

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3537

SATURDAY, AUGUST 14, 1937

Vol. 140

Science in Social Services

IN his farewell address on June 24 to the London School of Economics, Sir William Beveridge emphasized the need for both observation and detachment in the social sciences. Failure to be scientific in method and detachment on the part of both economists and statesmen, he said, had largely been responsible for the tardy development or recognition of the social sciences, alike in the neglect of observation of facts as the basis of theories and as the control of theories, and in the lack of detachment from partisan actions and the giving of judgment on controversial political issues. The social services of Great Britain might well have been cited by Sir William Beveridge to illustrate his point. They continue to grow piecemeal, and every session Parliament adds something to the imposing structure; but it is nearly thirty years since the last comprehensive inquiry into public social provision in Great Britain was made. Continually, however, we witness particular aspects of the social services criticized strongly to prove or disprove some political tenet or preconceived idea, and it is rare indeed to find them considered in relation to a comprehensive and well-defined social policy.

The report on the social services which has just been issued by P E P (Political and Economic Planning) accordingly meets a definite need as well as provides a noteworthy example of the type of impartial and comprehensive analysis of the facts desiderated by Sir William Beveridge. The report has the freedom from preconceptions which characterizes the investigations of P E P and gives us a comprehensive and detailed examination of each of the social services.

With some of these individual social services, which are grouped in three categories—namely, constructive community services, such as education and public health and the employment exchanges; social insurance services, such as national health insurance, unemployment insurance, widows', orphans' and old-age contributory pensions, as well as workmen's compensation; and social assistance services, such as non-contributory old-age pensions, unemployment and public assistance—scientific workers may have their own particular contact as individual citizens. With the collective review of the services as a system, the mapping of the ground they cover, and the intervening gaps, as well as with the indications which this report affords of trends in policy which are not yet fully developed in the existing social services, scientific workers will, however, have a keen, if not a professional, interest.

The admirable survey and analysis which are provided in this report are primarily a stimulus to further constructive thinking; and opinions in some matters that have sometimes ranked as established convictions will require re-examination by unprejudiced students. Despite the great increase in the last thirty years of expenditure on social services, which now reaches the sum of £400,000,000 a year, that is, nearly £9 a head, or about a tenth of the national income of 1934, 71 per cent of which is financed out of rates and taxes, the report shows clearly that there has been no spectacular transfer of wealth from rich to poor. Indirect taxation of the working classes has increased side-by-side with the direct taxation of the well-to-do.

The main argument of the report is not that we should begin to economize on our social services but that we should plan them better. At present they are the result of piecemeal political and administrative improvisations which need replacing by a more deliberate social service policy, a continued review with a programme of priorities and the filling of gaps. Many of these gaps, as well as serious anomalies and defects, wide disparities, and abuses, appearing unchecked in our present system, are duly pointed out in the report, which leaves no doubt of the room for reform. But the report does more than this. It assists the emergence of a mature philosophy and a broad strategy of the social services, and thus the replacement of fairly strong but largely unconscious tendency by conscious purpose.

This establishment of guiding principles, and of authority to ensure their observance in practice, is best secured not by a Royal Commission, which is regarded as too cumbersome, but by the establishment of a Social Service Statutory Committee, acting as an advisory general headquarters staff. The value of this type of detached examination and criticism is demonstrated by the experience of the Unemployment Insurance Statutory Committee and of the Law Revision Committee. The suggested committee would have three main duties: to study the basic principles of the services; to promote efficient and economic working, indicating any needful change of administrative and financial structure; and to direct attention to anomalies and gaps, making remedial proposals.

Scientific workers will be quick to recognize in this suggestion something of the ideas expounded by General Smuts in his Sidgwick Memorial Lecture on "Democracy"; and this further plea for an extension of scientific method and inquiry into controversial matters which should be settled on a basis of fact, and not prejudice, will be welcomed by them. Equally, too, the report makes clear the impossibility of isolating politically the social services. Economic policy, social service policy, and industrial wage policy are closely interlocked. Under our present health insurance system bad industrial organization may be persistently subsidized. The powers provided under the National Health Insurance Act to survey the health of local communities, and penalize employers responsible for high sickness rates, have never been used, and certain factories and offices continue to be so unsatisfactorily arranged or operated that

they give rise to excessive numbers of sickness claims.

The increasing part which scientific workers take in the administrative side of industry gives them special responsibilities in these matters, and the report also comments on the failure of those in charge of the great public social insurances of the United Kingdom to be alive to these questions and to take the broad view of their functions in helping to reduce accidents and disease, which some private enterprise insurance companies have done. Dereliction of duty of this type is one of the prime concerns of associations of professional workers, and it is clear that such associations need much more general support from the rank and file of the professions and also continued stimulus if their functions are to be fully and wisely discharged.

The clear thinking of this report, no less than its analysis of the facts, can scarcely fail to be highly suggestive to many scientific and professional workers and to stimulate further thought and effort in many fields. There are, however, other matters of immediate personal concern to scientific workers on which the report touches. For example, in its summing-up of the problem of the family, the report favours the introduction into the general wage and salary system of Great Britain of the principle of family allowances, to which social reformers as well as industrialists have been largely opposed. The report argues that public social services must either consciously be used as an agency for adjusting burdens as between large and small families, or else they will tend more and more to reinforce those commercial and other agencies which are steadily making it less attractive for the average citizen to rear a family.

A second matter raised by the report, which is also of direct concern to scientific workers, is that of the personnel of social service administration. On this subject it makes two main criticisms. The preparation of the report has revealed a serious amount of compartmental outlook and experience as characterizing those engaged in the administration of the social services at this stage. There are many men and women who are well informed about particular branches or aspects, but it is rare to find anyone who has given much thought to the inter-relations of the social services with one another, or to their repercussions on social or economic life and to their lines of development.

One of the first needs of to-day is the breakdown of this sectionalism and departmentalism; those concerned with particular aspects or subjects should start thinking intensively about the place of their own specialism in the whole scheme of the social services. In part, this is a matter in which professional associations could exert a useful influence, and their direct contribution to the effective co-ordination of the social services with one another, and with national policy as a whole, or to the re-examination of the forms of democratic control and public accountability in the social services, should not be negligible. In part, however, it is a matter of recruitment, and here the report refers to the failure to implement the recommendations of the Departmental Committee on the Recruitment and Training of Local Government Officers, in its report issued in 1935.

The need for improved recruitment and training is not, however, confined to the local government service. Although the quality of the personnel is often of the highest order, existing arrangements for the recruitment and training of officers for certain forms of social work, for example, the work of the Unemployment Assistance Board, are not entirely satisfactory. Apart from the importance of recruiting officers for the social services whose training and outlook raises them above departmentalism and stimulates constructive thought

about the place of their special work in the social services and policy generally, the formal training requirements of various departments or branches of the service are very narrow and overweighted by technical questions arising out of statutes, regulations and codes of instructions.

The report suggests that there is a real need for a comprehensive course of training in social case work to be taken by all who wish to engage in this career; and it is clear that, in this matter also, professional associations could offer a very useful contribution. Moreover, the report shows that there are very important spheres of social service in which, whether because of their experimental or controversial nature at the time, the exceptional freedom of opinion and experiment demanded for teaching or research, or the individual attention required for intimate personal problems, voluntary organizations are not only more appropriate but also may have essential functions to fulfil.

At a time when scientific workers generally are considering so closely the social consequences of their work, the P E P report not only provides a very stimulating survey of the field which indicates definite directions for further research, but also issues a challenge to really practical efforts which can scarcely be ignored by such workers if their interest in social affairs and social science is sincere.

History of Elementary Mathematics

Geschichte der Elementar-Mathematik in systematischer Darstellung: mit besonderer Berücksichtigung der Fachwörter. Von Dr. Johannes Tropfke. Band 3: Proportionen, Gleichungen. Dritte, verbesserte und vermehrte Auflage. Pp. iv + 239. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 10 gold marks.

ALL who are interested in the history of mathematics will be delighted to see that Dr. Tropfke continues to make progress with the publication of the third edition of this invaluable work which, in the form it took in the second edition, has long been an indispensable book of reference. It is nearly thirty-five years since the date of the preface to the first edition (summer 1902) in two volumes; the second edition, much enlarged and

modified in arrangement, came out in seven volumes or parts between the years 1920 and 1924, and grew to a compass of nearly 1,300 pages in all. The third edition, in consequence of the mass of fresh material which has accumulated since 1924 through new discoveries and researches, bids fair to show an increase in size of one third or thereabouts. It is gratifying to find that each volume as it comes out brings the subject of it up to date. There are many references in the present volume to books and papers of date so recent as 1936. Some slight inconvenience will be caused by the fact that, owing doubtless to the amount of work involved, the volumes are appearing at considerable intervals—vol. 1 appeared in 1930, vol. 2 in 1933, and vol. 3 in 1937—so that, as each volume comes out necessitating a multitude of fresh references, the references in the earlier volumes

also have to be added to or corrected. This disadvantage, however, is minimized by ingenious tables given at the end of each volume showing the correspondence of the pages in the second and third editions respectively, and the changes in the numbering of the various footnotes.

The subject of proportions takes up only one tenth of the volume, the other nine tenths being devoted to equations. This is because, with the gradual evolution of algebraical notation, the subject of proportions has come to occupy less and less space in original works and text-books. The Greeks, for example, had largely to use proportions and their transformations (by compounding, etc.) as a substitute for what we state and manipulate in the form of equations; in their 'geometrical algebra', this was the only means by which they could overcome the restriction of their work to not more than three dimensions. It was not until Heron's time that their treatment of equations became arithmetical enough to enable a number representing an area to be added to a number representing a length and so on, whereas the Babylonian, many centuries before, had done this without any hesitation. Beyond indications that the idea of ratio and proportion is found in Babylonian mathematics and in the Moscow Papyrus, the section on proportion shows little change from the second edition.

The history of equations is treated under the following heads: general historical survey, the distinction between the known and the unknown quantity, technical terms, equations of the first degree (*a*) with one unknown, (*b*) with more unknowns, equations of the second degree, 'reciprocal' equations, quadratic equations with more than one unknown, equations of the third degree and solutions of the same by algebra, geometry and trigonometry respectively, as well as solutions by approximation and by the method of 'false hypothesis' (*regula falsi*), equations of the fourth degree, equations of degree higher than the fourth, and lastly indeterminate equations including 'Diophantine analysis', etc.

The bulk of the new material which called for treatment in the new edition relates to mathematics before the time of the Greeks. Thanks to the new editions of the Rhind Papyrus by Peet and Chace respectively, to the publication by W. W. Struve of the Moscow Papyrus in 1930, and to the extensive discussion to which they have given rise, we are now in a much better position to judge of the scope of the ancient Egyptian mathematics. More important still, the publication by O. Neugebauer of Babylonian cuneiform texts of mathematical content going back to 1800 and 2000 B.C., and the books and papers that have been written upon them in recent years (by O. Neugebauer himself,

Kurt Vogel and others), have thrown a flood of light on the achievements of the Babylonians in arithmetic and algebra. It is now shown that the Babylonians of those early days consistently used and manipulated with ease the sexagesimal system of numeration (including the successive sexagesimal fractions) necessitating the use of multiplication tables going up to 59 times 59; they solved quadratic equations by steps precisely equivalent to the use of the regular formulæ of our text-books, though without any statement of a rule and with no better technical terms for the unknowns (which we call *x*, *y*, *z*, etc.) than the words 'length', 'breadth', 'depth' and such-like written in full; some of their problems lead even to a type of cubic equation which can be put in the particular form $x^3 + x^2 = a$; one of these gives $x^3 + x^2 = 4$, 12 (= 252), and the solution $x = 6$ is merely stated, leaving us to speculate how it was arrived at, which would be a complete mystery but for the discovery of a table of sums of numbers of the form $n^3 + n^2$ for different values of *n* from 1 to 1,0 or 60. All these things are duly recorded in the volume before us, with very full references.

The dependence of the Greek solutions of quadratic equations on geometry, and ultimately on the discovery by the Pythagoreans of the method of 'application of areas', has long been known; but the specific connexion with propositions in Euclid (Book 2 generally and Props. 4, 5, 6 in particular, Book 6, 27-29, and Props. 84-86 of the "Data") is here treated at much greater length and much more fully elucidated with diagrams than it was in the earlier edition.

A word should be added about the appendixes. These include, besides the tables showing the correspondence between page numbers and note numbers in the third and second editions, three noteworthy features. (1) Chronological tables showing the gradual evolution of modern algebraical notation. (2) Original examples of the actual working-out of solutions of equations, from the Babylonians downward to Newton. These with their great variety of notations are fascinating to follow: there are seventy-two of them, and they include solutions by Al-Khwārizmī, Leonardo of Pisa, Regiomontanus, the authors of German and Latin MSS. of 1461 and 1481, Nic. Chuquet, Johan Widman, Luca Pacioli, Grammateus (Heinrich Schreiber), A. Riese, Christoff Rudolff, Michael Stifel, Cardano, Johannes Buteo, Bombelli, Stevin, van Schooten, Kepler, Harriot, Fermat, Descartes and Newton. (3) Solutions by means of conics of the cubic equations, $x^3 = a$, $x^3 + bx = a$ from Omar Khayyām's algebra.

The book cannot be too strongly recommended,

T. L. H.

Mechanism of Growth in Plants

Growth Hormones in Plants

Authorized English Translation of "Die Wuchsstofftheorie und ihre Bedeutung für die Analyse des Wachstums und der Wachstumsbewegungen der Pflanzen". By Prof. Boysen Jensen. Translated and revised by George S. Avery, Jr. and Paul R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiv+268. (London: McGraw-Hill Publishing Co., Ltd., 1936.) 21s.

THIS book is very necessary, and has been well done. During the last decade, no field of work has been more popular among students of plants; the output of papers has been enormous. The field is very adequately covered in this book, which also contains a very extensive bibliography.

Prof. Boysen Jensen's original experiments demonstrating the continued phototropic curvatures of the base of the coleoptile after its tip had been cut off and then replaced when only this tip region was afterwards illuminated laterally, formed the basis upon which all this superstructure of experiment and theory upon growth regulation in the plant has since been erected, so that it is entirely appropriate he should be the author of this volume, which is now translated and revised by American workers in this new field.

