NATURE

SATURDAY, MARCH 17, 1928.

CONTENTS.

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

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

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

No. 3046, Vol. 121]

Industrial Research Laboratories.[1]

THE National Research Council of the National Academy of Sciences, Washington, has recently published the third edition (revised and enlarged) of a bulletin on the industrial research laboratories of the United States, including consulting research laboratories. The original publication, compiled in 1920, listed about 300 industrial laboratories; the first revision, in August 1921, included 526 laboratories; and the present revision contains data for 1000 laboratories. The survey does not include laboratories connected with Federal, State, or municipal governments, or with educational institutions, and it is limited to the laboratories rather than organisations supporting research. It is claimed not that the present compilation represents a complete list of the industrial research laboratories, but that it probably gives a "fair survey of industrial research" in the United States. Under each entry there are given: the name and address of the company and address of the laboratory if different from that of the company; the name of the director of research and the number of his staff; and the chief lines of research work. In addition to the alphabetical list of laboratories, there are a subject classification and a geographical classification.

The value and quality of the information given in the bulletin must, of course, depend largely on the method of compilation. It is stated that all the information has been obtained directly by correspondence. Moreover, no investigation was made to ascertain the character of any laboratory listed nor the quality of the work done. *Questionnaires* were sent to about 1500 firms, and the information given is based mainly upon the replies received to these *questionnaires*. It will be realised that the answers supplied in this way must vary in quality and accuracy. The conscientious firm will be careful not to include, in its enumeration of research staff, employees who are little better than technical craftsmen engaged in routine testing, and will be scrupulous to distinguish between genuine industrial research and the mere checking of works products. On the other hand, the less conscientious firm, anxious to make some sort of a 'splash' in a comprehensive record of national research agencies, will be inclined to include employees who can only by a long stretch be brought into the category of research workers, and to look upon mere repetitive

[1] *Bulletin of the National Research Council, No. 60:* Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Third edition, revised and enlarged. Compiled by Clarence J. West and Ervye L. Risher. Pp. 153. (Washington D.C.: National Academy of Sciences.) 1 dollar.

testing as being, in a sense, industrial research. Nothing is said in the bulletin as to whether the *questionnaire* sent out indicated the criteria by which a firm was to decide whether it had, or had not, a veritable industrial research laboratory, meet for inclusion in the list.

Bearing in mind these qualifying considerations, we must, nevertheless, admit that the publication affords remarkable evidence of the variety and extent of the industrial research being prosecuted in the United States, the firms enumerated ranging from such a body as the Bell Telephone Laboratories, Incorporated, with its staff of 2000 full-time research workers, to firms claiming only a single research worker who—it is occasionally admitted—is engaged "intermittently" on research problems. One gets a picture—perhaps not more than a flashlight picture—of a thousand industrial laboratories engaged in the task of winning the scientific knowledge and elucidating the scientific principles involved in many hundreds of varied industries; and in devising ways of applying to industrial practice the science so acquired, so as to cheapen or improve existing materials, to find new materials, to discover new processes and, generally, to raise the level of production in quantity, quality, and variety, while lowering its cost. If we envisage this scientific work associated with the contemporaneous movement, organised on a national scale, for the elimination of waste, and with corresponding developments in business organisation, scientific management, advertising efficiency, and methods of distribution, we shall understand—without taking into account the favourable monetary position of the United States—what formidable competitors in international trade American firms and corporations as a whole must be.

A few salient features of the bulletin may be noticed. In glancing through it we meet, as we should expect to meet, abundant evidence of the provision made for industrial research by those industries which have, as it were, sprung from the loins of science—for example, the chemical, electrical, and optical industries. What is significant is the evidence of a growing application of scientific research to industries hitherto largely empirical, with little or no scientific tradition behind them—industries that, like Topsy, simply 'growed.' To take a few examples only, we find industrial research laboratories dealing with baking, flour and foods, canning and preserving, fruit and fruit products, building materials, fur products, laundering and milk. There are a few laboratories maintained by the co-operation of several firms in the same industry organised as research associations; but, for the most part, the laboratories enumerated are parts and parcels of the industrial organisations of individual firms and corporations. Their number is significant of the extent to which science is gaining domicile within the industrial units.

The Mellon Institute of Industrial Research, at the University of Pittsburgh, is in a class by itself. Its work is carried on under the Industrial Fellowship System of Robert Kennedy Duncan. Individual firms or groups of firms provide the funds for the maintenance of one or more industrial fellows whose full time is given to the investigation of technological problems that require protracted periods—a year or longer in each case—for their satisfactory solution. The industrial fellows at present comprise 79 chemists, 10 ceramists, 10 engineers, and 3 biologists, and they are engaged upon sixty different lines of scientific investigation.

It is probably true that the greater part of the scientific work done in these industrial research laboratories, taken as a whole, is directed to the immediate problems of the respective firms or industries; but, even so, it must involve some, perhaps much, fundamental research. In the laboratories of the larger firms or corporations a great deal of fundamental research—research in pure science—is deliberately planned and undertaken on broad lines, irrespective of any prospect of immediate industrial benefits, because it is realised that such scientific research is the fountain from which the streams of applied science must flow.

We need a similar compilation of industrial research laboratories for Great Britain, so that we may see in some measure how we stand. Are the individual industrial firms in this country calling in science to redress the balance of international competition? No doubt the big industrial corporations are devoting considerable expenditure and human effort to scientific investigation, and the modern tendency towards greater industrial aggregations, by the combination of smaller firms, will increase the facilities for more extensive scientific research. But a great area of British industry is occupied by small or medium-sized firms, directed by strongly individualistic owners, where the industrial units are too small to enable industrial research, on any adequate scale, to be carried on individually. Much has been done to provide the industrial research needed in this area by the establishment of the research associations formed under the ægis of the Department of Scientific and Industrial Research. These associations are like

the research associations in the United States, in that they are financed on a co-operative basis, but they differ from the American associations in that they are partly financed by grants-in-aid from the Government and they are more numerous and cover a wider and more diversified industrial field. For this area of numerous and varied medium-sized or small firms, they constitute probably the only practicable scheme for securing the prosecution of scientific research in the closest association with industrial effort—for getting the relevant industries saturated with science—and their future existence and development is a matter of national concern.

The census of production, imperfect though it be, has already been of great industrial value in enabling us to appreciate our economic position. A most useful supplement to such a census would be the publication of a conspectus of all the industrial research laboratories in Great Britain, especially if it could be ensured that only laboratories and workers engaged in veritable industrial research were included. Such a return, though it might disturb our complacency, would be likely to quicken our sense of the leeway to be made up, in this matter of applying science to industry, if we are to meet in the open markets of the world our chief foreign competitors — notably the United States and Germany—on at least equal terms.

J. W. WILLIAMSON.

A Record of a Dying People.

The Arunta: a Study of a Stone Age People. By Sir Baldwin Spencer and the late F. J. Gillen. In two volumes. Vol. 1. Pp. xxviii + 390 + 87 plates. Vol. 2. Pp. xvi + 391-646 + 64 plates. (London: Macmillan and Co., Ltd., 1927.) 36*s*. net.

NO anthropological book has had so favourable a reception or given rise to such voluminous discussions as "The Native Tribes of Central Australia," by Prof. Baldwin Spencer and F. J. Gillen, on its publication in 1899. Twenty-eight years later, Sir Baldwin Spencer has issued a new edition under the title of "The Arunta." The first edition was the result of several years' work; in the new edition is embodied the record of later investigations down to 1926, and thus the accounts of imperfect or partly understood native ceremonies and beliefs have been amplified and rectified. Comparison between the two editions will show, however, that a great deal has remained unchanged, because the earlier contained careful descriptions of what the authors actually observed, and being a record of facts, must remain valid for all time. It is in such matters that the anthropologist has the advantage over most scientific men, for observations in the field when made, as in the case of the Australian, on a vanishing people, cannot be repeated by future students, and therefore researches of this kind will never become out-of-date. The impossibility in many cases of subsequent checking of his statements thus imposes on the anthropological observer a grave responsibility. Sir Baldwin Spencer was a scientifically trained zoologist when he began to study the natives of Central Australia, and we can rely entirely on his account of what he witnessed. The late Mr. Gillen had for a long time gained the confidence of the natives and was thus an indispensable colleague.

The discussions alluded to above necessitated a reconsideration of certain interpretations and a new inquiry into some of the statements previously made and into the belief of the natives. Sir Baldwin has done his best to clear up these matters. Not long after the publication of the first edition, the investigations made by the late Rev. C. Strehlow were published in a series of papers in the *Veröffentlichungen aus dem Städtischen Völker-Museum*, Frankfurt-am-Main, and these were accepted as authoritative by German anthropologists, and most English students took them very seriously. The earlier parts were edited by the late M. F. von Leonhardi, who in the 'Vorrede' to the 1910 issue strongly supported Strehlow against his critics. Certain discrepancies between the observations of the German and English investigators have been ascribed in part to their working among different sections of the great Arunta tribe. It also seems that there were definite limitations attached to the researches of Strehlow, so that, despite his mastery of the language, he was unable to partake in personal experience of the ceremonial life of the natives which the lay investigators were able to obtain. It is, moreover, a common experience that for obvious reasons missionaries cannot always persuade natives to disclose their secret and sacred beliefs and practices. Sir Baldwin has discussed, in foot-notes and appendices, some of the points in which the two accounts varied or differed. We have, therefore, in this book the matured judgment of the author on subjects that required elucidation.

It will be noted that in the new book there has been a slight rearrangement of certain sections, and some have been enlarged, such as that on "Social Organisation," though in this section allusions to the social organisation of neighbouring tribes has been omitted. The earlier discussion

following the account of " knocking out of teeth " has been greatly abbreviated, and the comparison with other tribes has been omitted, but, fortunately, references to the customs of neighbouring tribes are usually retained elsewhere. Attention should also be directed to the fact that there are a few alterations in the spelling of native words, or even in the words themselves. It will be necessary for all those who have made notes for lecture or other purposes to go over these carefully with the new book, as throughout this work there are many modifications, more especially in the account of religious beliefs. The description of the stone implements has been greatly enlarged and more fully illustrated, and improvements have been made in the parts dealing with material culture and decorative art. There are nearly twice as many illustrations in the new book as there were in the old, and so, being of excellent quality and carefully printed, they add very greatly to the value of the book.

As occurs elsewhere in Australia and also in parts of Melanesia, physical differences are said to characterise the two moieties ; here one is supposed to have straight and the other curly hair (vol. 1, p. 42). Forty samples of hair were collected and given to Dr. O. W. Tiegs for examination ; his report is reprinted in Appendix E, in which he says he cannot confirm the aboriginals' belief, though from blood tests on South Australian natives there is evidence to show that a mixture of ' blood ' has occurred. " This suggests that the widespread idea of the aboriginal that he is composed of two distinct races, still recognisable by their straight and wavy hair, is a tradition which has descended from a past age, when a wavy- and a straight-haired race existed, and that these two races have now largely fused " (vol. 2, p. 599).

In the earlier discussions on the Arunta, emphasis was laid by some on their very primitive character ; indeed, some regarded them as the most primitive of all people, and this in face of the elaborate ceremonies, complicated social system, and the fact that " the traditions of the tribe recognise four more or less distinct periods in the Alcheringa " (" The Native Tribes of Central Australia," p. 387). The periods and the cultural innovations which characterised them were also summarised (*l.c.* p. 421). The evidence in the new book confirms this. Except for a few objects of material culture, the Andamanese, to take but one people, are much 'lower' than the Arunta or any Australian tribe.

In the far distant Alchera time, a few superhuman beings called Nŭmbăkŭlla brought elements of culture to the Inapătua creatures (*i.e.* incomplete human beings), whom we may regard as being the very backward aboriginal population ; these were made into men, doubtless through the instrumentality of initiation ceremonies. The culture-bearers brought the *churinga* and reorganised social relations. There is thus traditional evidence of cultural movements which ultimately affected the whole of Australia—just as in New Guinea and Melanesia we find analogous cultural drifts. Migrations of culture are due (1) in some cases simply to the borrowing of elements of culture from neighbours ; (2) in others, there is a definite introduction of culture by means of a limited number of persons who appear to be more advanced members of the same race as the recipients, or at all events closely related ; (3) in a few cases there is evidence that the immigrants belong to an alien race. In Australia, the evidence seems to point to the first and second of these alternatives, as it does in New Guinea as a whole. There is also good reason to believe, as indeed is most probable, that this cultural drift came from New Guinea.

A. C. HADDON.

Geology of the Alps.

(1) *The Structure of the Alps.* By Prof. Léon W. Collet. Pp. xii + 290 + 12 plates. (London : Edward Arnold and Co., 1927.) 16*s.* net.

(2) *Die Deckentheorie in den Alpen* (*Alpine Tektonik, 1905–1925*). Von Prof. Dr. Franz Heritsch. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 6, Heft 17.) Pp. iv + 75-210. (Berlin : Gebrüder Borntraeger, 1927.) 8 gold marks.

NOT the least fascinating of the many aspects of Alpine studies is that of the geological history and growth of the elevated region from which the peaks as we see them have been carved. With good cause has it been claimed that the synthesis of the Alps is that of the mountain-mass in general. In the two books before us the authors have set forth the latest views of Alpine tectonics, particularly those of recent developments of the theory of *nappes* or *Decken*. In the Alps, between two rigid massifs of rocks, folded and metamorphosed in Palæozoic and possibly pre-Palæozoic times, is found a zone of well-bedded Mesozoic and Cainozoic sediments. Movement of the southern massif towards the northern caused buckling in the intermediate region, and the folds thus developed were overturned and finally squeezed out and expelled north-westwards as great overlapping sheets (*nappes de recouvrement, Deckfalten*).

More than twenty of these nappes can be recognised: they lie one above another, folded and rippled in their upper portions, but drawn-out, sheared, and torn in their lower limbs. Different nappes may be folded with or may envelop one another. The later folds deform the older and, like waves, break and splash north-westwards over them. In places the upper nappes, by their forward movement, are supposed to have set in motion the lower and less extensive sheets. Where resistance to movement varied (as, for example, in the area between the Mont Blanc and Aar massifs), the nappes, retarded laterally, may swell forward into arcs or festoons of arcs, and exhibit fold 'virgation.' From the brow of a nappe in the north or north-east to its roots in the south or south-east, the translation of the rocks may amount to more than 100 km.

Such is the fascinating conception of the theory of nappes or Decken. In Prof. Collet's book, which will be welcomed as the first exposition in English of these views, Alpine problems are considered almost (if not exclusively) from the viewpoint outlined above. Prof. Heritsch's work, however, goes much farther than its title might suggest; it summarises the evidence for and against views of Alpine tectonics which seem irreconcilable.

(1) There is no question that Prof. Collet's book will serve a very useful purpose in attracting the interest of travellers to the geology of the Alps; students in universities and schools will doubtless also be grateful to him for his lucid treatment of a difficult subject. At the outset, the author introduces the reader to the fundamental conception of the Alpine geosynclines or large basins of deposition, and their intermediate geanticlines or ridges. The margins of the basins yielded the autochthonous sequences and the deeper parts supplied the rock-successions of nappes. These principles are applied to the elucidation of various regions in turn. In the Mont Blanc area the granite is thrust northwards over the sedimentary zone of Chamonix and is separated by it from the ancient mass of the Aiguilles Rouges. The Aar Massif and High Calcareous Alps, with their autochthonous and parautochthonous rocks (the latter term not being defined except by implication), are illustrated by excellent descriptions of the districts of Kandersteg and Grindelwald, of Jungfrau, Mönch, etc.

These accounts are given in a form which will enable visitors to the Alps to search out the evidence for themselves, especially if they are also provided with the excellent geological guides of the Swiss Alpine Club; we cannot therefore grudge the space devoted to them, particularly as they embody the results of much of the excellent and arduous investigations of Prof. Collet himself. Some readers, however, may wish that the space occupied by 24 pages on the Jura Mountains had been at any rate in part devoted to the expansion of the account of the Glarus Alps or the wonderful Klippen (nappe-outliers) of the Pre-Alps of northern Switzerland.

The Pennine Nappes, the piling-up of which has produced the Valais Alps, are interpreted in the light of Argand's work, and are so described that geological study may be combined with climbing and sightseeing at such resorts as Arolla, Zermatt, and the Upper Engadine. Eastwards, the great half-window of the Swiss Alps is closed on the famous 'Rhine-line' from Constance to Chur, for the Aar massif and older nappes plunge beneath the later sheets which form the Eastern Alps (the Austrides of R. Staub). Prof. Collet makes a praiseworthy effort to render clear the succession and relationship of the nappes of the Eastern Alps, according to the view of Termier, Kober, R. Staub, and others, but the necessarily condensed form of the account and the absence of detailed locality-maps will render this section difficult for students.

Prof. Collet writes with such freshness and vigour that we fear the reader may forget that the Decken theory in its wider implications is but a theory. In a book of this size it is perhaps difficult for an author to separate evidence from speculation. It is a little tantalising, however, to be told, without being informed of the evidence, that the Alps provide "a great support to Wegener's theory" (p. 22), or that (p. 246) "We shall see, later on, that the higher Prealps . . . represent a small part of Africa resting on Europe." Unfortunately, Africa is not mentioned again in the book. True, it is postulated that the northward-drifting of Africa (or Gondwanaland) closed the geosyncline (the Tethys of Suess), the sediments of which were forced upwards and forwards to build the Alps, the underlying sima being injected as basic intrusions in the Pennine nappes. The existing Mediterranean area is then regarded by Argand and Staub as due to distension produced by the drift of Europe away from Africa. But this is hypothesis, albeit brilliant.

The extensive bibliographies form a valuable feature of the book. A glossary, with an explanation of the terms as ordinarily used in Britain, would also help non-geological readers.

(2) Prof. Heritsch's review of the progress of investigation of the Alps is a publication of an entirely different character. It is a compilation

certain to be of the utmost service to those who wish to undertake a serious study of Alpine tectonics and to appraise the evidence leading up to the different interpretations of the complicated structures. Its bibliographical details alone are of great value. Prof. Heritsch himself has done much original and valuable work in the Eastern Alps, but although he calls himself an opponent of the Decken theory so far as that region is concerned, he spares no trouble to set out the views of its various supporters, paying frequent tributes to the publications of Albert Heim, Rudolf Staub, and other exponents of it. He traces the history of Alpine investigation and the development of the 'mushroom,' overthrust and Decken theories. To make clear his later discussion he gives an admirable account of the terminology and rationale of the Decken theory. A brief description of the structure of the Swiss Alps forms a prelude to a comparison with the Eastern Alps. A detailed account of the tectonics of the latter and an exposition of the conflicting views constitutes the greater part of the book. Incidentally, the character of the famous 'window' of Hohe Tauern is discussed in some detail.

Finally, the age of the several phases of the mountain-building movements, the cause of the diastrophism and the difficulties of determining the age of the glyptogenetic stages, are set forth. Throughout the book the author insists on the view of the East Alpine geologists that the movements were not a unified and continuous series, but phases of crumplings separated by time-intervals. The present position in the study of Alpine tectonics may therefore be summarised by saying that, between the views of the extremists of the Swiss school on one hand and many of the Austro-Alpine geologists on the other, there is a great gulf fixed, no less deep and significant than the Tethys of Suess itself.

P. G. H. BOSWELL.

The Electron, the α-Particle, and the X-Ray.

Handbuch der Physik. Herausgegeben von H. Geiger und Karl Scheel. Band 24: *Negative und positive Strahlen, zusammenhängende Materie.* Redigiert von H. Geiger. Pp. xi + 604. (Berlin: Julius Springer, 1927.) 49·50 gold marks.

THIS important book is divided into six chapters, each of which is written by an authority on his subject; the whole is edited by Prof. Hans Geiger. Dr. Bothe gives an informed and comprehensive account of the work on the passage of electrons through matter, their velocity and ionising power, their absorption in and scattering by substances, and on the secondary rays to which the electrons give rise. The second chapter, by Prof. Rüchardt and Prof. Baerwald, deals with the passage of canal-rays through gases and solid objects; special attention is directed to the importance of the Doppler effect in canal-rays. The editor is responsible for the chapter on the passage of α-particles through matter, a subject which in the hands of Sir Ernest Rutherford and his pupils has been one of the most revealing in modern physics. This chapter, which is an excellent account of all the physical properties of the α-particle, is perhaps the best in the book.

A chapter on the absorption of γ- and X-rays by matter, which one would expect to follow the first three, is not included in this work. Instead, the subject of absorption is dropped in favour of two chapters on the structure of matter as revealed by X-ray analysts. These chapters comprise nearly half the contents of the book. The first, by Prof. Ewald, describes in detail experimental work, and covers the whole field of contemporary activity; the second, by Prof. Born and Dr. Bollnov, deals with the theoretical aspects of the structure of solid objects and includes a section on the thermodynamics of solid substances. These two chapters are without doubt the best description of the investigation of crystal structure by X-rays that has been penned. In the concluding chapter we are introduced to a third subject, that of the relation between the properties of simple chemical substances and their atomic and molecular structure; this is the work of Prof. Grimm.

The book should make a wide appeal to all physicists who wish to follow the extraordinarily interesting and varied work which has resulted from the discoveries of the electron and α-particle, and the methods of X-ray analysis in recent years. Indeed, all but the first chapter could be read with real profit by physical chemists also. Neither physicists nor chemists will find all of this book easy reading; the subjects discussed cannot of necessity be described in terms of simple ideas; but the different authors have done their best to make their subjects intelligible. They have not been content to extract from the literature the more important work and to leave it uncritically to the reader's notice; they have made a determined attempt to convey to the reader by words and diagrams what the best workers on the subject at the present time regard as most important.

Too many works of reference at the present

time give experimental results without a description of the more important methods by which these results have been obtained. In this book, with its 374 illustrations, which, although never elaborate, are always adequate, the methods of investigation are fully described. In this respect, in its comprehensiveness, in the care which both contributors and editor have given to the various chapters, and in the printing, this book is in the best German manner. A. S. R.

Social Science.

(1) *The Task of Social Hygiene.* By Havelock Ellis. New edition. Pp. xix+414. (London: Constable and Co., Ltd., 1927.) 6*s.* net.

(2) *Heredity and Human Affairs.* By Prof. E. M. East. Pp. ix+325. (New York and London: Charles Scribner's Sons, Ltd., 1927.) 16*s.* net.

(3) *The Foundations of Social Life.* By Prof. H. P. Fairchild. (Social Science Series.) Pp. vii+287. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 13*s.* 6*d.* net.

(4) *The Science of Society.* By Prof. W. G. Sumner and Prof. A. G. Keller. (Published under the Auspices of the Sumner Club on the Foundation established in Memory of Philip Hamilton McMillan, of the Class of 1894, Yale College.) Vol. 1. Pp. xxxii + 734. Vol. 2. Pp. xxii + 735-1481. Vol. 3. Pp. xxi + 1483-2251. (New Haven: Yale University Press; London: Oxford University Press, 1927.) 18*s.* net each vol.

(1) "THE Task of Social Hygiene" was first published fifteen years ago. It very well deserves the place which it has won, and a new edition needs no recommendation here. There can be few books of that date dealing with social problems of the moment which on re-reading at the present time would not seem stale. But such is the breadth and sympathy of Mr. Ellis's treatment, so illuminating is his presentation, that the book fully maintains its freshness. Mr. Ellis must be counted among the most inspiring teachers of his time, and the next generation will be fortunate if it finds someone with his depth and variety of scientific knowledge and his diversity of gifts to review its problems.

