ ^2S$. Here, too, the two terms are close together and a study of the structures of the lines in question would decide the correct configuration.

It is very interesting to note that the small energy changes in the radiation due to the interaction of the nuclear magnet with the extra-nuclear electrons helps to decide the electron configuration involved in a particular transition, and this is particularly useful when the terms are close together and it is otherwise difficult to assign the correct electronic configuration.

Details of the above investigation will be published elsewhere.

J. S. BADAMI.
Department of Physics,
Wilson College,
Bombay.
Sept. 10.

[1] Lang, *Phys. Rev.*, **35**, 445; 1930.
[2] Tolansky, *Proc. Roy. Soc.*, A, **146**, 182; 1934.
[3] Fisher and Goudsmit, *Phys. Rev.*, **137**, 1059; 1931.
[4] Goudsmit, *Phys. Rev.*, **43**, 636; 1933.
[5] Badami, *Z. Phys.*, **79**, 206; 1932.

Occurrence of the Reversed Absorption Edges of the Long Wave-Lengths of X-Rays

IN the region of the long wave-lengths of X-rays, there are difficulties in obtaining absorption edges, for the intensity of the continuous ground of the X-radiation is very small. A further difficulty is in the classification of some of these edges, as, for example, the M_V-edges. Also it is well known that the calculated energy values of the M_V-edges for higher elements do not agree with the measured values[1], and it is not possible to extrapolate or to say what differences can be expected in this region. We have found some reversed edges in this region[2], which must be classified as M-edges of silver and bromine. The classification of these edges requires a detailed discussion for which space cannot be afforded in NATURE. It may, however, be of interest to give the results and the difficulties in obtaining a L_{III}-reversed edge.

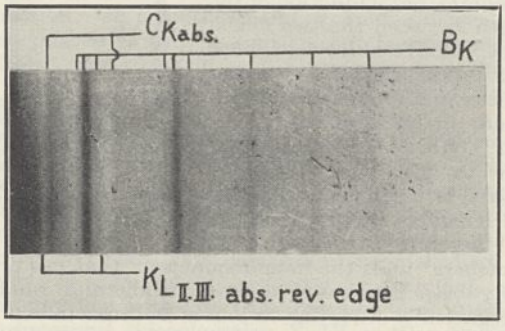


FIG. 1.

Two years ago, we obtained a reversed absorption edge of the wave-length $\lambda = 42{\cdot}1$ A., which corresponds to $\nu/R = 21{\cdot}6$. But on some plates, made with different anticathodes, this absorption has been either displaced, or appeared as a white absorption line or entirely disappeared. We have now found

that the above-mentioned phenomena were caused by occasional overlapping of emission lines, and the said overlapping could not be recognised on account of the lines in the region of long wave-lengths being broad and the dispersion small. It is now evident that this edge is only due to the emulsion of different photographic plates, and it belongs to the $L_{II, III}$-absorption edge of K (from potassium bromide), giving for L_{III} the calculated value $\nu/R = 21{\cdot}5$. One of the plates of this edge, made on Eastman-Kodak plate, shows (in the first and second orders) a clear potassium edge appearing as a broad white line. The appearance of this edge as a white line is caused through the simultaneous occurrence of the normal edge of carbon with the said reversed edge, as seen in Fig. 1. The value given above has been measured from other plates with greater dispersion, with copper and tungsten anticathodes, giving sharper reference lines.

With these results, obtained with the low tension ionic tube[3], the existence of the reversed absorption edges in this region is verified.

M. BAČKOVSKÝ.
V. DOLEJŠEK.

Spectroscopical Institute,
Charles University,
Prague.
Sept. 28.

[1] M. Siegbahn, *Z. Phys.*, **67**, 567; 1931.
[2] V. Dolejšek and B. Janíček, NATURE, **132**, 443; 1933.
[3] V. Dolejšek and V. Kunzl, *C.J.M.F.*, **6**, 242; 1932. *Z. Phys.*, **74**, 565; 1932.

Reactions of Sulphuryl Diamide (Sulphamide)

APART from salt formation (for example, work by F. G. Mann in 1933) only two reactions of this substance have been recorded. Traube and Reubke (1923) obtained a 5 per cent yield of a condensation product with benzaldehyde, and in 1933 I showed (with Mr. A. E. Battye) that sulphamide readily condenses with formaldehyde to give a resin-like body from which a tetramethylol derivative may be isolated.

I have now found a third 'organic' reaction for this substance, which again exhibits its great similarity with urea. If xanthydrol in alcohol is added to a solution of sulphamide in acetic acid and water, after some time, beautiful lustrous crystals of dixanthyl sulphamide, m.p. 182°–4° C., are obtained. Condensation products have also been obtained with xanthydrol and

p-aminobenzene sulphonamide, m.p. 209°
m-benzene disulphonamide, m.p. 170°
p-toluene sulphonamide, m.p. 198°.

Details will be published elsewhere of this general reaction for the sulphamides and sulphonamides, which in certain cases may be conveniently used for their estimation.

F. C. WOOD.

11 Amherst Road,
Fallowfield,
Manchester.
Oct. 24.

Points from Foregoing Letters

ULTRA-RAPID photography has shown that lightning strokes consist of a 'leader' from cloud to earth and a return stroke in the opposite direction. From fluctuations in the luminosity of the return stroke at the ground end, D. J. Malan, Dr. B. F. J. Schonland and H. Collens infer that the return stroke is made up of several component discharges, the intensity and time separation of which in micro-seconds they have measured. The authors are now investigating the influence of these components upon the wave-form of atmospherics radiated by the lightning flashes.

Some experiments by the late Sir John McLennan and Mr. W. H. Rann on the radioactivity produced by neutron bombardment of certain rare earths are described. They confirm earlier results of Hevesy and Levi and of Sugden and Marsh.

Finch and Quarrell suggested some time ago that the 'extra' rings obtained in electron diffraction experiments with metal foils (containing oriented crystals) were due to two-dimensional refractions at the exit crystal faces. Dr. L. H. Germer submits calculations showing that this cannot be the case. Dr. G. I. Finch agrees with Dr. Germer's findings and points out that they are consistent with the new interpretation put forward by Finch, Quarrell and Wilman, namely, that the 'extra' rings are due to surface contamination.

G. Wald finds in the light-adapted retina of the bull-frog, as in the case of other species of frogs, two substances chemically related to carotene, the yellow pigment of carrots: vitamin A (visual white), and retinene (visual yellow). In the dark, the yellow retinene changes to visual purple. Extracted retinene is transformed on standing into vitamin A. In the intact eye vitamin A is resynthesised to visual purple.

Prof. E. S. Pearson, continuing a discussion on statistical tests, contends that all hypothetical frequency distributions are merely graduation formulæ. We are never concerned with whether a hypothesis be true or false, but only with the extent to which it graduates our experience of Nature. But nevertheless, the efficiency of statistical tests can be assessed by the manner in which, on repeated application, they control certain errors of practice.

During the process of meiosis, the chromosomes carrying the inheritable characters from two parent nuclei join together, exchange certain portions, and then split (disjunction). Re-arrangement of certain portions (crossing-over) may occur. Darlington has stated that crossing-over is a necessary condition of regular chromosome splitting. Dr. S. Gershenson reports experiments with female fruit flies from which it appears that this is not the case. Dr. C. D. Darlington replies that this hypothesis applies to normal (homozygous) organisms and not to hybrids such as were necessarily used by Gershenson.