Prof. Boysen Jensen is able to show that the theory that substances may be released from the apical tissue of the coleoptile and transported in some way to the elongating base of this structure, where they control the rate of elongation of the basal region, has rallied to its support a host of new experimenters with new methods; that analogous substances have been synthesized or extracted from such unlikely substances as urine; and that these substances are now suggested as essential parts of a general growth mechanism in the plant, regulating shoot growth and root growth, phototropic and geotropic response and, still more recently, suggested as controlling cambial activity.

The book covers very thoroughly, though necessarily very briefly, the whole of this wide field, and is most valuable, therefore, as presenting a clear, authentic picture of the range of experimental investigation in this new field. The first chapter contains a most ingenious double-page illustrated chart of the development of the new field of work, though this sketch, naturally brief,

links Loeb with views from which he departed very widely in his later writings on regeneration.

Such a book as this naturally evokes an appraisal, in the mind of the reader, of the general effect of this new phase of activity upon our knowledge of the plant. The present reviewer in earlier years ventured into print as a sceptic of the new hypothesis: he has had to consider again in the light of this book whether he finds this view of the mechanism regulating plant growth convincingly established.

The strength of the case has always been the experimental demonstration, first given by Boysen Jensen, that the severed tip of the coleoptile, laterally illuminated, in some way so modifies the growth of the coleoptile base beneath, with which no living tissue connexion is left, that a phototropic curvature occurs in this basal region. Since that time a host of experimenters, associated particularly with the Utrecht school, have devised most ingenious experimental technique showing that substances which diffuse from the base of the excised coleoptile tips, and which may be collected on agar disks or in other ways, can modify the growth-rate of the coleoptile. Much has now been learnt of the growth of the coleoptile; throughout the period of phototropic response the growth is almost entirely by cell extension, not cell multiplication, so that a tendency has been to term this growth-modifying substance an auxine rather than a hormone, and much valuable work has been done on an analysis of the factors controlling cell extension; but it may be gathered from this review that as yet no definite conclusion can be drawn as to the way in which auxine or hormone affects this mechanism of cell extension.

The channels and mechanism of transport of the hormone from apex to base still remain mysterious, but in view of the state of our knowledge of water or food movement in the plant this is perhaps not surprising; the reviewer is still intrigued by the hypothesis that the growth regulator is secreted mainly by the apex of the coleoptile. There is a curious contradiction here that runs throughout this field of work. Investigators of the coleoptile have learnt to regard the growth-regulating mechanism as regulating cell extension, but their experimental results are freely quoted by investigators who are claiming growth-regulating effects on the meristematic tissues of buds or of cambia. Similarly, many investigators now report, in other plants, a distribution of the growth hormone which is correlated with the

meristematic activity of the plant tissue, and yet this apex of the coleoptile, like most other monocotyledon leaf apices, is a region that has ceased to grow.

In this book Prof. Boysen Jensen repeats the curious argument that as a decapitated coleoptile begins to grow after a few hours, this must mean that there has then been a physiological regeneration of the tip from which growth hormones are again resuming their flow. The first experimenters to postulate this regeneration do not seem to have troubled to look to see if it occurred, and apparently the experimenter in this field is not interested in the fact that there is no visible regeneration. Fatty deposits accumulate over the cut stump, which ceases to bleed; no new cells are formed and no striking accumulation of protoplasm is visible in the cells below the injury. But it is not clear why regeneration is necessary; cells of the original apex were inert to all appearance, the cells below the cut surface are similarly so. It is one of the curious anomalies of this coleoptile story that the cells which are supposed to be most vigorously active in hormone production are conspicuously inactive in every other way, whilst the cells which will show most elongation during growth are situated in the part of the coleoptile farthest removed from them. The difficulty has been discussed by Went and others, and leads to further hypotheses, but the strength of the position of the author, and of the numerous botanists who think with him, lies in the fact that there is no alternative hypothesis which

adequately explains basal curvature in the hypocotyl when laterally illuminated only at the tip, especially when that tip has been excised and replaced.

There may yet, however, be found some other explanation of this mechanism of stimulus reception and growth response, and at least until this mechanism is more fully understood some caution seems advisable in extending the hypothesis to cover growth mechanisms in general in view of the fatal facility with which a hypothesis can be constructed to explain anything, by postulating substances from unknown sources moving by unknown channels to work by unknown methods. The same mechanisms may apply in other growing systems as in the coleoptile—though meristematic tissues in dicotyledons may be expected to differ widely in behaviour from the vacuolating tissues of a monocotyledon leaf—but as yet we seem far from the stage when a satisfactory picture of growth regulation can be based upon our conceptions of such growth-regulating substances.

None the less, very interesting facts have emerged as to the action of some substances, in some cases chemically pure substances, in promoting callus formation on wound surfaces or in accelerating root production; and the rapidly growing army of workers in the new field, indicated by the extensive bibliography, is an ample guarantee that the possibilities of this new method of interpreting growth phenomena in the plant will be fully explored. J. H. PRIESTLEY.

Metallurgy of Gold

The Metallurgy of Gold

By Sir Thomas Kirke Rose and W. A. C. Newman. (Griffin's Scientific Text-Books.) Seventh edition, revised throughout and re-set. Pp. xiii + 561. (London: Charles Griffin and Co., Ltd., 1937.) 36s. net.

DURING most of the period covered by known history, gold has occupied a special position in the thoughts and affairs of men. It has been responsible for explorations, migrations, wars and conquests, and it was in efforts to obtain it by transmutation that the science of chemistry had its origin. Recent developments in civilization have been such as to require the use of increasing quantities of iron and steel, copper, aluminium and certain other metals, which have become increasingly important through their numerous applications at the same time as gold has tended to disappear into deposit vaults. Nevertheless, the

position of gold is still unique, and the quest for it is scarcely less eager than in the past.

Other metals become more important as the number of useful purposes for which they can be employed increases. Gold, however, is scarcely affected by such factors, and although its present use is symbolic rather than tangible, it is being produced in larger quantities and sold at a higher price than at any previous time. Gold, in effect, is an economic instrument, and, unlike other metals, it passes out of the sphere of industry into that of economics and finance after it has been extracted from its ores and refined. This affects the metallurgy of gold, in that little attention is given to such aspects as alloying, fabrication, treatment and behaviour under different conditions of service, which are of great importance in the metallurgy of other well-known metals. Thus, in the book under review, most of the space is

devoted, as it should be, to the plant and technique used and the phenomena involved in obtaining gold from its ores.

The book begins with an account of the physical and chemical properties of gold. This is followed by a description of the binary alloy systems formed by gold and a number of other metals. Many such systems have been studied, and some of them exhibit features of considerable scientific interest; but the only metals alloyed with gold for practical purposes are copper, silver, palladium, nickel and zinc. In the third chapter, the chemistry of the compounds of gold is considered, and the remainder of the book consists of fourteen chapters on the processes of crushing, grinding, concentrating, extracting and refining used in the metallurgy of gold, and three on assaying and ore testing.

In one sense, this book may be regarded as the seventh edition of a classic work the first edition of which appeared in 1894 and the sixth in 1915. In another sense, however, it is a new book, for the name of W. A. C. Newman appears for the

first time on the title-page along with that of the original author, Sir Thomas Kirke Rose. The combination has proved very effective, for whereas the general plan of the book and much of the original matter have been retained, new chapters on flotation and ore testing have been added and the original chapter on chlorination omitted, while throughout the text as a whole new information has been included and obsolete matter deleted so as to present a balanced account of the subject as it is to-day. All this is very important, for standard works of this kind are, or should be, primarily intended for those who desire to learn something about the subject, and are not prepared to provide interesting reading for those who are sufficiently well informed to sort out the up-to-date information from that which applies to the past. Actually the present work is more up to date than most new editions of classic works produced after a lapse of time, and better arranged than a new book appearing for the first time.

J. M. R.

Geology in Engineering

Engineering Geology

By Prof. H. Ries and Dr. Thomas L. Watson. Fifth edition. Pp. vii+750. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25s. net.

THE fifth edition of this well-known work is to be especially welcomed in Great Britain, where geologists pay far less attention to the allied sciences than is the case abroad, with the result that we have not yet produced a book dealing with the application of geology to civil engineering problems—a position to be regretted.

The number of rock-forming minerals dealt with in Chapter i is rightly reduced to the bare minimum required by engineers, some two hundred pages on rocks and their structural features following. Rock-weathering and soils, treated in Chapter iv are probably of less importance to engineers than is realized by the authors, while the treatment of run-off is disappointing, since this offers a ready, and so far untapped, field for the application of precise geological methods. It is, however, a relief to find a book which does *not* give Stokes's law for the elutriation of sediments. The section dealing with sub-surface waters is extremely interesting, and goes to show that a great deal more work has been done on this branch of the subject in the United States of America than in Great Britain.

Landslides are discussed adequately in Chapter vii, the matter on wave action being less closely linked with civil engineering practice. Lakes and glaciers are quite briefly treated. The geology of reservoir and dam sites is well covered in Chapter xi; but some of the recent work on building stones, both here and abroad, is not mentioned in the following chapter, which is otherwise ample enough.

The technology of limes, cements and plasters is so varied that one is not surprised to find it described briefly in eighteen pages, and this is also true of the clays and clay products treated in fourteen pages. It is obvious that a book which goes on to deal with coal, petroleum and natural gas, ore deposits and the outlines of historical geology, requires considerable ingenuity on the part of the authors as to what to include and what to omit, so that the allocation of only fourteen pages to road materials, a subject the importance of which has greatly increased in recent years, is quite understandable. In a later edition, perhaps, the application of recently developed microscopic methods might be added to this portion with advantage.

This work can be recommended to the student of civil engineering and to the practising engineer as being certainly one of the best, if not the only one, of its kind.

B. H. KNIGHT.

The Mechanism of Nature being a Simple Approach to Modern Views on the Structure of Matter and Radiation. By Prof. E. N. da C. Andrade. Revised and enlarged edition. Pp. xii+188+8 plates. (London: G. Bell and Sons, Ltd., 1936.) 6s. net.

THIS book is chiefly intended for the man who has not had the advantage of a scientific education but is anxious to know something of modern scientific developments. There are no mathematical formulæ to put the reader off. Sir James Jeans says somewhere that without considerable mathematical knowledge it would be quite impossible for anyone to understand those branches of science which deal with the fundamental nature of the universe, as, for example, the theory of relativity, the theory of quanta and wave mechanics. So the reader must not expect to be able to do this unless he be a well-equipped mathematician. Prof. Andrade, however, is so skilful in the use of words that his statements impart all there is to know on these subjects short of the employment of mathematics.

In this, the fifth edition, the whole book has been revised and alterations and additions have been introduced to bring it into harmony with recent work. The treatment of cosmic rays has been modified to accord with advances made since the last edition, and a brief account is given of the recent discovery and meaning of heavy hydrogen, the neutron and the positron, of artificial radioactivity and the striking development of artificial transmutation of matter. The explanation of the cause of isotopes—substances which have the same chemical properties but different atomic weights—is of much interest; 'heavy hydrogen' is the most remarkable of these. Another matter of interest is the question of how artificial atomic transmutation was brought about, to which Lord Rutherford has contributed so much. It has, however, so far never produced weighable quantities of any new atom, but established the possibility of transmutation. This, of course, completely revolutionizes the classic ideas of the nature of the atom. All these are treated with admirable clearness by the author, who is a master of exposition where complicated matters are concerned.

H. L. C.

Aftermath :

a Supplement to the Golden Bough. By Sir James George Frazer. Pp. xx+494. (London: Macmillan and Co., Ltd., 1936.) 21s. net.

IT might seem that the twelve volumes of "The Golden Bough" had already covered the ground more than adequately, and stood in no need of a supplement. Here, however, the author has gathered together data, not numerous, which had escaped his attention previously, and the more important items of evidence bearing upon his arguments, which have accrued in field work since the publication of the last edition of the major work. Hence this new volume is a corpus of additional facts, corresponding in its division into chapters with the arrangement of topics in "The Golden Bough", but making no addition to theory, except by way of corroboration.

Much of the material will already be familiar to anthropologists, who have not failed to note on numerous occasions how investigations in these fields of inquiry have served to confirm interpretations first tentatively suggested in "The Golden Bough". Prof. Seligman's Frazer Lecture dealing with the magical ritual of kingship, of which his own investigations among the peoples of the Upper Nile formed the starting-point, affords perhaps the most striking instance of the prescience shown by Sir James, not once alone, but on many occasions. Notwithstanding advancing years, the hand of Sir James has not lost its cunning. His latest work in no way falls behind its many predecessors in style and charm of diction.

Marconi :

the Man and his Wireless. By Orrin E. Dunlap, Jr. Pp. xxii+360+16 plates. (New York: The Macmillan Co., 1937.) 16s. net.

THE author gives a good and temperate account of the life-work of one of the world's greatest inventors. One of the early pioneers of radio attributed Marconi's success chiefly to his instinctive intuition as to what was wanted and the best way of getting the solution. It must not be forgotten that he had a company with plenty of capital behind him and that its success or failure depended upon the rapid development of radio in the early days. With this money behind him he had the courage to launch out on great experiments. The fact also that the organization was called the Marconi Company added greatly to his prestige and always kept his name prominently before the world. When 'Cables obtained control of Wireless' in England, and the Marconi Company became practically a manufacturing organization, the most interesting period of its life had passed.

The author describes both the 'man' and the 'inventor', and links them together into one personality. Marconi crossed the Atlantic eighty-nine times on voyages of scientific research and good will. This view of him from an American angle throws much light on his career. We hope that it will not become customary in the United States to refer to Oliver Heaviside as Sir Oliver Heaviside.

Hardness of Metals

By Dr. F. C. Lea. Pp. vii+141. (London: Charles Griffin and Co., Ltd., 1936.) 12s. 6d. net.

THE hardness of metals, as Dr. Hugh O'Neill once said, like the storminess of seas, is easily appreciated but not readily measured. Prof. Lea has attempted to describe the various methods of measuring hardness, to establish, from the results of a long series of tests, the relationships between hardness measured by each of these methods, and thence, by means of curves and a chart, to make it possible within certain limits of accuracy to obtain corresponding hardness numbers as determined by the various methods. The book is not so much a discussion of 'the hardness of metals', therefore, as a collection of hardness data obtained on a series of materials comprising chiefly heat-treated steels.