(2) Mr. Ellis may be said to be concerned with the broad problem of the right use of our growing knowledge to 'make and remake life.' Prof. East, in "Heredity and Human Affairs," is concerned with the application of our rapidly increasing knowledge of one branch of biology to the betterment of human affairs, and he has written a very readable book on this theme. It need scarcely be said that his scientific credentials to discuss problems of heredity are unimpeachable. It appears further that, unlike some of his fellow workers, he does not abandon his scientific attitude when he touches social questions, and as a result he has produced as good a book on eugenics for the general reader as exists to-day.

(3) Prof. Fairchild, in "The Foundations of Social Life," has essayed a difficult task. He has felt the need for a treatment of certain fundamental facts with which in his opinion students of any social science should be acquainted, and has therefore attempted in a short book to sketch the biological characteristics of man, his reaction to the environment, the nature of society, and the possibilities of rational control. It may perhaps be doubted whether success in so small a compass is possible, but if the attempt is to be made, it would be difficult to improve the plan of the present work. The execution of the plan is not so satisfactory. The author tends to talk down to his readers and the phrasing is sometimes loose. We may sympathise with Prof. Fairchild's desire to broaden the student's interests and to lead him to see the relation of what is to be his own special line of study to other problems. But is this the way to do it? There is certainly a danger in beginning with what is of necessity a very sketchy and inexact treatment of vast problems.

(4) There is a certain impertinence in reviewing in a few hundred words a work in three volumes containing close upon a million words that has cost one of the two authors a quarter of a century's work and his colleague a great part of the last ten years of his life. It seems that the idea of the book took shape in 1899, and that Prof. Sumner's "Folkways," published in 1907, was a development of part of the original scheme. Having treated this section in a separate work, he returned to the main task. He died in 1910, and Prof. Keller, who had been associated with him for a great number of years, has now brought the task to a conclusion, though there remains a final volume containing a case-book, bibliography, and index. The volumes are a monument of painstaking labour. The authors have spared no trouble in their search for facts, and the amount of literature consulted is immense. They present ample evidence for their generalisations. But, nevertheless, the impression left is one of disappointment. Why is this?

Let us first give in their own words the authors' intention in this work.

"In general we seek the sense of societal customs and institutions. That means to us their expediency as adjustments in living, whether or not we can come to any conclusion as to their origin. Nor do we regard it as enough merely to exhibit them as adjustments, so proved because of their survival; we hope to show also how and to what adjustment has been made."

The arrangement of the book is to describe and discuss customs and institutions classed in the following manner: (1) those having to do with self-maintenance, including (*a*) industrial organisation, (*b*) property, (*c*) regulative organisation, and (*d*) religion; (2) those having to do with self-perpetuation, including marriage and the family, and those having to do with self-gratification. The authors embark upon their immense labour with this programme and carry it through with devotion in some million words. But it fails to grip. The reader feels out for a guiding thread to lead him through the maze. There is no thread such as a truly scientific or purely descriptive treatment would have provided. The authors assume adaptation. They treat groups of customs and institutions as adaptations. They move a little way back and a little way forward by means of generalisations as they deal with each group, and then they pass on.

In many ways the treatment is reminiscent of Herbert Spencer's sociology, though the use of facts and the avoidance of grandiose generalisations render the present authors' work greatly superior. Is not the fundamental mistake this clinging to the conception of adaptation? Unless it is analysed, it is a truism of little value. In a sense every institution shows adaptation. But when the term is analysed it is found to cover many different conditions. Without analysis it is a vague and unsatisfactory conception. Upon analysis it leads to problems that demand a treatment quite other than that given in this book. Furthermore, however scientific may be the attitude of the authors in their reliance upon facts and their freedom from preconceived theory, no truly scientific treatment can begin from such a starting-point.

Thus we are led to regard the plan as misconceived. Nevertheless, the book is a mine of accurate information, and in it other students can dig. But they will not dig with profit unless they study method. Methodology in social science is the most urgent study in this field to-day.

Our Bookshelf.

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 4. Pp. 267-383 + plates 7-9. (Cambridge: Bowes and Bowes, 1928.) 6*s*. net.

INCLUDED in this part are an article by the editor on Wicken Fen, and accounts of the fossil vertebrates, protozoa, planarians, cladocera, copepoda, diplopoda and chilopoda, and insects—Collembola, Coleoptera, Hemiptera-Heteroptera (Part II.), Orthoptera, Neuroptera, and sawflies. For many of the species recorded notes are added on the biology and ecology. In the account of the Coleoptera a list is given of the species which occurred in the fen districts of Cambridgeshire before 1854, but which are now not taken (26 spp.) or are less readily found, and another list of species which are now taken but were never recorded by the old collectors. Mr. Lowndes records that the same species of copepods are found living under the most varied conditions and in widely separated districts, but that these individuals do not exhibit greater differences than do those that live in any single pond. The *p*H was found not to have any direct influence on *Cyclops langvidus*—a result differing from that reached by Labbé.

Prof. Stanley Gardiner emphasises the interest of Wicken Sedge Fen as an area that has not only never been cultivated, but also has never been deliberately drained, and thus constitutes a real bit of the old fenland. Except for bush growth, the Sedge Fen is much as Ray knew it in 1660, but some plants common then are rare now. Prof. Gardiner rightly claims that Wicken Fen is not only a "place of historic interest and of natural beauty," but also is the one place from which the history of the changes in the fauna and flora of the wet lands of England can be deduced with reasonable exactness. We congratulate him and his co-workers on these further results of their investigations, which are not only of great interest in themselves, but will also afford trustworthy information to our successors for comparison with conditions in their time.

Ministry of Agriculture and Fisheries. Fishery Investigations. Series 2, Vol. 9, No. 2, 1926. *Plaice-egg Production in 1920–21, treated as a Statistical Problem, with Comparison between the Data from 1911, 1914 and 1921.* H. J. Buchanan-Wollaston. Pp. 36 + 11 charts. (London: H.M. Stationery Office, 1926.) 8*s*. 6*d*. net.

QUANTITATIVE studies of living organisms in their natural habitats have a biological and mathematical interest far beyond the technical purposes for which they are usually made. The study of plaice-egg productions treated as a statistical problem by H. J. Buchanan-Wollaston affords a good example both of the interest and of the difficulties of such research. The report deals with egg counts of samples taken with the Hensen net in 1920–21, and comparison of the egg distributions inferred from these and earlier methods

for 1911, 1914 and 1921. The mathematical methods are explained in a series of interesting appendices. These methods have a somewhat home-made appearance, and should not yet be regarded as standardised. Applied intelligently, and with a constant effort to keep in touch with the realities to be represented, they seem well suited to the immediate problem.

The statistical terminology is not always happy; terms like 'datum solid' used when 'frequency surface' seems to be intended, tend to obscure the essential contrast between *data* and *quæsita*. Much mathematical work will evidently be necessary before an adequate procedure is evolved, since the observations are necessarily sparse and are not simultaneous. The reviewer would judge that the full value of the observations will not be made available until the distribution problems involved are treated by methods of fitting rather than by methods of interpolation. R. A. F.

A Course of Modern Analysis: an Introduction to the General Theory of Infinite Processes and of Analytic Functions; with an Account of the Principal Transcendental Functions. By Prof. E. T. Whittaker and Prof. G. N. Watson. Fourth edition. Pp. vi + 608. (Cambridge: At the University Press, 1927.) 40*s.* net.

WITH the exception of certain corrections and additions, the fourth edition of this comprehensive work differs in no material respect from the third edition published in 1920. "Whittaker and Watson" has entered and held the field as the standard book of reference in English on the applications of analysis to the transcendental functions. This end has been successfully achieved by following the sensible course of explaining the methods of modern analysis in the first part of the book and then proceeding to a detailed discussion of the transcendental functions, unhampered by the necessity of continually proving new theorems for special applications. In this way the authors have succeeded in being rigorous without imposing on the reader the mass of detail which so often tends to make a rigorous demonstration tedious.

The book is admirably printed. The only faults which have been noticed are the omission of the upper and lower bar in the definitions of the 'upper' and 'lower' Riemann Integral (§ 4·11) and the omission of the line in the fraction on the right of the first identity in § 13·14. These are insignificant defects in a fine work which makes accessible a continuous account of methods recorded in a scattered series of memoirs. L. M. M.-T.

Blut und blutbildende Organe menschlicher Embryonen. By Dr. W. Knoll. (Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band 64, Abl. 1.) Pp. ii + 81 + 9 Tafeln. (Zürich: Gebr. Fretz A.-G., 1927.) n.p.

OPPORTUNITIES for the examination of fresh human tissues are of such rare occurrence that the present monograph will be greeted with interest by cytologists and medical hæmatologists. Dr. Knoll has been fortunate enough to collect human embryos in a living condition by surgical removal of the uterine contents through an abdominal incision, in twenty-eight interrupted pregnancies. He has undertaken a detailed examination of the various cellular structures in human embryonic blood, not only in permanent sections of the rapidly fixed embryo, but also in blood films prepared by the more modern hæmatological methods; especially interesting is the examination of fresh embryonic cells in hirundinised plasma. The physical characters and staining affinity of the various types of cells are analysed and also the oxidase reaction studied. Dr. Knoll's technique is presented in detail; for the oxidase reaction he uses a mixture of 1 per cent. α-naphthol in normal saline and 1 per cent. di-methyl-para-phenylene-diamine base.

The work is well illustrated and contains nine magnificently reproduced plates in colour presenting the details of the blood cells and stages in their development.

Coup d'œil sur la théorie des déterminants supérieurs dans son état actuel. Par Maurice Lecat. Pp. viii + 100. (Bruxelles: Maurice Lamertin, 1927.) 16 francs.

THE matrix in n-dimensions was originated by Cayley and Sylvester. It is quite possible that this purely algebraic conception may find a physical application in space of more than two dimensions. The contributions of M. Lecat to our knowledge of this subject are many, and the present summary is a forerunner of a treatise in three volumes to be published shortly, in which the original researches of the author will be more fully treated. The symbol of Kronecker which figures largely in the exposition is not defined. It may help the reader to note that this symbol $\delta_{i,j}$ is equal to unity if $i=j$ and is zero if $i \neq j$.

Physics for School Certificate (Heat, Light and Sound): a Revision Course. By W. Littler. Pp. 231. (Exeter: A. Wheaton and Co., Ltd., 1927.) 3*s.*

THIS is frankly a revision course. It contains the information required by the examiners in a reasonably small compass, and should prove useful in any school in which the chief object of including physics in the curriculum is to provide another subject for the school certificate examination. That there is a demand for such books is a serious criticism of the relative functions of schools and examinations.

Examen des différentes méthodes employées pour résoudre les problèmes de géométrie. Par G. Lamé. Pp. xii + 124 + 2 planches. (Paris: J. Hermann, n.d.) 21 francs.

A SIMPLE reprint, without introduction or notes, of an early work on algebraic geometry, first published at Paris in 1818. It is important historically as being the first book in which it was remarked that all curves (or surfaces) of order n which pass through the points common to two, $f=0$ and $g=0$, of this order, are represented by equations of the form $f+\lambda g=0$.

Letters to the Editor.

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

The Origin of the Nebulium Spectrum.

In a letter to NATURE of Oct. 1, 1927, p. 473, Mr. Bowen has announced the very interesting relationship that some of the lines of unknown origin which are found in the nebulæ and in the Wolf-Rayet stars and were so long attributed to a hypothetical element nebulium, are really due to ionised light elements like O^{++}, N^{++}, O^{+}, N^{+} . . . ; they do not arise from the transitions usually allowed, but are due to transitions which are usually prohibited. Prof. A. Fowler has also lent his support to this hypothesis. The object of this note is to discuss the nature of these transitions.

Mr. Bowen finds that the following well-known trio of nebulium lines are due to O^{++}, and due to transitions shown below :

5006·84	$^3P_2 - {}^1\bar{D}_2$
4958·91	$^3P_1 - {}^1\bar{D}_2$
4363·21	$^3P_1 - {}^1\bar{S}_0$

The structure diagram of O^{++} is shown below :

O^{++} . . . $2K\ 2L_1\ L_2$

$$M_1 \longrightarrow M_2 \longrightarrow M_3.$$

$2L_2(p^2)$ gives us $^3P_{0\ 1\ 2}$, $^1\bar{D}_2$, $^1\bar{S}_0$.

All other four-valence elements, namely, C, N^{+}, O^{++}, . . . and C, Si, Ge, Sn, Pb have similar ground levels due to the electron-configuration p^2, that is, two electrons in p- (or L) orbits. The lines arise from transitions between metastable levels as pointed out by Bowen. It is interesting to note that though such transitions are not found in the spectra of light elements, they are of frequent occurrence in the spectra of heavy elements. In the spectrum of Pb, which is analogous to that of O^{++}, the values of the fundamental levels are

$^3P_0$	$^3P_1$	$^3P_2$	$^1\bar{D}_2$	$^1\bar{S}_0$
59821	52004	49173	38365	30355

Dr. Sur (*Phil. Mag.*, vol. 2, p. 623; 1926) in this laboratory found that the following lines exactly analogous to the above-mentioned nebulium lines are obtained in the heavy arc of lead. They are not present in the usual arc :

$$^3P_1 - {}^1\bar{D}_2 = \nu 13637, \quad \lambda = 7330 \text{ A.}$$
$$^3P_1 - {}^1\bar{S}_0 = \nu 21649, \quad \lambda = 4618 \text{ A.}$$

Other elements of the same group, namely, C, Si, Ge, Sn, can theoretically give similar lines, as the following Table shows, but a scrutiny of the existing literature shows that they have not yet been obtained. Whether they can be obtained in the heavy arc is yet to be seen.

$^3P_1 - {}^1\bar{S}_0$ for C	?
Si	$\nu 15317$
Ge	$\nu 15810$
Sn	$\nu 19101$

Let us now consider the nature of violation of the selection principle. I have shown that in the case of complex spectra the selection principle can best be explained not in terms of the different quantum numbers, but in terms of *electron transition*. Thus $pp \longrightarrow ps$ or $pp \longrightarrow pd$ transitions are allowed (one electron changing from the p-orbit to the s-orbit, or the d-orbit, corresponding to $\Delta k = \pm 1$ where k = azimuthal quantum number), but $pp \longrightarrow pp$ transitions are not allowed ($\Delta k = 0$). In terms of the structure diagram, this means that only those transitions are allowed in which the total number of electron transitions is odd. Hence the transition involved in the origin of the nebulium lines really violates the selection principle $\Delta k = \pm 1$; we have here $\Delta k = 0$, and in addition $\Delta n = 0$ (change of total quantum number $n = 0$).

It is well known from the experiments of Koch on helium and other subsequent experiments, as well as from theoretical considerations, that such violations take place when the region where the spectrum is produced is traversed by a big electric field, or in regions where the free charge density is high. In heavy elements, the principle is easily violated, because the central atomic field deviates largely from the radial. A big external electric field, or free electric charges, would help the process, where such internal fields are not present, as in light elements, or are insufficient. Such, in fact, is the interpretation to be put on Dr. Sur's results. Similarly, in other heavy elements, namely, Bi, Th, Au, prohibited transitions of this type are very frequent.

Bowen's interpretation of the nebulium lines as being due to prohibited transitions in light elements therefore implies that unusually big electric fields are present in nebulæ and Wolf-Rayet stars. This can be explained, because, owing to the extremely high temperature, matter must be in a very highly ionised state, and large fluctuations of electrical density, owing to accumulation of charges of one sign, must be very frequent. Bowen further finds that besides these lines, lines due to the transitions $L_2M_1 \longrightarrow L_2M_2$ and $L_2M_2 \longleftarrow L_2M_3$ of O^{++} are obtained in these stars. The fact that the electron, while returning from the higher excited group of orbits (due to L_2M_2), appears to linger too long in the less stable $^1D_2$ of the L_2L_2 combination, is to be attributed to this big electric field.

MEGHNAD SAHA.
The University, Allahabad.

Fluorescence of Mercury Vapour.

An experiment with a double bulb of quartz containing mercury *in vacuo* and heated to a constant temperature, which showed fluorescence under illumination by the light of an aluminium spark only when one of the bulbs was cooled by an air blast, has been cited by one of us as proof that only distilling mercury vapour exhibits the phenomenon. This has been denied by Niewodnizanski, who obtained brilliant fluorescence in stagnant vapour.

We have re-examined the matter and find that the effects observed with the double bulb are due to traces of water vapour, the distillation carrying them over into the cooler bulb and leaving only pure mercury vapour in the warmer one. We have prepared bulbs which could be made to fluoresce in either way. A double bulb fairly well degassed by long heating and pumping, when sealed from the pump, shows brilliant fluorescence at constant temperature ; if superheated locally with a flame for a few minutes, it will be found to fluoresce only when one bulb is cooled and distillation started. If now it is subjected to an electrodeless discharge by placing it between the metal plates of a high frequency oscillator ($\lambda = 2{\cdot}5$ metres), in the course of ten or fifteen minutes the discharge becomes very feeble and the bulb is now found to be in its original condition, showing fluorescence in the absence of distillation. The electrical discharge appears to have driven the water vapour back into the quartz.

Niewodnizanski also reported that the 4358 arc line of mercury appeared on his photograph with excitation by the aluminium spark, but no other mercury lines. This we find due to the fact that his spectrograph was of too low dispersion.

We find practically all of the brighter arc lines, at least in the violet and ultra-violet, and they appear to result from two stage absorption as they vary in intensity with the *square* of the intensity of the exciting light, as shown by the wire-gauze test recently described by one of us in this journal.

Lord Rayleigh has found that the disappearance of the fluorescence by superheating, which was observed by one of us many years ago, holds only for the visible band in the blue-green region. The ultra-violet band remains. The band spectrum in this case was excited electrically.

We find that, with aluminium spark excitation, superheating the vapour at constant density destroys the blue-green band and *enhances* the ultra-violet band enormously (possibly tenfold). The arc lines which appear under this excitation are also greatly enhanced by the superheating. We are now using moving streams of mercury vapour to study the time relations of these processes.

R. W. WOOD.
V. VOSS.

Johns Hopkins University,
Baltimore.

Ultra-Violet Microscopy.

IN preparation for giving a course of instruction in ultra-violet microscopy, I have had occasion to study some of the incidental problems in this subject. One of the most troublesome was the provision of a satisfactory immersion fluid, which has hitherto consisted of a mixture of glycerine and water adjusted to give homogeneous immersion for the fused quartz system at $\lambda = 0{\cdot}275\mu$. This mixture is strongly hygroscopic, and the absorption of water by the film of liquid between the objective and slide causes a gradual change of focus sometimes noticeable in a few minutes. Moreover, in the process of changing objectives, a necessary part of the present technique developed by Barnard, some of the liquid becomes smeared on the slide, where it can readily absorb water and thus contaminate the liquid on the next objective inserted in position. A 'ropy' layer of liquid appears extremely likely, and this must constitute a serious drawback and a source of uncertainty.

I have lately been able to overcome this difficulty. By means of a recently designed refractometer, I have been able to measure the ultra-violet refractive indices of cane-sugar solutions in thin films, although the liquids are sufficiently absorbent to preclude a satisfactory measurement with a hollow prism for wave-lengths which are *shorter* than the region of $\lambda = 0{\cdot}275\mu$. By interpolation from the results, it was found that a cane-sugar solution having a refractive index for sodium light $n_D = 1{\cdot}4516$ would have the required refractive index (1·4961) for the ultra-violet. Glycerine and water has to be adjusted to $n_D = 1{\cdot}4530$. These figures are approximately correct for 18° C. An Abbe refractometer is convenient in practice.

Control experiments were made by adjusting cane-sugar and glycerine solutions to the same visual refractive index and measuring the refractive index after thorough mixing; this was found to be the same within the probable error of experimental conditions. Although there are indications which would make closer investigations desirable, we may assume a zero change for the present purposes.

Solutions of cane-sugar and glycerine adjusted to the figures given above should possess the same refractive index for the ultra-violet. 10 c.c. of glycerine solution was placed in each of four stoppered tubes to which 1, 1·5, 2·0, 2·5 c.c. of cane-sugar solution respectively were added and thoroughly mixed. The liquids containing least sugar were found to be still hygroscopic, but that with most sugar was found to evaporate very slowly; all such mixtures will, on exposure to the air, absorb or evaporate until equilibrium is reached. Thus on one day the following figures were found:

Proportion of sugar . .	1	1·5	2·0	2·5
Original n_D of mixture .	1·4529	1·4528	1·4528	1·4527
Equilibrium, n_D	1·4497	1·4509	1·4527	1·4540

It is clear that the liquid with its refractive index at 1·4527 is still practically at the strength which gives homogeneous immersion for fused quartz; on another day, another liquid might be nearer; it will be advantageous to have more steps in the series. The small proportion of sugar has not been found to absorb the ultra-violet sufficiently to render its use a drawback in the slightest degree at $\lambda = 0{\cdot}275\mu$.

With such a number of mixtures constantly exposed in shallow flat open dishes, it is possible, then, to select in a few minutes a liquid which will have for the time being a practically constant refractive index, and so obtain all the advantages which have already been hinted at. To illustrate the utility of the method, an inspection should be made of the ultra-violet photograph, Fig. 1, which was taken after

FIG. 1.—Chemically deposited silver film by transmitted light. ×3200. Image given by quartz monochromat using λ0·275μ.

the apparatus had been set up and focused with the quartz lens, *and then left for more than 26 hours*; one portion of the field was then *still* in critical focus; central focus was obtained by relative displacement of the objective and stage through 0·6μ only.

The optical homogeneity of the liquid contributes materially to the possibility of high resolution. This photograph was taken with an original magnification of 800, and enlarged up to 3200. Every resolvable

detail should thus be clearly visible to unaided vision. This image is better than any we have been able to obtain of the same object using an apochromat (N.A. 1·3) and blue light ($\lambda = 0{\cdot}45\mu$), but there are reasons for thinking that the performance can be still further improved.

The fused quartz objective N.A. 1·20 was made by Messrs. R. J. Beck, Ltd., from material specially selected by thorough interferometric tests in the Technical Optics Laboratory; the design of the objective is due to Mr. R. J. Bracey, of the British Scientific Instrument Research Association. So far as the work has been successful up to the present, it is owing in no small measure to the skill and thoroughness of Mr. B. K. Johnson, who carried out the difficult refractometry necessary in the attainment of this new type of stabilised immersion liquid for the ultra-violet, and has also taken the greatest pains in the difficult initial adjustments of the microscopic apparatus.

L. C. MARTIN.

Technical Optics Department,
Imperial College of Science
and Technology
(Royal College of Science),
South Kensington, London, S.W.7,
Feb. 3.

The Pressures developed in Gaseous Explosions.

IN the current issue of the *Journal of the Chemical Society* (Jan. 1928), Dr. G. B. Maxwell and Prof. R. V. Wheeler have published a paper entitled "The Pressures produced on Inflammation of Mixtures of (*a*) Carbon Monoxide and Air, and (*b*) Hydrogen and Air in a Closed Vessel." From their carbon monoxide–air results they deduce the dissociation of carbon dioxide and offer some criticism of Fenning and Tizard's recent work (*Proc. Roy. Soc.*, A, **115**, 318; 1927). One of us has already written a criticism of Fenning and Tizard's paper (see NATURE, July 30, 1927), and we have nothing to add to the views offered in that letter, except to express the opinion that dissociation in a gaseous mixture undergoing combustion is probably very different from that in a gas heated by external means. We note with interest that the Sheffield school now recognises the reality of incomplete combustion at the moment of maximum pressure, at any rate in carbon monoxide–air explosions.