One or more eyes have been experimentally produced by G. Lopashov in *Triton tæniatus* by implanting into the blastocœls of early gastrula stage, dead optic vesicles from other specimens of *T. tæniatus* or of axolotl.

Using the known value of the magnetic moment of the nucleus Sb^{121}, a study by Dr. J. S. Badami of the hyperfine structure of the lines of the spectrum of the doubly ionised antimony atom has led to a modification of the gross-structure analysis of the spectrum Sb III.

Research Items

Pithecanthropus and the Gibbon

DR. EUGÈNE DUBOIS, having shown on the evidence of five thigh bones both the organic differentiation of *Pithecanthropuus erectus* and at the same time its close affinity with the gibbon, has now considered the trend of the evidence derived from the volume of its brain, much too large for an anthropomorphous ape, very small in comparison with the average of that of a man (*Proc. Akad. Wet. Amsterdam*, **38**, No. 6). Study of the laws regulating the size of the brain in mammals points to a relationship between its volume and the size of the body. In every case the functional degree can be expressed by the 'co-efficient of cephalisation' (or 'factor of animal organisation') which appears to arrange the mammal groups in a systematic order agreeing with what we know of their animal organisation. This has been found to hold good for birds, reptiles and fishes, and vertebrates generally. It was found that this law applied functionally to the psychencephalon, chiefly the cerebral hemispheres. Further, it has been found that in not a few cases of closely related mammals the co-efficient of cephalisation increases by doubling and redoubling, that is, in a geometric progression with a ratio of 2. This law of the autonomic phylogenetic progression of the psychencephalon is of direct significance for the taxonomy of *Pithecanthropus*. It is possible to arrange all the existing groups of mammals in a geometrical series with progressive 'co-efficients of cephalisation' in which there are no gaps, with one exception—that between man and the anthropomorphous apes. This marks the place of *Pithecanthropus erectus*. By a calculation on this basis, the probable weight of the body is shown to be 104 kgm. That probability is in favour of the accuracy of this figure is argued from the chief dimensions of the femur, on the analogy of similar organisms, for example, the gibbon. The gibbon resemblance also appears in the place of the gravitation centre of the head before the condyles, and also in the general form of the skull. The mandible resembles that of the gibbon and shows that *Pithecanthropus* was devoid of the power of human speech.

Rural Population in the United States

AN instructive series of investigations bearing on the character and movements of the rural population of New York State are being carried on by the Cornell University Agricultural Station, Ithaca, N.Y. A study of the activities and interest of the young women of the open country and villagers of Genesee County, N.Y., in 1934, has now been followed by a similar investigation among young men ("Interests, Activities and Problems of Rural Young Folk. (2) Men 15 to 29 Years of Age." By W. A. Anderson and Willis Kerns. *Bull.* 631. Cornell Univ. Agric. Station). Data were obtained from 307 young men, of whom 54 per cent were the sons of farmers and 33 per cent of skilled or unskilled labourers. Their interests were found to be mainly social-recreational and economic-vocational. The evidence collected pointed very definitely to the need for vocational guidance. For there was a very distinct urge towards a skilled trade as a life-work, but very little evidence of any definite plan to give it effect. A preponderating number expressed a preference for rural life and farm work. In this connexion it is significant that a previous inquiry ("Mobility of Rural Families" by W. A. Anderson. *Bull.* 623) showed that while agriculture in New York State is carried forward by the same type of population with only slight geographical shifting, giving the rural areas a stable social organisation, and while farming shows a greater tendency to be handed on from father to children than any other major occupation, it appears that this industry can employ only thirty per cent of the children reared in farm families, although previously the estimate had been placed so high as fifty per cent.

Breeding Habits of Common Catfish

A STUDY of the reproductive habits of the common catfish (*Ameiurus nebulosus*), by C. M. Breder, shows that they give the clue to some peculiarities developed in other nematognaths (*Zoologica*, **19**, No. 4; 1935). Thus the oral gestation of the Ariidae seems to be foreshadowed by the way in which the common catfish uses its mouth for churning the eggs about, taking them into its mouth and ejecting them violently; the adhesion of the eggs to the ventral surface of the Aspredinidae is suggested by the position of the catfish during incubation, when it lies upon the egg-cluster; and the special use of the ventral fins in working over the developing eggs initiates a habit which may have culminated in the use of the ventral fins as an inseminating basket, as in *Corydoras*. The common catfish may spawn twice in a season after a temperature of 21° C. has been reached, and the young fish, as well as the eggs, are guarded by the parents during their development.

Ecology of a Salt-Marsh

IN a paper on the ecology of a salt-marsh in Aberlady Bay on the Firth of Forth, fifteen miles east of Edinburgh, Edith A. T. Nicol (*J. Mar. Biol. Assoc.*, **20**, 1935) records that *Protohydra leuckarti* was common at certain times in some of the pools. It was present in May and June 1931 in large numbers in one pool and was still abundant in October, but died out during the winter and was not rediscovered until the summer of 1933, when it appeared in an adjacent pool. The uneven distribution and the difficulty of seeing this animal probably account for the few records of its occurrence in Britain. It has been previously recorded by Hickson from Southampton Water and from near Plymouth but, in addition to finding it in the Firth of Forth, Dr. Nicol found it in large numbers, in one pool only, in a small marsh at Torridon in Western Ross. She records that in one pool in Aberlady Bay, in June, there were 8,890 young *Nereis* in an area of one square foot of mud and in another pool 3,672 larvæ of *Chironomus aprilinus* were present in a square foot, and on the bare mud of the banks of the stream which runs through the marsh *Hydrobia ulvæ* was present to the number of 3,020 per square foot. Detailed observations were made on the conditions, salinity, oxygen-content, alkali-reserve, hydrogen ion concentration and temperature, under which the

animals in the pools were living, and the relationship of the conditions—of which the most difficult for the animals is that of changing salinity—to the life of the animals is discussed in connexion with recent work on the physiology of certain inhabitants of brackish water.

Vernalisation of Seeds

THE announcement by Lyssenko, a few years ago, of the process of vernalisation of seeds, raised very considerable hopes of enhanced yields and easier cultivation among the community of gardeners. Storage of the seed for certain periods at low temperatures was the main feature of the discovery. A short note in the *Gardeners' Chronicle* of October 19, by Mr. S. Burr and Miss D. M. Turner, throws further, but unfavourable, light upon the process. Tomato seed vernalised between 1° and 3° C. for periods ranging from 7 to 44 days was not equal, either in vigour of germination or in subsequent yield, to untreated seed. Normal seed germinated 97 per cent, whereas vernalisation for 44 days gave 20 per cent. Less extreme, though quite significant, were the yields—plants grown from seed vernalised 32 days yielded only 72 per cent of the untreated group. Cucumbers gave similar results.

New Virus Diseases of Tomato

THE number of virus diseases of plants increases at a really astonishing rate. Fifteen years ago, the well-authenticated virus diseases might have been enumerated without using two figures, but now they occur in hundreds. Dr. Kenneth Smith, of the Potato Virus Research Station, Cambridge, announces the discovery of three new virus diseases of the tomato (*J. Roy. Hort. Soc.*, 60, 448–451, Oct. 1935). One malady causes cessation of growth, yellowing and purpling of the lower leaves, and malformation of the whole plant. The second is referred to as the 'distorting virus', and justifies its title by causing severe malformation of the leaves. Many fine leaflets appear instead of the usual well-favoured foliage, and the terminal leaflet frequently becomes a tendril. Symptoms of the mosaic type distinguish the third disease, which, however, differs slightly from the ordinary tomato mosaic by producing a greyness upon the leaf, with bandings of yellow and green. The two latter diseases may have been brought to Great Britain by the importation of smoking tobacco.