Boucher de Perthes and the Foundations of Prehistoric Archæology

PREHISTORIC archæology, being one of the younger among the sciences, has had few opportunities of celebrating centenaries. It is a little more than a hundred years ago that the excavation of Kent's Cavern, Torquay (1825-29), first afforded a warrant for the tentative suggestion that man had lived in some remote past as a contemporary of an extinct mammalian fauna. Until this coexistence was demonstrated conclusively, discussion of the antiquity of man had no solid factual basis of inference on which to proceed. For this reason, Boucher de Perthes, on account of his discoveries of flint implements in the valley of the Somme, derived from geological horizons in which they were shown to be associated with the fossilized remains of extinct mammals, has been regarded as the founder of prehistory, and more especially of that branch of archæological studies which deals with the industries and cultures of the Old Stone Age.

It was in August 1837, according to his own record made not long afterwards, that Boucher de Perthes initiated his investigations of the geological deposits of the Somme valley for evidence of early man, and acquired the first objects in his collection. There is reason for thinking, however, that the correct date may have been in the following year. In fact, if Boucher de Perthes's statements be accepted, it is difficult to follow the course of events, or arrive at a just estimate of the credit to be assigned to him in the crucial discoveries in the later 'thirties and the 'forties of the last century.

In 1837, Boucher de Perthes was neither archæologist nor geologist. On his return to Abbeville from Paris in 1830, he was known only as an unsuccessful writer of satirical drama and a tendentious political economist, who had been expelled from the public service on account of his radical views; while up to 1841 he was immersed in the publication of a vast work entitled "La Création" on metaphysics, a subject in which, on his own showing, he had never read a word, and in which he relied not so much on his reason as his imagination. Writing in 1863, he claimed that so far back as 1805, when as a youth of seventeen he visited the Cave of Roland at Marseilles, and again in the Papal States in 1810, the idea of discovering evidence of man as a contemporary of extinct mammals had been before him. But in making this claim, as well as others for an early dating of his views on the antiquity of man, his recollection was coloured by after

events. These dates cannot be substantiated. His memory was highly imaginative, and he verified neither his recollections nor his dates.

Recent research in the early records of archæological studies in France has shown that prehistory, unlike Minerva, did not spring full-fledged from a single head. In Great Britain, the discovery of flint implements at Hoxne by John Frere in 1797 gave a lead; similarly, in France from the early years of the nineteenth century, archæological discovery, as for example in the work of Jouannet in Perigueux, was pointing the way to the recognition of primitive phases in the development of civilization transcending by far the time limits then fixed by archæologist, palæontologist and geologist alike, whose vision for the time being was bounded by the views of Cuvier on the recent origin of man.

The apparent paradox of Boucher de Perthes's achievement as the founder of prehistory by his discoveries in the valley of the Somme, when contrasted with his character, attainments and previous history, has led M. Aufrère of the Institut de Géographie in the University of Paris* to examine not only his published works and correspondence, but also the drafts of his writings and letters with their numerous deletions, alterations and amendments, as well as the records of scientific activity at Abbeville at that period among those with whom Boucher de Perthes and his father before him were in touch. The result has been to throw an entirely new light on the course of events, and to give a new orientation in the investigations made by Boucher de Perthes, while meting out justice to the inspiration to which they were due.

The story begins with the foundation of the Société d'Emulation at Abbeville in 1795. Of the original members the most distinguished was Emmanuel Baillon, who had been of signal assistance to Buffon in his great work on natural history by his accurate observation of birds. Five years later, Cuvier was elected a member, and the announcement of his election was accompanied by a box of fossil bones of mammals found by the members in the neighbourhood of Abbeville. Cuvier's influence on the ideas and pursuits of the members of the society was considerable, especially in the domain of geology and palæontology. His view of the recent origin of man largely determined their attitude in discussing archæological material.

* *Le Mouvement Scientifique à Abbeville dans la Première Moitié du XIX^{me} Siècle et les Origines de la Préhistoire (1795-1840)*. Par L. Aufrère. Sciences, Assoc. Fr. pour l'Avmt. des Sciences, No. 4, 1936; *Essai sur les Premières Découvertes de Boucher de Perthes et les Origines de l'Archéologie Primitive (1838-1844)*. Par L. Aufrère. *Épreuves et Synthèses*, No. 1. (Paris. L. Staude, 1936.) Also other papers.

This accounts for the readiness of Boucher de Perthes and others to maintain, or, on occasion, revert to, the view that the stone implements discovered in the Somme deposits, like those found elsewhere, were 'Celtic'.

In the work of the fifty years which followed the foundation of the society, closing in 1844-45 with the presentation of the account by Boucher de Perthes of his discoveries, the achievement of certain of the members stands out. Of some of these only a brief mention must suffice.

The first in chronological order is Laurent Traullé (1758-1828), palæontologist and archæologist, wild in theory, but excellent in observation and discovery. It was he who supplied Cuvier with the fossil remains of elephant, rhinoceros, Bovidæ, horse and deer. He was the finder, in 1814, of a 'Celtic' hafted axe; but his most noteworthy contribution to archæology was the recorded observation of the stratified cultural sequence in the deposits of 'Celtic', Roman and 'Francisque' in this invariable order—an observation pregnant for archæology, albeit unfortunately forgotten until revived more than twenty years later. Most important of all, however, was his account of the stratification of the geological deposits of the Somme valley, the first of its kind.

Of those who were working at Abbeville in the years preceding Boucher de Perthes's investigations, two names to be noted are those of Alfred Tillet de Mautort and Dr. F. P. Ravin (1795-1849); both careful observers of geological evidence, whose detailed accounts of stratification in recording archæological finds brought archæology and geology into intimate relation. Dr. Ravin's authoritative records of geological formations were later to prove of much value to Boucher de Perthes, who made use of his specialized knowledge to support and authenticate his own observations.

The full implication of the relation between geology and archæology in the work of Ravin and de Mautort was developed by Casimir Picard, a name that has been forgotten, but deserving a better fate as that of an outstanding personality in the scientific, and more especially the archæological, activities of the Abbevillians between 1830 and 1840. Picard was born at Amiens in 1806, and went to Abbeville from Paris as a qualified medical man in 1828. Widely interested in scientific pursuits, but especially botany, palæontology and geology, he had unbounded energy, and on attaining office in the Société d'Emulation rapidly spurred that body to strenuous activity. He was associated with Boucher de Perthes in the organization of the Abbeville Museum, an association which, as M. Aufrère suggests, may have been responsible for the

foundation of prehistory. His powers of lucid and cogent archæological argument were far in advance of his time, and would stand the test of modern application. In fact, his contributions to archæological theory went far to lay the foundation of archæology as a science. Of these, the more important were the rehabilitation of the flaked implement as something more than an unfinished stage, or a reject in the manufacture of a polished implement, as was then held; the demonstration of the relation of core, or nucleus, and flake as correlatives in the technique of flint fracture; and the argument from stratification for the contemporaneous character of deposits and contained artefacts, and hence the inferred coexistence of man and extinct fauna as contemporaries.

In May 1838, Picard presented a preliminary sketch of a report on the antiquities of Abbeville to be prepared in response to an official request. From this it appears probable that he had in mind a project for a series of excavations and investigations in the neighbourhood of Abbeville. Unfortunately, pressure of other interests, such as the foundation of the Linnean Society of Northern France in 1838, drew him away; and three years later, in March 1841, he died at the early age of thirty-four years. Had his life been prolonged, there can be no doubt that the early history of prehistoric discovery in the Somme valley would have been far different. His precision and appreciation of scientific method would have averted the ineptitudes which delayed the acceptance of Boucher de Perthes's very considerable contribution to the advancement of knowledge.

Picard's archæological insight and his enthusiasm, however, were not to be without effect. On more than one occasion Boucher de Perthes recorded that his investigations, whether beginning in 1837 or in 1838, were first undertaken, with some reluctance and even distaste on his part, in order to continue the work which Picard had planned, and no doubt hoped to carry out himself. His death took place before he realized that anything but a 'Celtic' antiquity was involved, and that his plan of campaign, if it produced any result at all, would lead to the discovery of diluvial man. Nor was Boucher de Perthes, in his earlier investigations at La Portelette, Menchecourt and the Hôpital site, in better case. So far from appreciating that his aim, as he afterwards claimed, was fossil man, it was some time before the distinction, which appears on the title-page of his capital work, between "antiquités celtiques" and "antiquités antédiluviennes" was presented to his mind. Unfortunately, when the reported occurrence of pottery and stone implements, especially of axes, which first appeared in 1841,

convinced him, though he had not seen these finds *in situ*, that he was dealing with diluvial man, the heterogeneous character of the finds, which included Venetian glass, as well as knives and axes of stone which would now be termed neolithic, only provoked ridicule when submitted to expert examination. Boucher de Perthes then reverted to the idea that they belonged to a 'Celtic' civilization, though still maintaining their association with an extinct fauna. It was not until 1843 or 1844 that he saw, *in situ*, the first of the axes, now to be regarded as Lower Palæolithic, which confirmed his contention of the existence of diluvial man. This find from the Hôpital site

heralded the evidence which, notwithstanding such vagaries as a large proportion of fractured flints of non-human origin, and a collection of so-called representations of animal forms, was to win a verdict in his favour from the British commission of inquiry of 1859.

So far as the foundation of prehistory was the outcome of anything like a scientific conception of the aims and methods of archæology, the credit belongs to Picard rather than to Boucher de Perthes; but to the latter must be conceded a tenacity of purpose which carried through the actual investigation and won recognition in the end.

The Proposed Everglades National Park, U.S.A.

By Dr. John Kunkel Small, New York Botanical Garden

THE proposed Everglades National Park, recently authorized by the Congress of the United States, after thirty years agitation, is of importance to all who are interested in outdoor life. Its area (capable of enlargement) of two thousand square miles is less than that of several national parks in the United States and elsewhere; but it surpasses in the abundance, variety, and activity of plant and animal life. In most large parks life is in a decline. Variety is giving way to uniformity. Erosion is tearing down mountains; species are disappearing; plant and animal life is maintained with difficulty in increasingly artificial conditions. Such is not the case in the Everglades. Both at the outer fringes of mangroves and far within, land is naturally and continually increasing. Life in the warm humid climate is luxuriant, active—primeval, as if species were making. Plants and animals live as they have for ages, and as they may continue to live for years to come.

The area (Fig. 1) is not technically within the tropics, but the Tropic of Cancer lies only seventy-five miles distant, and ocean currents, prevailing winds, and migratory birds have found a strictly tropical rendezvous scarcely surpassed anywhere in congenial conditions and lack of disadvantages. The area is about equally divided between land and water. The highest points of land are scarcely ten feet above tide, and the water has an average depth of but a fathom or so. Most of the area is accessible by boat in protected waters, a mode of transportation least disturbing to wild life. However, when roads and trails are desirable they can be built at little expense.

ANIMAL LIFE

There are few places where marine life is so abundant and active; the greater part of it is in continuous motion and change, either anchored or free swimming. On one hand, this fact can be observed and studied in the shallow crystal-clear waters of the vast continental shelf on which the Florida Keys now stand and which fringe the mainland. These waters are teeming with life, in almost innumerable quantities and variety. A handful of mud from a bleak and lofty area like the United States Great Smoky Mountain Park will remain motionless; a handful from the Bay of Florida will be in continuous motion as a result of the included active marine life. The kinds of lowest animals—sponges, jellyfish, corals, sea-anemones, moss-animals, molluscs, sea-urchins, sea-cucumbers, starfish and stone lilies—are legion.

Associated with these, fish of almost innumerable kinds, forms, and colours, and great range in size, abound in the waters, fresh and salt. The vast numbers of fish may be realized by the fact that the schools are often so large that they fill bays and sounds to the exclusion of a great part of the water.

Ascending in the life-scale, we find amphibians and reptiles. Frogs abound. Several kinds of large turtles are found, and the alligator and the crocodile are outstanding. Among serpents is the dangerous cotton-mouth moccasin and the largest and most dangerous American reptile, the diamond-back rattlesnake, which sometimes attains a length of nine feet. Lizards are numerous, but most of them are small.

More evident than the amphibians and reptiles are the birds. The bird life of this region is prodigious, ranging from the minute humming-bird to

the wood ibis and the golden eagle. Naturally, from the make-up of the country, both land and water birds abound. The latter are often seen in greater abundance. As a result of their feeding habits—diurnal and nocturnal—flocks of innumerable birds, like flakes of snow in a storm, may be seen in flight both day and night. The sight of their going and coming between the feeding-grounds on a bright moonlight night, not to mention the uncanny noises of their cries and the swish of wings, is something never to be forgotten. Black and various colours of plumage are continually seen. Very conspicuous are the white and pink ibis and the rare roseate spoonbill, of which thousands, even hundreds of thousands, were

of eastern North America roam through the wilderness. Prominent among these are the panther, lynx, bear, deer. Curiously enough, the otter lives here just as it does in the Hudson Bay region. The larger aquatic mammals are the massive sea-cow and the whale.

PLANT LIFE

Broad-leaved vegetation is the most evident form of plant life to the casual observer, whether it be in swamp, prairie, or hammock; but underneath it grow ferns and flowering plants bewildering in attractiveness and variety. In this tropical wilderness, vegetation grows to its full stature and natural age without interference from man.

It is true the destructiveness of Nature is rampant; but it is normal and in its way orderly. Plants and animals grow rapidly and soon return to dust, a process hastened here by a moist warm climate and the presence of a host of fungi and bacteria ever ready to do their work. In spite of the natural inroads, as the source of supply is inexhaustible, the flora is maintained while the land gradually rises higher and higher above the tides.

In the Everglades, tropical vegetation dominates; but the ranges of north temperate trees dovetail with those of the West Indian tropics. The north temperate elements have extended southward through the hammocks and along the cool waters of the prairies. The tropical ones have been brought beyond the tropics by the warm ocean currents, the winds, and the birds; and

thus plants of opposite temperature requirements mingle, and there is a unique balance in life-forms.

Withal it is a strange country, a land of anomalies and the grotesque. Here fish sing*; snakes often live in trees; epiphytes grow as terrestrials; terrestrials grow as epiphytes; giant oak trees are arbours for aerial plants and ferns; cacti grow in water; oysters grow on trees that dip into the creeks; large pine trees and broad-leaved trees grow on rocks lacking soil; fig-trees grow as petriphytes trying to strangle the rocks; giant palms more than a hundred feet tall and cactus trees thirty feet tall grow as humus-plants; strangler figs kill other trees, and often turn upon themselves and commit suicide.