Messrs. Maxwell and Wheeler use their hydrogen–air explosions for the purpose of calculating the specific heat of steam, and they show that in explosions in which there is excess hydrogen present, so that dissociation is presumably negligible, the calculated mean specific heat ($15°$-$t°$) does not vary much between 15°-1400° and 15°-2120° C. They infer from this that the specific heat of steam does not increase over the range of 1400° to 2120° C., but it is not probable that this inference will receive much support.

It so happens that we have been engaged on this problem for some considerable time, and while we are disinclined to accept the absolute values as determined by Maxwell and Wheeler, our results suggest that the *apparent* specific heat, as calculated from explosions with excess hydrogen, does not vary greatly over a wide range of maximum temperatures. We believe that we have experimental evidence to show that these peculiar results are due to incomplete combustion of varying extent.

The method which we originally adopted was that of varying the proportion of hydrogen to air, using 'airs' containing varying ratios of nitrogen to oxygen, with the result that we have been able to make investigations over the temperature range 1400° to 2600° C., at an initial pressure of 1 atmosphere. At the lower temperatures dissociation must be negligible, and, on the assumption that combustion is complete at maximum pressure in mixtures containing a heavy excess of hydrogen, we were able to estimate the amount of the incomplete combustion in mixtures which do not contain an excess of hydrogen. Our results are shown in the following table:

MINIMUM VALUES FOR PERCENTAGE INCOMPLETE COMBUSTION AT MAXIMUM PRESSURE.

Hydrogen (per cent.)	Ratio of Nitrogen to Oxygen.				
	0	2	3·7	4·8	5·8
15	6·6	..	..	..	..
16	8·0	7·0	..	..	3·0
18	9·0	8·3	..	..	3·0
20	9·0	9·0	4·5	6·8	3·5
22	..	10·0	6·0	8·0	5·6
24	..	10·8	7·3	8·0	..
26	..	..	7·7	..	..

We are now convinced, however, partly on account of the comparatively small variation in the calculated specific heats over such a wide range of temperature, and partly owing to the results of work by the aid of flame photography now being carried out in conjunction with Messrs. S. G. Richardson and W. Davies, that even with excess hydrogen present, combustion is far from being complete at the moment of maximum pressure. The values for incomplete combustion shown in the table are therefore much too small.

We have not yet published these results, because we wish to combine them with similar experiments at varying initial density. It is thought possible, in view of the fact that the ratio of the maximum pressure developed to the initial pressure for any given mixture strength increases as the initial pressure increases, that the apparent specific heat will, with increasing density, show an asymptotic approach to the true value.

W. T. DAVID.
B. H. THORP.

The University, Leeds,
Feb. 17.

Carbon Dioxide Tension in Tissues in Relation to Cancerous Cells.

IN a paper which appeared in the *British Medical Journal* of Jan. 28 last, I brought together a number of facts from which the deduction was made that a localised increase of the carbon dioxide tension in the tissues, due to a diminished blood supply, may be an important factor in the cancerous change of cells, and may even be the factor common to many known 'causes' of cancer. Exactly how an increase in carbon dioxide tension could alter the cells so that afterwards they continue to behave in an abnormal manner for a vast number of generations, was not suggested. Some recent observations made upon *in vitro* cultures of rat kidney under varying carbon dioxide tensions are suggestive in this connexion. Before dealing with these, and in view of the fact that both X-rays and radium cause cancer, I propose very briefly to refer to some of the effects of these radiations on living cells.

The early workers exposed eggs and noted death

or abnormal development according to the dose. The smaller the dose the less was the deviation from normal development. At the same time, it was noted that mitosis was very abnormal after radiation, the chromatin being especially effected. It was not, however, until recently that attempts were made to see whether there was any effect on inheritance. We now know that inheritance is altered. This information at once suggests an explanation for the cancerous change of cells after exposure to X-rays or radium. It may well be that during abnormal mitosis there is an abnormal distribution of genes or even chromosomes between the daughter cells, so that like produces not like, but unlike, and a normal cell becomes a cancer cell. Now, abnormal cell division not only follows radiation, but has also been observed under other abnormal conditions, and the observations referred to show that they occur when cells are incubated *in vitro* in high concentrations of carbon dioxide. Fig. 1 shows a number of metaphases of fibroblasts extruded from cultures of rat kidney. The numbers in the diagram give the

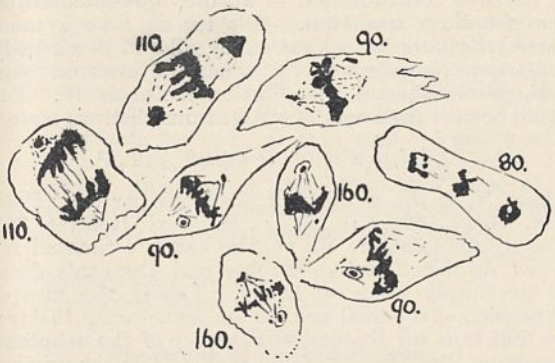

FIG. 1.—Metaphases of fibroblasts extruded from cultures of rat kidney. Cultures were fixed in Bouin's mixture and stained with Weigert's hæmatoxylin.

pressure of carbon dioxide in mm. of mercury. It is seen that fragments of chromatin, chromidia, are not suspended at the equator of the spindle, but are situate in the neighbourhood of the centrosomes. They appear to be outside the spindle, and often surrounded by a small amount of clear cytoplasm or nucleoplasm. These appearances have not been seen in cultures grown in lower concentrations of carbon dioxide. They suggest that as a result there is an unequal division of chromatin between the daughter cells, with the possibility of accompanying hereditary disturbance. Thus a hypothesis with regard to cancer following radiation will apply also to cells subject to other adverse conditions.

J. C. MOTTRAM.

The Radium Institute,
London, W.1,
Feb. 21.

Correlation Coefficients in Meteorology.

IN the *Meteorological Magazine* for February, a much criticised statistical theorem of W. H. Dines is restated by F. J. W. Whipple. The original theorem was to the effect that "If there is a cause X and a result Y with a correlation r between them, then in the long run X is responsible for r^2 of the variation of Y." It is suggested that this be altered to "If the correlation coefficient for two variables X and Y is r, and if the appropriate regression equation is used for estimating X from known values of Y, then x', the estimated departure of X from the mean, is related to x, the true departure of X from the mean, by an equation of the type

$$x' = r^2 x + \xi,$$

in which ξ is a variable quantity not correlated with x." A rider is added to the effect that the rule involves no assumption as to the distribution of the values of x and y, and no assumption as to the existence of other correlated variables.

That the subject of correlation is full of pitfalls for the unwary, is well illustrated by an example given of the practical use of the theorem in its revised form, added for the benefit of readers unfamiliar with the theory of correlation. In this example, which deals with two places, A and B, between the annual rainfalls of which there is a correlation coefficient of $\frac{1}{2}$, it is calculated that in years when A has an excess of 8 inches, the calculated excess at A obtained from B's rainfall would be $(\frac{1}{2})^2 \times 8$, that is, only 2 inches. But unless the relationship between two variables be linear, the regression equation gives no information about the average value of one variable that will be associated with one particular value of the other, and the example is therefore a misuse of both the original and the revised theorems. It is in any event difficult to see why a special theorem is necessary in order to emphasise the importance of the square of the correlation coefficient, unless it be to show that, having found a correlation of r between X and Y, it is still possible that a correlation, not of $1 - r$, but of $1 - r^2$, may exist between X and some third variable independent of Y.

To mention another important source of error in the use of the correlation coefficient, meteorological literature abounds in examples of a quite indefensible process whereby the existence of a genuine connexion between two quantities is made to appear far more probable than is actually the case. The process is a misuse of the equation

$$\sigma = \frac{1 - r^2}{\sqrt{N}},$$

which gives approximately the 'standard error' of r in terms of the true value of r (not yet known), and of N, the number of pairs of mutually 'independent' observations used in finding r', the apparent correlation coefficient. In order to see whether r' may not be fortuitous, that is, an error of sampling from uncorrelated material, the value 0 should clearly be used for r in the first instance in the above equation, yet the usual practice is to give it the value r': the reality of r' is assumed before this has been established. Let us suppose that r' be found to be 0·7 from 16 pairs of observations, then σ is calculated to be

$$\frac{1 - (0{\cdot}7)^2}{\sqrt{16}} = 0{\cdot}13$$

instead of

$$\frac{1 - (0)^2}{\sqrt{16}} = 0{\cdot}25.$$

Now 0·7 is not sufficiently large compared with 0·25 to be accepted with very great confidence, and the reality of the connexion would be doubtful. Had the true standard error of sampling been 0·13 on the other hand, the odds in favour of a genuine connexion would have been overwhelmingly great.

E. V. NEWNHAM.

The Buoyancy of Whales.

MANY questions arising in connexion with whales have yet to be answered satisfactorily; why, for example, do whales recently dead float in some cases, and in others sink?

Whales may be attacked with the hand-harpoon, weighing about 10 lb., with the simple gun-harpoon

weighing about 12 lb., or with the Norwegian bomb-harpoon weighing about 150 lb.

Whales struck or harpooned with the hand harpoon or with the simple gun-harpoon rarely die at once but survive, and after descending to a great depth, return to the surface, when they are again attacked with harpoons, being finally despatched with whale-lances; a few, however, of those that survive and descend, fail to return to the surface and are drowned.

Greenland whales, bottlenoses, narwhals, and probably other species as well, irrespective of age, sex, or individual peculiarity, that die at the surface invariably float, while those dying at a depth invariably sink.

Greenland whales dying at the surface, notwithstanding the thickness of their blubber, float no higher than bottlenoses or narwhals; as Scoresby says, they barely float, while those dying under water exert a heavy downward strain on the whale-line, and if it breaks, or if the harpoon draws, the prize is lost.

How are the foregoing facts to be explained? It appears, from a consideration of all the circumstances, that whales usually retain sufficient air in their lungs to enable their bodies to float, but that if a whale dies by drowning and this air escapes, its body sinks, like that of any other mammal. Death by drowning is, however, a fate which only overtakes whales that have descended to a depth and are in some way or another prevented from returning to the surface. Whales that die at the surface do so not from drowning, but from exhaustion or shock, and as the blow-holes are valvular, the air required to give them bouyancy is retained and their bodies float, unless weighted by heavy harpoons and heavy whale-lines.

The instinct of the whale to descend when attacked, and the necessity it is under of returning to the surface to breathe, were fortunate circumstances for the old whalers, for the first exhausted it and the second made it easy to attack the whale a second time. The failure of a large whale struck with a light harpoon to reappear at the surface was an embarrassing circumstance for the old whalers, owing to the time wasted in raising it, and the risk of drawing the harpoon in the process. In 1876, in the Greenland Sea, a large Greenland whale struck with the gun-harpoon, descended to a depth of 900 fathoms and died in a little under an hour. To allow gases to generate and make the whale easier to raise, it was allowed to remain suspended by the line for ten hours; the actual raising of it occupying six hours. On another occasion, when a large hoary-headed old bottlenose was being raised, the harpoon drew when the prize was only 50 fathoms from the surface.

Harpooned whales that descend to a great depth seem to feel the weight of the whale-line when returning to the surface, and if the harpoon is wrongly placed, they feel it more than usual, and may fail to reach the surface and consequently drown; at least this is the explanation given in one case of which I know.

ROBERT W. GRAY.

33 The Strand,
Exmouth, Devon.

Nebulium and Hydrogen in New Stars.

IN a recent paper (NATURE, Jan. 28, p. 136) S. R. Pike pointed out that the condition of co-existence of O^{++} and H lines in the spectra of new stars leads to a density of the order 10^{-7} gm./c.c., which is directly opposed to the current ideas that forbidden transitions can occur only at very low densities, as determined, for example, by C. T. Elvey (NATURE, Jan. 7, p. 12) using the 'expanding shell' theory of novæ. Since Mr. Pike's arguments are equally applicable to the spectra of planetaries, it seems of importance to analyse the subject further and to find the probable way out of the difficulty. I think that the real cause of the discrepancy mentioned is involved in the use of Saha's formula, which holds only in thermodynamic equilibrium, and of course cannot be applied to the gaseous shells as produced by the expansion of novæ or those of planetary nebulæ, because in these cases the exciting radiation is extremely diluted; a more general ionisation formula is to be used.

Let us suppose with Mr. Pike that 'coexistence' means that not more than 99·9 per cent. of H is ionised and not less than 0·1 per cent. of O^+. The lowest temperature at which those two substances (H and O^+), having ionisation potentials χ_1 and χ_2 at the same electron pressure, can coexist by the ordinary Saha's formula as used by Mr. Pike, is $T = 840\ (\chi_2 - \chi_1)$. In our case $(\chi_2 = 29{\cdot}5\ ;\ \chi_1 = 13{\cdot}5)$ and the *minimum* temperature required will be $T = 13{,}000°$, and the density (for H) only 10^{-8} gm./c.c. in decisive contradiction to all our present ideas on the nebulium spectrum. But let us take a more correct formula for ionisation by diluted black body radiation (temperature T), when the electron temperature is T_0 and the dilution factor is W. For small optical thickness of the gaseous shell we have

$$\frac{X_{i+1}}{X_i} N_e = W e^{-\chi/\kappa T} (2\pi m)^{\frac{3}{2}} (\kappa T_0)^{\frac{1}{2}} \kappa T / h^3$$

where N_e is the number of electrons per c.c. (*Proc. Am. Acad.*, **62**, 5; 1927; Harvard Reprint 38). The dilution factor, W, can be easily estimated for Nova Aquilæ 3, using Hubble and Duncan's data, as previously used by Elvey. Taking the rate of expansion of the shell as 1700 km./sec. during 19 days, we find that for the first appearance of the nebulium spectrum the distance of the shell d from the original star was $2{\cdot}8 \times 10^9$ km. We can reasonably suppose that the nuclear star has a radius R of the order of one solar radius, that is, of 7×10^5 km.; we obtain, therefore, $W = \left(\frac{R}{d}\right)^2 = 6 \times 10^{-8}$. Now neglecting the unknown difference between T and T_0, we calculate that the resulting density of the shell is 6×10^{-16} gm./c.c. By his method Elvey obtained 2×10^{-17}; taking into account the very rough character of our calculations, we can consider the agreement as very satisfactory and the difficulty raised by Mr. Pike as settled.

It is noteworthy that the calculated density of an expanding gaseous nova envelope (planetary nebula *in statu formandi*) appears to be from 10^2 to 10^3 times higher than that of an already formed planetary, as determined by the theory of a gaseous shell supported by radiation pressure (*Astr. Nach.*, **225**, 90; 1925).

B. P. GERASIMOVIČ.

Harvard College Observatory,
Cambridge, Mass.

The Polarisation Factor in X-ray Reflection.

IN comparing the observed intensity of X-ray reflection from crystals with the theoretical formulæ, and in particular in calculating the atomic scattering factor, F, from measurements of the absolute intensity of reflection, it has always been assumed that the incident X-ray beam is unpolarised. This has the effect of introducing a polarisation factor $\frac{1}{2}(1 + \cos^2 2\theta)$, where θ is the glancing angle of reflection, into the expression for the intensity of reflection. Now experiments by Bishop (*Phys. Rev.*, **28**, 625; 1926) show that the characteristic radiation from a molybdenum Coolidge tube may be 15 per cent. polarised,

and Kirkpatrick (*Phys. Rev.*, **29**, 632; 1927) points out that this must have introduced errors into the values of F calculated from experiment. He calculates for the polarisation factor

$$\{\sin^2 a + P\cos^2 a + (P\sin^2 a + \cos^2 a)\cos^2 2\theta\}/(1+P),$$

where P is a measure of the degree of polarisation of the incident beam, being unity for an unpolarised beam, and a is the angle between the plane of reflection and the plane containing the incident beam and the electron stream in the X-ray tube.

In most experiments a has been zero and, in this case, a degree of polarisation such as that indicated by Bishop would introduce errors of perhaps 5 or 10 per cent. into the values of F determined experimentally for large angles of scattering. This has been pointed out by Havighurst in a recent paper (*Phys. Rev.*, **31**, 16; 1928).

Now Kirkpatrick suggests that it would be advisable in all such experiments to work with $a = 45°$, since in this case the polarisation factor reduces to $\frac{1}{2}(1+\cos^2 2\theta)$, and is independent of the degree of polarisation of the incident beam.

In view of the detailed comparison of the theory of atomic scattering with experiment which has been based on them, it is perhaps worth while to state that in the determinations of F recently published by the writer and Miss Firth (*Proc. Roy. Soc.* A, **117**, 62; 1927), a was in fact 45°, so that these results would appear to be unaffected by this source of error. It is, however, only fair to state that this value of a was used for reasons of practical convenience and not because of any particular foresight on our part.

R. W. JAMES.

Physical Laboratories,
University of Manchester, Feb. 22

Spectrum of Ionised Sodium.

FOLLOWING the extension of the irregular doublet law given by Messrs. Saha and Kichlu [NATURE, Feb. 18, p. 244], I have tried to analyse the spectrum of Na^+, proceeding from the spectrum of neon. I have been able to identify the lines $5L_2(M_1 \longrightarrow M_2)$ completely, and the lines $5L_2(M_2 \longrightarrow M_3)$ partially. The combination $5L_2M_1$ gives four terms ${}^3P_{0\,1\,2}$, ${}^1P$ analogous to Paschen's s_2, s_3, s_4, s_5 of neon. The differences ${}^3P_0 - {}^3P_1 - {}^3P_2$ are -765 and -592 and ${}^3P_1 - {}^1P_1 = 3072$. The combination $5L_2M_2$ gives 10-terms $\begin{pmatrix} {}^3D & {}^3P & {}^3S \\ {}^1D & {}^1P & {}^1S \end{pmatrix}$ analogous to Paschen's p-terms. They have been all identified with the exception of ${}^1S_0$, and the differences are found to be roughly double the corresponding neon differences (Paschen's P-terms).

There seems to be strong reason for supposing that the identification is quite precise; for Millikan and Bowen (*Phys. Rev.* vol. 23) discovered two lines in the hot-spark spectrum of Na having the wavelengths λ372·3 and λ376·6 with the frequency difference 3075. They are just the fundamental lines ${}^1S_0 - {}^3P_1$ and ${}^1S_0 - {}^1P_1$ arising from the transition $6L_2 \longrightarrow 5L_2M_1$. 3072 is just the difference found for $({}^3P_1 - {}^1P_1)$ in my analysis.

Assuming that the value of $5L_2M_3$-terms $= 4N/3^2$, the value of the ionisation potential of Na^+ comes out to be about 47 volts, with a radiation potential at 32·8 volts. Mohler's values obtained from the electron bombardment methods are respectively 45 volts and $35 \pm 1{\cdot}5$ volts. Considering the limitations of this method, the agreement seems to be quite tolerable.

The full analysis will be published shortly.

K. MAJUMDAR.

Department of Physics,
Allahabad University, Jan. 11.

Mnemotropism: Persistence Tendency in Remembering.

MANY hundreds of estimates of given short time intervals incidentally revealed a tendency of successive estimates to approximate each other. For example, in a thousand estimates of ten seconds, varying from 3 to 16·2 seconds, the frequency of differences between successive estimates can be summarised as follows:

0-2 seconds	556 times
-4 ,,	288 ,,
-6 ,,	110 ,,
6+ ,,	45 ,,

There appears to be a tendency to repeat compensatory under- or over-estimates, for example, 10, 6, 10, 7, 10, 7 seconds; or, 11, 8, 6, 12, 8, 6, 12, 8, 8, 7, 11, 7 seconds.

This mnemotropism is comparable to the tendency recently described by Prof. Cathcart and Dr. Dawson (*Brit. Jour. of Psychology*, Jan. 1928) as 'diabatic' or 'persistence.' Working on an ergometer, they found that the rate at which repetitive movements are reproduced is deflected towards the rate at which intervening movements of a similar kind have been made. They also point out that 'persistence' shows itself in piano playing.

The circumstance that estimates of given time intervals appear to run in series (of either low, approximately correct, or high figures), further demonstrates the existence of a momentum or persistence in remembering. It may be added that, in my own crude stop-watch experiments, the interval of ten seconds (that is, 10·0*s*) was estimated correctly in only 2 per cent. of the tests, and in 2·7 per cent. only of one thousand estimates of twenty seconds (20·0*s*).

J. H. KENNETH.

Clynder,
Feb. 17.

The Urinogenital Organs of the Male Frog (*Rana temporaria*).

AN interesting error occurs in the description of the male urinogenital organs of the male frog (*Rana temporaria*) in such standard works as Ecker's "Anatomy of the Frog" (Haslam's translation), Wiedersheim and Parker's "Comparative Anatomy of Vertebrates," and Parker and Parker's "Practical Zoology." Briefly, it is stated that sperms pass through the vasa efferentia to enter a longitudinal duct in the kidney, and thence through transverse ducts in the kidney to the ureter, which acts as a vas deferens.

I have consulted a number of more recent textbooks, *e.g.* those of Borradaile, Bourne, O'Donoghue, Thomson, etc., and find that they state that the vasa efferentia open to the kidney and that the sperms pass through the *kidney* tubules to the ureter; no mention being made either of the longitudinal or transverse ducts of the older writers.

This latter statement coincides with my own observations on a very large number of sections. Not only have I failed to discover any trace of special seminiferous tubules in the kidney, but I have on several occasions examined sections in which sperms were clearly to be seen in very large numbers in the ordinary urinary tubules.

I have, however, failed to find any contradiction of the statement of Ecker and his contemporaries; the two diverse statements being equally available to zoology students.

J. H. LLOYD.

University College,
Cardiff.

Action of Lead-tetra-ethyl in Delaying Detonation in the Internal Combustion Engine.

By Dr. E. MARDLES.

THE arrival in Great Britain from the United States of ethyl petrol—the anti-knock fuel containing 6 c.c. of ethyl fluid (lead-tetra-ethyl 54·5 per cent.; ethylene dibromide 36·5 per cent.; and monochlornaphthalene 9 per cent., with a trace of Sudan IV. Red dye) per gallon of petrol, has aroused public interest in the remarkable action of minute quantities of lead-tetra-ethyl and other substances in delaying detonation or 'knocking' in the internal combustion engine. Questions have been raised in the daily press with regard to the benefits to be derived from the use of 'doped' fuel, and as to whether its use is attended with any ill effects on the health or any deleterious action on the mechanism of the engine.

In brief, distinct advantages are to be gained by the use of 'anti-knock' fuels; deleterious action on the engine mechanism by the use of ethyl petrol, if any, is negligible, whilst after investigations in the United States no grave poison hazard appears to have been discovered. The petrol has been sold in America since 1923, and although about 800 million gallons U.S. have been consumed, no illness attributable to its use has been found. In Germany iron-penta-carbonyl in petrol is marketed under the name Motalin as an anti-knock fuel.

Action of Lead-tetra-ethyl.

The main function of the lead-tetra-ethyl is to mitigate the distressing engine trouble of 'knocking' or detonation which arises when a car is accelerating or climbing with open throttle on top gear, especially when the cylinders contain carbon deposits or when an inferior fuel is used. The halogen compounds, namely, ethylene dibromide and monochlornaphthalene, help to remove the lead from the cylinder in the form of lead halogen compounds after the lead-tetra-ethyl has done its work, and they also contribute slightly to the anti-knock action.

It has been found impossible to use an ordinary straight run petrol for high compression engines such as are used for aeronautical or racing purposes without loss of power due to detonation, and it is necessary to employ either mixtures of petrol with benzene, alcohol, etc., for these purposes or to add a small amount of an anti-knocker, such as lead-tetra-ethyl. Ethyl petrol with increased amounts of 'dope' was employed in the winning of the Schneider Trophy (1927) and by Capt. M. Campbell in establishing the world's record of motor-car speed, February 1928.