Transmutation by Deuterons

E. O. LAWRENCE, E. McMillan and R. L. Thornton (*Phys. Rev.*, Sept. 15) have studied the yield of induced radioactivity in a number of elements, activated by deuteron bombardment, as a function of the energy of the bombarding beam. Sodium, aluminium, silicon and copper all give β-radioactive products, probably by reactions typified by $Na^{23} + H^2 \rightarrow Na^{24} + H^1$. The yield increases with increasing deuteron energy (up to $3{\cdot}6 \times 10^6$ v.) less rapidly than would be expected on the Gamow theory of penetration of the particles through a potential barrier. Further, the activation of an element of atomic number as high as copper with deuterons of only 3×10^6 v. energy is much larger than would be expected on the Gamow theory. A theory is developed by J. R. Oppenheimer and M. Phillips (*Phys. Rev.*, *ibid.*) along the following lines: The deuteron is built of a proton and a neutron linked with a certain binding energy. When the deuteron is projected against a nucleus, the proton is held back by the repulsive field, but a wave-mechanical calculation shows that the neutron has a relatively high probability of entering the nucleus. The actual shape of the function giving the variation of the neutron penetration with energy depends on the binding energy; and a good fit with experiment is obtained by taking this about $2{\cdot}0 \times 10^6$ v., which is consistent with the value obtained by other methods.

Industrial Applications of Electrolysis

THE field of electrochemistry as it is concerned in the industrial deposition of metals, the electrolysis of alkali and alkali chloride solutions and oxidations, has been summarised by H. J. T. Ellingham in an article (*Chemistry and Industry*, 54, 895; 1935) which gives some useful general information. In recent years the electrolysis of fused sodium chloride for the production of sodium is tending to displace the earlier method of electrolysis of the hydroxide. The normal annual production of aluminium is 270,000 tons, while 20,000 tons of sodium and 2,500 tons of magnesium are produced per annum, with small quantities of calcium, cerium, beryllium, potassium and lithium. The principal countries producing aluminium are the United States, Germany, Canada, Norway, France, Italy and Great Britain, and during the last year the U.S.S.R. has become a major producer. For some years, the British Empire has produced about 20 per cent of the total output. The modern electrolytic zinc extraction process now competes with the retort process, and is operated on an increasing scale. The roasted zinc sulphide concentrates are extracted with dilute sulphuric acid and the rigorously purified solution is electrolysed between aluminium cathodes and insoluble lead anodes. Pure (exceeding 99·9 per cent) zinc is obtained, with cadmium as a by-product. Modern electrolytic plating and refining processes are also described.

Costing of Petroleum Refinery Operations

PROFIT and loss accounts are comparatively straightforward when cost and individual products can be assessed. With refineries, however, such assessment is not as a general rule practicable, since the main plants produce not one, but several, products. Allocation of operating costs to individual products is, therefore, an arbitrary matter. Mr. Gordon Kerr, who read a paper on "The Costing of Petroleum Refinery Operations" on October 8, before the Institution of Petroleum Technologists, suggests that, cost per product being inaccessible to refinery operators, process costs should be calculated. These being obtained, comparisons between the cost of operating plants from period to period, or for one refinery as opposed to another, are made possible. Moreover, in special circumstances, data are provided for comparison of alternative plants and methods of operation. In order to draw up a satisfactory process cost sheet, the processes to be costed must first be decided upon. Secondly, expenditure must be analysed and allocated to these various processes. Finally, distinction must be made between direct costs which automatically cease in the event of a particular process being discontinued, and indirect costs. These preliminary calculations having been made with the assistance of engineers, chemists and accountants, Mr. Kerr suggests that a perfectly satisfactory statement can be drawn up, and indicates the form it should take.

Symbols and Nomenclature in Physical Science

PROF. A. V. HILL'S recent letter[1] directing attention to the confusion arising out of the inconsistent use of symbols is a timely reminder of the need for greater uniformity. A certain amount of work in this direction has already been done. In 1914, committees of the Physical Society of London, and of the International Electro-Technical Commission reported upon this subject[2] and made certain suggestions as regards some of the more important physical symbols. The Smithsonian Physical Tables contains a table of symbols for electrical and magnetic quantities as adopted by the American Institute of Electrical Engineers, and the International Critical Tables gives a list of symbols based upon the recommendation of the International Association of Chemical Societies[3]. More recently, the S.U.N. Commission of the International Union of Pure and Applied Physics has recommended symbols for a limited number of physical quantities[4]. General agreement, however, upon anything like a sufficient number of symbols is not yet in sight.

Pending such agreement, as a step in the right direction and to prove its urgency, it would be instructive to have tables showing the variety of symbols employed by different authorities for the same physical quantity. A table giving symbols of some common thermodynamic quantities as found in a number of textbooks was compiled by the S.U.N. Commission in its report (mentioned above) and a similar table is appended here as an example; it will be seen how readily confusion can arise. Not only do the symbols differ, but also terms such as 'free energy' and 'thermodynamic potential' are used with different meanings by different authors.

With the exception of entropy, the various quantities given in the table are forms of (or have the dimensions of) energy, and the relation between them, using Gibbs's notation, is:

$$\overbrace{\underbrace{Q}_{\chi} + \underbrace{\zeta - W}_{\psi}}^{\varepsilon}$$

where Q, W and ζ stand for the energies obtained by multiplying the extensive quantities, entropy, volume and mass by their respective intensive factors (or potentials), temperature $(d\varepsilon/dS)_{v,m}$, pressure $(d\varepsilon/dv)_{s,m}$ and thermodynamic potential $(d\varepsilon/dm)_{s,v}$. It is unfortunate that many authors have used the term 'thermodynamic potential' in referring to energy quantities. Bryan[5] has used it to denote ψ, χ and ζ; Ogg, in the English translation of Planck's "Thermodynamics", refers to the energy equivalent of ζ as "thermodynamic potential at constant pressure", and the term is used in the same sense even in the International Critical Tables.

Quantity \ Author	Gibbs (1876)	Bryan (1903)	Goodenough (1912)	Planck (1922)	Planck (Eng. Trans. 1929)	Lewis and Randall (1923)	W. C. M. Lewis (1925)	S.U.N. Commission
Entropy	η	S	S	S	φ	S	S	S, P
Heat given to system	Q	Q	Q	Q	Q	Q	Q	—
Work given to system	−W	−W	W	A	W	−W	A	−W
'Free energy' (Helmholtz)	ψ	$\mathfrak{F}_v$	F	F	F	A	f	F
'Free energy' (Lewis and Randall)	ζ	p	φ	—	—	F	φ	G
Heat content	χ	$\mathfrak{F}_s$	I	W	H	H	—	H, I
Internal energy	ε	U	U	U	U	E	U	U, E

In its recent report the S.U.N. Commission states (p. 20): "As to the four quantities, U, $U - TS$, $U - TS + PV$, $U + PV$, it was pointed out that they are all cognate and should be regarded as on a parity in the sense that they are all potentials, so that by suitable differentiations of each, any of them can yield the complete state of a substance, entropy or temperature, pressure or volume, thermoelectric current or e.m.f. . . . The British Committee are also prepared to accept the name Thermal Potential for Gibbs' function." It may be pointed out, however, that Gibbs (*Scientific Papers*, **1**, 92) used the term potential in a different sense; he defined his thermodynamic potential as "the differential coefficient of the energy taken with respect to the variable expressing the quantity of the substance", as we have done above.