* On the reef small fish attach themselves to the hull of a boat after dark and give off their plaintive notes all night long.

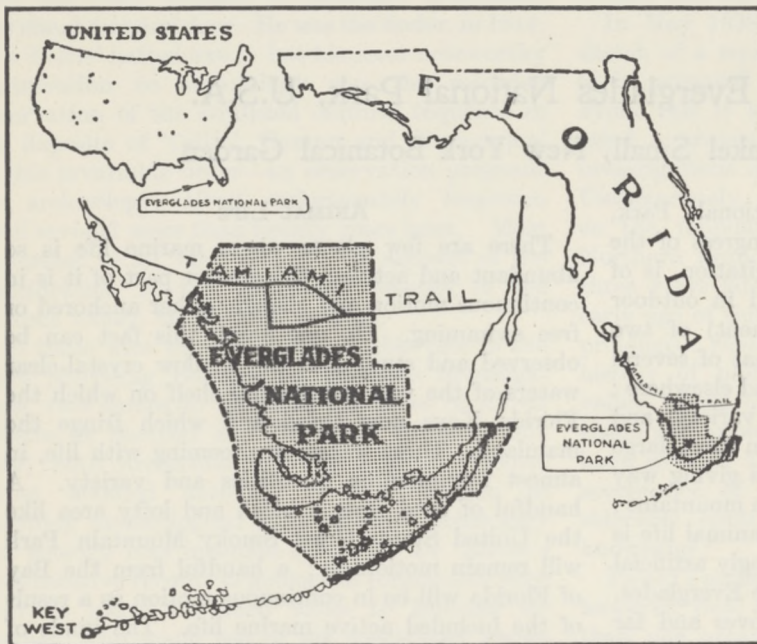


Fig 1.
THE PROPOSED EVERGLADES NATIONAL PARK.

formerly seen at a time. The well-known egret is a decorative associate. The smaller highly coloured migratory birds pass this way, and are evident in season at this midway station.

On the land, one finds the insects universal as well as yet innumerable. The numbers of kinds can be only roughly estimated. Fascinating and grotesque forms may be seen everywhere. A short description of them would fill volumes. Many of the kinds are almost or quite microscopic; but large and ornate butterflies and moths abound. Less graceful but fascinating are the devils-horses, a showy grasshopper commonly six inches long which travels over the land by the million devouring vegetation as it goes.

Mammals are present on the land and also in the water. Several species of the large quadrupeds

Bioclimatic Zones of Australia*

By Dr. J. Davidson, Waite Research Institute, University of Adelaide

TEMPERATURE and moisture are the chief factors affecting the physical environment of terrestrial plants and animals. In association with soil type, they exert a dominating influence on geographic distribution and seasonal abundance. In Australia, moisture is the chief limiting factor; temperatures during winter are moderate, the mean for the coldest month being above 43° F., except in parts of Tasmania and the highlands of Victoria and New South Wales. The essential elements of climate, on which the availability of moisture depends, are precipitation and atmospheric humidity; loss of moisture by evaporation influences the effectiveness of precipitation.

During recent years, attempts have been made by various workers in climatology to develop a formula by means of which the efficiency of rainfall may be assessed in relation to the moisture requirements of plants and animals. These investigators have taken into account the influence of temperature and atmospheric humidity on the rate of evaporation from an exposed surface. The simplest formula is the ratio proposed by A. Meyer in 1926, in which precipitation is related to evaporation by dividing annual values for rainfall by appropriate values for atmospheric water vapour saturation deficit, both expressed in inches or centimetres. Annual values for these elements are inadequate for bioclimatic studies, particularly in Australia, owing to the seasonal character of the rainfall and its unreliability over the greater part of the continent.

It is recognized that the best index to the relationship between climate and moisture at the soil surface is the ratio of precipitation to evaporation, the critical value being $P/E = 1$; with decreasing values dryness increases, with increasing values wetness increases. Unfortunately, suitable records for evaporation are available at comparatively few stations.

Where adequate data for temperature, rainfall, atmospheric humidity and evaporation are available they can be used to interpret the moisture and temperature 'conditions' in the environment of plants and animals. From the point of view of ecology, zones in which the essential elements of climate can be assessed in this respect may be defined as 'bioclimatic zones'. The flora and

fauna of the different zones may be related to similar or different environments. This emphasizes the significance of environment, in contrast with the conception of phylogenetic grouping of animals, implied in the boundaries of the faunal regions of the world as defined by Alfred Russel Wallace. The term 'bioclimatic zone' was used by A. D. Hopkins (1921), who considered temperature to be the most trustworthy guide to the range of the zones. Experimental work since that time has abundantly demonstrated that temperature alone does not give a true index to the effect of climate on the flora and fauna of an area; the index must express the effect of moisture and temperature working in combination.

I employed the Meyer formula as a monthly ratio (P/Sd) in order to assess the degree of wetness or dryness over Australia, month by month. For this purpose, P/Sd was interpreted in terms of evaporation, (P/E) by reference to records for evaporation at the capital cities. Values for P/E were computed for 235 stations in the Commonwealth. The continent was divided into areas showing the areas and months in which values for P/E are greater or less than 0.5; the value 0.5 was selected tentatively as the minimum value, below which adequate moisture will not be available for general plant growth. The areas were grouped to form the five moisture zones defined in Fig. 1. For each of these zones it is known how many consecutive months have values for P/E greater than 0.5.

The intensity of dryness in any zone depends upon the number of consecutive months that values for P/E are less than 0.5, together with the value of the ratio. The intensity of wetness in any zone depends upon the number of consecutive months in which values for P/E are greater than 0.5, and the value of the ratio. In the central portion of Fig. 1, values for P/E are less than 0.5 for every month of the year; the region is classed as an ecological 'desert', the vegetation is characterized by acacia - semi-desert, shrub steppe and porcupine grass climax associations. The boundaries of this region, as shown in Fig. 1, differ somewhat from those obtained by employing the climatic relationships of desert areas as interpreted by Köppen (1923). The arid regions are defined as having one to six consecutive months in which P/E exceeds 0.5; they have been grouped to form the arid and semi-arid zones. The humid regions are defined as having seven to twelve consecutive

* This article gives the chief features of a series of four papers by the author dealing with certain aspects of bioclimatology (*Trans. Roy. Soc. S. Aust.* 1934-1936); under the same title, it formed the subject of a paper given at the Auckland (1936) meeting of the A.N.Z. Ass. Adv. Sci. (Section D, Zoology).

months in which P/E exceeds 0.5; they have been grouped to form the semi-humid and humid zones. It is of interest to note the small area of Australia, north of the Tropic of Capricorn, which falls in the humid zone.

The temperature zones have been defined on the following basis:

A. *Hot*—the mean annual temperature exceeds 70° F.

The boundaries of the various zones appear to give a better fit to the actual climate in the zones than those developed by Thornthwaite (1933), who assessed "precipitation effectiveness" by evaluating the P/E ratio from data for rainfall and temperature.

There is a close agreement between the bioclimatic zones shown in Fig. 1 and the distribution of types of native vegetation; also there is a

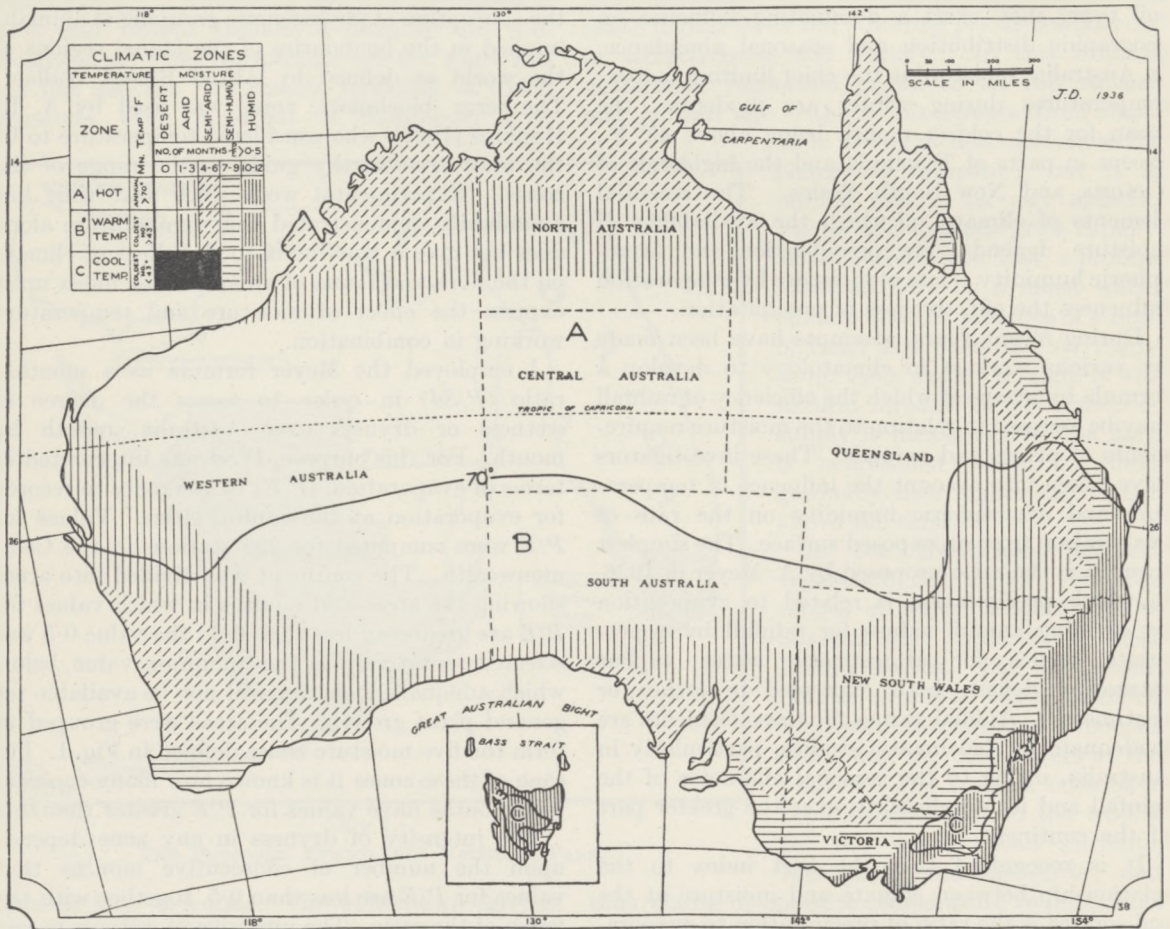


Fig. 1.

B. *Warm Temperate*—the mean temperature for the coldest month does not fall below 43° F.

C. *Cool Temperate*—the mean monthly temperature may fall below 43° F. during one to five months of the year.

In local areas at high elevations in Zone C, the average monthly temperature may fall below 43° F. for more than five months; these areas may be classed as having a cold climate.

The methods described above give a good index to the climate in the different zones; improvement in detail will be obtained when allowance can be made for the influence of additional factors affecting evaporation, such as air movements.

correlation between these zones and the distribution of areas where particular agricultural crops are grown, and the sheep and cattle carrying capacity of the pastoral country. This has an important bearing on the question of settlement in Australia. The methods may be useful as a means of obtaining an estimate of the potential population of the Commonwealth, on the basis of land utilization and production.

It is easier to assess the influence on plants, than on animals, of the physical environment as determined by climate. This is particularly so with active vertebrates which can readily move away from adverse local conditions.

Obituary Notices

Prof. E. B. Elliott, F.R.S.

PROF. EDWIN BAILEY ELLIOTT, sometime Waynflete professor of pure mathematics in the University of Oxford, honorary fellow of the Queen's College, and formerly fellow of Magdalen College, died at Oxford on July 21 at the age of eighty-six years.

Prof. Elliott was the son of Mr. Edwin Litchfield Elliott, of Oxford, and was educated at Magdalen College School, from which he obtained a demyship at Magdalen College. He took his degree in 1873, after obtaining first classes in mathematics, both in Moderations and in the Final School, and in 1875 was awarded the senior university mathematical scholarship. In 1874 he was appointed fellow and mathematical tutor at the Queen's College, holding the office for nearly twenty years, until in 1892 he was elected to the Waynflete professorship of pure mathematics, and so returned to Magdalen as a fellow. He resigned the professorship in 1922. He joined the London Mathematical Society in 1875, and was for a long time an active member, serving on the Council for many years beginning from 1882; he was president of the Society in 1896-98, being preceded in the chair by Major MacMahon and followed by Lord Kelvin.

All his life, Prof. Elliott produced a steady flow of papers giving the results of his investigation and research. They are to be found in the *Proceedings of the London Mathematical Society*, the *Quarterly Journal of Pure and Applied Mathematics*, and the *Messenger of Mathematics*. His chief work was done in the algebra of invariants, but he also published important papers on Frullani's integrals, on other definite integrals, and on differential invariants.

When Sylvester went to Oxford as Savilian professor of geometry, in succession to H. J. S. Smith, he was full of his theory of reciprocants and of the transformation of differential operators, a theory very much akin to Sophus Lie's theory of continuous groups. Under the influence of Sylvester's enthusiasm, Elliott wrote a paper "On the Interchange of the Variables in certain Linear Differential Operators" (*Phil. Trans. Roy. Soc.*, 1889). He was elected a fellow of the Royal Society in 1891.

His great work, "An Introduction to the Algebra of Quantics" (first published in 1895, second edition, 1913), made Elliott's name well known to all English mathematicians, and thirty years ago was a textbook for all students of higher algebra. He says in the preface, "The primary object of the book is that of explaining, with all the clearness at my command, the leading principles of invariant algebra. . . . Lucidity in mathematical works has often suffered from undue compression. My constant aim has been to guard against such a possibility here. . . . The title Algebra of Quantics' is perhaps one of my own introduction. It probably needs no defence, and can

scarcely fail to convey the right meaning. The mathematical world has now for half a century associated the algebra of invariants and co-variants with the name of Cayley and with his 'Memoirs on Quantics' so that it may perhaps be regarded as appropriate that a new work appearing in a year which has seen the close of the labours of the renowned author of these memoirs, and dealing with their subject, should bear a name which recalls his memory".

It is interesting to note that in the "New English Dictionary" there are three quotations under the word "Quantic", the first being from Cayley (1854) whilst the last stands thus "1896. E. B. Elliott. (title) An Introduction to the Algebra of Quantics". The book is a masterly exposition of results due to Cayley and Sylvester, and of those due to Salmon, MacMahon and Elliott himself.