Engine Experiments with Ethyl Petrol.

For ordinary purposes the following engine experiments illustrate the typical action of 5 c.c. ethyl fluid per gallon of petrol. In a comparatively low performance water-cooled engine which detonated badly at 5 to 1 compression ratio when run on petrol alone, detonation was immediately suppressed when run on the ethyl mixture, and the compression could be raised to 6 : 1 before detonation began. It was calculated from the data obtained that an increase in power of 10·5 per cent. and a decrease in consumption of fuel of 6 per cent. were obtained by employing the higher compression.

In a high performance air-cooled engine at 5 : 1 compression ratio, a slight gain in power was always noticed on changing over from petrol to the ethyl mixture without altering any other condition. Detonation as before was suppressed, and a further gain in power could be got by increasing the magneto advance.

Compression and Efficiency.

The development of the internal combustion engine has been seriously impeded by the tendency of an ordinary straight run petrol to detonate when the compression ratio is raised above 5. It will be seen from Table I., prepared from tests carried out by Ricardo, that considerable progress can be made with the use of higher compression ratios involving an annual saving in the aggregate of many million pounds sterling.

Table I.

Compression Ratio.	Indicated Horse-power.	Indicated Thermal Efficiency.
4	30·3	28·8
5	33·1	32·8
6	35·2	35·9
7	36·8	38·3

Highest Useful Compression Ratio.

H. Ricardo discovered (1918) that though detonation in the internal combustion engine is influenced by a number of important factors, for example, magneto timing and position of plugs, mixture strength, design of piston head, and cylinder shape, etc., the trouble is due to a specific failing of the fuel. Under standard conditions, using a variable compression engine, the E.35 type, he

Table II.

Highest Useful Compression Ratios of Substances (Ricardo).

Substance.	H.U.C.R.
Aromatic free petrol	4·85
Kerosene (heavy fuel)	4·2
Cracked spirit (53 per cent. unsaturated)	5·55
Pentane	5·85
Hexane	5·1
Heptane (normal)	3·75
Carbon disulphide	5·15 (pre-ignition at this point)
Benzene	6·9 (ditto)
Toluene and Xylene	7·0
Cyclohexane (93 per cent. pure)	5·9
Ethyl alcohol (98 per cent.)	7·5
Methyl alcohol	5·2 (pre-ignition at this point)
Butyl alcohol	7·3
Ethyl ether	3·9

determined the point at which during increasing compression the engine gave the first audible signs of detonation. This point he has referred to as the Highest Useful Compression Ratio (H.U.C.R.), that is, the highest compression ratio which it is worth while to employ with a given fuel. If the compression ratio is raised above this limit, excessive detonation leads to pre-ignition and loss of power.

The anti-detonating action of lead-tetra-ethyl is seen at a glance from Table III., which has been

TABLE III.

	Brake Mean Effective Pressure.	H.U.C. Ratio.
Petrol	122 lb./sq. in.	4·9
Petrol + 0·05 per cent. lead-tetra-ethyl	126 ,,	5·3
+ 0·1 ,, ,,	131 ,,	5·7
+ 0·2 ,, ,,	138·5 ,,	6·5
+ 0·3 ,, ,,	142 ,,	7·0
+ 0·4 ,, ,,	144 ,,	7·35

compiled from engine data obtained at the Air Ministry Laboratory, Imperial College of Science and Technology, and shows the effect on the H.U.C.R. of a fuel by the additions in varying amounts.

The petroleum refiner, in an endeavour to increase the yield of petrol fraction by including a part of the less volatile distillate which was formerly put into the kerosene fraction, produces a motor fuel which has a greater tendency to ' knock,' but by the use of anti-knockers this disadvantage is removed.

CONDITION OF ENGINE PARTS AND DEPOSITS.

The results of prolonged engine trials with fuel containing not more than 6 c.c./gal. confirm the claims made that ethyl petrol will not injure spark plugs, valves, or stems. After a 33-hour continuous run, an engine which was stripped showed a slight grey oily deposit slightly different from the usual appearance.

Typical analyses of the deposits are as follows :

TABLE IV.

I. Total weight of deposit from piston head and exhaust valve . 2·3 gm./40 sq. cm.
Total weight of lead present in the petrol . . . . . 28·5 gm.

Deposit analysis.	Per cent.
Oil	4·4
Lead bromide and sulphate	12·2
Iron and aluminium bromides	0·2
Carbon and volatile matter	77·1
Oxides of iron and aluminium	5·4

Lead was found to be present in the oil, but not bromine.

TABLE V.

II. Total weight of lead added . . . 83·7 gm.

Analysis of deposits.	Total weight, grams.	Lead per cent.	Total weight of lead, grams.
Engine head samples :			
Grey deposit	38·23	54·09	20·7
Black deposit	13·49	21·04	2·8
Exhaust pipe :			
First 2 ft. section	106·14	27·80	29·5
Remainder	12·79	2·26	2·9
Total lead in crank case (oil and deposit)			10·5
Total lead in drop pans under exhaust outlet			1·0
Total lead from all deposits			67·4

The amount of lead in the exhaust gases (undiluted and containing 7 per cent. carbon monoxide) was on an average 150 mgm. per 10 cub. metres.

EXPLANATIONS OF THE PHENOMENON OF DETONATION.

Ricardo from his engine experiments (1918) concluded that detonation differed entirely from pre-ignition, and attributed it to the spontaneous inflammation of residual unburnt charge owing to its compression by the expanding burnt and burning portion. The ignition of the residual charge under high compression and at high temperatures would cause a rapid rise in pressure, causing the cylinder walls to vibrate as though struck by a hammer.

Tizard and Pye extended Ricardo's line of investigation, and studied in particular the behaviour of gaseous mixtures under adiabatic compression. They found that carbon disulphide gave much greater lag periods, subsequent to the arrest of the piston before the rise in pressure due to inflammation occurred, than did ether or heptane, both of which detonate at low compressions, whilst carbon disulphide tends to raise the H.U.C.R. when added to a fuel. They concluded that detonation is a function of the temperature coefficient of the reaction velocity of combustion of a fuel, the lag period being an indication of this value.

Midgley and Boyd (1922), who first discovered the anti-detonating properties of lead-tetra-ethyl and other organo-metallic compounds, aniline, etc., in the engine, considered that detonation is set up in the cylinder when the rate of advance of the flame front reaches the velocity of sound. They attribute such a high rate of flame propagation to a high reaction velocity of combustion. The addition of substances which raise or lower this reaction velocity correspondingly should promote or delay detonation. They showed that isoamyl nitrite promotes detonation to a remarkably high extent, whilst other substances lower it to a greater or less extent, as shown by their results in Table VI.

TABLE VI.

Substance.	Volume in petrol required to effect a given suppression in detonation.
Benzene	25·0
Ethyl iodine	1·6
m. Xylidine	2·0
Tin-tetra-ethyl	1·2
Selenium ethyl	0·4
Tellurium ethyl	0·1
Lead-tetra-ethyl	0·04

Midgley and Boyd employed a $\frac{3}{4}$-kw. Delco-light engine and measured the degree of detonation by means of a rod or pin resting freely on a steel diaphragm set in the cylinder head. When detonation occurred the pin was bounced free from the cylinder, and by means of an electrolytic cell the time whilst in the air was measured from the volume of gas collected. This method is used in the United States, whilst the variable compression engine is employed in Great Britain for measuring the detonation tendency of a fuel.

The view that detonation in the engine is the

same phenomenon of rapid wave propagation observed by Berthelot and Le Chatelier with gaseous explosions in long tubes is now considered to be incorrect, since the engine cylinder is too short to render this probable, and an analysis of the pressure diagrams of Tizard, Pye, and Dixon shows that there is no abrupt transition to the detonation wave during sudden compression. Egerton and Gates found that 'anti-knocks' did not affect the position of detonation in a tube 150 cm. long, even up to initial temperature of 230° C. and pressures of about 100 lb./sq. in.

Nuclear Drop Theory of Callendar.

A theory proposed by Prof. H. L. Callendar (1925) explains in a lucid and simple manner the phenomenon of detonation, and throws light on a large number of isolated facts left unexplained by numerous other theories. In brief, it regards detonation to be due to the simultaneous and violent ignition of a comparatively large volume of unburnt charge containing droplets or nuclei. When petrol is atomised in a current of air, the drops as they evaporate leave a residue or nucleus consisting chiefly of the less volatile constituents, such as the heavier paraffins, which have low self-igniting temperatures and serve as foci of ignition. When benzene and pentane and other fuel vapours are *compressed* they show cloudy condensation. Again, when gaseous mixtures, such as acetylene in air, are heated, a thick fog of ionised particles is produced which sensitises the mixture to ignition. It can be demonstrated that the self-ignition of a gaseous mixture containing liquid droplets is sometimes more than 100° C. below that of the mixture entirely in the vapour state. The inflammation, too, is far more violent in the presence of drops. Thus, a fine spray of amyl nitrite ignited with a violent explosion when projected into a glass tube at 140° C., but the vapour–air mixtures caught fire relatively mildly when a temperature of 480° was reached.

The subject of the formation of ionised particles or nuclei in gaseous media and the chemical changes which occur during the slow combustion in the pre-flame period during adiabatic compression is of considerable significance to the subject of detonation, and is being studied at the Air Ministry Laboratory of the Imperial College of Science and Technology. Quantitative analysis of the products of slow combustion of various fuels shows that aldehydes and acids are formed in profusion, but since these do not promote detonation in the engine, a prior compound was suspected. Further investigations indicated the presence of active oxygen, presumably in the form of organic peroxides, in the condensation products, especially when liquid drops were present and the mixture heated for a few seconds only. It was considered that the aldehydes, carbon monoxide, etc., were the decomposition products of primarily formed peroxides of the fuel, which by concentration in the nuclear drops caused self-ignition of an exceedingly violent character at relatively low temperatures. Organic peroxides are known to be violent explosives. Thus Brodie, who first prepared alkyl peroxides, showed that a few drops detonated like a cannon. Staudinger also found that small quantities of organic peroxides adhering to the walls of a beaker were sufficient to shatter it.

Engine Experiments with Organic Peroxides.

In engine experiments carried out with the use of a synchronised sampling valve, portions of the gas mixture during the compression stroke and before ignition have been withdrawn for analysis. The oxidation products were found to contain aldehydes, acids, etc., and to be similar to those obtained during slow combustion experiments in glass tubes or bulbs in the laboratory. In a 4-stroke engine running at 1200 r.p.m.—that is, with a compression stroke of $\frac{1}{80}$ of a second duration—the presence of active oxygen was demonstrated. With the addition of iron carbonyl or lead-tetra-ethyl to the fuel, the yield of peroxides was appreciably diminished. Experiments were tried with the use of petrol to which small additions of organic peroxides and nitrogen peroxide had been added, and it was found that they all promoted detonation to a marked degree.

Moureu, Dufraisse, and Chaux, working on the autoxidation of hydrocarbons, confirm Callendar's conclusion that peroxidation occurs in the liquid state and is responsible for detonation. Callendar from his experiments (1925) showed that lead particles from the thermal decomposition of lead-tetra-ethyl became concentrated on the surface of nuclear drops, which are in this manner protected against rapid oxidation and early self-ignition, the primary higher oxides formed by the oxygen molecule with the fuel being immediately decomposed by the metal and autoxidation thus delayed.

Experiments with Metallic Vapours.

Egerton and Gates demonstrated that lead vapour from a low tension arc behaved similarly to lead-tetra-ethyl in raising the self-igniting temperature of fuel mixtures and delaying detonation in the internal combustion engine. They investigated the action of anti-knockers and metallic vapours on the self-igniting temperature, determined by the Moore method, of petrol mixtures, and found, for example, that with thallium vapour a rise of 180°, and with lead a rise of 100°, was obtained. Lead-ethyl gave a rise of 90°, iron carbonyl 130°, and selenium diethyl 140°. They concluded that the stable peroxides of the metal react with and destroy the fuel peroxides, for example, aldehyde peroxide, and are then regenerated so that in this way the substances which autocatalyse combustion are destroyed.

Ionisation and Radiant Energy.

Detonation in the engine is accompanied by marked ionisation, and the spectrum of 'knocking' combustion shows an extension in the ultra-violet region. It was considered (Symposium on Gaseous Reactions, Faraday Society, 1926) that these phenomena are the accompaniment rather than the

cause of detonation, though at one time it was considered that 'anti-knocks' acted by absorbing either the radiant energy or the electrons which by advance from the flame front increased the flame propagation and so led to detonation.

Bennett (1927), who studied the influence of substances on the ionisation of various flames and on ionisation during the slow combustion of a number of gas mixtures, found *inter alia* that lead-tetra-ethyl, and iron carbonyl, as well as amyl nitrite, greatly increased the ionisation. It was considered, therefore, that ionisation was not a cause of detonation but merely a temperature effect.

Landlocked Salmon.

FOR many years there has existed in the middle and upper parts of the River Otra, in southern Norway, a fish known locally as the 'Blege,' a name applied throughout the whole of south-western Norway chiefly to the juvenile stages of the sea trout. In fact an important fishery for the 'Blege' took place in old days in the southern parts of the Bygglandsfiord, a fishery mainly restricted to the spawning season late in the autumn and lasting until Christmas.

It is only recently [1] that this fish has been discovered by Mr. Knut Dahl to be a true landlocked salmon (*Salmo salar*). Only exceptionally does this salmon exceed 30 cm. (about 12 in.) in length, and for this reason Mr. Dahl has called it a 'Dwarf-salmon.' In general appearance it resembles an overgrown smolt, through the silvery coat of which the blue parr- or finger-marks are still faintly visible. An examination of such characters as the number of scales in the oblique row running backwards from the adipose fin to the lateral line, the shape and slenderness of the tail, and the short upper jaw, shows that it is indistinguishable from the young of typical migratory salmon, its only difference from the adult salmon being the retention of certain characters peculiar to the juvenile stages and its small size.

The adult fish are somewhat pelagic in their habits and roam about in schools all over the lake, unlike the ordinary trout, which appear to keep more to the shallow water and do not congregate so markedly in shoals. This roaming character is probably correlated with their feeding habits, since their food chiefly consists of the planktonic crustacean, *Bosmina obtusirostris*. Scale examination shows that many exhibit the typical growth periods of the migratory salmon, spending their first years in the river under poor feeding conditions, and then migrating into the lake where food is more abundant. Some, however, are born in the lake itself, and do not show this change in growth rate. A migratory habit is also exhibited by the landlocked salmon of Lake Wenern, which migrate into the river to spawn, returning afterwards to the lake, but unlike the dwarf-salmon they grow to a considerable size. Of the dwarf-salmon born under river conditions, the majority migrate after 2-5 winters. Most of the fish captured were of an age of four to six winters, and older fish were rare. Spawning took place for the first time generally in the fifth or sixth winter.

True salmon are prevented from migrating into these waters by high falls situated at Vigelandsfoss, 15 kilometres from the sea, and from geological evidence Mr. Dahl estimates that the dwarf-salmon must have arisen from fish landlocked about 9000 years ago.

At the present day the impression gained was that these fish were as numerous as the common trout, though the net fishing has diminished owing to the damming of the Bygglandsfiord as a reservoir. Mr. Dahl gives a vivid description of the sport afforded by the dwarf-salmon to the angler, and maintains that in fighting powers they surpass the trout, a supremacy which they hold also as a table delicacy. F. S. R.

[1] The "Blege" or Dwarf-salmon. A landlocked salmon from Lake Bygglandsfiord in Setesdal. By Knut Dahl. *Skrifter utgitt av Det Norske Videnskaps-Akademi i Oslo.* I. Matem.-Naturv. Klasse 1927. No. 9. Oslo, 1927.

Research and Development in Australia.

THE main objects of the Science and Industry Research Act (1926) of the Commonwealth Government were to reorganise the Institute of Science and Industry, which was founded in 1920, and to provide adequate funds for developing scientific and industrial research in Australia. The first Annual Report of the Council for Scientific and Industrial Research (Melbourne, 1927) contains a review of the activities of this newly constituted body between April 1926 and June 1927; the Science and Industry Research Act, 1920–26, is printed as an appendix to the Report. At the first meeting of the Council, it was decided to devote particular attention to investigations on plant and animal pests and diseases, fuel problems, preservation of foodstuffs, and forest products. In accordance with this decision, arrangements were made to secure information and reports on some of the problems concerned from Prof. T. G. B. Osborn (Adelaide), Prof. H. A. Woodruff (Melbourne), Dr. Franklin Kidd (Low Temperature Research Station, Cambridge), Mr. A. J. Gibson (Indian Forest Service), and other specialists. The various fields thus laid open to inquiry are all of first-rate importance, but a particular interest may perhaps be anticipated for Mr. Gibson's report, which is to deal with forest products problems and with the advisability of establishing a forest products laboratory in Australia.

The Annual Report affords a comprehensive summary of the many investigations in progress, some of which have already been noticed in the Council's journal (see NATURE, Oct. 8, 1927, p. 520). Many of the activities of the Council have an intimate bearing upon the progress of agriculture in Australia. A standing committee on agriculture

has been appointed; a register of agricultural research is being compiled; and the Council is drawing up plans, in collaboration with the British Empire Marketing Board, for the creation and organisation of a tropical agricultural research institute in Queensland.

In co-operation with the Development and Migration Commission and the Anglo-Australasian Tobacco Company, the Council is organising a comprehensive investigation of tobacco-growing in Australia, a sum of £30,000 having been made available for this purpose during the first period of three years. The citricultural research station at Griffith, in the Murrumbidgee irrigation area, is now owned and financed jointly by the Council and the Water Conservation and Irrigation Commission of New South Wales, the Commission contributing £1500 per annum and supplying water free of cost. For work in viticulture the Council has acquired the research station at Merbein, near Mildura; considerable success has attended the researches into manurial and processing problems which are in progress at this institute, the introduction of the 'cold-dip' process for drying sultanas having led to a gain in quality equivalent to some £30,000 during the last season. For reasons connected largely with the quality of the soil, it is proposed to establish a research station at Coomealla, 12 miles from Mildura, for the investigation of irrigation problems.

With regard to plant and animal pests and diseases, a report upon the practicability of controlling and eradicating St. John's wort by the introduction into Australia of suitable insect enemies has been furnished by Dr. R. J. Tillyard, and investigations are being conducted in England with *Chrysomela hyperici* and other species. Dr. B. T. Dickson, formerly professor of plant physiology in McGill University, has been appointed to direct a comprehensive series of researches dealing with the rusts and smuts of cereals, soil-infecting fungi, and plant diseases in general. Prominent among the animal pests under consideration is the cattle-tick; this has caused enormous financial loss in Queensland, and has only been kept out of New South Wales by the maintenance of a buffer area. It is now feared that the buffalo-fly, if permitted to spread southwards from the Northern Territory, may become a worse pest than the cattle-tick. In attempts to effect control by natural enemies, experiments are in progress with *Hydrotæa dentipes*, which may possibly parasitise the larvæ of the buffalo-fly, since in the larval stage it lives on the larvæ of the stable-fly and the house-fly.

News and Views.

HEARTY congratulations are offered to the veteran engineer, Sir Alexander B. W. Kennedy, F.R.S., who celebrates his eighty-first birthday on Mar. 17. Born at Stepney, son of the Rev. John Kennedy, D.D., resident there, he was educated at the City of London School, entering, on the completion of school life, at the Royal School of Mines, South Kensington. His active technical career started with the firm of J. and W. Dudgeon, engineers and shipbuilders, Millwall, afterwards becoming chief draughtsman in Palmer's Engine Works, Jarrow. Elected professor of engineering at University College, London, in 1874, Sir Alexander, for fifteen years ensuing, devoted himself to the establishment of an engineering laboratory in which teaching and practice could proceed with harmonious interaction. Undoubtedly his work in this field had far-reaching results elsewhere. He designed the steel and concrete internal structure of the Alhambra Theatre, when for the first time, we believe, flat concrete slabs were used on a large scale to carry weights. Sir Alexander's services were utilised for many of the early electric undertakings in London and the chief provincial towns, and he was much in request as an official adviser on Government projects. He was president of the Institution of Mechanical Engineers in 1894–1895, and of the Institution of Civil Engineers in 1906–7. In an inaugural address entitled 'Engineering and Modern Life,' Sir Alexander said in modest vein, "I have worked in many branches, from marine to academic, from constructional to electrical. Having spent forty years in so many different wildernesses I cannot reasonably claim to know the ways of any one of them as thoroughly as my more judicious predecessors have shown in their particular regions." So long ago as 1894, at the Oxford meeting of the British Association, Sir Alexander was president of Section G (Mechanical Science).

SIR JAMES EDWARD SMITH, F.R.S., founder of the Linnean Society of London, and its president for forty years, died at Norwich, his birthplace, on Mar. 17, 1828. This centenary, relating to a distinguished botanist and leader of science, merits notice. Besides the foregoing, however, Sir James is remembered through his acquisition in early youth of the scientific collections, library, and manuscripts brought together by Linnæus, the great Swedish naturalist. Smith was the author of numerous botanical treatises; whilst his "English Botany" (1790–1814), issued in thirty-six volumes, with coloured figures by James Sowerby, achieved high success. He published a paper in the *Philosophical Transactions* in 1788, entitled "Observations on the Irritability of Vegetables." "Having heard," he begins, "that the stamina of the Barberry, *Berberis communis*, were endued with a considerable degree of irritability, I made the experiment in Chelsea Garden, May 25, 1786, on a bush then in full flower." It may be mentioned that in the same volume were papers by his eminent contemporaries, John Hunter, Priestley, and Cavallo. The Linnean Society possesses a portrait of Sir James. He was elected into the Royal Society in 1785.

THE story of the purchase and transference of the Linnæus collections to England, to become the personal property of an individual barely twenty-five years old, is of singular import. The more or

less accidental circumstance of breakfasting with Sir Joseph Banks on a certain morning in December 1783 was the mainspring. Smith had just completed his medical studies at Edinburgh, and was deeply interested in botany. He learnt from Sir Joseph that an offer had been made to him by Prof. Acrel, of Upsala, to acquire by purchase the whole of the collections made by Linnæus, with some later additions. The sum named was 1000 guineas. Banks for some reason or other had himself decided against the proposal; but he impressed the matter upon Smith. Correspondence with Prof. Acrel ensued; ultimately, with the provision of funds by Smith's father, the son, Dr. J. E. Smith, undertook to buy. The collections were to be entrusted to a master mariner sailing between Stockholm and London. On Aug. 13, 1784, the safe receipt of the collections in Stockholm was notified, and by the end of October following, the ship, *The Appearance*, Capt. Sweder, had arrived in the Thames with the precious packages.

THE sale of the collections incurred the grave displeasure of the King of Sweden, Gustavus III., who sent a vessel to intercept the voyage, and a courier by land to assist. These efforts, however, were unavailing. Apartments were taken in Paradise Row, Chelsea, for the accommodation of the collections, and soon Banks and Jonas Drylander were assisting in their arrangement. In March 1788, Dr. Smith removed to Great Marlborough Street, of course taking the series with him. After a six years' residence there he moved to Hammersmith, and finally to Norwich. He was knighted in 1814. Annually for forty years the Linnean Society had re-elected its founder as president. However signal the honour, reciprocity was not seen in the bequest of the collections to the Society. On the contrary, the council received an offer from Smith's executor to purchase the collections (as they then were, for some minor sales had occurred) for the sum of £5000. Ultimately 3000 guineas was accepted as the purchase price. But this financial responsibility held the Society to ransom for many years.