Two other points may be here touched upon:

Owing to the relatively large number of physical concepts, authors have often recourse to Greek, German and other alphabets in order to find distinctive letters. An alternative way would be to use a combination of two or more letters as is done for chemical symbols. This would also have the advantage of allowing one to distinguish between, say, gas pressure *Pg* and osmotic pressure *Ps*, while at the same time indicating other generic similarity.

The addition of one or more letters could be resorted to in order to direct attention to the operational meaning attached to a given symbol: for example, *Psh* might stand for "osmotic pressure measured hydrostatically across a semi-permeable membrane", while *Psf* might indicate "osmotic pressure calculated from freezing point determinations". The need for some such device to express the operational meaning of concepts in order to prevent many unnecessary controversies and paradoxes has been discussed at length in a previous paper[6].

To summarise—there are three points worth consideration:

(1) The need for comparative tables giving the different symbols used for the same concept by various scientific workers.

(2) The advantages of symbols consisting of several letters.

(3) The advisability of using symbols which express the operational meaning of a concept.

V. C.

[1] NATURE, **136**, 222; 1935.
[2] NATURE, **94**, 541, 545; 1915.
[3] *J. Chem. Soc.*, **119**, 502; 1921.
[4] NATURE, **135**, 419; 1935.
[5] "Encyc. Math. Wissensch.", Bd. 5, t. 1, p. 74; 1903.
[6] *Science Progress*, **26**, 126; 1931.

Prof. Charles Flahault and the Scots College at Montpellier

PROPOSED MEMORIAL

MEN of science throughout the world will welcome the news that a movement is afoot to commemorate the work of the great geobotanist Charles Flahault. A committee of patronage has been founded to erect in L'Hort de Dieu, on Mont Aigoual, a commanding peak of 5,000 ft. in the Cevennes, a monument to the memory of this noted savant and essentially human figure. Flahault began life in modest circumstances. From being gardener of the Natural History Museum, Paris, he attained, through his undoubted ability, his application and hard work, the highest university degrees. At twenty-six years of age he found his place among the young savants of great promise. As professor in the Faculté des Sciences in 1883, he worked and taught for forty-four years in Montpellier, the University of which he never abandoned in spite of repeated calls of the Natural History Museum and of the Sorbonne.

Flahault was the founder in France of botanical geography, the aims, the methods and nomenclature of which he clearly defined. He organised the Botanical Institute of Montpellier, and by his learned words and guiding influence made Montpellier a noted centre for Mediterranean studies. His scientific activity aimed through all his life's work at an essentially human goal. He sought to discover and to teach the relationship of plant life to its environment and thereby to increase the yield of Nature for the benefit of man.

In retirement, Flahault turned his attention to the replanting of the *garrigues* and mountains, to the improvement of the cultural aspect of sand-dunes and to the uncultivated marshes which border the lagoons. The last seven years of his life were spent in this work, unceasingly giving practical advice, writing reports, articles and booklets into which he condensed the results of his researches and experiments. These included observations which he had made on the Aigoual in the Hort de Dieu, where he founded a botanical mountain garden and laboratory. Thus from the lagoons of the seashore to his hill-station on the edge of the Massif Central, Flahault revealed the unity of Mediterranean vegetation.

To students and men of science from Great Britain, the special significance of Montpellier and its region is its key-position at that point of the Mediterranean lands which is nearest to our own. This fact formed a fertile contact between Flahault and ecologists from our own shores. The unbroken friendship of the late Sir Patrick Geddes and Flahault, dating from the 'eighties, led to the founding of the Scots College (Le Collège des Ecossais) at Montpellier, and Geddes taking up residence there in 1924; the garden of the College with its wide variety of *garrigue* flora was planned by the two friends as an ecological museum of Mediterranean vegetation. Latterly, a co-worker of Flahault, M. Braun-Blanquet, has placed his Station Internationale geo-Botanique Mediterranéenne et Alpine (S.I.G.M.A.) in the College garden. Recently, at the College itself, the warden, M. Paul Reclus, has aided the supervision of ecological studies by British students. Thus the work of Flahault is continued, not only by his successor M. Pavillard at the University, but also at the College where so much of his time was spent. Students are ever welcome to this centre of study and research, and it is hoped that the College with such a beginning and tradition will receive the support of those interested in the allied sciences.

Progress in Road Research

THE first report of the Road Research Board, covering the two years ended on March 31, 1935, since the Department of Scientific and Industrial Research assumed responsibility for the researches on roads carried out at the Road Research Laboratory, Harmondsworth (H.M. Stationery Office. 3*s*. net), appears appropriately enough when an important discussion on science and the control of road traffic at the British Association meetings at Norwich has directed attention to the importance of road surface and similar factors in the prevention of accidents. A major group of problems with which the work of the Board is concerned is directly related to the reduction of accident ratios, the other main group of problems being concerned with economy in road construction and maintenance.

The report of the Board itself outlines the general policy pursued in its work and is followed by the report of the Director of Road Research. The first section of the latter report outlines a preliminary programme of research covering both materials and processes for road-making and providing for routine tests and *ad hoc* investigations by the highway authorities and the Ministry of Transport, which under the present scheme remains responsible for full-scale tests outside the Laboratory and is the channel of communication with highway authorities. This programme is designed to supply a real knowledge of all the fundamental factors involved in the processes and materials used by the industry, and the work falls into four main divisions: road construction, road usage, development of special testing apparatus, physiological and psychological effects.

The major part of the report is concerned with materials and processes for road construction. Investigations are outlined dealing with questions of the settlement, drainage and other characteristics of the sub-soil which are of importance with the use of large impervious surfaces in modern roads. The properties of the various road materials and their

mixtures with binders are being investigated to assess scientifically their suitability for use in road construction and to enable satisfactory specifications to be compiled. One of the first steps has been the designing of satisfactory workability tests for mixes. Bituminous binders are also receiving attention and co-operative research has been arranged with the British Road Tar Research Association. The report also stresses the importance of improving methods for the control of concrete during laying, and for the determination of the factors which influence the design and laying of road slabs and foundations.

In regard to road usage, special interest is attached to the studies of forces applied to roads by various types of vehicles, with the object of correlating these forces with the type of pavement, subsoil and vibration, as well as to attempts to determine the factors in vehicle design and usage which cause damage to the road. The value of scientific knowledge on these points needs no emphasis, while the importance of the attention being given to the problem of skidding is equally apparent. This work aims at determining the factors in vehicle design which induce skidding as well as those factors in road construction and road conditions which promote skidding. An apparatus for assessing the slipperiness of wet surfaces has been designed which has given numerical values for the slipperiness of surfaces in good accord with experience of actual usage of the roads tested. The work has shown, rather surprisingly, that in wet weather roads are in general more slippery in summer than in winter. Other work on road testing machines has been designed to provide some other means of judging durability than waiting for deterioration under normal usage, and it is hoped that the machines being built will form a link in the chain between the laboratory and the road, and ultimately establish a scale against which the probable performance of new forms of materials and construction can be estimated.