Elliott's last published paper (*J. Lond. Math. Soc.*, 1; 1926), which bore the title "A Simple Exposition of some Recently Proved Facts as to Convergence", was a proof of Hardy's theorem that if b_n denote the arithmetical mean of the positive numbers, $a_1, a_2, a_3, \dots, a_n$, and $k > 1$, then

$$\sum_1^n b_r^k \leq \frac{k}{k-1} \sum_1^n b_r^{k-1} a_r \leq \left(\frac{k}{k-1}\right)^k \sum_1^n a_r^k.$$

This was an inequality of great interest to all workers in the theory of convergence, and Elliott's proof was greeted with enthusiasm by Hardy as the best, and in fact the last, word on the subject.

All who have studied mathematics at Oxford in the last forty years will feel that they have lost a friend now that Elliott is gone. He was always ready to help and encourage his younger colleagues with criticism and advice, and mathematics at Oxford owes him a great debt.

A. L. DIXON.

Prof. P. Gardner

PROF. PERCY GARDNER was born on November 24, 1846, and passed away on July 19 last, after a few days illness, interested almost to the last in ideas, persons and things, and above all, in his friends. He was educated at the City of London School, and after a year's experience of business went to Christ's College, Cambridge, where he graduated with first-class honours in the Classical and in the Moral Sciences Tripos, and was elected a fellow in 1872. He had already entered the British Museum, and under great chiefs, Lane Poole and Barclay Head, spent fifteen years in a remarkable combination of metrological and æsthetic studies which determined his outlook on antiquity, while it earned him European repute. In 1877 he visited Greece, at a stirring time; Mycenae and Olympia had been excavated; there was talk of work at Pergamon, and even around the Acropolis of Athens. In 1880

he was appointed Disney professor of archæology at Cambridge, concurrently with his museum work; and it was with this double experience that he entered on his professorship of classical art and archæology at Oxford in 1887. Since 1880, too, he had been one of the original editors of the *Journal of Hellenic Studies*, and responsible for the high standard of scholarship and wide scope at which it aimed.

Classical archæology was in its infancy in 1887 as an academic subject in Oxford. Gardner's only predecessor, Sir William M. Ramsay, had been interested in exploration and in epigraphy, and had spent much of his time in travel. There were valuable collections, the 'Arundel Marbles' and the like from seventeenth century patrons of learning; and the new Keeper of the Ashmolean Museum, Sir Arthur Evans, was accumulating new materials in classical as well as prehistoric archæology. But there were few books, no casts or place for housing them; for a disastrous bargain had glutted the University Galleries with replicas of the works of Sir Francis Chantrey. But even before the reorganization of the Ashmolean Museum, and as part of a comprehensive plan, originals were installed, casts were acquired, and a modest work-shed was provided. Gardner's own conviction, bred of museum experience, and illustrated by his monumental "Numismatic Commentary on Pausanias" (1887), that in ancient coins we have a compendious and inexhaustible series of miniature illustrations of all aspects of Greek art, as well as of religious belief and local tradition, gave him initial advantage in planning his academic programme under such conditions, and in dealing with such early pupils as Sir George Hill and Dr. J. G. Milne. The breadth of Gardner's interests at this time is illustrated by his share in a collaborated "Manual of Greek Antiquities" (1892); his judgment and critical taste by his "Catalogue of the Ashmolean Vases" (1895) and "Sculptured Tombs of Hellas" (1896), and his deep philosophic interest in æsthetic problems by his "Grammar of Greek Art" (1905). As pupils became more numerous, systematic publication was less frequent, especially since there was no departmental staff, and only occasional lectures by college tutors supplemented the professor's own teaching. For many years, Gardner did the work of a college tutor for all his men, as well as his own. But he was a frequent contributor to the *Numismatic Chronicle* and the *Journal of Hellenic Studies*, and remained an editor of the latter until 1926.

It was during this later period too, from the publication of "Exploratio Evangelica" in 1899, that he allowed himself to give expression to his profound interest in the critical and historical aspects of early Christianity, in regard to which he combined what were then advanced liberal views with a simple reverence and personal piety which commended his scholarship and philosophical outlook to a wider circle of readers. From 1915 until 1923 he was president of the Modern Churchmen's Union, and remained an intimate and trusted counsellor of theologians of many schools. Though he took little public part in university business, he was a convinced advocate of research as an essential of university training,

and of facilities for it after graduation; and his "Oxford at the Cross Roads" (1903) expressed frankly and strongly what only a few of his colleagues had then begun to envisage clearly, still less to advocate or practise.

In 1925 Gardner retired as emeritus professor, but continued for some years to publish, and even, on occasion, to lecture; combining in his "Principles of Christian Art" his two dominant interests. In 1934 a slender volume of "Autobiographica" unveiled much that only intimate friends appreciated or suspected, of his devotion to scientific truth, to the interpretation of beauty in men's handiwork, and to the realization of his own high standard of living.

J. L. M.

Dr. A. H. Church, F.R.S.

DR. EDITH PHILIP SMITH, of the Department of Botany, University College, Dundee, writes as follows:

As an old student of A. H. Church, I should like to add a few words of appreciation and recollection to the obituary notice appearing in NATURE of May 22.

No one who has not had the privilege of studying under Church can fully appreciate the manner of man he was. To his students he was an unflinching (but not an uncritical) friend. No slipshod or incomplete work was tolerated: everything had to be done to a finish, in which he set an example by his unremitting application to his own research. But it was his dispassionate accuracy and integrity of purpose which created the deepest impression.

Church was an inspired teacher. The condensed and often cryptic English of his writings (which has prevented their full appreciation) became clear and enthralling when expanded in lecture or tutorial.

Church's writings have not yet taken the place they deserve in botanical literature, partly on account of their difficult style, and partly because they were all in advance of their time. The "Types of Floral Mechanism", for example, contains the prolegomena to a serious theory of the flower, which has scarcely been assimilated after twenty-nine years. I was told by Church that he had the remaining material of his projected study of the flower completed, but that the expense of publication was prohibitive. I do not know whether any project is on foot for a memorial to Church at Oxford, but I can think of no more appropriate tribute to his memory than to assist in the publication of his floral studies (if they still exist).

WE regret to announce the following deaths:

Sir Edward Davson, Bart., K.C.M.G., an authority on Colonial trade and Imperial economics and a trustee of the Imperial Institute, on August 7, aged sixty-two years.

Sir David Masson, K.B.E., F.R.S., emeritus professor of chemistry in the University of Melbourne, aged seventy-nine years.

Prof. F. C. S. Schiller, emeritus professor of philosophy in the University of California, on August 6, aged seventy-three years.

News and Views

Bicentenary of Dr. Charles Hutton, F.R.S.

ON August 14 occurs the bicentenary of the birth of the well-known English mathematician Dr. Charles Hutton, who for thirty-four years held the chair of mathematics at the Royal Military Academy, Woolwich, and who for a long period was a prominent member of the Royal Society. Born in Newcastle-upon-Tyne, Hutton was the son of a colliery labourer and though he attended a dame's school in the Gallowgate, he was almost entirely self-taught. He began life as an assistant teacher at Jesmond, and from 1760 until 1773 he conducted a school of his own in Newcastle and while doing so contributed to the *Ladies' Diary* and other periodicals, and published some excellent elementary works on arithmetic, book-keeping and mensuration. The failure of a bridge in his native city led him to write his "Principles of Bridges and the Mathematical Demonstration of the Laws of Arches", and in 1773 after a severe competitive trial he was appointed to the professorship at Woolwich, where he worked until 1807. In 1774, he was admitted to the fellowship of the Royal Society; in 1775 he made the calculations in connexion with Maskelyne's experiments at Schiehallion, Perthshire, for determining the mean density of the earth, and in 1779 was made LL.D. of the University of Edinburgh and foreign secretary of the Royal Society. This position he held until 1783, when complaints having been made of the way he had carried out his duties, he resigned. Sir Joseph Banks was then president, and Hutton's resignation raised a storm of protest at the way he had been treated. At a meeting of the Society on December 18, 1783, however, when Hutton submitted his "Defence", a resolution was passed stating "that if Dr. Hutton hath been in the opinion of any Member of the Society incriminated, it is the opinion of the Society that he hath fully justified himself".

HUTTON already in 1778 had been awarded the Copley Medal for his paper on "The Force of Fine Gunpowder, and the Initial Velocity of Cannon Balls", and for many years he continued to add to mathematical literature. In 1785 he published his "Mathematical Tables" and this was followed by his "Tracts on Mathematical and Philosophical Subjects", his "Compendious Measurer" and his "Elements of Conic Sections". In 1795 he published his "Mathematical and Philosophical Dictionary" which was described by the "Encyclopaedia Britannica" as the most valuable contribution to scientific biography that had yet appeared in England. In 1803, with the naturalist Dr. George Shaw (1757-1813), and the physician and chemist Dr. George Pearson (1751-1828), he began the abridgement of the *Philosophical Transactions*, an arduous task which occupied him for six years and for which he received £6,000. Retiring from his post at Woolwich in 1807 on a pension of £500 per annum, he took up his residence

in Bedford Row, London. Recognized as a most skilful teacher and a man of amiable character, he died on January 27, 1823, in his eighty-sixth year and was buried in the family vault at Charlton, Kent. His "Life" was written by his successor at Woolwich, Dr. Olinthus Gregory.

Digestive Troubles among Omnibus Workers

THE belief that gastric disorders are unduly common among busmen is widespread among the men themselves and their leaders. The problem was placed before the Industrial Health Research Board, and considered by a joint Committee of the London Passenger Transport Board and the Trade Union of Transport and General Workers, and it was the unanimous opinion that an answer should be sought to the following question: Do omnibus workers suffer from digestive complaints more frequently or more severely (or both) than other groups of workers of similar economic and social position? The Committee of the Industrial Health Research Board considered that the investigation of the problem had in the first place to be statistical, and it was decided to make a comparison of the incidence of sickness (limited to periods of more than two weeks' duration) among omnibus workers and tramway workers. The investigation was undertaken by Dr. Bradford Hill, and the results of his inquiry are now published (Report No. 79. Medical Research Council Industrial Health Research Board. H.M. Stationery Office. Price 6d. net). An examination was made of the sickness records of omnibus and tramway workers in the employ of the London Passenger Transport Board. The data were extracted for the years 1925-26 and 1933-35, but the records of the first period were found to be unsatisfactory and the analysis of the sickness experience was therefore confined to the data relating to the years 1933-35. The age distributions of the omnibus and tramway workers differ considerably, and it was necessary to compare the occupational groups age by age, and in reaching a comparative figure for all ages to allow for the differences in the age distributions.

It is found that the omnibus drivers at all ages had in 1933-35 a relative excess of gastric sickness (that is, in proportion to sickness from all causes) of 12-14 per cent over the figure shown by the tramway drivers. In the same way, it is found that the omnibus conductors at all ages had a relative excess of gastric sickness of 15-18 per cent over the figure shown by tramway conductors. But this relative excess varies very considerably with age, for omnibus drivers being confined to the age-group 30-49, and for omnibus conductors to the age-group 20-39, and the higher figures at these ages must be balanced by the lower figures at other ages. When this correction has been made, taking only sicknesses of more than two weeks' duration and a wide group of diseases as

attributable to gastric causes, it is found that there was in 1933-35 some excess of gastric illnesses recorded among omnibus workers as compared with tramway workers at those age-groups to which the majority of the former belongs, though at these ages the total sickness experience, from all causes, of the omnibus workers was rather more favourable than that of the tramway workers.

Japanese Trawlers in Indian Waters

A LEADING article in *Current Science* of May directs attention to the rapidly increasing activity of Japanese trawlers in the Bay of Bengal. On more than one occasion the Government of India has been warned that unless adequate steps were taken to improve and develop Indian fisheries in Indian waters, some other country would sooner or later step in and exploit this area for its own benefit; but with the exceptions of the Government of Madras and, more recently, of Bombay, little or nothing has been done by either the Central or Provincial Governments. For some years past the average catches made by Japanese trawlers operating in the Pacific have been steadily decreasing, partly owing to increased competition but also in the main, no doubt, owing to over-fishing, and in consequence they are now seeking for more profitable areas in other waters. So long ago as 1908-9, the *Golden Crown* carried out a series of experimental trawls for the Government of Bengal, and these showed that there were a number of excellent trawling grounds in this area. The average catch obtained compared very favourably with those taken in European waters. The experiment was a failure from the financial side mainly because of difficulties in the distribution and marketing of the catches.

Indian Coastal Fisheries and their Exploitation

If the Japanese now working in the Bay of Bengal can overcome the marketing difficulties, there seems to be no doubt that they will very materially increase the supply of fresh fish in those ports to which they bring their catches, and in this respect will benefit the inhabitants; at the same time, it must be remembered that this is but one side of the fishing industry and that much material is obtained in the trawl that can be turned, by suitable treatment, to other uses, such as the preparation of dried and salted fish and the manufacture of fish-oil, fish-meal and even fish-manure. In the past, the bulk of the fish guano that is prepared in the Province of Madras is exported, through Ceylon, to other countries and particularly to Japan; the value of this export rose, under the fostering care of the Madras Fishery Department, from 188 tons, valued at Rs. 13,648, in 1910-11, to 32,000 tons, valued at Rs. 24,40,000 in 1922-23, and in 1927-28 it had risen even further to 100,000 tons. If the Japanese trawling in the Bay of Bengal proves to be a success, it is highly probable that in the very near future there will be a marked falling off in the sales to Japan of these Indian fishery products, to the great detriment of the Madras fishermen.