DURING the recent visit to Great Britain of Mr. W. Nowell, the director, considerable progress was made with the recruitment of the staff for the Amani Research Institute, or, as it is to be known, the East African Agricultural Research Institute, Tanganyika Territory. When Mr. Nowell was appointed, he had just taken up his duties as Director of the Department of Science and Agriculture, British Guiana, to which post he had been transferred from that of Assistant Director, Department of Agriculture, Trinidad. He lost no time, however, in visiting his new headquarters, and for a considerable period afterwards he toured extensively in East Africa to familiarise himself with local conditions and to become acquainted with the heads and staffs of the agricultural departments. During his visit to England last winter he was busily engaged in framing the general policy of the Institute and making arrangements for the recruitment of staff. Up to date, the following appointments have been made: entomologist, Mr. C. B. Williams, late Director, Plant Protection Service, Egypt; plant pathologist, Dr. H. H. Storey, late mycologist in charge of the Natal Herbarium, Union of South Africa; soil chemist, Mr. G. Milne, late lecturer in agricultural chemistry, University of Leeds; geneticist, Mr. G. F. Clay, late agricultural officer, Uganda; plant physiologist, Mr. F. J. Nutman, late of the Forest Products Research Laboratory; systematic botanist, Mr. P. J. Greenway, late of the Imperial Forestry Institute, University of Oxford. Mr. F. M. Rogers, who for the past few years has been in charge of the station pending its reorganisation, has been appointed superintendent of plantations, and Mr. K. E. Toms, lately of the Department of Agriculture, Zanzibar, assistant superintendent of plantations. Capt. E. M. Nicholl has been appointed manager of the Kivumkoro Coffee Estate which is now attached to the Institute. Mr. R. E. Moreau is appointed secretary and librarian.

THE capital expenditure on the East African Agricultural Research Institute, which must now be regarded as one of the chain of research stations which it is intended to establish throughout the tropical Colonies of Great Britain, is estimated at a total of £22,500. Towards this the Colonial Research Committee has provided £2000, whilst it is expected that the balance will be found from the East African Guaranteed Loan. The recurrent expenditure will be met partly by the East African Governments and partly by the Empire Marketing Board. The following are the annual contributions which are being paid at present: Tanganyika £4000, Kenya £1200, Uganda £1200, Zanzibar £1200, Northern Rhodesia £200, Nyasaland £200. The Empire Marketing Board is expected to make a maintenance grant up to one-third of the running costs of the Institute, but it will not exceed £6000 in any one year, and is subject to reconsideration after a period of three years.

THE Colonial Secretary appointed a committee last June, under the chairmanship of Lord Lovat, to make recommendations for the formation of a Colonial Agricultural Scientific and Research Service for the British Empire, in accordance with the recommendations of the Colonial Office Conference (NATURE, June 4, p. 824). This committee has now issued its report (Cmd. 3049. London: H.M. Stationery Office. 9*d*. net). It is recommended that the proposed Service should include both agricultural and specialist officers. It should be created immediately and recruited from officers of proved attainments in the field or laboratory. The formation of a Colonial Advisory Council of Agriculture and Animal Health, with two committees, dealing with agriculture and animal health respectively, is suggested. Each committee, and also the Council, should be composed of a representative of the Colonial Office, the director of the Imperial Institute, an agriculturist with tropical experience, and other technical and scientific officers, with a lay chairman. The duties of Council and committees would be to attend to the supply of agricultural and scientific officers for Colonial agricultural services, the establishment and direction of central research stations, and the direction of the

main agricultural research policy of the Colonial Empire, the collection and distribution of information in fields not already served, and so on.

IT is particularly interesting to note that Lord Lovat's committee recommends salaries of £2500 and £2000 a year respectively for the chief and the assistant agricultural adviser for the new Service. It is considered that the chief adviser should be a distinguished man of science of proved administrative and organising ability, and it is hoped that the creation of a stable Colonial Agricultural Service, and including in it a grade with a maximum salary of £3000 a year, will attract and retain the ablest men. The cost of the new Service is estimated as £58,000 for the agricultural side, £35,000 for the specialist side, £14,000 for the Advisory Council, and £20,000 for one central research station, to be met by a cess of 1/400 on the revenues of Colonies with agricultural interests and a contribution of about £16,300 from the Empire Marketing Board.

WE have received the first *Annual Report of the Pure Rivers Society*, which was founded last October with the object of aiding landowners and others to bring actions to restrain pollution of rivers and inland waterways, and to give weight to representations for the same purpose. The objects of the Society appear to coincide with those of the Standing Committee on Rivers Pollution, which has done much during the last seven years to check the increasing pollution of the rivers of Great Britain and to bring a serious and growing abuse before the notice of the public. In a leaflet on "River Destruction" by this Society, it is pointed out that sufficient knowledge is available, without further research, to deal satisfactorily with many noxious effluents which are allowed to flow direct into streams. Although cleansing some of our most polluted rivers which pass through industrial cities may be beyond hope, it is abundantly clear that action under existing law would suffice to improve materially the condition of many other rivers without imposing great expense upon the various undertakings required to render their effluents harmless. In most cases the cost of taking such action precludes landowners and riparian authorities from exercising their legal rights, and the Government has been shy of imposing directly upon industries the financial burden of treating noxious effluents before emptying them into the rivers.

THE International Radio Communication Conference which was held last autumn at Washington was attended by 346 representatives from 79 countries. Almost every interest was represented, and the admission of representatives of the press was a departure from precedent which shows the tendency of the age. The general regulations which have been adopted were signed by all countries. The allocation of wave-lengths amongst the various services was one of the most difficult questions that had to be settled. Wave-lengths for ships' services had been previously dealt with at the London Conference in 1912. The further questions considered were in connexion with fixed services, aircraft services, broadcasting services, and commercial and amateur experimental services. Services between fixed stations will have to work on wave-lengths between 30,000 metres and 3000 metres, that is, with waves the frequencies of which lie between 10 and 100 kilocycles. The band between 3000 m. and 1875 m. is for the mobile services, that is, for ships, aircraft, motors, etc. The 2400 m. to 2000 m. wave-band is exclusively for ships' services; that between 2000 m. and 1875 m. is shared between fixed services and broadcasting services. In Europe the range between 1875 m. and 1550 m. is to be used for broadcasting services only, that from 1550 m. to 1340 m. for broadcasting and air services, and that from 1340 m. to 1050 m. for air services only. Waves from 1050 m. to 545 m. are assigned to mobile services, those from 950 m. to 850 m. being for air services only. The S.O.S. wave-length remains as at present, 600 m. Waves from 545 m. to 200 m. are for broadcasting services. For small ships a wave-length of 220 m. can be used. Waves from 200 m. to 5 m. are split up into bands for all services. The band 10·7 m. to 13·1 m. has been left unreserved. It is gratifying to find that a truly representative international conference, after a very thorough and lengthy discussion, has come to a fairly satisfactory solution of a most difficult technical problem.

IN the Faraday lecture given to the Institution of Electrical Engineers on Mar. 1, Dr. S. Z. de Ferranti emphasised the utilitarian value of applied electricity. He pointed out the importance of relieving as much as possible the present routine drudgery of work in the home. The traditional mechanical aptitude of Englishmen has been fostered by the advent of the motor-car, and radio receiving has fostered an interest in electrical matters which will be extremely helpful, as motors and other electrical devices are used more and more widely in the home. The ever-extending use of alternating current supply has brought prominently to the front the many advantages that would accrue provided we could store electric energy delivered by alternating current in a similar way to that provided by the lead storage cell for direct current supply. He pointed out, however, that there is nothing easier than to convert electricity into heat, and that this heat can be stored in water. The most important requirement of the household at the present time is low-grade heat in the form of hot water. Electrical engineers ought to advocate strongly this application of electricity. As to the future, he regarded electricity as the only means of regenerating the agricultural industry in Great Britain, taking into consideration the small acreage available and the need for the most intensive culture. He also visualised the wonderful results that would ensue if some concentrated form of storage after the manner of the lead storage battery, but without the drawbacks of its weight and cost, were invented. It would do away with the internal combustion engine, with the steam locomotive, and even with the steam turbine on board ship. He hoped also that in the future the Faraday lecturer, instead of having to give the lecture five times in different parts of the country to individual audiences, would be able to broadcast it to them all, and at the same time keep in touch with each meeting.

DR. R. S. CLAY delivered his presidential address to the Optical Society on "The Stereoscope" on Mar. 8. He stated that it was Sir Charles Wheatstone who first conceived the idea of presenting a pair of stereoscopic drawings to the right and left eye respectively, so producing the illusion of an object in relief. From a letter written by R. Murray, of Messrs. Murray and Heath, it was proved that Wheatstone had apparatus made for this purpose, using both prisms and mirrors, so early as 1832, though his actual paper, "Contributions to the Physiology of Vision," was not presented to the Royal Society until 1838. In 1840, Wheatstone had induced Fox Talbot (one of the inventors of photography) and Collen (one of its first exponents) to use the new art for taking stereoscopic pictures. Brewster in 1849 devised a more convenient, lenticular instrument, which was introduced and popularised through the agency of Duboscq at the time of the 1851 Exhibition. By the courtesy of the Delegacy of King's College, London, several of Wheatstone's original stereoscopes were exhibited. Among these was a 'moving picture' apparatus, in which a series of stereoscopic pictures of a French soldier presenting arms, mounted on a drum, was rotated by an ingenious intermittent motion. There were also a large number of early stereoscopes loaned from the Science Museum. These included a beautiful example of Swan's 'Cube' from the Court Collection, in which, by the combination of two stereoscopic pictures on the back and side of the 'cube,' an image of a lady appears in stereoscopic relief within the glass. Two original Wheatstone pseudoscopes were shown, by which a rotating glass beaker suspended from a string viewed from one direction appears to be changing its shape as it rotates; while from another direction it appears to be turning over and over about a horizontal axis, when it is really rotating about a vertical one.

MR. A. D. RICHARDSON (*Scot. For. Jour.*, vol. 41, pt. 2) has discussed in an interesting paper the value and quality of the Scots Pine in the north of Great Britain. We are not in full agreement with the writer in his opening statement: "While coniferous timber of such fine quality as that grown at higher latitudes—in Finland and Northern Russia, for example—cannot be produced in this country . . ." The difference in quality of timber may be attributed, we believe, primarily to the fact that our present day Scottish pine is chiefly of plantation and planted origin. The timber from natural seedlings growing in close canopy will always be superior to that from the ordinary type of plantation seen in Great Britain. In making this statement it may be admitted that the slower the growth the finer the quality of timber. That the opinion here expressed is held in expert timber quarters is supported by the following extract from the *Timber News* of Jan. 20: "It is not generally known [the writer presumably refers to trade circles] that the so-called fir or pine wood that is sent to London and other markets in large quantities from Baltic ports is no other than the produce of our native Scotch pine grown under more favourable conditions than are generally to be found in this country. For almost all classes of work this Continental wood is largely in use, such as road paving, building construction, and in the manufacture of small wooden ware of various descriptions. In a few districts of Northern Britain, notably Aberdeenshire, timber of the native pine is produced of quite as good quality as any that is forwarded from Norway, Sweden, or Russia, as was noticed and commented upon by the Canadian wood-fellers during the War." Mr. Richardson's article is chiefly concerned with a remarkable letter, bearing on the Scots pine and its development, which was written by Mr. James Farquharson, of Invercauld, on June 22, 1775, and sent to Dr. Hunter, F.R.S., the editor of the new (York) edition of John Evelyn's "Sylva" published in 1786. Farquharson's remarks with reference to planted and natural pine are worth reading and acting upon if we are ever to reproduce Scots pine to rival the naturally grown forests of Scandinavia and northern Russia.

SHEETS of metal so thin that ordinary type can be read through them are now available as the result of research by Dr. Carl Mueller, of the Charlottenburg Laboratory, Berlin. His method of preparing them is to electroplate the metal on the surface of some soluble substance, such as rocksalt, and then dissolve away the support. A ring of thicker metal can be used to support the films, of which two and a half million would have to be piled to make a stack an inch high. Such films have been made of iron, nickel, gold, silver, and platinum, and it is found that although the nickel is much less transparent to visible light than gold, it readily transmits the shorter ultra-violet rays. The films are very elastic, and will bulge out for as much as a tenth of their diameter without breaking. Another curious thing about them is their high electrical conductivity. As these films are practically all surface, a strip of film containing no more metal than in a round wire one-hundredth of a millimetre in diameter will carry enough current to light several lamps; if the same current were passed through the wire, the latter would be instantly melted. This film may find use in radio and phonograph reproducers, since ordinary diaphragms are so heavy that they dampen some of the overtones and so coarsen the sounds.

THE fourth International Congress of Entomology will be held at Cornell University, Ithaca, N.Y., on Aug. 12-18 of this year, with Dr. L. O. Howard as president. Invitations to send delegates have been forwarded to foreign governments through the State Department at Washington, and a programme is being arranged which provides for every important interest, educational, scientific, and economic. The mornings will be reserved for papers of more general interest, and during the afternoons, sections will deal with taxonomy, distribution and nomenclature, morphology, physiology and genetics, ecology, medical and veterinary entomology, and economic entomology relating to forest, field, and garden, bees, insecticides, and appliances. On an all-day visit to the Geneva Experiment Station, demonstrations of methods of spraying by machinery and dusting by aeroplane will

be given, and immediately after the Congress, excursions are planned to the Niagara Falls, entomological museums of eastern cities, and laboratories of the U.S. Bureau of Entomology. [Cornell being the Alma Mater of a very large number of American State entomologists, and Dr. L. O. Howard the organiser of the U.S. Bureau of Entomology, a model for other countries, the attendance of American entomologists will be very large. Various European governments and institutes have already intimated that they will send delegates, and it is sincerely to be hoped that Great Britain likewise will be well represented at the meeting. The great difficulty for Europeans is the question of expenses. In order to obtain certain facilities of travel and to reduce the expenses, it is proposed to arrange for a party to travel together. Particulars of the party can be obtained from Dr. K. Jordan, Zoological Museum, Tring (Herts), the permanent secretary of the International Congresses of Entomology.

ANY technical man who cares to peruse the advertisement pages of almost any technical publication, and then compares such advertisements with those in the general press, must surely be convinced that engineering propaganda is not conducted so effectively as it ought to be. In fact, nearly all technical advertisements look alike, except for the change in illustration and manufacturer's name. In the United States, technical propaganda is conducted with much greater effect, and that explains, perhaps, why Americans are capturing markets that were once British strongholds. Now anything that will advance any branch of science—and 'technical' advertising is a highly specialised science—is welcome. In "The New Propaganda in Industry," a booklet written jointly by a thoroughly trained technical man and an advertising consultant, and published by The Technical Advertising Service, Fitzalan House, Arundel Street, London, W.C.2, entirely novel considerations are brought to bear on this vital problem. Such questions as the nature of the thing to be advertised, how influence is established, the importance of a good policy, and the practical measures for giving effect to the psychological points which are even more important in industrial propaganda than they are in general publicity, are discussed in a way that must appeal to all those who have technical products to market.

THE managers of the Royal Institution have appointed Dr. Alex. Muller to be assistant director of the Davy Faraday Research Laboratory. Dr. Muller is the author of a number of notable papers on the analysis of crystals, particularly the long chain compounds, which have been published in the proceedings of the Royal and other scientific societies.

AT the annual general meeting of the Society of Public Analysts on Mar. 7 the following officers for the year 1928 were elected: *President*, Mr. Edward Hinks; *Vice-Presidents*, Mr. John Evans, Mr. Thomas Macara, Mr. John White; *Hon. Treasurer*, Mr. E. B. Hughes; *Hon. Secretary*, Mr. F. W. F. Arnaud.

THE earthquake which is reported in the daily press to have caused some damage in the south of Italy was recorded at Kew Observatory on Mar. 7, at 10 hr. 59 min. 7 sec. G.M.T., as a well-defined shock. The records show that the epicentre was at a distance of 1250 miles in a south-easterly direction from Kew Observatory, and therefore probably in Sicily. Oscillations persisted for half an hour. A shock was also registered on Mar. 7 at 23 hr. 3 min. 31 sec. G.M.T. The epicentre is estimated to have been 4000 miles from Kew Observatory.

A VERY large earthquake was recorded at Kew Observatory on Mar. 9 at 18 hours 18 mins. 35 secs. The distance of the epicentre is estimated to have been 6200 miles away. Oscillations persisted for more than three hours. A message received at Kew from Bombay states that the distance of the shock from that station was 1880 miles. Combining these estimates, it appears that the earthquake must have originated either in the Indian Ocean or in the north of Sumatra and at about midnight local time.

SOME popular lectures on scientific subjects are being delivered at the Polytechnique, Regent Street, London, in support of the King Edward's Hospital Fund for London. On Mar. 9 Prof. Julian Huxley lectured on the habits and behaviour of ants; and there will be a lecture on beam wireless by Mr. T. L. Eckersley on Mar. 23, and one on liquid air by Mr. A. J. Philpot on Mar. 30—both with experimental illustrations. Tickets (2*s*. 6*d*. and 5*s*.) may be obtained at the doors or at any of Messrs. Keith Prowse and Co.'s offices. Parties of not less than ten from schools are admitted at half-price.

THE following nominations for office in the Chemical Society have been made, and the fellows thus nominated will be declared elected at the next annual general meeting: *President*, Prof. J. F. Thorpe; *Treasurer*, Dr. T. Slater Price; *Secretary*, Prof. T. S. Moore. The retiring president, Prof. H. Brereton Baker, will deliver his presidential address, entitled "Constitution of Liquids: Some New Experiments," at the annual general meeting to be held at Burlington House on Thursday, Mar. 22, at 4 P.M., and the anniversary dinner will be held the same evening at the Hotel Victoria at 7 for 7.30 P.M.

IT is announced by the Natural Resources Intelligence Branch of the Department of the Interior at Ottawa that it has been decided to name the highest peak in British Columbia (13,260 feet) after Dr. G. M. Dawson, the well-known geologist on whose work the chief knowledge of the geology of British Columbia is based. Dr. Dawson was for several years director of the Geological Survey of Canada, and in the course of his work made a detailed examination of more than 6000 square miles of the interior of British Columbia. The exact location of Mount George Dawson given by the Provincial Government Surveys Branch is Lat. 51° 22′ N. and Long. 125° 16′ W., which is about 175 miles north-west of Vancouver and near the head of Knight Inlet.

IN an article in the *Chemiker Zeitung* for Feb. 11, by Prof. Haber, attention is directed to the fact that exactly twenty-five years have elapsed since the late Prof. Birkeland and Dr. S. Eyde solved the difficult problem of producing nitric acid commercially from atmospheric nitrogen. The need for applying a high-tension discharge was of course known, but the many previous attempts to utilise such a discharge on the commercial scale were unsuccessful until Birkeland and Eyde employed the device of electromagnetic distortion of the arc. That this method of solving the problem of nitrogen fixation had in course of time to give place to the more practicable ammonia-processes, was inevitable on thermodynamical grounds. Nevertheless, the achievement of these two pioneers may be regarded as marking the beginning of a new era in industrial chemistry.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 157 of books relating to botany. Of the 1300 works listed, many are choice and rare. The catalogue can be had upon application.

MESSRS. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, have just issued a short catalogue of second-hand books of science, ranging over the subjects of botany, natural history (including ornithology and zoology), mathematics, and physics. Copies can be had upon application.

WE understand that the works by Sir Flinders Petrie noticed in NATURE of Mar. 3, p. 311, can be obtained from Lady Petrie, University College, Gower Street, London, W.C.1, at the following prices: "Glass Stamps and Weights," 31*s.* 6*d.*; "Ancient Weights and Measures," 52*s.* 6*d.*; or, the two works together, 63*s.*

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A laboratory assistant to the biochemist of the Glasgow Royal Infirmary—The Secretary and Cashier, Royal Infirmary, 135 Buchanan Street, Glasgow (Mar. 22). A junior chemist under the Lancashire and Cheshire Coal Research Association—The Director of the Association, College of Technology, Manchester (Mar. 23). A woman assistant lecturer in geography in the department of education of the University of Birmingham—The Secretary, University of Birmingham (April 28). A professor of biology in Canterbury College, Christchurch, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (April 30). A demonstrator in organic chemistry and a demonstrator in physics at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (April 30). A full-time teacher of rubber technology at the Northern Polytechnic—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7. A test assistant for photographic work at the Royal Aircraft Establishment—A.269, Chief Superintendent, R.A.E., South Farnborough. A lecturer in geography in the Queen's University of Belfast—The Secretary, Queen's University, Belfast.

Our Astronomical Column.

EXTENT AND DURATION OF THE UNIVERSE.—Dr. J. H. Jeans delivered the Trueman Wood Lecture before the Royal Society of Arts on Mar. 7, its title being "The Wider Aspects of Cosmogony." He naturally dwelt rather fully on the recent researches by Prof. Shapley and Dr. Hubble on the distances of the globular clusters and spiral nebulæ, which have so amazingly widened our conception of the volume of space that is accessible to our largest instruments. He referred to the Einstein view of space re-entering on itself, and concluded that the re-entrant region is not distant more than a thousand times the distance of Hubble's farthest nebulæ, which are at an estimated distance of 140 million light-years. Assuming that the whole of Einstein space is filled with nebulæ as densely as the portion surveyed, he estimated the number of stars in it as 2×10^{24}; he noted that the same number of grains of sand would suffice to cover England with a layer hundreds of yards in depth.

Dr. Jeans introduced some of his own conclusions on the interior of stars. He postulates that the central regions are liquid rather than gaseous, and thinks that this view explains the fact that stars tend to divide themselves into standardised sizes according to the number of rings of electrons left round the nucleur of the atom; the number may be 0, 1, 2, or 3, but cannot be fractional. Stars like Betelgeuse are concluded to have three rings left, while the small dwarf star discovered by Van Maanen has none left. He conjectures that elements exist in the central regions of the stars of higher atomic weight than any known on earth; this would explain the enormous amount of energy that they contain, which is able to keep stars shining for millions of millions of years. A few points in the lecture would not meet with universal assent, but it gave a very graphic picture of the vastness of the universe and its immense duration. Dr. Jeans tries to estimate the past duration in several different ways; they all give periods of the order of five to ten millions of millions of years.

COMETS.—*Popular Astronomy* for February contains a photograph of Encke's comet taken by Prof. van Biesbroeck at Yerkes on Jan. 21; it had a sharp nucleus and a broad tail 5′ long pointing westward; the present is the thirty-seventh observed apparition of Encke's comet; it has not been missed once since 1819. Comets Stearns (mag. 12½), Schaumasse (mag. 15), and Schwassmann-Wachmann (mag. 17) were also observed in January at Yerkes or Bergedorf; there seems to be no doubt now that the last-named comet passed perihelion in 1925; this brings up the number of perihelion passages of comets in 1925 to eleven, which is the greatest number on record; 1898 had ten.

NOVA PICTORIS.—This nova, like many recent ones, has now developed a nebulous ring round it. *Harvard Announcement Card, No. 55*, states that Prof. Hartmann at La Plata describes it as being 1″ in diameter; Mr. Paraskevopoulos, of the Boyden Station, Bloemfontein, notes that the nova is surrounded by a rather narrow well-defined ring of low density and small diameter; it was photographed with a Metcalf triplet, 10 cm. in diameter. Fuller details are promised in a forthcoming *Harvard Bulletin*.

Research Items.