The report shows that a good beginning has been made on a programme of research not incommensurate with the expenditure of more than £50,000,000 involved in the making and upkeep of roads in Great Britain and in the problem of road safety.

Technical Features of the *Normandie*

AT a joint meeting of the Institution of Mechanical Engineers with the Société des Ingénieurs Civils de France (British Section) held at the Institution of Electrical Engineers on November 15, M. Jean Marie read a paper on the *Normandie*. He gave a very interesting description of the precautions taken against fire. The first precaution is the use so far as possible of fireproof materials for floor, ceiling and wall coverings. Where the use of materials such as plywood, linoleums, rubber carpets, etc., was unavoidable, these were made almost incombustible by the use of asbestos and fire-resisting paints. The only really combustible materials are the bedding, linen, clothes and the passengers' and crew's luggage. The outbreak of fire is limited by partitioning, six cabins being the maximum in the subdivisions. If a fire, however violent, breaks out in one of them, its extent is limited for more than thirty minutes by the insulating barrier, the temperature remaining normal during this period in the neighbourhood of the attacked cell.

There is a special fire patrol which has its headquarters in the central security post, with which 1,075 automatic devices are connected to give the alarm. If it happens to be a cabin, a red alarm light appears in the corridor. No bell system is installed in order to avoid the risk of a false alarm among the passengers should a bell ring accidentally. In the engine rooms, an outbreak is safeguarded against by means of a hose supplied with carbonic acid foam. In the lower parts of the ship, a plentiful introduction of carbonic gas can be arranged and in the upper parts there are numbers of fire extinguishers. Flying scaffolds are provided so that it is possible to introduce a hose, fed from an upper deck through a porthole, or shut the porthole should it allow a draught. The officers, staff and men who maintain this safety service are specially recruited for the purpose.

The electric lighting system is of low voltage (110 volts) and the power and lighting wires are everywhere kept separate. It is possible to cut off the electric supply from the single zone where a fire might originate. The fight against the outbreak and the normal life on board are thus not interfered with. In the main public rooms, marbles, onyx, plaster of Paris and glass (moulded or worked) have been used as much as possible. Furniture is either of metal or of a fire-resisting wood. Safety paints and varnishes are employed; all of them were tested to see that their burning point was not less than 400° C., and that their liability to spread fire was less than a certain fixed standard.

As the length of the *Normandie* is 1,029 ft. and the breadth at the overhang of the promenade deck is 120 ft., it is out of the question to use oil engines on account of the power that has to be developed, the weight and size of the engines and the risk of vibration resulting from the use of reciprocating moving parts. Water tube boilers and steam turbines were therefore chosen. Electrical transmission of the power generated to the propellers was chosen because of the absence of noise. It has, however, the disadvantage that it cannot be reversed, and so separate machinery has to be used for going astern. A double hull protects the two rooms where all the machinery is located.

The main power station has four 33,400 kilowatt turbo-alternators which run at 2,430 r.p.m., which is ten times faster than the propeller motors. On its first trip, the *Normandie* captured the coveted 'blue riband' of the Atlantic, going westward at an average speed of 29·98 knots and returning at 30·31 knots.

In all fast ships, vibration appears and is troublesome at definite speeds, and the *Normandie* is no exception. Alterations are being carried out during this winter to remedy this inconvenience, and the Compagnie Générale Transatlantique believes that they will be successful.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notice that the Jacksonian professorship of natural philosophy is vacant. The professorship is assigned for this turn to experimental physics, and intending applicants should inquire of the Vice-Chancellor whether provision can be made for the researches that they wish to conduct. Applications must be sent to the Vice-Chancellor on or before December 31.

Sir Rowland Biffen has been appointed to act as head of the Department of Agriculture during the absence on leave of Prof. F. L. Engledow, Drapers' professor of agriculture, from November 15 until April 2, 1936.

Mr. G. E. Briggs has been appointed to act as director of the Sub-Department of Plant Physiology during the absence on leave of Dr. F. F. Blackman, reader in botany, in the present term and Lent term, 1936.

The absence of Prof. F. J. M. Stratton with the eclipse expedition during the Lent and Easter terms 1936 has necessitated the appointment of Dr. T. W. Wormell as acting head of the Department of Astrophysics and director of the Solar Physics Observatory during that period.

AT the time of going to press, the following representatives of university parliamentary constituencies in Great Britain and Northern Ireland were announced as elected or returned unopposed: Cambridge, Sir John Withers (Unionist) and Mr. K. Pickthorn (Unionist); Combined English Universities, Miss E. Rathbone (Independent) and Sir R. Craddock (Unionist); London, Sir Ernest Graham-Little (National); Oxford, Lord Hugh Cecil (Unionist), Mr. A. P. Herbert (Independent); Queen's University, Belfast, Colonel T. Sinclair (Unionist); Wales, Mr. E. Evans (Liberal).

THE School of Librarianship at University College, London, has published an account of its present courses. In the new syllabus for the diploma, stress is laid on languages, especially French and German, the latter being compulsory, and on practical work in cataloguing, classification and library administration. Candidates may specialise in palæography and archive work or in university or special library administration. Fees for the postgraduate diploma course amount to about £45 for tuition, registration and examination fees and books. The school was opened sixteen years ago, and received substantial assistance for a period of ten years from the Carnegie United Kingdom Trust. Its sphere of usefulness has expanded since then with the remarkable development of library services in the south of England, especially London and the home counties, where the number of registered municipal library users increased in five years by 56 per cent, and county library users and book stocks more than doubled. There is no indication in the prospectus of measures for giving effect to the resolutions passed at the recent International Congress at Madrid in favour of special courses for rural librarians and hospital librarians, but it is stated that a course may be arranged in the Easter or summer vacation.

Science News a Century Ago

Meeting of the Royal Society

AT a meeting of the Royal Society on November 26, 1835, Sir John Rennie being in the chair, two papers were read. The first of these was by E. J. Cooper and was communicated by Captain Beaufort. It was entitled "Observations on Halley's Comet made at Mackree, Sligo, in the months of August, September, October and November 1835". The observations, which were made with an equatorial telescope having a focal length of 25 ft. 3 in., "were communicated in the state in which they were taken, and without corrections for refraction and parallax, with a view to assist computors in the calculation of a new approximate orbit".

The second paper, "An Account of the great Earthquake experienced in Chili, on 20th February 1835", was by A. Caldcleugh. "The earthquake," the author said, "began at half-past eleven o'clock in the morning. The first oscillations of the earth were gentle and attended with little noise. They were succeeded by two extremely violent tremors, continuing for two minutes and a half. All the buildings of the town of Conception were thrown down during these undulations". Later on "an immense wave was seen slowly advancing towards the shore, and rolling majestically onwards, in ten minutes reached the city of Conception, which was soon overwhelmed in a flood of an altitude of 28 feet above high water mark. . . . Vessels navigating the Pacific Ocean within a hundred miles of the coast, experienced the shock with considerable force. Its influence was very perceptible in the island of Juan Fernandez, a basaltic mass 360 miles distant from the coast; as was shown by the sudden elevation and subsidence of the sea, which at one time rose 15 feet above the usual level carrying all before it."