THE present Japanese invasion of Indian waters appears to have commenced in 1935; but its origin can probably be traced back to several years earlier. In 1929-30 the Japanese commenced a surreptitious exploitation of the *Trochus*-shell beds of the Andaman and Nicobar Islands by divers working from motor-boats that were based on Singapore, and this increased to such an extent that the Government of India appointed a fishery research officer in 1931. Unfortunately, owing to lack of proper supervision, undersized shells were fished and, in the absence of any patrolling vessel, grounds that were supposed to be closed were poached, while considerable poaching on the authorized grounds was carried out by unlicensed vessels: in consequence, the shell-beds were rapidly decimated and will take many years to recover. Some of these motor-boats brought with them their fishing nets, and an experiment carried out off Port Blair showed that these nets could be used in these waters with very considerable success, one boat after an absence of two days returning with a catch of about 1½ tons of fish. The natural resources of the ocean are everywhere open to all nations outside the three-mile territorial limit, but unless adequate patrolling of these Indian coastal waters by fishery-protection vessels is carried out—and in view of the great length of coast-line involved this would seem to be impossible—Japanese trawlers will certainly exploit the inshore waters, should experience prove that they are profitable trawling-grounds. A comparison of the various species of fish brought to market by the local fishermen of Akyab in Burma and Puri in Orissa, on opposite sides of the Bay of Bengal, with those taken by the *Golden Crown*, reveals that a large percentage are identical. These local inshore fishing-grounds extend out from the coast for distances varying from about five miles up to as much as 10-15 miles; thus, even were the territorial limit of three miles strictly enforced for these trawlers, there can be little doubt that such trawling by Japanese vessels will affect adversely, and perhaps seriously, the Indian coastal fishing industry.

National Institute of Sciences of India

PROF. M. N. SAHA informs us that the Government of India has decided to make a grant-in-aid of Rs. 6,000 per annum to the National Institute of Sciences of India, Calcutta, with effect from 1937-38. The grant will be subject to the following conditions: (1) Provision should be made for a nominee of the Government of India on the Council of the Institute. (2) An annual report of the working of the Institute, together with a duly audited statement of accounts, should be furnished regularly to the Government of India. (3) The Institute should tender advice on any scientific problems which may be referred to it by the Government of India and discharge any other functions which may be assigned to it by the Government of India. No provision exists in the current year's budget of the Central Government for this grant. It is proposed, however, to include a sum of Rs. 12,000 in the budget estimates for 1938-39

on account of the grant for the year 1937-38 and 1938-39 and, subject to the vote of the Legislative Assembly, steps will be taken to pay this amount early in the year 1938-39.

Devices for Fighting Fires

In the High Tension Conference held in Paris in June interesting discussions took place as to the relative merits of fire-fighting equipment. In Part 2 of an article by T. Rich in the *Electrician* of July 16, the latest opinions of French engineers on the devices used in practice are given. For protecting transformers and alternators of large output, alarm indicators are used as well as extinguishing appliances. They are of the fixed type which operate automatically when the station has no attendants and when the generators are very large. The movable apparatus generally used consists of extinguishers, boxes of sand, blankets and water jets directly connected to the mains or to a foam generator. Gas masks, smoke fans and emergency lamps are auxiliary apparatus. Portable extinguishers are only used for very small fires. It is important that the material used should be a bad conductor of electricity, as small fires make a close approach necessary and the jet may give a dangerous shock. Carbon tetrachloride has high extinguishing powers and it is not a good conductor. But at high temperatures it decomposes into a gas that is corrosive and poisonous, so that a gas mask is desirable although it entails a loss of time. Methyl bromide is generally thought to give out less poisonous fumes but it is expensive. Saline solutions with a base of potash have a high extinguishing capacity but they are dangerous to use as the jet is a conductor. Carbonic acid snow is not such a good extinguisher but its use entails no danger to personnel. It can be used without cutting off the current, and so is useful in the case of small fires, but the risk of re-ignition is serious. Fire-resisting blankets are used to put out burning clothes on persons. They should be kept in metallic cases with anti-moth material and a window should be put in the case to ensure that the contents have not been borrowed for other purposes. 'Atomized' jets which work under a high pressure have been found useful both in putting out oil fires and cable fires. For hoses rubber is better than woven material. Each 'fire' point at an electric station should have a sand box with wood shovels, a gas mask and a lantern.

Annual Report of the Ministry of Health

THE eighteenth annual report of the Ministry of Health, 1936-37, has been recently issued (H.M. Stationery Office. 5s. net). It consists of an introduction and seven chapters, and includes the work of the Welsh Board of Health. The death-rate was 9.2 per thousand, the death-rate of infants below one year 59, and the maternal mortality rate 3.81, per 1,000 live births. Tuberculosis mortality was the lowest on record, being a rate per million living of 583 for pulmonary, and of 109 for non-pulmonary, tuberculosis. Notifications of diphtheria were 7,290 less than for 1935, but still considerably in excess of

those for 1933. Of enteric fever, 2,493 cases were notified, compared with 1,750 in 1935, the increase being mainly due to the epidemic last summer at Bournemouth, Poole and Christchurch. Public analysts examined 146,438 samples of food and drugs—a record number—of which 7,802 were reported against. Of this total, 80,082 were samples of milk and 7,588 those of butter. Under slum clearance and rehousing, up to the end of last year 100,355 houses had been demolished and 127,553 houses built to replace them, this being the fourth year of the five years' plan. This year, general progress in town and country planning, especially in preserving the countryside, has markedly increased. No less a sum than £65,000,000 of Exchequer money was spent in 1936 on services administered by the Ministry, but only £2,200,000 of this was expended on central administration.

Apparatus for Testing Petroleum and Related Products

A CATALOGUE of scientific apparatus is necessarily a classified list of separate items and to repay reading must be clearly printed, attractively set out, adequately illustrated and up to date. Messrs. Gallenkamp and Co.'s catalogue (No. 96A, 1937 Edition) listing apparatus for testing petroleum, tar, asphalt and their products, fulfils all these requirements and will be of definite interest to those engaged in the examination of these substances. The listed apparatus includes types standardized for routine tests by the Institution of Petroleum Technologists, the Standardization of Tar Products Test Committee, the British Standards Institution and the American Society for Testing Materials, as well as many other special forms which for one reason or another have not been so standardized. The drawings, in general, have been executed with due attention to detail, although on p. 35, an unsuitable type of ring burner has been included in the diagram of the apparatus for the determination of water in asphaltic substances; on p. 43, the position of the thermometer in the R and B softening point apparatus is incorrect and on the same page, the K and S softening point apparatus depicted is not the standard type specified by the S.T.P.T.C. The arrangement of the subdivisions is at present somewhat haphazard, necessitating frequent reference to the index; it could be improved by the substitution of an alphabetic order on the lines of the Institution of Petroleum Technologists' hand-book. Despite these defects, the catalogue will be appreciated by technologists specializing in the fields indicated in the title.

Natural Colour Eclipse Photography

WE have received from Mr. Edward R. Hewitt, of 127 East 21st Street, New York, a correction of the statement, quoted in *NATURE* of March 13, that the *National Geographic Magazine* of February contained the first natural colour photograph of a total solar eclipse ever reproduced. Mr. Hewitt informs us that the *Scientific American* of April 1925 reproduced a colour photograph, made by him, of the total eclipse of January 24, 1925, and has sent

us a copy of the reproduction. Mr. Hewitt, in 1925, used Autochrome plates specially sensitized by himself, and his camera had a focal length of 3 ft. Dr. Gardner, in 1936, used Dufay colour plates and a camera of 19-ft. focal length. Owing to the greatly differing circumstances, any detailed comparison of the two pictures would be invidious. The picture Mr. Hewitt has sent us is about a tenfold enlargement of the original, and shows a yellow coronal image extending to about a fifth of a solar radius from the limb, so that on the original plate the coronal image can only have been about 0.6 mm. across, whereas Dr. Gardner's picture was reproduced at about actual size and showed a corona extending to about a solar radius or about 20 mm. on the original plate. In view of the low resolving power of colour plates, it would be absurd to expect much recognizable detail on the 1925 plates, and indeed there is only a suggestion of coronal form, and the colour is presumably in error, but the photographs had the value of demonstrating that colour plates could be made sensitive enough to photograph a total eclipse.

Plant Diseases and Pests of India

Science and Culture contains an interesting review of "Some Plant Diseases and Pests of India and their Control" by Amil Mitra (2, Nos. 8 and 9, Feb. and March 1937). The paper should serve the useful purpose of directing attention to the serious nature of plant disease, for it includes succinct references to the monetary or percentage losses occasioned by many fungi and insect pests. These are sufficiently convincing. The world's loss through the activities of various rust diseases of wheat is estimated at about £60,000,000, and India bears about £4,000,000 of this. A smut disease of the Jowar crop, caused by the fungus *Sphacelotheca sorghi*, causes a loss of 20-25 per cent, and in the Bombay Presidency alone, this means a cost of two crores of rupees (about £2,000,000). Sugar cane mosaic, caused by a virus, often lowers the yield of sugar by 30-35 per cent, whilst a wilt of the pea crop caused by the fungus *Fusarium Vasinfectum* seems to cause the highest percentage damage, for more than half the crop is often lost as a result of its depredations. The review mentions the particular methods of control for each disease or pest, which have been found most effective in practice. A few insect and eelworm enemies are mentioned, but the main emphasis of the paper is that of a mycologist.

Journal of Parapsychology

AN introduction by Prof. Wm. McDougall gives reasons for the publication of a new journal, the *Journal of Parapsychology*, and making clear its object. Throughout the ages, people have asked: Are mental processes always and everywhere dependent upon material and physical organizations? What are the relations of mind and matter? Do the volitions and beliefs of men make any difference to the historical course of the events of the world? Is the physical co-extensive with the mental and the powers and potentialities of mind to be defined by

the laws of the physical sciences? For the most part, the psychology studied in the universities has not concerned itself experimentally with these problems, and such work as has been undertaken has generally been the leisure-time pursuit of interested amateurs. Prof. McDougall thinks that all those phenomena vaguely denoted by the phrase, 'psychical research', ought to be the study of trained scientific workers in the universities, both in the interests of the development of knowledge and of the public. A beginning was made at Duke University in 1930 to study what the researchers called 'extra-sensory' perception. In order that the experiments made in one laboratory may be repeated by other workers, it seemed desirable that there should be a journal. The need for multiple repetitions by different observers of all experiments purporting to give positive results is greater in this field than in others. The word parapsychology is chosen to denote the more strictly experimental part of psychical research. The journal is published quarterly, and the first number is dated March 1937 (Durham, N.C.: Duke University Press. Subscription 3 dollars a year).

Cist Burial at Blaydon-on-Tyne

AN interesting example of a cist burial is reported from Blaydon-on-Tyne (*The Times*, Aug. 6). The discovery was made by workmen digging in a sand-pit, who uncovered the broken upper slab of the chamber. The dimensions of the cist were 3 ft. 8 in. in length, 2 ft. 3 in. wide and about two feet in depth. The interior was filled with sand, but among the contents were found a human skull and bones of the skeleton. With them was a flint knife about two inches in length. The site was visited and the cist examined by Miss G. M. Scott, assistant curator of the Hancock Museum, Newcastle, Mr. W. Bulmer, of the Corbridge Museum, and other authorities of the locality, in whose opinion the find belongs to the Bronze Age and is to be assigned, notwithstanding the absence of the beaker which might be expected, to a date at about 1500 B.C. A burial with skeletal remains of a somewhat earlier date was found on Summerhill, not far away, seven years ago and is on view as reconstructed in the Hancock Museum.

National Museums of Natural History

FREQUENT visits from, and even interchange of, the staffs of the larger museums of the British commonwealth of nations, as referred to in an article in *NATURE* of January 9, has evidently the strong approval of Mr. Frederick Chapman, the well-known authority on the Foraminifera, who has written to us from Melbourne on the subject. The 'Australian Museum' is situated at Sydney and there is the 'Melbourne National Museum', which from the wealth of its collections, especially palaeontological, must be regarded as also of the highest rank. It is immaterial that one museum may be richer than the other in some sides of biology, for such must always be the case. The important matter is that tightening of the bonds between all the museums in question, which has the approval of the Museum Association

of Australia. Further, we understand that a representative of this Association was deputed to discuss this with the trustees of the British Museum this summer. When can we expect to hear the result of this discussion?

Research at Armstrong College

FROM Armstrong College, Newcastle-upon-Tyne, we have received a report for 1935-36, somewhat belated, by the Standing Committee for Research. The importance of some of the work accomplished with the help of the Committee's small subventions (twenty-six grants amounting in the aggregate to £846) is well brought out in an eighteen-page summary prefixed to the individual reports of the recipients and list of publications. An obvious advantage of a fund such as that administered by the Committee, unappropriated in advance to specified fields, is that its administration compels representatives of different departments to take an interest in research in each other's fields, and this promotes inter-departmental collaboration in research, instances of which are cited in the report. Of the role of philosophy in the University, the Committee takes a liberal view, for it refers to works emanating from the College's Department of Philosophy as "original contributions towards the formation of that background of knowledge which forms, or should form, the background of university education".

American Documentation Institute

THE American Documentation Institute was incorporated at a meeting in Washington on March 13 as a corporation "not for profit" but for educational, literary and scientific purposes. The first objective of the new organization is to develop and apply the new technique of microphotography to library, scientific and other material. This national organization was foreseen as an outline of the documentation activities of Science Service when they commenced in July 1935. Bibliofilm Service has been conducted by Science Service in co-operation with the Library of the U.S. Department of Agriculture as a service to research workers, and in auxiliary publication through microfilm, leading academic and scientific journals have co-operated.

Cytological Technique

A SHORT but useful pamphlet giving an "Outline of Cytological Technique for Plant Breeders" is issued by the Imperial Bureau of Plant Genetics (1s. 6d.). Genetics and cytology have become so intimately interwoven in their results that every plant breeder needs to have some knowledge not only of chromosome investigations but also of the methods of cytology. The various techniques involved are sufficiently exacting if satisfactory results are to be obtained. This pamphlet gives an account of the paraffin method, the smear method and a short statement containing the essentials of technique in the use of the microscope, the methods being based mainly on the schedules in use at the John Innes Horticultural Institution, Merton.

Microscopy: the Quekett Microscopical Club

WATSON'S *Microscope Record* of May (No. 41), among other matter, contains an account by Mr. J. F. Stirling of the microscope used by John Dalton, now in the possession of the Manchester Literary and Philosophical Society, and an article by the editor on the appropriate eyepiece to use with certain objectives. Two new species of Bdelloid Rotatoria are described by Mr. W. E. Garner in the *Journal of the Quekett Microscopical Club* of April (Ser. 3, 1, No. 7, p. 280). Mr. W. E. Watson Baker is the new president of the Quekett Club, which is holding its annual conversazione on October 12 in the rooms of the Royal Society at Burlington House.