SOCIETY ISLANDS TECHNOLOGY.—Some interesting points in relation to the decay of native arts emerge from a study of handicrafts of the Society Islands, by Willowdean Chatterson Handy, which appears as *Bulletin 42* of the Bernice P. Bishop Museum of Honolulu. The processes studied are plaitwork, including basket making, matting, and braiding, and cord, rope, and net making, the preparation of material as well as the actual methods of making up being examined. The practice of these arts appears now to be identical in all the islands, but at one time there is no doubt that they could have been studied at each of the eight islands as local variants of a parent stock. Old objects are assigned to their place of original manufacture; for example, an old mat is recognised as from Maupati. Certain localities, however, are still recognised as having specialities. The manufacture of *tapa* has disappeared even in households which still carry on the native arts and crafts as part of the daily routine. The art of plaiting, on the other hand, is widely practised owing to the introduction of the making of straw hats by the missionaries in 1820. These, however, are worthy of record, as some of the plaits were formerly used in decorative plaiting on houseposts. On the other hand, the introduction of the sale of oranges in the markets of Papeete has led to the preservation of the nets once used for carrying or hanging bowls or gourds.

SICKNESS IN HUMID AND NON-HUMID WEAVING SHEDS.—The Industrial Fatigue Research Board in Report No. 8, has published some valuable data on artificial humidification in the cotton-weaving industry, by Mr. A. Bradford Hill (London: H.M. Stationery Office). For the successful weaving of certain classes of cloth it is maintained that a high degree of humidity is necessary, and so the natural humidity of the air is increased by injecting additional moisture into the air of the weaving sheds in the form of steam. There has been strong opposition to the practice from the operatives, and several parliamentary inquiries have been held with resulting statutory regulations. It is claimed that the effects of working in these humid sheds is to lower the state of the operative's health. This report aims at determining what is the difference actually in sickness between the workers in humid and non-humid sheds. The weaving sheds chosen were situated in five Lancashire towns, in three of which sheds of both types were to be found; in one only 'dry' sheds, and in one only 'wet' sheds. In all, seventy-four firms took part in the inquiry; the number of separate sheds was 128, and the number of weavers concerned more than 20,000. The sickness history was obtained from the National Health Insurance approved societies. A year's investigation of the sickness incidence revealed no significant difference between the two types of sheds either in the number of days of sickness experienced, in the number of claims made, or in the number of persons suffering from one or more sicknesses. Analysis according to the *nature* of the incapacity suffered in the two environments yielded no evidence of any consistent or distinct differences in the distribution of specific sicknesses between the humid and non-humid sheds.

A CIRRIPEDE PARASITE FROM THE DOGFISH.—The Report for 1926 of the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel, contains much that will interest both marine biologists and zoologists. Besides a number of small papers there are two which, both on account of their greater size and their considerable intrinsic interest, command attention. Prof. J. Johnstone and Miss W. E. Frost contribute a valuable paper on the general morphology of *Anelasma squalicola* (Lovén) which considerably advances our hitherto meagre knowledge of this very interesting cirripede parasite which they obtained from the dogfish, *Etmopterus spinax*. The fish were caught on the hake grounds off the south-west of Ireland at depths of about 150-180 fathoms, and some 5 per cent. of them were infected with the parasite which was rooted in the dorsal muscles. The paper contains a detailed account of the morphology of the parasite, well illustrated with clear, though somewhat diagrammatic, figures. Though mouth parts are present, only smaller than in the free-living cirripedes, the tubules of the 'digestive gland' in the one adult specimen examined showed signs of degeneracy, and the authors are inclined to agree with Broch that some part, at any rate, of the food is obtained from the host fish by way of the roots, which were originally exclusively organs of fixation. On the disputed point of the cement glands, they are of the opinion that these are derived from the original germinal material and that the cementing matter, no longer required for its original purpose, is modified to provide a portion of the food yolk in the mature eggs. The other important paper is by R. J. Daniel and is concerned with "The Abdominal Muscular Systems of the Common Shrimp (*Crangon vulgaris*)." The muscles are described and illustrated in minute detail, and their function in causing the backward spring, so important in the life of decapod Crustacea, is clearly demonstrated. It is a paper impossible to summarise here owing to its nature. Congratulations are due to Mr. Daniel for his highly successful treatment of a very difficult piece of work.

NEW INDIAN TREMATODES.—Dr. E. C. Faust reports (*Records Indian Mus.*, vol. 29, pp. 215-218, 1927) on a unique holostome, about fifty specimens of which were collected from the intestinal tract of a holothurian (*Actinopyga mauritiana*) in the Andaman Sea. The most remarkable feature in the structure of this worm, which is designated *Cleistogamia holothuriana* gen. et sp. nov., is the entire absence of cirrus, genital atrium, and uterine opening. At the posterior end of the seminal vesicle, where a genital pore or a cirrus-sac might be expected, the vesicle bends abruptly forward and becomes constricted into a hollow filament which is continuous with the vagina. This apparatus therefore permits the transference of spermatozoa from the seminal vesicle directly into the vaginal sac. "The process here involved is not merely self-fertilisation; it is obligatory self-fertilisation or cleistogamy." The egg bears a long terminal filament, frequently coiled on itself like a watch-spring, which may either serve in rupturing the blind uterine sac, thus allowing dispersal of the enclosed eggs, or it may serve to entangle and fix the egg after discharge. This appears to be the first trematode recorded from a holothurian, and it is further exceptional in that the adult form occurs in an invertebrate. Dr. Faust remarks that the only other mature trematode in an invertebrate is Aspidogaster. S. C. Verma describes (*Op. cit.* pp. 139-156, 1927) a new species of Opisthorchis—only the second species of this genus known from fishes. This species (*O. pedicellata*) was found in the gall-bladder of the siluroid fish *Rita rita*, collected in the rivers Ganges and Jumna, about half the fish being infected. The characters by which *O.*

pedicellata may be differentiated from its nearest relatives are pointed out, and appended is a key to the species of Opisthorchis.

NICTITATING MEMBRANE OF BIRDS AND MAMMALS.—Mr. E. P. Stibbe (*Jour. Anat.*, **62**, 159-176; 1928) has investigated the homologies of the so-called nictitating membrane of birds and mammals, and concludes that the plica of man and mammals differs entirely from the nictitating membrane of birds both structurally and functionally, and that there is reasonable ground for supposing that it is morphologically different also. He proposes to substitute the term *plica intercipiens* for the so-called nictitating membrane of mammals. The author hopes by a study of the ontogeny of the plica in mammals to elucidate its true morphology.

BRANCHING IN THE OIL PALM.—A most remarkable case of branching in this palm (*Elæis guineensis*) is recorded by M. T. Dawe in the recent issue of the *Kew Bulletin of Miscellaneous Information* (No. 1, 1928). The palm in question is at Sierra Leone, is supposed to be more than a hundred years old, and has never been known to bear fruit. It branches very abnormally at a height of six feet or so from the ground, and sends out and up from a kind of fasciated growth eight normal-sized branches which attain a normal height. A further remarkable feature is that two of these branches have also branched. In many cases branching or forking in palms is due to injury or destruction of the growing point. The author finds it difficult to believe that the branching in this case is due to accidental causes, since the repeated branching would seem to indicate a physiological character. He would be interested to learn if any other cases of branching in the oil palm have been met with in any other part of West Africa or elsewhere.

PERIODICAL FLOWERING OF BAMBOO.—In the *Japanese Journal of Botany*, vol. 3, No. 4, Seiichi Kawamura analyses the problem of periodicity in the flowering of the bamboo. The brakes come into flower at intervals of many years, the phenomenon occurring universally and simultaneously in the case of all brakes of the same species, even though situated in different provinces of Japan and in different latitudes. Different species, however, come into flower at different periods. The period of flowering seems to be unrelated to the age and extension of the brake, the thickness of the aerial stems, the fertility and humidity of the soil, exposure to sun, or climate of locality. From incomplete chronological records, the author assumes that the species *Phyllostachys Henonis* flowers at intervals of 120 (occasionally 60) years. Other species of bamboo show a similar order of periodicity. From consideration of the vegetative propagation of the bamboo, carried out by means of subterranean organs, it is suggested that all members of one species originated vegetatively from one ancestor, and thus all individuals of that species would be ontogenetically of the same age. This would explain the simultaneous flowering, which is seemingly independent of external conditions.

GLACIERS OF EDGE ISLAND, SPITSBERGEN.—One of the main objects of the Cambridge expedition which spent August last year on Edge Island was to determine the extent of the ice on that land, for little is known of the island and the interior has not been explored. In a lecture on Feb. 20 to the Royal Geographical Society, Mr. H. G. Watkins pointed out that the ice-covered area is horse-shoe in shape, surrounding the central unglaciated valley which lies in the south-west, at the head of Deevie Bay. On the south-east the ice-cap meets the sea in the well-known King John Glacier, which is an ice cliff more than twenty miles in length. On the south, and probably on the east, glaciers also reach the sea, but on the west and north no glaciers reach the coast. The scarcely known east coast was, however, not explored by the expedition on account of bad weather and lack of time. The ice-cap consists of large rounded domes, each about 1500 ft. in height, on which, in summer, there was the usual absence of snow. All the glaciers which do not reach the sea are retreating except one near the northern limit of the ice-cap; this is temporarily advancing. The bad weather prevented much survey being done by the expedition except on Deevie Bay and in the north-west of the island. It was even impossible to fix the position of Cape Heuglin in the north-east, the exact position of which is doubtful. The work that has been done is linked with the accurate work of the Russian Arc of Meridian expedition of 1899–1901 on the west and north coasts.

INDIAN FOSSIL SUIDÆ.—The fourth, and concluding, memoir of volume 8 of the Geological Survey of India contains Dr. Pilgrim's account of the fossil Suidæ. The wealth of the fauna is shown by the description of more than thirty new species distributed over many genera, seven of which are described for the first time. After an explanatory introduction, the memoir is devoted to a detailed account of the material, which is well illustrated by twenty plates.

ENGLISH EOCENE MOLLUSCA.—The English Eocene Mollusca have long stood in need of revision under the light of modern researches and knowledge. This is now being undertaken by Mr. A. G. Wrigley, whose second paper comprising the Fusinidæ has just appeared (*Proc. Malac. Soc. Lond.*, vol. 17). A careful and critical systematic description of the genera and species is given with beautifully clear line drawings by the author himself of the more important of them. Grabau's hypothesis that the changes in the sculpture of a single gastropod shell as it develops from its protoconch to maturity indicate the history of the stock to which it belongs, comes in for severe castigation, and the author remarks that unfortunately Grabau's 'ancestral' forms are all too frequently preceded by their theoretical descendants.

UPPER CRETACEOUS CEPHALOPODS.—J. B. Reeside, jun. (*U.S. Geol. Surv. Prof. Paper*, 150B; 1927) gives a history of the views which have been held as to whether Scaphites is a natural or a polyphyletic group. Nine generic divisions have been proposed for Scaphites, of which the author accepts four as valid, namely, Scaphites (restricted), Desmoscaphites, Discoscaphites, and Acanthoscaphites, referred to the families Stepheoceratidæ, Desmoceratidæ, and Cosmoceratidæ respectively. A catalogue is given of all the specific names which have been applied to Scaphites, and the work concludes with a table showing the stratigraphical distribution of the species from the Upper Gault to the Mæstrichtian. In another memoir, the same author (*ibid.*, *Prof. Paper*, 150A; 1927) gives an account of the cephalopods from the lower part of the Cody Shale, Oregon; he recognises a zone found in the Niobrara formation of the Great Plains, and considers that some of the species present strongly support the correlation of the Niobrara formation with the European Coniacian (Emscherian). Reeside (*ibid.*, *Prof. Paper*, 151; 1927) also describes and figures the cephalopods of the Eagle Sandstone, in which the principal genera represented are Baculites, Scaphites, Placenticeras, and Peroniceras.

FLUCTUATIONS OF THE LEVEL OF THE CASPIAN SEA.—Prof. A. V. Voznesensky, who studied this problem on the spot very thoroughly, gives in *Priroda* (No. 10, 1927) a brief summary of his observations. The latter are based mainly, so far as ancient fluctuations are concerned, on the historical evidence, particularly with regard to a large building, a karavanserai, in the Baku bay. The building was erected in about 1135 A.D., of course on dry land, on a small hillock. In the interval from 1135 until the beginning of the eighteenth century, the building is not mentioned in any documents; this is understandable, since there exists trustworthy historical evidence that in 1306 Baku was flooded by the sea, which reached a mark about 16 metres above the level of 1135. From the fifteenth and sixteenth centuries there are historical records of the sea receding again, and about 1723 the top parts of the karavanserai appeared from the water. Towards the middle of the eighteenth century the level of the sea rose again almost to the level of the fourteenth century; since then a series of smaller fluctuations has followed, but on the whole the waters have receded, and in 1925 even the foundations of the building became visible. The reason for these fluctuations is partly in the climatic variations (Bruckner's periods), but mainly in the seismic disturbances. The practical importance of the fluctuations is obviously great, since even a small lowering of the level affects navigation and fisheries in the whole of the Caspian Sea, and this makes a detailed study of the problem highly necessary. A survey was carried out on the Apsheron peninsula in 1911–12 by the Seismic Commission of the Russian Academy of Sciences, and it is to be hoped that another will be undertaken shortly which should give valuable data on the problem.

QUARTZ RESONATORS.—The use of quartz resonators as standards for measuring frequency, and also for stabilising the frequency of radio circuits in connexion with radio communication, is rapidly extending. Prof. Cady, of the Wesleyan University, Connecticut, made very valuable researches on the piezo-electric behaviour of small plates of crystalline quartz in 1922. In 1923, Dr. D. W. Dye pointed out that there appeared to be a field of usefulness for quartz vibrators as frequency standards and as frequency stabilisers. Since then, progress has been very rapid. In a paper read to the Institution of Electrical Engineers on Mar. 7, by G. W. N. Cobbold and A. E. Underdown, many practical developments carried out by them at the Army laboratory at Woolwich are described. They show that there is a very simple relationship between the dimensions of the quartz oscillator and the frequency produced. They point out that the frequency is very little affected by the temperature of the quartz. The temperature coefficients found experimentally were less than ten parts in a million per degree Fahrenheit. The other standards used for the determination of radio frequency are an oscillatory electric circuit consisting of an inductance associated with a capacity or an elinvar tuning fork. The latter, when associated with a multi-vibrator, can be made to provide a series of standard points in the band of frequencies used in radio work. The materials used in the construction of the electro-magnetic standard do not retain their permanence in the way that elinvar and quartz do, and their temperature coefficients are higher. The authors consider that for national and international standards of the highest quality the fork is the best. There is, however, a wide field for quartz resonators as secondary standards, especially in short-wave radio practice. In this case the frequencies are enormously high in comparison with the frequency of a tuning fork. The authors describe a crystal multi-vibrator which gives a series of frequencies from 2000 to 15,000 kilocycles per second, that is, from 150 to 20 metres in wavelength, in multiples of 1000 kilocycles per second.

GEOMETRICAL OPTICS.—In his presidential address to the Optical Society in February (*Transactions of the Optical Society*, vol. 28, Pt. 5) Mr. T. Smith dealt with the futility of the present methods of teaching geometrical optics. The well-known diagram of rays incident on one of the principal planes of an optical system and emerging from the other principal plane he characterises as "elegant" but "trivial," and "inconsistent with the known properties of light." As a basis for a more accurate and real geometrical treatment of the subject, he shows that when a ray of light travelling in air falls on the surface of a sphere and is refracted, a straight line drawn through the centre of the sphere to cut both rays cuts them in conjugate points, and that if the triangle formed by the rays and the radius be swung about the centre of the sphere, the ends of the radial line describe concentric arcs which are object and image with constant magnification. From this he shows that the surfaces of constant magnification for either a single refracting surface or for a lens can be easily and accurately drawn. It is to be hoped that these methods will soon find their way into elementary text-books.

SLAG, COKE BREEZE, AND CLINKER AS AGGREGATES.—The Building Research Station of the Department of Scientific and Industrial Research is carrying out work to determine the cause of failures occurring with concrete made from materials such as furnace clinker, and in Special Report No. 10 (London: H.M. Stationery Office) F. M. Lea and F. L. Brady summarise present knowledge on this subject. The composition of acid and basic slags, breezes, clinkers and cementing agents is discussed, and the factors affecting the suitability of these materials for various uses are considered. Slag forms a good concrete provided that it is not very acid or strongly basic, but coke-breeze-concrete is apt to be mechanically weak and is therefore only suitable for inside walls. This is due to the fact that coke-breeze is often contaminated with coal or may have a high sulphur content, in which case weathering causes oxidation of the calcium and iron sulphides to the sulphates with increase of volume. Clinker suffers from the same disadvantages and usually fails on account of the presence of unburnt coal. The methods of utilisation of these materials are discussed, and it is concluded that slag concrete can be made having a strength at least as great as that of gravel concrete. Clinker concrete is not so strong, but is better than that made from breeze. The report includes a bibliography of the more important papers on the subject.

THE SALTING-OUT EFFECT.—The influence of electrolytes on the solubility of *m*-cresol in water has been studied by J. S. Carter and R. K. Hardy, who have described their work in the January issue of the *Journal of the Chemical Society*. The solubility s of a non-electrolyte in a solution of a salt of concentration c is known in many cases to be represented by the equation $s = s_0 e^{-kc}$ where s_0 is the solubility in the pure solvent and k is a constant which is a measure of the salting-out effect. This law has been verified for the effect of sodium and magnesium chlorides and sulphates upon *m*-cresol solutions, but does not hold if the free acids are used. The sulphate ion is much more efficient for salting-out than the chloride ion, and the solubility of *m*-cresol is lowered more by salts than by the corresponding acids.

The Russian Academy of Sciences and its Institutions.

THE Russian Academy of Sciences, representing as it does the highest seat of learning in all its branches in the State, consists of a large number of affiliated institutions, and a survey of them, recently published by the Academy,[1] is of wide interest to all men of science. The interest is not affected by the fact that the survey has been prepared for a specific purpose, namely, for the occasion of the tenth anniversary of the Soviet government, with the view of showing the world the effect that the Revolution has had on Russian science. The volume consists of a series of chapters dealing with each institution separately, and we will follow this arrangement. Each chapter concludes with a bibliography of papers and books dealing with the particular institution, and with a list of scientific and technical staff.

The Library of the Academy was founded by Peter the Great, who brought a number of foreign books home from his travels. At first it functioned as a public library, but with the foundation in 1812 of a special Public Library in St. Petersburg it was transformed into a purely academic library. In 1924 a new building was completed for the library, with a floor space of 12,500 sq. metres. The number of titles of books and manuscripts in the library is more than three millions; the staff numbers 170.

The Steklov Physico-Mathematical Institute developed from the first Russian scientific laboratory, apparatus for which was actually acquired by Peter the Great before the Academy was founded. At first it was called the Physical Laboratory, and amongst its directors have been E. Lentz, B. S. Jacoby, O. D. Chwolson, B. B. Galitzine. The last-named started highly important work on seismology, and it is due to him that the Russian seismological service was developed, but during the civil war and the Revolution it was almost wholly destroyed, and only now are steps being taken to re-establish it. The Physical Laboratory during that time also practically ceased to function. In 1921 the mathematical cabinet was founded under the directorship of V. A. Steklov, and in the same year it was united with the Physical Laboratory to form the present Physico-Mathematical Institute, which was named after V. A. Steklov when the latter died in 1926. At present the institute consists of three departments: mathematical, physical, and seismic; the present director is A. F. Joffé.

The Chemical Institute developed from the chemical laboratory founded in 1748 by Lomonosov, one of the first Russian chemists, and such well-known chemists as Frizsche, Zinin, Butlerov, and others have worked in it. In 1924 the laboratory was transformed into the Chemical Institute with two departments: general and organic chemistry, high pressures and high temperatures. In connexion with the Institute are working some of the institutes of the Commission for the Study of Natural Resources (see below). The department of general chemistry under N. S. Kurnakov is working at present mainly on problems of physico-chemical analysis, pure and as applied to the study of ores and minerals. The second department, under V. N. Ipatiev, is studying the action of high pressures and temperatures on chemical compounds.

The Dokutchaev Soil Institute began its activities in 1881 as an independent public committee under V. V. Dokutchaev and later under K. D. Glinka, who has recently died (*v.* NATURE, Dec. 17, 1927, p. 887). Since 1918 it has been incorporated into the Academy, and at present it consists of a soil museum, department of soil cartography, department of soil surveys, and a department for the study of the dynamics of soil formation.

The Physiological Institute was founded in 1889 as a laboratory, and is at present under the directorship of I. P. Pavlov; its work is mainly on the problems of reflexes, and the physiology of brain generally.

The Yafetic Institute is one of the recently founded (1921) branches of the Academy, and its work consists in research on Yafetic languages of the original population of Europe. The director of the Institute is N. J. Marr.

The Laboratory of Biochemistry and Plant Physiology has been in existence since 1889. Its present director is S. P. Kostychev, and the work is mainly concentrated on biochemistry of fermentation, photosynthesis, fixation of atmospheric nitrogen, and mineral nutrition of plants.

The Special Zoological Laboratory, founded by A. O. Kovalevsky in 1893, was considerably enlarged in 1921 under the directorship of N. V. Nasonov, and is working on different branches of morphology and experimental zoology.

The Geological Museum was originally a part of the *Kunstkamera* founded by Peter the Great. In 1913 funds were obtained for a large new building, but the War prevented its erection, and it was not until 1922 that the Museum obtained new premises for development. At present only some of the galleries are open to the public, but scientific work is being carried out in all directions, under the directorship of F. J. Levinson-Lessing.

The Mineralogical Museum originated in the same way as the Geological Museum. It has now six exhibition galleries and scientific laboratories guided by A. E. Fersman. During the last ten years numerous expeditions have been organised by the Museum for studying mineral resources of outlying parts of Russia.

The Botanical Museum was also founded by Peter the Great. There are no exhibition galleries, the Museum consisting entirely of herbaria, occupying twelve halls. Research work is being conducted mainly in the Caucasus, Siberia, and Northern Russia. The present director is I. P. Borodin.

The Zoological Museum has existed since 1832 as a special institution, and consists of public galleries and scientific departments, under the directorship of A. A. Birula. The scientific staff includes 35 workers. Expeditions for the zoological survey of various parts of Russia are being organised more extensively than in the past, and collections from the Palæarctic region are enormous in size. There are, however, difficulties in publishing the results of scientific work. Exhibition galleries occupy two large halls.

Pushkin House is a museum for preserving all relics connected with the great national poet, for scientific research on Pushkin, and on the history of Russian literature generally. It has a remarkable collection of manuscripts, a library, and public museum. The present director is S. F. Platonov.

The Museum of Anthropology and Ethnography again developed as a part of the *Kunstkamera*. It represents the central place for all research on anthropological and ethnographical problems, and consists of laboratories and public galleries, under the directorship of E. F. Karsky.

The Asiatic Museum is rather a library than a museum, since all ethnographical objects have been

[1] Scientific Institutions of the Academy of Sciences, U.S.S.R. Leningrad, 1927. Pp. 169+17 plates.

transferred to the corresponding museum, and the main aim of the Asiatic Museum is collecting and studying literature, both printed and manuscript, on oriental problems; it has probably the richest collection in the world on oriental studies. The Museum is under the directorship of S. F. Oldenburg.

The Museum of Palæography was founded in 1925 and has as its aim a full representation of systems of writing, from the ancient inscriptions on monuments to the present-day printing technique. The Museum is still in course of organisation.