British Railways and Steamships in 1835

THOUGH a century ago the mileage of railways completed in Great Britain was quite small, a large number of lines were either in hand or being planned, and the advertisement columns of *The Times* of November 1835 contained many notices of meetings, prospectuses, etc., of railway companies. From London alone there were plans for lines to Birmingham, Greenwich, Bristol, Cambridge and the north, the eastern counties, Dover and Folkestone, Shoreham and Brighton, Southampton and other places. Robert Stephenson was the engineer of the London and Birmingham Railway, Brunel of the Great Western Railway, Joseph Gibbs of the Great Northern Railway, Charles Vignoles and John Braithwaite of the Eastern Counties Railway, Rastrick of the Brighton line, while George Stephenson was the engineer of the London and Blackwall Railway and Sir John Rennie of the Commercial Railway to the East and West India Docks. There were projects also for lines from Birmingham to Bristol, from Bristol to Exeter, from Exeter to Plymouth and Devonport, while among the lines in the north was one from Newcastle-upon-Tyne to North Shields and Tynemouth.

In *The Times* of November 28, 1835, was also a notice of the formation of the British and American Steam Navigation Company with a capital of £500,000, which ultimately built the two pioneer trans-Atlantic vessels *British Queen* and *President*.

Societies and Academies

LONDON

Royal Society, November 14. G. L. BROWN and SIR HENRY DALE: The pharmacology of ergometrine. Ergometrine produces the central excitation, with general sympathetic stimulation, previously described as an initial phase of the action of the more complex alkaloids of the ergotoxine group. It has, however, no more than a trace of the specific paralysing action on motor sympathetic effects, characteristic of these other alkaloids. It causes cyanosis of the cock's comb, but the effect is evanescent and has not led to gangrene. It causes a rise of body temperature when given in toxic doses. It is in general less toxic than ergotoxine, and is much more readily absorbed with oral administration. The most characteristic action of ergometrine, and the only one produced by small doses, is the initiation of a long persistent rhythm of powerful contractions in a uterus normally quiescent, as in the early puerperium. On several organs, apart from the centrally excited sympathetic stimulation, ergometrine appears to have a peripheral action of sympathomimetic type. This, however, is much complicated by other types of action, and does not account for its specific action on the uterus. M. J. D. WHITE: The effects of X-rays on mitosis in the spermatogonial divisions of *Locusta migratoria*, L. X-rays produce both lethal and non-lethal effects in the spermatogonia of *Locusta migratoria*. Cells which are killed go into pycnosis. Those which are not killed show different kinds of chromosome abnormalities. The commonest of these is chromosome fragmentation. Fragmentation of the *X*-chromosome is much rarer than autosomal breakage. A new type of chromosome abnormality which leads to chromatid-tetraploidy with only a diploid number of spindle attachments is described. It is believed that this results from inhibition of the division of the spindle attachment following on irradiation. The whole of the work strongly supports the view that the spindle attachment is a constant cell-organ and that new spindle attachments only arise from pre-existing ones. The independence of the spindle attachment from the rest of the chromosome in regard to time of division is emphasised by the new abnormality of mitosis described above. Evidence is presented that the spindle attachments in the Acridiidae are not terminal, as hitherto believed, but sub-terminal. D. E. SLADDEN: Transference of induced food-habit from parent to offspring (2). Experiments with the stick-insect (*Carausius morosus*) in which the insects for several generations were forced to accept a new food-plant (in this instance ivy) and then reared to maturity on it, have shown that the offspring of each subsequent generation accepted the ivy more readily than did their parents and even showed an increased preference for it. The increasing ability of offspring of ivy-fed parents to eat ivy indicated in experiments previously recorded is still maintained, though the rate of increase is slowing down as is clearly shown by the presentation tests. The preference tests continue to show an increased preference for ivy.

PARIS

Academy of Sciences, October 21 (*C.R.*, **201**, 693–748). HYACINTHE VINCENT: Remarks on streptococcæmia with accounts of some new results of serotherapy in this infection. Out of 310 cases of septicæmia due to streptococcus, 81 per cent were cured by the author's serum treatment. Stress is laid on the necessity of applying the serum treatment as early as possible. JEAN CABANNES and JEAN DUFAY: The spectrophotometric comparison of the zodiacal light and the light from the night sky. It results from these observations that the zodiacal light emits neither the line 5577 nor the bands 4838 and 4425. Allowing for the radiations from the night sky, the zodiacal light gives essentially a continuous spectrum with Fraunhofer lines. GEORGES BOULIGAND: The conditions of covariance of Meusnier's sphere. RAPHAËL SALEM: Certain continued functions and the properties of their Fourier's series. KARL MENGER: A general theorem of the calculus of variations. N. A. SLIOSKINE: Permanent capillary waves. HENRI MINEUR: The age of the Milky Way. LOUIS LEPRINCE-RINGUET: The sudden energy losses undergone by high energy electrons. LÉVI HERMAN and MME. RENÉE HERMAN: The absorption of oxygen in the ultra-violet. NY TSI-ZE and WENG WEN-PO: The influence of the electric field on the absorption spectrum of sodium. GEORGES BRUHAT and LOUIS WEIL: The construction and use of a quarter-wave plate made of quartz. MLLE. YVETTE CAUCHOIS: New measurements and observations relating to the non-diagram $L\alpha$ emissions of mercury, platinum and tungsten. PIERRE PREISWERK and HANS VON HALBAN, JR.: Some radio-elements produced by neutrons. Results obtained by irradiation with neutrons (radon + beryllium) of thallium, bismuth and phosphorus. The results of Sosnowski with bismuth were not confirmed; no activity was detected. J. CHÉDIN: The Raman effect in fuming sulphuric acid. Acids containing a high percentage of SO_3 give no line in common with H_2SO_4 and hence in fuming sulphuric acids containing up to 70 per cent of SO_3 the H_2SO_4 is entirely combined with SO_3. OCTAVE DONY-HÉNAULT and CLAUDE DECROLY: The direct determination of the concentrations of the zinc vapour in the thermal reduction of zinc oxide. MARCEL PRETTRE: The mechanism of the chain reaction of the hydrogen–oxygen mixture. The velocity of the reaction in glass coated with potassium chloride obeys the law of Arrhenius, it is sensibly proportional to $(H_2)^2$, to (O_2) and to p^4 (apparent order of reaction, about 4). The results are in agreement with the scheme suggested by Haber. GEORGES DARZENS and ANDRÉ LÉVY: The synthesis of octohydromethylphenanthrene carboxylic acid and of 4.methylphenanthrene. JOSEPH HOCH: A general method of synthesis and the chemical properties of the isocyanic α-ethylenic esters of the formula $R.CH=CR'.N=C=O$. The *N*-carboxethylketimines, for which the author has given a general method of preparation, are heated to 400° C. with a catalyst. MARC BASSIÈRE: The crystalline structure of silver nitride. The group N_3 is linear, the distance between the atoms being $1{\cdot}18 \pm 0{\cdot}04$ A., of the same order as those previously observed for other nitrides. GEORGES PETIT and PAUL BUDKER: The differentiation of cutaneous teeth, connected with the presence of sensorial crypts, in some Selacians. PAUL WINTREBERT: The explanatory value of physiological epigenesis. CHARLES JOYEUX and JEAN GEORGES BAER: Researches on the evolutive cycle of *Hymenolepis pistillum*. CONSTANTIN LEVADITI and MLLE. JEANNE VOET: A new classification of the neurotrope ectodermoses. FERNAND ARLOING, ALBERT MOREL and ANDRÉ JOSSERAND: The action on tumours, with intravenous injections, of new soluble complex ferrico-ascorbic salts.