Conference on Protection against Natural Disasters

THE first "Conférence internationale pour la protection contre les calamités naturelles" is to be held at the Paris Exhibition on September 13-17. The following titles of sections of the Conference indicate its scope: vulcanology and seismology, meteorology, zoology and epidemiology, economic and social crises (fires, famines), assurances. The organizers of the Conference are the Commission Française d'études des calamités, one of a dozen such national commissions which owe their existence to the initiative of the editorial board of the scientific periodical, *Matériaux pour l'étude des calamités*, established in 1924 by M. Raoul Montandon. In that year the Italian commission was formed. Its president is Giovanni Ciruolo, who is also president of the Union internationale de secours founded by the League of Nations in 1927, when the French commission was formed. Later, similar bodies were established in Austria, Belgium, Bulgaria, Chile, Czechoslovakia, Greece, Hungary, Italy and Switzerland. Others are in course of formation in Russia and Yugoslavia. The opening session will be presided over by the Under-Secretary of State for Scientific Researches and the closing session (to be followed by a reception at the Hôtel de Ville and a banquet) by the Minister for the Colonies. Admission to membership of the Conference involves payment of a fee of 100 francs, exclusive of the charge of 40 francs for participation in the banquet. Membership will carry the right of free entry to the Exhibition during the Conference. The address of the secretariat is: Laboratory of Applied Entomology, 45 bis, rue de Buffon, Paris, 5^e. The secretariat will, if desired, reserve bedrooms for members.

Comet Finsler

PREDICTION for the place of Finsler's Comet for the next three weeks is given in Announcement Card No. 421 issued by Harvard College Observatory. The ephemeris is based on a parabolic orbit computed by Dr. A. D. Maxwell of the University of Michigan. The time of deduced perihelion passage is August 15-76946 U.T. This comet was discovered on July 4 last by Finsler at Zurich; it was then of the 7th magnitude. It is now possible to locate the comet with the naked eye. The following predicted positions at 0^h U.T. show that the comet will pass 3° or 4°

west of the bright star, Arcturus, between August 22 and 23. In the latitude of London, Arcturus sets in the north-west about an hour after midnight (Summer Time) in the middle of the month.

Date	R.A.	Dec.	Date	R.A.	Dec.
Aug. 14	13h. 30.6m. +	45° 04'	Aug. 26	14h. 02.5m. +	13° 19'
" 16	13 40.6 +	37 54	" 28	14 04.4 +	10 11
" 18	13 47.8 +	31 31	" 30	14 05.9 +	7 26
" 20	13 53.1 +	25 57	Sept. 1	14 07.2 +	5 02
" 22	13 57.0 +	21 07	" 3	14 08.2 +	2 54
" 24	14 00.1 +	16 56			

Announcements

THE following research fellowships in tropical medicine have recently been awarded by the Medical Research Council: *Senior fellowship* to Dr. Frank Hawking, assistant lecturer in pharmacology, Welsh National School of Medicine, Cardiff; this is tenable for three years, for investigations to be made mainly in the tropics. Dr. Hawking will work in Africa on the chemotherapeutic treatment of sleeping sickness. *Junior fellowships*: D. A. Cannon; J. L. Dales, assistant pathologist, Royal Hospital, Sheffield; I. W. MacKichan, house surgeon, London Hospital.

ON the recommendation of the Agricultural Research Council the following awards of agricultural research scholarships, studentships for research in animal health and veterinary scholarships have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: P. J. Faulks (plant physiology), R. S. Russell (plant physiology), F. H. Malpress (nutritional chemistry), J. Wilson (plant genetics), G. H. L. Dicker (entomology), J. W. Whittick (animal pathology), F. D. Asplin (poultry diseases), Miss K. M. Massey (poultry diseases).

THE following awards for 1937-38 have recently been made by the Salters' Institute for Industrial Chemistry and approved by the Court of the Salters' Company: a fellowship has been renewed to L. M. Baxt, Imperial College; fellowships have been awarded to R. H. Freak, University of Oxford, A. J. Shorter, University of Birmingham, J. L. Tuck, University of Manchester, and S. H. Wade, Imperial College of Science and Technology; the Salters' Institute has also awarded forty grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

DR. J. ANDERSON has been appointed representative of the Scottish Beekeepers' Association on the Bee Research Committee that advises it in regard to investigations on bees carried out at Rothamsted. Dr. Anderson is well known for his special knowledge of bee problems and for his admirable work in Scotland in applying science to the solution of the beekeepers' difficulties.

EIGHT honorary memberships of the Engineering Institute of Canada were conferred at the semi-centennial meeting of the Society held in Montreal recently. The engineers honoured include Sir Alex-

ander Gibb, president of the Institution of Civil Engineers; the Hon. C. D. Howe, Minister of Transport, Ottawa; the Hon. Grote Stirling, former Minister of National Defence, Kelowna; Prof. R. W. Angus, professor of mechanical engineering at the University of Toronto; Dr. George Herrick Duggan, a past-president of the Engineering Institute of Canada and chairman of the Dominion Bridge Company, Montreal; and Mr. S. J. Hungerford, chairman and president of the Canadian National Railways, Montreal.

DR. JOHN K. SMALL, chief research curator of the New York Botanical Garden, who has described the proposed Everglades National Park on p. 263 of this issue, has sent us sixty papers, of diverse botanical interest, published in the *Journal of the New York Botanical Garden*, and extending over a period of twenty years. The papers demonstrate great field activity on the part of the author, especially in plant morphology and ecology. It is interesting to note that Dr. Small has published about a hundred reports on explorations and fourteen descriptive floras concerned chiefly with the south-eastern United States. Copies of these publications can be obtained from the Science Press Printing Co., Lime and Green Streets, Lancaster, Pasadena.

DR. ADOLF BUTENANDT, director of the Kaiser Wilhelm Institute for Biochemistry, has been awarded the Scheele Medal of the Chemical Society of Stockholm.

GEHEIMRAT PROF. CARL BOSCH has been elected president of the Kaiser Wilhelm Society for the Advancement of Science in succession to Prof. Max Planck.

THE Gluge Prize of physiology of the Belgian Royal Academy of Sciences has been awarded to Prof. J. J. Bouckaert of the University of Ghent.

DR. VICTOR G. HEISER has been awarded the Medal for Distinguished Service of the Pennsylvanian Society of New York in recognition of his medical research work under the auspices of the Rockefeller Foundation.

THE sixteenth American Congress of Physical Therapy will be held in Cincinnati, Ohio, on September 20-24 at the Netherlands Plaza Hotel, under the presidency of Dr. William Bierman of New York. Further information can be obtained from the editorial and executive offices of the Congress, 30 North Michigan Avenue, Chicago.

AN International Congress of the Scientific Press organized by the Professional Syndicate of the Scientific Press will be held in Paris on October 7-9. Further information can be obtained from M. Toutain, 25 rue du Four, Paris.

ERRATUM. In NATURE of August 7, p. 229, the date of the erection of the Roman bath at Leicester should be, obviously, A.D. and not B.C. as stated.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 283.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Lecithinæmia following the Administration of Fat

ABOUT two hours after the administration of a meal containing fat, the fat content of the blood begins to rise. Bloor¹ found that when olive oil is administered to a dog, besides an increase in the neutral fat content of the blood an increase in its lecithin content also takes place. The average increase was found to be about 20 per cent. A maximum is reached after four hours. Bloor was inclined to ascribe the lecithin formed after the administration and resorption of the neutral fat to a synthesis occurring inside the red blood corpuscles. Other explanations might, however, be suggested as well, namely: (1) The lecithin is synthesized in the intestinal mucose and resorbed into the blood. (2) The synthesis takes place, after the resorption of neutral fat, in the liver, or somewhere else outside the intestinal tract. (3) The increase in the lecithin content of the blood is due to mobilization of preformed lecithin after the resorption of the neutral fat.

To decide which of these suggestions is to be accepted we repeated Bloor's experiment, but administered simultaneously with the oil-labelled (radioactive) phosphorus in the form of sodium phosphate. In the case denoted by (1) the additional blood lecithin should contain chiefly labelled phosphorus; in case (2) the additional lecithin should contain only small amounts of labelled phosphorus; in case (3) the additional lecithin should contain ordinary phosphorus only.

We determined the normal P present in the blood lecithin, which was extracted by the usual procedure, by the method of Fiske and Subbarow, and the labelled P by means of a Geiger counter. While, as seen in the table, the lecithin phosphorus content of 100 c.c. of blood increased by 2 mgm. four hours after administering the oil, that of labelled P only increased by 0.096 mgm. We must, furthermore, take into account the fact that half the labelled phosphorus administered two hours before the oil produced 0.028 mgm. labelled lecithin P during that time. We must therefore deduct 2×0.028 mgm. from the 'oil effect' of 0.096 mgm., obtaining 0.04 mgm. per 100 c.c. of blood for the maximum value of the 'oil effect'.

An important objection can, however, be raised to our conclusion; it may be argued that the intestinal tract might contain large amounts of phosphorus other than the labelled phosphate administered by us, the presence of which must be accounted for when carrying out the above calculation. To investigate this point and to ascertain to what extent the labelled phosphorus was resorbed, we killed the dog after the last experiment, the results of which are seen in the table. We washed the intestinal tract with water and determined both its total P content and its labelled P content. We

found by activity measurements 39.6 mgm. labelled P and by chemical determination 175 mgm. normal P. Within six hours as much as 260.4 mgm. of the 300 mgm. administered to the dog was thus resorbed. The 135 mgm. non-labelled phosphorus got into the intestine, presumably along with the digestive fluids, so that the 40 mgm. labelled P were 'diluted' to 175 mgm. We determined also the total acid-soluble phosphorus content of the intestinal mucose; it was found to amount to about 40 mgm., bringing the above figures up to 215 mgm. But even if we make the assumption that this dilution was present during the whole of the resorption process we should get the result $5.2 \times 0.064 = 0.21$ mgm. per cent lecithin P, while an increase of 2 mgm. per cent was found in the blood lecithin P.

Time in hours	Labelled P given in mgm.	Lecithin phosphorus found in 100 c.c. blood		Labelled total P found	
		Total	Labelled	in 100 c.c. blood	in the total blood of the dog
0	150	—	—	—	—
2	150 (+ 50 gm. oil)	16.0 mgm.	0.028 mgm.	1.03 mgm.	6.18 mgm.
4	—	15.5 "	0.048 "	2.03 "	12.18 "
6	— (259.4 mgm. resorbed)	18.0 "	0.096 "	2.00 "	12.00 "

It is of interest to compare the labelled P content resorbed with that actually found in the blood stream of the dog. Six hours after the beginning of the experiment, as is seen in the table, only 4.6 per cent of the amount resorbed was found. This result illustrates beautifully the great rapidity of the phosphorus exchange in the body. As observed by us in numerous cases, the individual phosphorus atoms present in the blood stream exchange their places rapidly with others present in the different organs. For this reason we can conclude with certainty that during our experiments the ratio labelled phosphorus to ordinary phosphorus must have been appreciably higher in the intestinal mucose than in the blood.

The only moderate increase in labelled phosphorus in the blood lecithin after administration of oil, an increase which nevertheless in all our experiments exceeds the increase observed after the radioactive phosphorus was administered alone, leads to the conclusion that during the absorption of neutral fat, lecithin is formed outside the intestinal tract. A comparatively rapid formation of labelled lecithin in several organs in the course of normal metabolism has in fact recently been observed².

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium

mixture most kindly put to our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence, of the University of California. We should also like to express our best thanks to Mr. A. H. W. Aten, jun., and Miss Hilde Levi for their assistance in this work.

G. HEVESY.
E. LUNDSGAARD.

Institute for Theoretical Physics
and
Institute for Medical Physiology,
University of Copenhagen.

¹ Bloor, W. R., *J. Biol. Chem.*, **23**, 317 (1915); **24**, 448 (1916).
² Artom, C., Sarzana, G., Santagelo, M., and Segré, E., *NATURE*, **139**, 836 (1937). Comp. also Hahn, L., and Hevesy, G., *Scand. Archiv. f. Phys.*, Aug. 1937).

A New Source of Vitamin A

In the course of a study of the mode of occurrence and distribution of vitamin A, we have found that the viscera (excluding the livers) of halibut yield abnormally rich oils (see table).

VITAMIN A IN HALIBUT

Weight of fish (kgm.)	Weight of liver (kgm.)	Weight of 'viscera'* (kgm.)	Weight of liver oil (gm.)	Weight of 'visceral' oil (gm.)	Weight of vitamin A		Percentage† vitamin A	
					in liver (gm.)	in viscera (gm.)	in liver oil	in visceral oil
45.4	1.03	1.67	203	36	3.84	2.88	c. 2.0	8.0
45.4	0.54	1.47	70	27	1.53	1.51	2.2	5.6
28.6	0.40	0.76	34	15	2.1	1.05	6.3	7.0
23.6	0.34	0.85	—	15	—	0.9	c. 4.6	6.0
26.9	0.51	1.04	—	17	—	0.48	0.33	2.8
36.3	0.91	1.06	205	20	0.22	0.32	0.11	1.6

* In this table the term 'viscera' refers only to stomach, mesentery and intestines.

† Percentage is calculated on the basis of 1% 620 m μ 5,000
583 m μ 2,600
for vitamin A, so that for an 1cm. 328 m μ 1,600
8 per cent oil we have :—

1% 620 m μ 400
583 m μ 208
1cm. 328 m μ 128

The fish were caught in Shetland waters in May this year and their stomachs were free from food. The viscera are normally thrown into the sea although they may contain, as in these cases, as much vitamin as the liver, and may yield more potent oils.

In the eye, Wald has shown that vitamin A forms a complex with protein. In order to test whether a similar complex occurs in liver, we have attempted to extract liver oils without denaturing proteins. In a number of instances the oil obtained by the use of non-polar solvents contains much less vitamin A than the oil obtained in other ways from the same liver. The phenomenon is best shown with livers poor in vitamin, but even in halibut, part at least of the vitamin A is not present in oil solution.

This work is being carried out under the auspices of the Medical Research Council and the Food Investigation Board.

Torry Research Station,
Aberdeen.

J. A. LOVERN.

University of Liverpool.
July 6.