The Commission for the Study of Natural Resources was founded in 1915 on the initiative of its present president, V. I. Vernadsky, with the view of studying systematically the natural resources of Russia. The main directions of work are defined as: unification and consolidation of local work on the study of natural resources; independent field research; description of separate regions from the point of view of their resources; research in the practical utilisation of natural resources. In accord with its diversity of functions, the Commission has a number of working branches, as follow: Institute of Physico-Chemical Analysis, working on analyses of salt deposits in the Caspian Sea, metallic ores, etc.; Institute for the Study of Platinum and other Noble Metals, studying methods of analysis of platinum ores and the extraction of the metal from them; Section of Non-Metallic Minerals and Gems, which has published a series of monographs on asbestos, sulphur, etc., as well as on gems and valuable stones; Section of Stone Building Materials, which is studying building materials from the point of view of their distribution in Russia, and from the technical aspect as well; the Sapropelite Committee, which is engaged in studying lake deposits and their utilisation; the Gaseous Section, which studies natural gases, mainly from the point of view of the presence in them of helium for aviation purposes; the Section of Energetics is preparing a register of natural power resources, mainly of water, but also of wind and tides; the Geographic section is mainly engaged in research on problems of economic geography; the Bureau of Genetics studied at first problems of heredity in man, but at present it is engaged in work on heredity in wheat, domestic animals, etc.; Section for the Study of Living Substance, under V. I. Vernadsky, is engaged on problems of the influence of organic matter on geochemical processes; the Moscow section of the Commission has also several laboratories—for genetics, applied zoology, etc.

The Commission for the Study of Nationalities occupying Russia is studying the population, preparing maps, studying habits of various national groups, their occupations, etc.

The Commission for Scientific Expeditions is intended to correlate expeditions sent out by various institutions of the Academy. The number of expeditions has increased greatly during recent years, and for the last ten years (1917–1927) their number exceeded two hundred.

The Special Committee for the Study of Allied and Autonomous Republics was founded in 1926 in order to direct and co-ordinate surveys organised by the Academy at the request of republics. The committee is organising expeditions into Kazakstan (Kirghiz steppes), Karakum desert, Armenia, and other parts.

The Commission for the Study of the Yakut Republic was formed at the request of the said republic for a comprehensive survey of its natural resources. The work is calculated to take five years, and preliminary results have already been published.

The Commission for Science and Scientific Workers is preparing registers of all scientific workers in Russia, which it is intended to publish regularly.

The Polar Commission was founded in 1914 for co-ordination of work in polar countries done by different bodies. Its activities have developed only since 1923, and in 1925 an expedition to Novaya Zemlya was organised.

The Historico-archæographical Commission is dealing with the publication of historical documents and manuscripts on nationalities of Russia.

The Dictionary Commission has existed since 1922, and is preparing materials for a dictionary of the Russian language, which is being published.

The publications of the Academy and its institutions are produced in the Academy's printing office. Its publishing activities suffered much during the years of revolution, and at present the pre-War level is still not reached. Publications are distributed by the Academy book-store and the Bureau for International Exchanges. Interruption of exchanges was severely felt by the Academy, but at present exchanges are approaching normal.

The Glacial Retreat from Central and Southern Ireland.[1]

By Prof. J. K. CHARLESWORTH.

THE newer drift of Ireland is bounded on the south by a broad and well-developed kettle-moraine —the 'South Irish End-moraine'—which runs from the vicinity of Wexford round the northern flanks of the Dublin hills and by way of Baltinglass, Bennettsbridge, Cahir, Tipperary, Charleville, and Newcastle West to the mouth of the Shannon, a distance of 310 miles from coast to coast.

Contemporaneous with this stage of the Ivernian ice and the Irish Sea ice were the independent ice-centres in the Kerry and Wicklow Hills, the Comeraghs, Galtees, Knockmealdown, and other mountain clusters of the south. Their extent is likewise indicated by well-marked outer moraines, and corresponds to a snow-line on northern and eastern slopes of about 1000 feet and on other slopes of approximately twice that altitude.

The Irish glacial fauna is restricted, with but few exceptions, to the region outside these moraines.

The ice recession from the Dublin and Wicklow Hills is clearly shown by moraines and marginal drainage-features. These prove a pivoting of the ice on the northern slopes of the hills, immediately south of Dublin, and the sweeping of the ice-fronts to east and west, at successive stages of the retreat, in a series of curves which swing out of each other tangentially and northwards.

The dissolution of the Ivernian ice-sheet caused the emergence of the higher hills, such as the Castlecomer Plateau, the Slieve Bloom, and Keeper Hills, and the formation of large lobes protruded southwards down the intervening valleys. The moraines of the Barrow, Nore, Suir, Shannon, and other lobes are magnificently displayed, making possible the correlation from lobe to lobe and the delineation of the successive positions of the ice margin across the country from coast to coast. The festooning of the moraines in the southern part of the country is governed by the relief, while their sinuous form in the northern region is to be ascribed to the break-up of the ice-sheet into separate lobes, flowing on roughly parallel lines.

[1] Substance of a communication read before the Geological Society on Jan. 25.

The ice-sheet in its recession over southern Ireland remained pivoted on the Dublin hills, and retreated over ever-widening strips of country as the ice-front is followed westwards; a withdrawal of 65 miles in the west is represented south of Dublin by but a few hundred yards.

The ice retreating over the Central Plain was dissected into three perfectly distinct lobes, which centred upon the mountains of Donegal, Leitrim, and Galway respectively. Their stages of recession are indicated by countless moraines, the 'eskers' of Irish glacial literature. True osar occur subordinately, transversely within, and as integral parts of, the kettle-moraines.

University and Educational Intelligence.

CAMBRIDGE.—The Royal Society and the Royal Geographical Society jointly have given to the Polar Research Institute a sum of money of about £200 arising from the sale of the reproduction of *The South Polar Times*, published after the return of Captain Scott's first expedition. Lady Walston has offered to the University a sum of £3000 to endow a studentship in classical archæology, to be called the Walston Studentship, in memory of her husband, Sir Charles Walston. The purpose is to facilitate visits to Greek lands for young graduates of either sex studying archæology and architecture.

Miss S. M. Manton, Girton College, has been appointed University demonstrator in comparative anatomy. Mr. E. P. Weller has been appointed University lecturer in estate management, and Mr. L. F. Newman, St. Catherine's College, University demonstrator in methods of agricultural analysis. Mr. G. F. Hickson, Clare College, has been appointed secretary of the Board of Extra-Mural Studies.

Grants have been made from the Worts Fund to Mr. J. A. Steers, St. Catherine's College, towards his expenses on the British Association expedition to the Great Barrier Reef of Australia and to Mr. H. Gilbert Carter, Trinity College, towards the expenses of a botanical survey of the Island of Madeira. Dr. G. Shearer, Clare College, has been nominated to use the University's table at the zoological station at Naples during the coming vacation.

The throwing open of practically all scholarships, studentships, and prizes to women students has led to the proposal which the Council of the Senate is making to the University, with the consent of the councils of Girton and Newnham Colleges, that the separate Harkness scholarships in geology for men and women shall be united into a single scholarship. The new scholarship will have an endowment of nearly £190 a year.

The *Annual Report* of the Appointments Board shows a marked increase in the number of appointments secured. The steady growth of graduate employment in industry in Great Britain is a marked feature in the year's work.

LONDON.—The following doctorates have been conferred: D.Sc. in Chemistry on Mr. E. A. Fisher (Rothamsted Experimental Station) for a thesis entitled "A Study of Some Moisture Relations and Some Other Physical Properties of Soil, Clay, Wool, Cereal Products, and Some Other Colloidal Materials," and on Mr. D. H. Peacock for a thesis entitled "The Reactivity of Halogen Compounds and Other Papers," together with fifteen subsidiary contributions; D.Sc. (Engineering) on Mr. H. J. Gough, for a thesis entitled "The Manner, Causes, and Characteristics of the Failure of Metals under Static and Repeated Stresses," together with nine subsidiary contributions.

A course of three free public lectures on X-rays will be given at the Imperial College of Science and Technology by Prof. K. M. G. Siegbahn, of Upsala, at 5.30, on Mar. 20, 21, and 22. No tickets will be required.

OXFORD.—The Report of the Curators of the Bodleian Library, presented to Convocation on Mar. 13, contains a matter of special interest to scientific men, namely, the record of the fact that early in the past year the Radcliffe Science Library became a department of the Bodleian. This new development may be regretted on historical and sentimental grounds; but, as the Report points out, the change is certain to lead to increased efficiency, both in the supply of scientific books and periodicals, and in the facilities offered to readers. A strong scientific advisory committee has been appointed to assist the Bodleian Curators in matters pertaining to the Library. The necessary work of reorganisation has been begun, but time and persistent effort will be required for its completion.

UNDER the will of the late Mrs. Emma Grace Marryat, who was interested in Messrs. Caird (Dundee), Ltd., jute manufacturers, of Dundee, a sum of £200,000 is to be set aside for the foundation of travelling scholarships in engineering, electricity, aeronautics, and music, to be known as Sir James Caird Travelling Scholarships, eligible to natives of Scotland only.

THE spring meeting of the Geographical Association is to be held at Oxford on April 13-16. The proceedings will include a public lecture on April 14 by the Right Hon. Sir Halford Mackinder on "The British Empire in Relation to the Geography of the World," a lecture on April 16 by Colonel C. H. D. Ryder on "Surveys from Air Photographs," and a discussion on the same day, opened by Dr. L. Dudley Stamp, on "Practical Steps in Regional Survey Work and Local Studies." The address of the Association is 11 Marine Terrace, Aberystwyth.

THE following appointments have recently been made by the British Research Association for the Woollen and Worsted Industries, Torridon, Headingley, Leeds: Mr. J. A. Fraser Roberts, senior assistant at the Animal Breeding Research Department of the University of Edinburgh, to be head of the Biology Department; Mr. Norman Tunstall, senior physicist at the Department of Physics, University College of Wales, Aberystwith, to be senior physicist of the Physics Department; and Mr. Claude Rimington, research scholar, Bio-Chemical Laboratory of the University of Cambridge, to be bio-chemist to the Association.

THE sixteenth annual dinner of the Finsbury Technical College Old Students' Association was held on Mar. 2, when the chair was occupied by Mr. F. H. Carr, president of the Association. Prof. H. E. Armstrong, in proposing the toast of "The Association," said that Finsbury was the Technical College which Prof. Ayrton and he had started, to carry out the scheme of the City Guilds of London Institute; the curriculum was arranged at the beginning to provide the chemist with some understanding of engineering, and the engineer with some understanding of chemistry. The chemical engineer as produced to-day is neither chemist nor engineer; engineering should be left to the engineer. Finsbury decided at its outset never to touch Science and Art Department or other external examinations, whereas now everywhere examinations are the order of the day. The chairman in reply referred to Prof. Armstrong as the 'father' of Finsbury, who had throughout his life striven for the things which are so important, namely, first principles. Though the College has ceased to exist, its old students should continue to meet and to do what they could to further the principles for which it stood.

Calendar of Customs and Festivals.

March 18.

ST. CYRIL.—He succeeded Maximus as Patriarch of Jerusalem about 351 B.C. The most noteworthy event of his patriarchate in its effect on the church was the accession of Julian the Apostate to the Imperial throne in 361. At the time of his apostasy some ten years earlier, he had "washed off the laver" of baptism by a self-immersion in bull's blood. His last attack on Christianity was an attempt to rebuild the Temple and revive the Levitican sacrifices, a cause of great rejoicing to the Jews. The undertaking was brought to a stand by "fearful balls of fire breaking out near the foundations, which scorched the workmen." Then followed an earthquake, a whirlwind, fire from Heaven, a luminous cross in the air, and marks of crosses on the garments of the Jews.

ST. TETRICUS, BISHOP OF LANGRES, A.D. 572.—An incident during his ministration serves to illustrate the use of the Bible as a means of divination in the Christian church. Chramn, rebel son of Clothaire, wishing to be informed of the future, three books—the Prophets, the Gospels, and the Epistles—were placed on the altar in the church of St. John, Dijon, while the clergy and Chramn prayed. Each book was then opened. The unfavourable omens indicated by the passages upon which Chramn lighted were fulfilled by his defeat and death.

SHEELAH'S DAY, in Ireland, when the shamrock should be worn as on St. Patrick's Day. Tradition is uncertain who Sheelah was; but popularly she was connected with St. Patrick, either as wife or mother. It is interesting that tradition should associate closely a festival in honour of a female with that of the saint, just as the festival of his mother follows immediately on St. David's Day. In Celtic religion a female deity was usually associated with a male deity, by whom she often came to be, more or less, superseded.

MID-LENT.—The fourth Sunday in Lent, being the middle period of the fast (Mi-Carême), is still celebrated on the Continent by processions and rejoicings similar to those of Carnival. Some traces of the celebration represented in Mi-Carême also survived in Great Britain. At Bury, Lancs., this Sunday was known as Simnel Sunday, from the fact that people assembled in large numbers in the town and ate simnel cakes, and a general merry-making prevailed, usually with no little disorder, notwithstanding the day. The name of these cakes has been traced to the thirteenth century. It was usual for them to be stamped with a figure of the Virgin or of Christ.

Other names for this day are "Mothering Sunday," "Mulled Ale," and "Braggart Sunday." Mothering Sunday has been explained as the custom of visiting "Mother-Church" on this day and making a presentation on the high altar, or of visiting parents and making them a present of money, a trinket, or "some nice eatable." That these are mutilated survivals of a more significant observance is made clear when they are brought into relation with customs on Mid-Lent Sunday recorded elsewhere. In Seville, children appeared in the streets, fantastically dressed, making an incessant din and crying "Saw down the old woman." At midnight, parties paraded the streets knocking at every door and repeating the same formula. Finally, the figure of an old woman representing Mid-Lent was sawn in two. In Franconia the custom was known as "the Expulsion of Death." An image of straw was suspended on a pole and carried about from village to village, where either it was received with a feast for the bearers, or it was driven away. Sir James Frazer in "The Golden Bough" quotes a number of parallel observances, from which it is clear that the custom, which in England survived only as a merrymaking and feast, originally was a festival representing the death of winter, the figure in the end being burned or thrown into water; and the coming of spring, summer, or life, was represented by a green bough or tree, similar to the green boughs of May Day. This was carried in procession after "Death" had been "carried out."

March 19.

ST. LACLEAN OF CLONFERT, A.D. 622.—His birth was announced by an angel fifteen years before it took place, while just before the event milk from his mother's breasts healed an old man of blindness. At his baptism no water was at hand; but Mohemath took the fingers of the babe and marked with them a cross on the earth and instantly a fountain burst forth. A grain used as an emetic by the people of the country served as his diet without ill effect. This may be a reference to a form of trial by ordeal from which the saint was exempt in virtue of his sanctity. During a murrain, the red cow which had provided the saint with milk survived to the last; but when the babe was taken to it in his mother's arms, it revived, and its milk being distributed among the other cows, they also revived. The life of this saint, it may be noted, is based almost entirely on oral tradition.

March 20.

ST. CUTHBERT, A.D. 687.—The great saint of northern England. A border legend relates that when, in accordance with the practice of Celtic saints, he sang his vigils up to his neck in the waves and afterwards on the sands, two otters came out of the water and restored animation to his frozen feet by licking them while he prayed. For long he lived on the desert island of Farne, which no one would visit because it was haunted by demons. The tameness of a species of aquatic birds found on this island only, and known as the 'Birds of St. Cuthbert,' is attributed to the fact that, taking them for his companions, he inspired them with a trust in man which their descendants have inherited. Certain little shells of the genus Entrochus are known as St. Cuthbert's beads, and it is believed that he can be seen seated on a rock by night, using them as his anvil.

ST. WULFRAM OF LENS, A.D. 741.—Missionary to Friesland, where he laboured to suppress the pagan sacrificial rites. The victims were selected for sacrifice by the casting of lots among the children of the nobles. They were then hung on a tree as an offering to Woden, or fastened to a post between the tides and left to drown as an offering to Ran, the sea goddess, that she might not overflow the low-lying-land.

March 21.

ST. BENEDICT, *b.* A.D. 480, *d.* 543.—The initiator of the famous rule of the Benedictine Order, of whom many miracles are related. He was immune from the effects of both fire and poison. When thrown into a hot oven he was still unharmed at the end of twenty-four hours. A poisoned cup broke to pieces when he blessed it.

March 23.

ST. FINGAR, about A.D. 450, fled to Cornwall to avoid his father's wrath. While travelling, the saint and his party were received at night by a pious woman, who killed her cow for their food. St. Fingar took the skin and put the bones in it, whereupon the cow rose up whole and began to low.

Societies and Academies.

LONDON.

Linnean Society, Feb. 16.—E. Heron-Allen: On the further researches of Joseph Jackson Lister, F.R.S., F.L.S., upon the reproductive processes of *Polystomella crispa* (Linn.). At the time when the late J. J. Lister's paper on the production of microspheric young by the conjugation of flagellispores emanating from the megalospheric form of *P. crispa* and other Foraminifera (read in 1894) was in process of publication, he was engaged at Plymouth in further researches, as a result of which he was enabled to establish the production of megalospheric young by viviparity in the microspheric form. He left a succinct account of his work in MS., which was read by Mr. Heron-Allen.—M. A. C. Hinton: False killer-whales (*Pseudorca crassidens*) in the Dornoch Firth. The school which entered the Dornoch Firth last October was a large one. Most of the whales were carefully measured, their stomach-contents examined, and parasites, internal and external, collected; practically all the females were dissected for information as to breeding. With the help of local labour the whales were flensed, and the skeletons prepared and dispatched to the Natural History Museum. A full-grown bull and a large cow were sent entire to London, where plaster casts were made from them. Numerous dissections have been made and 143 skeletons collected and cleaned.—Mrs. L. Hunter: Alcyonaria of the Abrolhos Islands. There are twenty-four species, eight of which are new and nine of which are represented by new varieties. Representatives of the order Alcyonacea predominate, the majority being species of the Nephthyidæ. The orders Stolonifera and Gorgonacea are represented, but Heliopora, usually abundant on other coral reefs of the Indian Ocean, is absent. The creeping membrane in the specimens of Xenia provides a link between the orders Stolonifera and Alcyonacea. The three species of Eunephthya supply a link between the lobose members of the Alcyoniidæ and the tree-like forms of the Nephthyidæ. The spicules found on *Sarcodictyon tropicale*, the first species of the genus to be recorded in warm waters, are of remarkable interest, since it has incorporated in some way the silicious spicules of the tetractinellid sponge upon which the specimen is creeping.

Royal Statistical Society, Feb. 21.—T. H. C. Stevenson: Vital statistics of wealth and poverty. The method employed in the recently published Report of the Registrar-General on Occupational Mortality during 1921–23 is that of inferring social position from occupation. By this means regard can be paid to (average) culture as well as income, and the total occupied population can be included in the inquiry. Respiratory diseases, including phthisis, increase without interruption from a minimum in the highest to a maximum in the lowest social class. The process is reversed for diseases of the digestive system, and for diabetes in later life; mortality from appendicitis increases without interruption from a minimum for the lowest to a maximum for the highest of the five social classes distinguished. Mortality from cancer is lowest in the highest, and highest in the lowest, section of society; but this gradation applies to cancer of certain sites only, mortality from the remainder being much the same for all classes. The graded sites, which are responsible for about half the total deaths (in males, for whom alone the requisite occupational information is available), includes the upper alimentary canal from mouth to stomach inclusive, the skin and the larynx. It would therefore appear that cancer of these sites is largely preventable, though the factors determining its differential incidence will have first to be recognised.

Institute of Metals, Mar. 7 (Annual General Meeting).—W. Rosenhain (Presidential Address). It has been found by study of the microstructure of alloys that there is a close correlation between microstructure and all or most of the physical properties. The microstructure is the direct result of the mode of solidification of the alloy; and the most valuable diagram or chart which can be prepared for a series of alloys, therefore, is a chart showing the way in which they solidify and the changes which they undergo, in regard to structure, upon cooling after solidification. As an example of the need of great accuracy and completeness in the study of these diagrams, an account was given of the method of determining the 'solid solubility lines' of various alloy systems. Such determinations have not only furnished the explanation of the age-hardening of duralumin and other aluminium alloys, but form the foundation for a series of new and important alloys of copper and other metals. In some of these, notably the alloys of copper and beryllium recently developed in Germany, the age-hardening effects are very large. An alloy containing only a small percentage of beryllium in copper can have its Brinell hardness raised from 80 to 410 by age-hardening, the tensile strength in the latter condition being of the order of 90 tons per sq. inch. The production of high-strength copper alloys may prove to be of vital importance to the future of the non-ferrous industries.—S. Beckinsale and H. Waterhouse: the deterioration of lead cable sheathing by cracking and its prevention. The cause and prevention of the intercrystalline failures sometimes found in lead cable sheathing are discussed. The situations in which cable sheathing has failed by cracking indicate that the defect is a fatigue type of failure produced by small alternating stresses. The addition of other metals to lead raises the fatigue limit and so increases its resistance to this type of failure. Amongst the alloys which have been found very effective are certain ternary alloys containing cadmium.—Ezer Griffiths and F. H. Schofield: The thermal and electrical conductivity of some aluminium alloys and bronzes. Two groups of alloys were investigated: (1) Those rich in aluminium, with nickel, magnesium, iron, zinc, manganese, or silver as second or third constituents; (2) those rich in copper, with tin, zinc, lead, manganese, or aluminium. The aluminium alloys have a thermal conductivity of roughly 70 to 80 per cent. that of pure aluminium, whilst the bronzes range from one-fifth to one-tenth of the value for copper. In contrast with the pure metals, all give considerable increase of thermal conductivity with temperature. A minute amount of phosphorus in a bronze produces a marked lowering of the thermal conductivity. The lowering of the conductivity of copper due to an admixture of 10 per cent. of aluminium is comparable with that due to the same amount of tin. Of the aluminium alloys tested, the 8 per cent. copper and the 4·5 per cent. copper showed the highest conductivity (82 per cent. of that of pure aluminium). The lowest thermal conductivity of the series was given by a 13 per cent. zinc, 3 per cent. copper alloy (conductivity = 64 per cent. aluminium). The ratio of the thermal to the electrical conductivity in the range 80° to 300° C. obeys Lorenz's law with one or two exceptions.—R. Chadwick: The constitution of the alloys of magnesium and zinc. The metals form two intermetallic compounds, $MgZn_2$, $MgZn_5$, and all four solid phases; Mg, $MgZn_2$, $MgZn_5$, and Zn, form

solid solutions. In analysing the alloys, the magnesium and zinc are precipitated separately as pyrophosphates from the solution of mixed chlorides. —**Hugh O'Neill**: Historical note on density changes caused by the cold-working of metals. Priority for the observation that its density decreases when a metal is cold-worked is generally attributed to certain continental workers, notably to Spring (1891). It appears that Berzelius (1844) may previously have noticed the effect, but it is certain that Charles O'Neill of Manchester published a careful research upon the subject thirty years before the work of Spring was printed.—**F. S. Grimston**: Season-cracking of small-arms cartridge cases during manufacture. Until recently, burst cases have been attributed to inferior metal, but the defect can be reproduced by certain combinations of the tools used in the drawing operations. Season-cracking in the walls of the case take place during the interval between a drawing operation and the subsequent annealing under certain conditions. The conditions are: (*a*) The existence of differential stresses in the case wall caused by tools of wrong design; (*b*) storage of the unannealed cases in contact with soapsuds contaminated with dilute sulphuric acid used in the cleaning processes.—**F. Hargreaves**: The ball hardness and the cold-working of soft metals and eutectics. For soft metals and eutectics, the relation between diameter of impression and duration of loading is given by the equation $d = cts$, where d = diameter of impression, t = duration of loading, and s and c are variable factors. The temperature of testing is of great importance. In all the cases examined the effect of work is to increase factor s, and it is suggested that in the case of pure metals it is a measure of the rate of spontaneous annealing.—**W. L. Kent**: The behaviour of metals and alloys during hot-forging. Small cylindrical specimens of pure metals and some brasses were forged with a standard blow of 50 ft.-lb. at temperatures up to the melting-points, and the mechanism of hot-forging investigated by measurements of the degrees of compression produced and by comparison of the Brinell hardness values so obtained. It is concluded that although the forging test does not measure the malleability of a metal or alloy, it will indicate the relative forgeability at different temperatures, and also the liability for cracking to occur during the operation. When a metal is worked at elevated temperatures, it strain-hardens in much the same way as at normal temperatures, but not to the same extent.—**W. A. Cowan**: Minute shrinkage cavities in some cast alloys of heterogeneous structure. Minute cavities in certain heterogeneous alloys are due to shrinkage, accompanying change in volume between liquid and solid phases, of a relatively low freezing-point component, where it last freezes after the bulk of the alloy has solidified at higher temperature. For example, some tin-base alloys, the main component of which is a solid solution of antimony in tin, which solidifies at 237° C., contain a small amount of the eutectic mixture with lead; this solidifies at 183° C., producing minute shrinkage cavities. Similar alloys without any lead content show no cavities.