EDINBURGH

Royal Society, November 4. A. D. PEACOCK: Some aspects of animal parthenogenesis. An address mainly surveying recent researches, namely, haploid parthenogenesis and the viability of haploids in the light of cytological work; Whiting's hypotheses of 'complementary factors' and 'selective fertilisation', educed from genetical experiments, whereby the diploid female hymenopteron appears to be heterozygous for sex, XY, while the haploid males, though phenotypically alike, are of two types, X and Y; Guhl and Dozorceva's cytological evidence for Whiting's thesis; Vandel's work on geographical parthenogenesis and his evidence that the rare triploid males of a triploid parthenogenetic race of *Trichoniscus* show 'change of valency of the sex genes'; sex control experiments in cyclic forms by Banta, Shull, Tauson, Luntz and others, with Berg's hypothesis that males appear as the result of 'physiological depression'.

BRUSSELS

Royal Academy of Sciences (*Bull. Classe Sci.*, 21, No. 8–9, Aug. 1935). A. DEMOULIN: Sphere congruences of which the curvature is equal to one. P. FOURMARIER: A new observation à propos schistous cleavage. G. BOULIGAND: Stability of mathematical propositions (2). J. L. DESTOUCHES: Abstract spaces in logic and the stability of propositions. P. BURNIAT: Birational quadratic transformations in hyperspace. M. DE HEMPTINNE and J. M. DELFOSSE: Contribution to the study of the Raman spectrum of heavy and light phosphoretted hydrogen. An experimental study of the Raman spectra of these substances and a comparison with the theory of the vibrations of a tetrahedral molecule. L. VERLAINE: The analytical character of perception in the macaque (2). A further attempt to educate the macaque to recognise various simple geometrical shapes and colours.

CRACOW

Polish Academy of Science and Letters, October 7. S. ROZENTAL: The analytical form of the approximate functions of state of the light atoms. W. SWIETOSŁAWSKI, M. WOJCIECHOWSKI and E. SAPIRO: Researches by the boiling point method on the amount of impurities in succinic acid, proposed as a secondary thermochemical standard. The sample of succinic acid used by L. Keffler in his thermochemical work was found to contain 0·002 per cent of water. The method was also applied to determine the amount of water produced by the decomposition of the acid on prolonged heating to various temperatures. M. CENTNERSZWER and M. BLUMENTHAL: The formation and dissociation of the peroxides of the metals of the alkaline earths. M. CENTNERSZWER and MLLE. M. SWIERCZEWSKA: The lowering of the boiling point of a ternary system by non-volatile substances. The influence of potassium chloride on the boiling point of aqueous solutions of calcium chloride. At a certain concentration of calcium chloride, the boiling point remains unchanged on the addition of the third component. The author terms this an 'indifferent' solution. K. DZIEWONSKI and J. KOWALCZYK: Study of α-methylnaphthalene. WL. SZAFER: The method of 'isopolles' applied to researches on the history of trees and forests. The 'isopolle' is a line corresponding to equal amounts of pollen of the trees at different periods of time. As an example, the method is applied to the post-glacial history of the beech and spruce in Poland. J. MADALSKI: The Pleistocene flora of Sciejowice, in the neighbourhood of Cracow. R. WILCZEK: Mosses with forest associations in the mountainous region of the Cieszyn district. J. BIBORSKI: The segmentary vessels and vessels of the unpaired fins of the plaice (*Pleuronectes platessa*). A. ZIELINSKI: Phosphorus and the embryonic development of the frog.

GENEVA

Society of Physics and Natural History, October 17. P. ROSSIER: The calculation of the initial radius of a new star. The author gives a new formula which takes into account the fact that the sensibility of the eye is extended over a wide range of wave-lengths. The calculation is very simple if use is made of a table of absolute colour index. F. CHODAT and A. MIRIMANOFF: Conservation and respiratory rate of yeasts in the presence of glucose. The authors show by means of manometric measurements that the presence of sugar is necessary for the maintenance of the respiratory coefficient of yeasts kept at a temperature of 60° C. G. TIERCY: Conservation of the polytropic character of thermodynamic equilibrium in the hypothesis of the θ variable or β variable. It is a question of finding under what conditions the total pressure keeps the characteristic form of polytropic equilibria. The general form of the algebraic condition is given.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 2; 1935). N. MUSHELISHVILI: Solution of a mixed fundamental problem of elasticity in two dimensions. V. LUSTERNIK: The Brunn-Minkowski inequality in the case of any measurable quantities. W. TURKIN: A generalisation of a theorem of group theory by Landau. D. PANOV: A method of solution of limited problems in the case of differential equations with partial derivatives. B. NUMEROV: General formulæ for the development of perturbing forces in the calculation of absolute perturbations in polar co-ordinates. M. PODASHEVSKIJ: Influence of the photochemical coloration on the limits of stretching and of rigidity of rock-salt monocrystals. M. BRONSTEIN: Scattering of neutrons by protons. S. LEBEDEV and S. SERGJENKO: The dimerisation of butadiene-1, 3. B. RUBIN and L. NAUMOVA: Contribution to the methodology of the determination of ferments. B. DOSTOVALOV: Measurement of the dielectric constant and the specific resistance of rocks. L. BERG: Ecological parallels between lampreys and Salmonidæ. V. VOLOSCHUK: A new mite occurring in stored grain.

SYDNEY

Royal Society of New South Wales, October 2. A. R. PENFOLD and F. R. MORRISON: The essential oils of *Eucalyptus Australiana* and its physiological forms (1). *Eucalyptus Robertsoni* and *E. Phellandra* are simply physiological forms of *Eucalyptus Australiana* and they have now been described as varieties *A* and *B* respectively. These varieties, the essential oils of which are described, cannot be separated from the type, *Eucalyptus Australiana*, by morphological means, and are indistinguishable in the field. The chemical and physical constants of the various essential oils are given. G. F. K. NAYLOR: Palæozoic sediments near Bungonia: their field relations and graptolite fauna. The author discusses the evidence for assigning various geological ages to Palæozoic

sediments occurring east of Goulburn. He concludes that the following periods are represented: Upper Devonian, Upper Silurian (Ludlow stage), Lower Silurian (Llandovery stage), Upper Ordovician (Caradoc stage and Llandeilo stage). The Ordovician and Silurian series are overfolded in such a way that all the dips are westerly. The graptolites which have been collected from this area include several species of *Diplograptus* (*Orthograptus*) and *Monograptus*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 24

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Animal Communities".*

Monday, November 25

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—W. Campbell Smith: "Bible Minerals".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—A. M. Champion: "The Life of a Kenya Frontier Officer".

ROYAL AERONAUTICAL SOCIETY, at 6.—(at the Institution of Electrical Engineers, Savoy Place, W.C.2).—Dr. S. J. Zand: "Sound Proofing of Aircraft".

ROYAL SOCIETY OF MEDICINE (TROPICAL DISEASES AND PARASITOLOGY SECTION), at 8.30.—Dr. Magarino Torres: "Further Studies on the Pathology of Alastrim and their Significance in the Variola-Alastrim Problem" (Lloyd Roberts Lecture).

Tuesday, November 26

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION), at 4.30.—H. C. Sampson: "The Tana River Region of Kenya Colony".

ROYAL INSTITUTION, at 5.15.—Prof. Edward Mellanby: "A Survey of Modern Views on Nutrition" (succeeding lectures on December 3, 10 and 17).

Wednesday, November 27

ROYAL SOCIETY OF ARTS, at 8.—F. A. Secrett: "Modern Methods of Vegetable Production and Marketing".

Friday, November 29

QUEEN MARY COLLEGE (CHEMICAL COLLOQUIUM), at 5.—Prof. H. Freundlich: "Some Recent Developments in Colloid Science".*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. A. V. Hill: "Muscles and Nerves: Posture, Power and Communications in the Body" (Thomas Hawksley Lecture).

ROYAL INSTITUTION, at 9.—Sir James Jeans: "The Size and Age of the Universe".

Saturday, November 30

ROYAL SOCIETY, at 2.30.—Anniversary Meeting.
Sir Frederick Gowland Hopkins: Presidential Address.

Official Publications Received

Great Britain and Ireland

Public Museum, Gloucester. Occasional Papers, No. 3: Romano-British Pottery from the Site of the Girls' High School, Denmark Road, Gloucester, and a Romano-British Grave Group from Gloucester. By Charles Green. Pp. 8. (Gloucester: Public Museum.) 2*d*. [411

Aeronautical Research Committee. Report for the Year 1934–35. Pp. iv+74+4 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [511

Chemistry and the Body Politic. By Sir William H. Bragg. (The Seventh S. M. Gluckstein Memorial Lecture, 1935.) Pp. 18. (London: Institute of Chemistry.) [511

County Council of the West Riding of Yorkshire: Education Committee. Thirty-first Annual Report of the Education Committee for the Year ended 31st March 1935. Pp. 56. Report on the Examination for County Minor Scholarships, 1935. Pp. 38. Handbook of the Education Committee, Part 2: Higher Education. Section 10: Regulations relating to Scholarships and Exhibitions and the Training of Teachers, 1936. Pp. iii+44. (Wakefield: Education Office.) [511

Philosophical Transactions of the Royal Society of London. Series A, No. 747: III—The Structure and Physical Properties of Thin Films of Metal on Solid Surfaces. By Prof. E. N. da C. Andrade and Dr. J. G. Martindale. Pp. 69–100+plates 13–20. (London: Harrison and Sons, Ltd.) [511

Tropical Diseases Bulletin. Vol. 32, Supplement: Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year 1933. Summarized by Dr. H. Harold Scott. (Fifth Annual Issue.) Pp. 280. (London: Bureau of Hygiene and Tropical Diseases.) 7*s*. 6*d*. net. [611

The Calculus of Plenty (The Norman Lockyer Lecture, 1935.) By Sir Josiah Stamp. Pp. 35. (London: British Science Guild.) 1*s*. [1311

Other Countries

Newfoundland: Department of Natural Resources: Division of Fishery Research. Vol. 2, No. 3: Annual Report of Fishery Research Laboratory, 1934. Pp. 79+2 plates. 1 dollar. Vol. 2, No. 4: The Dried Codfish Industry. By Dr. N. L. Macpherson. Pp. 57. 50 cents. St. John's: Department of Natural Resources.) [211

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 10: Über Flächen und Kurven (14); Beiträge zur Geometrie der Kreise und Kugeln (14). Von Söji Matsumura. Pp. 245–264. (Tôkyô: Maruzen Co., Ltd.; Taihoku: Taiwan Nichi-Nichi Shinpô-Sha.) [411

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1934. Pp. ii+107. (Bangalore: Indian Institute of Science.) [411

Proceedings of the Fourth Silvicultural Conference, Dehra Dun, October 28th–November 4th, 1934. Pp. 11+318. (Simla: Government of India Press.) [411

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 3: Parent Education Opportunities. By Ellen C. Lombard. Pp. viii+54. 10 cents. Bulletin, 1935, No. 4: Compulsory School Attendance Laws and their Administration. By Walter S. Deffenbaugh and Ward W. Keesecker. Pp. vii+96. 10 cents. Pamphlet No. 63: The Education of Native and Minority Groups; a Bibliography, 1932-34. By Katherine M. Cook and Florence E. Reynolds. Pp. 25. 5 cents. (Washington, D.C.: Government Printing Office.) [511

Union of South Africa: Department of Mines: Geological Survey. The Geology of portion of the Country East of Steytlerville, Cape Province: an Explanation of Sheet No. 150 (Sundays River). By S. H. Haughton; with a Chapter on Underground Water Resources, by H. F. Frommurze. Pp. 44. (Pretoria: Government Printing Office.) 5*s*., including Map. [511

The Museum Journal. Vol. 24, Nos. 2–3: Evidence of Early Man in North America. By Edgar B. Howard. Pp. 53–176. (Philadelphia: University of Pennsylvania.) 1.50 dollars. [511

Smithsonian Miscellaneous Collections. Vol. 94, No. 8: The Manahoac Tribes in Virginia, 1608. By David I. Bushnell, Jr. (Publication 3337.) Pp. iv+56+21 plates. Vol. 94, No. 11: Melanesians and Australians and the Peopling of America. By Aleš Hrdlička. (Publication 3341.) Pp. ii+58. (Washington, D.C.: Smithsonian Institution.) [511

Contributions from the Arnold Arboretum of Harvard University. 9: The Species of Tradescantia Indigenous to the United States. By Edgar Anderson and Robert E. Woodson. Pp. 132+12 plates. (Jamaica Plain, Mass.: Harvard University.) 2.25 dollars. [711

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 129: On the Transverse Vibration of a Square Plate with Four Clamped Edges. By Susumu Tomotika. Pp. 299–328. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 30 sen. [811

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. Descriptions of New Birds from Peru and Ecuador, with Critical Notes on other Little-known Species. By M. A. Carriker, Jr. Pp. 343–359. (Philadelphia: Academy of Natural Sciences.) [811

U.S. Department of Agriculture. Miscellaneous Publication No. 226: The Tobacco and Solanum Weevils of the Genus Trichobaris. By H. S. Barber. Pp. 28. (Washington, D.C.: Government Printing Office.) 5 cents. [811

Smithsonian Miscellaneous Collections. Vol. 94, No. 12: Mount St. Katherine, an excellent Solar-Radiation Station. By C. G. Abbot. (Publication 3342.) Pp. ii+11+2 plates. (Washington, D.C.: Smithsonian Institution.) [1111

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 6: Items 2608–2727, April, May, June, 1935. By Ernest A. Hodgson. Pp. 117–138. (Ottawa: King's Printer.) 25 cents. [1111

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1934. Pp. v+46. (Trinidad: Imperial College of Tropical Agriculture.) 6*d*. [1111

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi, 1928 to 1931. Observed and reduced under the direction of Dr. J. M. Baldwin. Pp. vi+146. (Melbourne: Government Printer.) [1111

National Geological Survey of China. Geological Memoirs, Series A, No. 14: Physiographic History of the Yangtze. By G. B. Barbour. Pp. iii+112+2 plates. Palaeontologia Sinica. Series C, Vol. 9, Fascicle 2: Miscellaneous Mammalian Fossils from Shansi and Honan. By C. C. Young. Pp. 56+7 plates. (Peiping: National Geological Survey of China.) [1111

Catalogues

Marmite (Yeast Extract) in Preventive and Curative Medicine. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

Alumina Laboratory Ware. Pp. 8. (Wallsend-on-Tyne: The Thermal Syndicate, Ltd.)