(*To be continued.*)

MANCHESTER.

Literary and Philosophical Society, Jan. 10.—**B. B. Bancroft**: On the notational representation of the rib-system in Orthacea. A notation is described and applied to certain species and genera of Orthacea, which are very important fossils in the Palæozoic rocks. It depends upon the type of rib branching, and has been defined principally with reference to the dorsal valve. Certain longer ribs are determined as primaries; branches of primaries are termed secondaries, and branches of secondaries are termed tertiary ribs. The valve is bilaterally symmetrical, so that the ribbing can be described by reference to one half of the valve only. All ribs lying between their parent ribs and the median line are termed internals, and ribs lying on the outer sides of their parents are described as externals. These are represented by appropriate signs. The tertiary ribs derived from the fourth primary in a particular shell would be described thus:

$$4\bar{a}\bar{1},\ 4\bar{a}\bar{2},\ 4\bar{a}\mathring{1},\ 4\mathring{a}\bar{1},\ 4\mathring{a}\mathring{1}.$$

For descriptive purposes a rib and the entire system of branches derived from it is called a sector, which may be of primary, secondary, tertiary, or higher order, and is denoted by a Roman numeral or letter. The method lends itself to statistical and graphical representation.

PARIS.

Academy of Sciences, Feb. 6.—The president announced the death of H. A. Lorentz, foreign associate. —**Gabriel Bertrand and L. Silberstein**: The ordinary presence of barium, and probably of strontium, in arable earth. Twenty specimens of earth from France, Italy, Denmark, and Serbia have been proved to contain traces of barium. In certain cases spectroscopic proof of strontium was also obtained.—**E. Bataillon and Tchou Su**: Maturation, fertilisation, and polyspermia in the egg of *Bombyx mori*.—**G. Nicoladzé**: Contact between geometrical figures belonging to a continuous system.—**Jacques Chokhate**: The convergence of mechanical quadratures in an infinite interval. Applications to the problem of moments, and to the calculus of probabilities.—**Tibor Radò**: Remarks on subharmonic functions.—**J. A. Lappo-Danilevski**: Algorithmic resolution of the problem of Poincaré for systems of linear differential equations with arbitrary rational coefficients.—**Michel Plancherel**: The rôle of Laplace's transformation in the integration of a class of mixed problems of the hyperbolic type, and the developments in series of a couple of arbitrary functions.—**A. Kovanko**: A generalisation of nearly periodic functions.—**Nikola Obrechkoff**: The summation of certain divergent series. —**Bernard Salomon**: The gyroscopic analogies of electricity: asynchronous gyroscopic apparatus and the application of the theory of the gyroscope to continuous movement or to alternating movement. —**Kiveliovitch**: The problem of three bodies with successive collisions of one body with the other two. —**Julien Pacotte**: The electrical vector-potential with five components.—**A. Andant and E. Rousseau**: The photolytic action on pure saccharose of the total or filtered radiations of the mercury arc. Various light filters were employed, removing different parts of the spectrum: the amount of reducing sugar formed was taken as a measure of the photolytic action.—**Svend Aage Schou and René Wurmser**: The reducing power of glucose. The spectrographic study of glucose solutions, maintained out of contact with oxygen, affords evidence of the production of a reactive form which may account for the reducing power of these solutions. —**Jean Calvet**: The action of hydrochloric acid upon extra-pure aluminium. The resistance of highly purified aluminium to attack by dilute hydrochloric acid is only temporary, since after immersion for a period of some days the metal is clearly attacked, the hydrogen produced growing regularly for some time, and then becoming constant.—**Ch. Courtot, Fayet, and Parant**: Contribution to the study of the indene halohydrins.—**L. Bert**: The synthesis of benzene hydrocarbons by means of mixed organomagnesium

compounds. The decomposition by water of 25 mixed organomagnesium compounds, 21 of which have been prepared for the first time, constitutes a method of preparing benzene hydrocarbons which combines the advantages of the method of Friedel and Crafts and that of Fittig and Tollens.—**Marcel Godchot** and **Mlle. Cauquil**: Molecular transposition in the cycloheptane series. A reaction is described which transforms a seven carbon ring into a six carbon ring.—**Wahl** and **Féricean**: New derivatives of isoindigotin.—**Henri Moureu**: The tautomerism of the α-diketones. The two forms of methylbenzylglyoxal and their reciprocal transformation.—**L. Malaprade**: The oxidation of some polyhydric alcohols by periodic acid. Applications. Glycol, glycerol, erythrite, and mannite reduce periodic acid to iodic acid at the ordinary temperature, and a method of determining these alcohols is given which is based on this reaction.—**Joseph Péneau**: The presence of facies with schist structure in the Devonian of the region of Chalonnes (Maine-et-Loire).—**Pierre Pruvost**: The geological results obtained from the test boring of Ferrières-en-Bray.—**A. Demay**: The lower elements of the Cévenol tectonic complex.—**Etienne Patte**: The persistence of the genus Lingullela in the Tonkin Devonian.—**E. Chemin**: An endozoic Achrochætium and the development of its spores.—**Liugi de Caro**: The comparative energy yields of various glucides in the development of moulds. In the growth of moulds the ketonic grouping is better utilised than the aldehyde function.—**P. Bourcet** and **G. Dugue**: The digitin of Nativelle. A specimen of digitin prepared by Nativelle has been found to contain two substances, one soluble in chloroform and melting at 278° C., the other insoluble in this solvent, melting point 315° C. The latter is identical with digitonin; the former agrees with the gitogenin of Windaus and Schneckenburger.—**Raymond-Hamet**: The bradycardia produced by uzara and by other digitalis preparations.—**Philippe Fabre**: Direct muscular stimulation by progressive currents.—**G. Lavier**: Paravacuolar formations of the trypanosomes.

Official Publications Received.

BRITISH.

Aeronautical Research Committee: Reports and Memoranda. No. 1110 (M. 51): Note on some Fatigue and Density Tests made of Aluminium Aggregate. By H. J. Gough. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 195.) Pp. 8. 4*d*. net. No. 1116 (Ae. 289): Wind Tunnel and Dropping Tests of Autogyro Models. By L. E. Caygill and A. E. Woodward Nutt. (T. 2360.) Pp. 5+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

The Pure Rivers Society (covering Inshore Waters). Report of the Executive Committee to be presented at the First Annual General Meeting to be held at the Connaught Rooms, Great Queen Street, London, W.C.2, at 2.30 P.M., on Thursday, March 15th, 1928. Pp. 8. (London.)

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 1 (New Series), No. 1, January. Abstracts No. 1-191. Pp. ii+40. (London: H.M. Stationery Office.) 9*d*. net; Annual subscription, 10*s*. net.

The Journal of the Institute of Metals. Vol. 38. Edited by G. Shaw Scott. Pp. xii+813+59 plates. (London.) 31*s*. 6*d*. net.

Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau), 1926-27. Pp. iv+142+13 plates. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 3*s*. 3*d*.

Institute of Marine Engineers. Catalogue of Papers read and discussed from April 1889 to December 1927. (Supplement to February Transactions, 1928, Vol. 40.) Pp. 40. (London.)

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape, (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending 31st December 1926. Pp. 27. (Kirstenbosch.)

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 30: Statistics of Teachers Colleges and Normal Schools, 1925-1926. Pp. 65. (Washington, D.C.: Government Printing Office.) 10 cents.

United States Department of Agriculture. Technical Bulletin No. 32: Returns from Banded Birds, 1923 to 1926. By Frederick C. Lincoln. Pp. 96+3 plates. (Washington, D.C.: Government Printing Office.) 20 cents.

Carnegie Institution of Washington. Year Book No. 26, July 1, 1926, to June 30, 1927, with Administrative Reports through December 9, 1927. Pp. xix+404. (Washington, D.C.: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 39: Statistics of State School Systems, 1925-26. Pp. 50. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 79. Notes on the Types of *Lepidocyclina mantelli* (Morton) Gümbel, and on Topotypes of *Nummulites floridanus* Conrad. By T. Wayland Vaughan. Pp. 299-303+1 plate. Littoral Barnacles of the Hawaiian Islands and Japan. By Henry A. Pilsbry. Pp. 305-317+3 plates. (Philadelphia, Pa.)

Proceedings of the Imperial Academy. Vol. 3, No. 10, December. Pp. xxv-xxvi+637-709+xii. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 123: Condensation of Nitriles with Thiamides. vi: Action of Sulphur Acid Chlorides upon Thiamides. By Seiichi Ishikawa. Pp. 237-248. 25 sen. Nos. 124-125: Formation of the Radioactive Manganiferous Deposits from Tanokami, and the Source of Manganese in the Deep-Sea Manganese Nodules, by Satoyasu Iimori; The Green Kaolin from Tanokami; Identity of the Universal Minor Constituents of the Igneous Rock with the Chromospheric Elements of the Sun, by Satoyasu Iimori. Pp. 249-257. 20 sen. No. 126: The Radiograph of a Crystal having the Body-centered Cubic Lattice. By Masaichi Majima and Sakuichi Togino. Pp. 259-261+plates 23-37. 45 sen. No. 127: Stark Effect for the Spectra of Silver, Copper and Gold. By Yoshio Fujioka and Sunao Nakamura. Pp. 263-276+plates 38-40. 35 sen. No. 128: Condensation of Nitriles with Thiamides. vii: Tolunitrile with Thiotoluamide, Naphthonitrile with Thionaphthamide, and others. By Seiichi Ishikawa. Pp. 277-292. 25 sen. No. 129: Condensation of Nitriles with Thioacids. Part i. By Seiichi Ishikawa. Pp. 293-300. 20 sen. No. 130: The Action of Metallic Salts upon Thiamides and their Derivatives. i: The Action of Mercuric Chloride upon Thiamides and their Derivatives in the Ethereal Solution. By Seiichi Ishikawa. Pp. 301-312. 25 sen. (Tōkyō: Iwanami Shoten.)

Rit Vísindafélags Íslendinga. 2: Synopsis of the Fishes of Iceland. By Bjarni Sæmundsson. Pp. 68. (Reykjavík: Prentsmidyan Gutenberg.)

CATALOGUES.

To Metallurgists, Metallurgical Engineers, and all interested in Heat Treatment. Pp. 4. (Birmingham: Birmingham Electric Furnaces, Ltd.)

For Sale, Choice Botanical and Zoological Works: Bibliographies, General Literature: Old Medical and Mechanical Arts. (Catalogue No. 3.) Pp. 16. (London: John H. Knowles, 92 Solon Road, S.W.2.)

"Judex" Analytical Reagents and Laboratory Chemicals. Pp. 26. (London: The General Chemical and Pharmaceutical Co., Ltd.)

Steam Storage: Greater Productive Efficiency in Industrial Plants. An Exposition of Dr. Johannes Ruths' Steam Accumulator System. By Alfred J. T. Taylor. Pp. 56+7 plates. (London: Ruths' Steam Accumulators, Ltd.)

Diary of Societies.

SATURDAY, MARCH 17.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at St. Bernard's, St. Andrews Road, Exmouth), at 12.—S. Hutton: Short Notes on Exmouth Municipal Undertakings.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District) (at County Hall, Ipswich), at 2.—E. Tasker: Superelevation.—L. T. Weaser: Bridge Reconstruction.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—W. B. Brown: Some Notes on Accidents from the Use of Explosives.—J. F. C. Friend: Roof Control on Longwall Faces.—*Paper open for further discussion*:—Miners' Nystagmus, by Dr. R. J. Perring.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, University College) (Annual General Meeting), at 3.—F. W. Lamb and J. V. A. Simpson: Assessment of Schoolboys by Air Force Tests.—F. W. Lamb, E. D. Portman, and G. J. Woolham: Posture Deviations of the Arm and Their Reversal.—A. N. Birkett and F. W. Lamb: Balance of Ocular Muscles in Normal Subjects.—Dr. A. D. Macdonald and E. D. Portman: The Diuretic Principle of Pituitary Extracts.—W. H. Wilson: Responses to Electrical Stimulation of the Tectum Mesencephali in Varanus.—J. H. Gaddum and J. H. Burn: Some Properties of the Separated Active Principles of the Pituitary (Posterior Lobe).—Prof. Swale Vincent and J. H. Thompson: (*a*) The Blood-pressure Reflexes under Varying Conditions; (*b*) Pharmaco-dynamical Action of Chloralose.—J. H. Thompson: The Splanchnic Rise of Blood-Pressure under Various Conditions.—S. Wright: Depressor Reflexes.—I. de Burgh Daly: Conditions Governing the Blood Volume of the Lungs.—G. A. Buckmaster and H. B. Hickman: The Tension of Oxygen in Human Urine.—L. M. Pickford and Prof. E. B. Verney: Kidney Perfusion Methods.—Prof. E. B. Verney and F. R. Winton: The Action of Caffeine on the Isolated Kidney of the Dog.—Prof. E. B. Verney: The Osmotic Pressure of the Plasma Proteins in Water Diuresis in Man.—G. P. Crowden and M. G. Pearson: The Effect of Cold on the Adrenalin Content of the Supra-renal Glands. (Preliminary communication.)—Demonstrations:—F. Campbell Smith: A Simple Method for the Rapid Ultrafiltration of Undiluted Blood Serum.—G. Popa: Demonstration of Pigeons with Wings Deprived of Sympathetic Innervation.—A. C. Downing and Prof. A. V. Hill: Myothermic Apparatus.—L. E. Bayliss and E. A. Mueller: High Speed Rotary Pump.—Prof. D. T. Harris: (*a*) Instantaneous Actinometry of U.-V. Lamps with Photo-electric Cells and Thermionic Valves; (*b*) A D.C. Amplifier for Bio-electric Currents and Potential Differences.—W. R. Amberson: Electric Response of Nerve to Single Shock.—E. W. H. Ellis and C. F. Palmer: Modifications of Physiological Apparatus.—L. E. Bayliss, A. R. Fee, and E. Ogden: An Artificial Lung.—A. R. Fee and M. G. Pearson: A Convenient Method of Kidney Perfusion.—

H. R. Ing and Dr. E. B. Verney: A Method of Comparing the Actions of Two Drugs on the Isolated Mammalian Kidney.—G. P. Crowden and H. A. Harris: Radiograms of the Chest in Forced Inspiration and Expiration against Obstruction.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Transformation of Matter (II.).

MONDAY, MARCH 19.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr. E. Bushe: The Precise Action of Faith on Thought Power, and the Mystery of its Influence on our Physical and Spiritual Welfare.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. A. Erlebach and others: Discussion on The Registration of Engineers.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool), at 7.

RAILWAY CLUB (25 Tothill Street, S.W.1), at 7.30.—W. A. Willox: A Railway Journey in Spain.

CHEMICAL INDUSTRY CLUB, at 8.—A. J. Underwood: Industry in Soviet Russia.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Mrs. Patrick Ness: From the White Nile to Ruanda.

TUESDAY, MARCH 20.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. I. Bennett: Some Problems of Nephritis (Goulstonian Lectures) (III.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: The Behaviour of Animals (V.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Special General Meeting.

MINERALOGICAL SOCIETY (at Geological Society of London), at 5.30.—A. F. Hallimond: On the Atomic Volume Relations in Certain Isomorphous Series II.—Prof. A. Holmes and Dr. H. F. Harwood: The Age and Composition of the Whin Sill and the Related Dikes of the North of England.—A. W. Groves: The Identification of Dumortierite in Grains; Dumortierite in Cornish Granite.—Dr. T. V. H. Rao: On Bauxite from Kashmir, India.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the month of February 1928.—G. C. Robson: On the Giant Octopus of New Zealand.—Dr. H. H. Scott: Tuberculosis in Marsupials.—Dr. H. C. James: On the Post-Embryonic Development of the Female Genitalia and of other Structures in the Chalcidoid Insect *Harmolita graminicola* Gir.—Dorothy J. Jackson: The Biology of *Dinocampus* (*Perilitus*) *rutilus* Ness, a Braconid Parasite of *Sitona lineata* Linn.—Dr. Marie V. Lebour: The Larval Stages of the Plymouth Brachyura.

INSTITUTION OF CIVIL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Mrs. H. D. Kay: Sand Dunes.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Technical College, Derby), at 6.45.—G. G. Blake: Applications of Electricity to Medical Practice.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—A. H. Law and J. P. Chittenden: Higher Steam Pressures and their Application to the Steam Turbine.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—F. H. Rosencrants: Practice and Progress in Combustion of Coal as applied to Steam Generation.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—W. E. Ballard: Non-Ferrous Tubes.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group) (Annual General Meeting), at 7.—W. T. Astbury: Photography and Photometry in X-ray Crystal Analysis.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Ing. Giovanni Chiesa and D. M. Shannon: The Development of the Fiat Marine Oil Engine.

ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8.30.—Annual General Meeting.

WEDNESDAY, MARCH 21.

SOCIETY OF GLASS TECHNOLOGY (in Coal, Gas, and Fuel Industries Department, University, Leeds), at 2.30.—J. T. Howarth and Prof. W. E. S. Turner: The Study of a Fundamental Reaction in Glass Making.—E. J. C. Bowmaker: A Method of Testing the Probable Durability of Tank Blocks.

ELECTRICAL ASSOCIATION FOR WOMEN (at Westminster Electric Supply Corporation, 112 Victoria Street, S.W.1), at 3.—The History of Electricity Supply in the Westminster District (Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. F. B. A. Welch: The Geological Structure of the Central Mendips.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (in Prince Henry's Room, 17 Fleet Street), at 5.30.—J. E. Hodgson: James Sadler: Aeronaut, Engineer, Chemist, and Inventor.

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with Kindred Societies) (in Mappin Hall, Sheffield University), at 7.30.

MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30.—A. Wilkinson and J. Gould: Display of Pond-Life, etc., under the Microscope, and Short Lantern Lecture by A. Wilkinson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—H. W. Newton: The Sun's Cycle of Activity (G. J. Symons Memorial Lecture).

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Prof. D. C. Blair: A Nerve Mechanism in the Capillaries of Muscle.—Dr. J. A. Murray: Contribution to the Study of Diatom Markings.—Dr. G. S. Sansom: A Portable Microscope Table.

ROYAL SOCIETY OF ARTS, at 8.—Lieut.-Comdr. R. T. Gould: The Modern Typewriter and its Portable Future Development.

FOLK-LORE SOCIETY (at University College), at 8.—Exhibits and Short Communications.

INSTITUTE OF CHEMISTRY (London Section).

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (jointly with Institute of Chemistry—London Section).—D. J. Macnaughtan: Common Defects in Nickel Deposits.

INSTITUTION OF MECHANICAL ENGINEERS (Bristol Branch).—E. G. Herbert: Cutting Temperatures: their Effects on Tools and on Materials subjected to Work.

THURSDAY, MARCH 22.

CHEMICAL SOCIETY (Annual General Meeting), at 4.—Prof. H. B. Baker: Constitution of Liquids: Some New Experiments (Presidential Address).

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. Collier: Epilepsy (Lumleian Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Group-Capt. Martin Flack: Physiological Aspects of Flying.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—P. D. Morgan: Electrical Research Association Report on a Critical Study of the Continuous Rating of Low-Pressure Ordinary-Duty Fusible Cut-Outs.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) and SOCIETY OF CHEMICAL INDUSTRY (Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 8.—Dr. W. T. H. Williamson: Recent Advances in the Chemistry of Soils.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—F. Kidd and others: Discussion on The Treatment of Stricture by Excision.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Capt. H. G. M. Beames: The Reorganisation of Crewe Locomotive Works.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section).—B. D. Porritt: Single Texture Proofing.—Dr. E. P. Rydings: Paper.

FRIDAY, MARCH 23.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—W. D. Flower: The Terminal Velocity of Drops.—Satyandra Ray: Longitudinal Waves Along a Rod.—J. J. Manley: The Damping of Mercury Ripples.—Demonstration by J. E. Calthrop of *Die Eastermethode*.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Present State of Knowledge regarding the Innervation and Movements of the Intestine.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College, Regent's Park, N.W.1), at 5.30.—Miss A. M. Bodkin: The Study of Imagination through Poetry.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Annual Business Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.—G. P. Barnard: The Vacuum Tube Family.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. H. Walker and others: Mechanical Handling of Goods.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—H. G. Williams: The Steering of Ships.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—B. J. Axten: High Tension and Low Tension Supply for Wireless Receivers from Electric Mains.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—A. A. King: Ultra-Violet Radiation in Industry.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. C. O. Stallybrass: Season and Disease.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. E. Cohen: A Physical Chemist in Search of Purity in an Impure World.

SOCIETY OF DYERS AND COLOURISTS (Scottish Section).—A. J. Hall: Some Features of the Swelling and Solution of Cellulose.

SATURDAY, MARCH 24.

ROYAL SANITARY INSTITUTE (at Municipal Buildings, Taunton), at 10.30 A.M.—Discussion on Present Tendencies regarding Disinfection and on House Refuse Collection.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Transformation of Matter (III.).

PUBLIC LECTURES.

SATURDAY, MARCH 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Food and Famines in India.

MONDAY, MARCH 19.

GRESHAM COLLEGE, at 6.—G. P. Bailey: Modern Science and Daily Life: The Conquest of the Air.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—A. Amos: High Farming *v.* Low Farming.

TUESDAY, MARCH 20.

IMPERIAL COLLEGE OF SCIENCE—ROYAL COLLEGE OF SCIENCE, at 5.30.—Prof. K. M. G. Siegbahn: X-rays. (Succeeding Lectures on Mar. 21 and 22.)

WEDNESDAY, MARCH 21.

BRITISH MEDICAL ASSOCIATION (Tavistock Square, W.C.1), at 8.—Sir George Newman: The Fundamentals of Health (Sir Charles Hastings Memorial Lecture).

THURSDAY, MARCH 22.

BRITISH MEDICAL ASSOCIATION (Tavistock Square, W.C.1), at 5.30.—Dr. E. Graham Little: The Future of Medical Practice.

SATURDAY, MARCH 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. E. Marion Delf: Light and Life.

CONFERENCE.

MARCH 28 TO 31.

GERMAN BALNEOLOGICAL CONGRESS (at Baden, near Vienna).