J. R. EDISBURY.
R. A. MORTON.

Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium

In view of conflicting evidence as to the sign of the nuclear spin of potassium 39, it was decided to make a quantitative investigation of the intensities of the hyperfine structure components of the resonance lines. The method used was similar to that used by the authors for the hyperfine structure of the resonance lines of silver¹. The absorption produced by an atomic beam of potassium in the resonance lines given by a potassium lamp similar to that previously described was observed by means of an etalon of 5 cm. plate separation, with heavily silvered plates. Under these conditions, the adjacent orders of the emitted lines are well separated from each other, and the hyperfine structure can be observed as a narrow absorption doublet. In order to measure intensities, a photograph is made first of the emitted light without absorption, and then with absorption; the reductions in the logarithmic intensities by the absorption lines give their respective absorption coefficients, and the ratio of these the required intensity ratio.

The collimation of the atomic beam was 1:8; the absorption of the hyperfine structure was observed best when the temperature of the potassium was about 150° C. (v.p. = 5×10^{-4} mm. mercury), the absorption in the weaker component of the line $4S_{1/2} - 4^2P_{3/2}$ being about 50 per cent. Seven determinations of the intensity ratio were made for this line; the values were 1.44, 1.44, 1.44, 1.38, 1.43, 1.48 and 1.45, the mean being 1.44; the component of longer wave-length being the stronger. For the line $4S_{1/2} - 4^2P_{1/2}$, four determinations of the intensity ratio were made, the values being 1.52, 1.42, 1.40 and 1.45, mean 1.45; the component of longer wave-length was the stronger. A photometer trace of this line is shown in Fig. 1, three orders being shown.

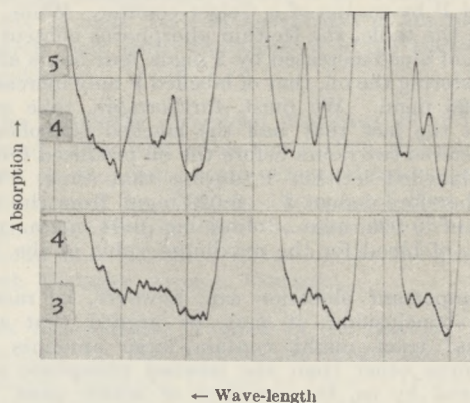


Fig. 1.

a, LIGHT SOURCE ONLY; b, ABSORPTION OF ATOMIC BEAM.

It was observed that when the density of the atomic beam was increased twenty times by raising the temperature of the potassium to 200° C.

(v.p. = 7×10^{-3} mm.) the short wave-length component in both resonance lines became considerably broadened, its width being about 0.012 cm.^{-1} , that of the other component being about 0.008 cm.^{-1} .

According to Millman and Fox and Rabi² the nuclear moment of K39 is $3/2$. The observed intensity ratio is in agreement with this if it is assumed that both the hyperfine structure components of K41 lie on the weaker component of K39; in this case the observed

intensity ratio should be $1.67 / \left(1 + \frac{2.67}{14}\right) = 1.40$, the total intensity of K41 being $1/14$ of that of K39. This is in good agreement with the observed value 1.44. The broadening of the weaker component at very high densities is strong evidence in favour of this interpretation, as the separation of the two high-frequency components of K41 is 0.00853 cm.^{-1} according to Manley³. The spreading out by this structure of the absorption of K41 could reduce its influence on the intensity by about one third, the calculated intensity ratio becoming 1.46, and thus in even better agreement with the observed. No trace of absorption due to K41 outside that due to K39 was found with 5 cm. and 2 cm. etalons when the atomic beam was twenty times as dense as that needed to give 50 per cent absorption by K39; and the intensity of the background was varied by giving exposures up to 20 times normal.

On the above view the centre of gravity of the components of K41 overlaps the weaker component of K39; this indicates a violet isotope shift of K41 equal to about 0.009 cm.^{-1} ; the normal centre of gravity shift is theoretically 0.009 cm.^{-1} .

It is thus shown that the spectroscopic determination of the nuclear moment of K39 is in complete agreement with those made by Rabi and others; the sign of the magnetic moment is positive⁴, and the value of the spin $3/2$.

In a previous note⁵, we stated that the short wave-length hyperfine structure component of $4S_{1/2} - 4^2P_{3/2}$ appeared stronger; this discrepancy can be explained; for the photometer traces of the absorption in which this was observed were made from photographs (intended for measurement of distance of high-frequency components and not for intensity measurements) made with an etalon of 10 cm. plate separation; under these conditions the emitted lines in adjacent orders overlap each other, so that in the position where the absorption was observed there is unabsorbable light from the wing of the emitted line in the adjacent order. The density of the atomic beam was very high (temperature of potassium 220° C.) so that the absorption was almost complete, and the light transmitted was due to the overlapping wing, and had no significance as to the intensity ratio of the high-frequency components.

The observation of Fisher⁶ that the short-wave components appear stronger in an excited atomic beam can perhaps be explained by self-absorption; moreover, it has been observed by K. W. Meissner⁷ that the long wave component is the stronger in an excited atomic beam.

Clarendon Laboratory,
Oxford. July 16.

D. A. JACKSON.
H. KUHN.

¹ Jackson, D. A., and Kuhn, H., *Proc. Roy. Soc., A*, **158**, 372 (1937).
² Millman, S., *Phys. Rev.*, **47**, 739 (1935). Fox, M., and Rabi, F., *Phys. Rev.*, **48**, 746 (1935).

³ Manley, J. H., *Phys. Rev.*, **49**, 921 (1936).

⁴ Torrey, H. G., *Phys. Rev.*, **51**, 501 (1937).

⁵ Jackson, D. A., and Kuhn, H., *NATURE*, **137**, 108 (1936).

⁶ Fisher, R. A., *Phys. Rev.*, **51**, 887 (1937).

⁷ Private communication from Prof. Meissner.

Expulsion of Neutrons from Lead by Cosmic Rays

A NEUTRON counter was made of a brass tube 10 cm. long and 1 cm. in diameter, the inner surface being coated with a thin film of borate a few microns thick. The axial collector of the ionization chamber was directly connected to a set of the improved linear amplifier system, which was so carefully mounted that the counting system was perfectly free from the mechanical and electrical disturbances of the surroundings, and gave only two to four clear, natural kicks in an hour. By a series of control experiments with neutrons from a radium-beryllium source (of 10 mgm. radium), it was found very reliable for observing slight variations in the number of kicks under various experimental conditions.

Now when the counter was placed inside a lead chamber 50 cm. long and 10 cm. thick (the dimensions are shown in Fig. 1) the number of kicks was found to increase to about 7 per hour, while it amounted to about 15 per hour when the space around the chamber was filled with paraffin.

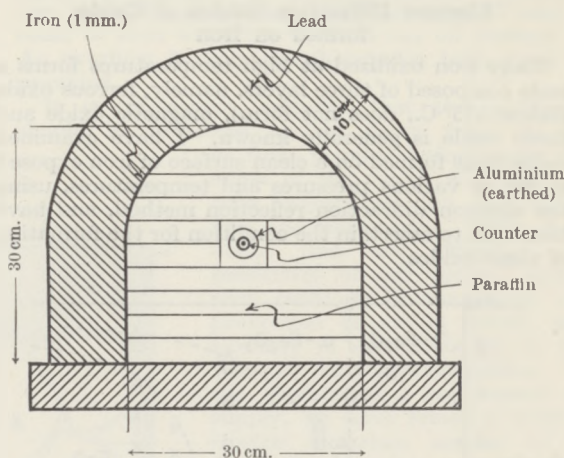


Fig. 1.

These observations were carefully done intermittently for half a year. Though it was difficult to maintain the constant reliability of the counting system for a long duration of time (the results for different dates were sometimes markedly different) most of the results obtained in good conditions were found to lie within the following extreme values:

	Natural kicks outside the chamber	Kicks inside the lead chamber without paraffin	Kicks inside the lead chamber filled with paraffin	Kicks outside the chamber but within paraffin
Min.	2 per hour	4-6	9-12	Less than those counted in the lead chamber without paraffin
Max.	4	7-9	18-20	

(Boron-surface: 10 cm. in length and 1 cm. in diameter.)

This result shows that a number of fast and slow neutrons are produced by the action of cosmic rays in lead (or less probably in iron or in paraffin).

At first it was suspected that they were liberated at the instant of the production of a 'shower' in lead. But the remarkable Wilson chamber photograph taken by Blackett¹ showing the disintegration of an atomic nucleus into heavy particles by cosmic

rays, and the interesting research on the general nuclear photo-effect reported by Bothe and Gentner², suggest to us that a neutron or neutrons may be liberated from a lead nucleus by a cosmic ray photon, presumably accompanying a kind of disintegration into heavy particles (general Chadwick and Goldhaber's effect).

A recent report by Fünfer³ on the existence of slow neutrons in the atmosphere corresponds probably with the existence of the natural kicks in our experiment, which is, however, not sufficiently sensitive to decide the matter.

Institute of Physics,
Kyoto Imperial University,
Kyoto.
June 6.

B. ARAKATSU.
K. KIMURA.
Y. UEMURA.

¹ "Kernphysik", edited by E. Bretscher, p. 108 (E. J. Williams) (Berlin: Julius Springer, 1936).

² Bothe, W., and Gentner, W., *Naturwiss.*, 25, 90 and 126 (1937).

³ Fünfer, E., *Naturwiss.*, 25, 235 (1937).

Electron Diffraction Studies of Oxides formed on Iron

THAT iron oxidized at high temperatures forms a scale composed of three layers, namely, ferrous oxide (below 575° C., does not form), magnetic oxide and ferric oxide is generally known. I have examined oxide films formed on a clean surface of iron exposed to air at various pressures and temperatures, using the electron diffraction reflection method, and have been able to ascertain the condition for the formation of these oxides.

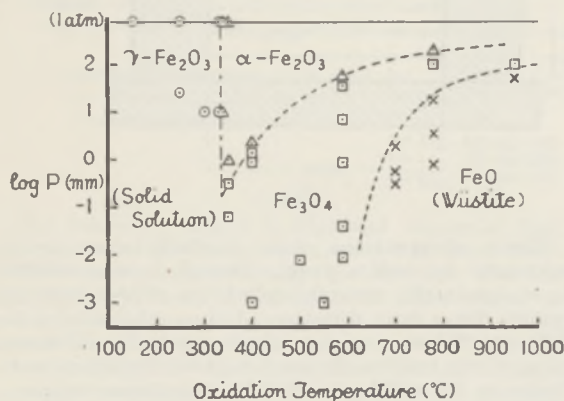


Fig. 1.

The iron specimens, after being etched to remove any polishing effects, were heated to definite temperatures in a highly evacuated tube and then oxidized by introducing air at definite pressures. After an appropriate period of oxidation, the tube was again evacuated as quickly as possible and in the meanwhile cooled in two or three minutes to room temperature. The space lattices of oxides were determined by electron diffraction photographs. The regions where the various oxides are formed are shown in Fig. 1. The duration of exposure has no effect on the resulting oxide except in a few cases.

The facts that lower oxides are formed at higher temperatures under reduced pressures and that prolonged exposure does not elevate the degree of oxidation but is manifested only in the increase of scale thickness are interesting phenomena indeed. These

phenomena lead us to the suggestion that iron atoms migrate more vigorously towards the surface with rising temperature and check any further oxidation of the lower oxides.

Only the oxide of the structure of Fe_3O_4 type is obtainable below 340° C., and considering other parts of the diagram this oxide was concluded to be $\gamma\text{-Fe}_2\text{O}_3$. The invisible films¹ of passive iron and of the iron polished in air and the oxide film² formed in air below 200° C. were recently concluded to be $\gamma\text{-Fe}_2\text{O}_3$. These two cases are included within the $\gamma\text{-Fe}_2\text{O}_3$ region of the diagram.

In other investigations³, the transition point between $\gamma\text{-Fe}_2\text{O}_3$ and $\alpha\text{-Fe}_2\text{O}_3$ was indistinct; but in this work it was ascertained that the point lies almost at 340° C., and in the immediate vicinity of this temperature both oxides are formed in almost amorphous state. The ordinarily impossible transition from $\alpha\text{-Fe}_2\text{O}_3$ to $\gamma\text{-Fe}_2\text{O}_3$ was verified to be possible by maintaining the temperature of this nearly amorphous $\alpha\text{-Fe}_2\text{O}_3$ at 330° C.

Specimens heated at 200° C. and 250° C. for a short while produced an extra ring corresponding to 3.4 Å., besides the diffused $\gamma\text{-Fe}_2\text{O}_3$ pattern, which disappeared on further heating. It is hoped that better identification may be arrived at for this unknown primary oxide from a different angle.

Experimental details and technique will be reported in the *Scientific Papers* of this Institute.

I wish to express my thanks to Dr. I. Iitaka and Mr. S. Miyake for their kind guidance.

TAKEO IIMORI.

Institute of Physical and Chemical Research,
Tokyo. July 5.

¹ Iitaka, I., Miyake, S., and Iimori, T., *NATURE*, 139, 156 (1937).

² Milley, H. A., *Iron and Steel Inst., Carnegie Schol. Mem.*, 25, 209 (1936).

³ Fricke, R., and Zerrweck, W., *Z. Elektrochem.*, 43, 54 (1937).
Miyake, S., *Sci. Pap. I.P.C.R.*, 31, 165 (1937).

β -Decay as due to a Neutrino Shower

ACCORDING to the Fermi theory of β -decay, the β -curve representing the number of electrons with a given energy lying in the interval of the transition energy of the nucleus, is governed by a statistical factor which may, however, be deduced in a simple manner as shown by Uhlenbeck and Goudsmit. Experimental curves indicate the existence of a marked asymmetry about half the transition energy of the nucleus, while the statistical factor in the Fermi theory is practically symmetrical.

If we imagine the final process to consist of a shower of neutrinos (the number in the shower depending on the transition energy of the nucleus), with intermediate stages, the asymmetry can receive a simple explanation. Indeed, following the basic transformation pictured by Fermi and assuming the Jordan formulation that a high-energy electron makes a transition to a lower energy state with the emission of two neutrinos the total energy of which is equal to the transition energy of the electron, we can follow the shower production in a way analogous to Heisenberg's theory. The transformations in the β -decay would be

$$N \rightarrow P + e + n, \quad (\text{Fermi})$$

$$\left. \begin{aligned} e &\rightarrow e^{\text{I}} + n^{\text{I}} + n^{\text{II}}, \\ e^{\text{I}} &\rightarrow e^{\text{II}} + n^{\text{III}} + n^{\text{IV}} \end{aligned} \right\} (\text{Jordan})$$

resulting in

$$N \rightarrow P + e^{\text{II}} + n + n^{\text{I}} + n^{\text{II}} + n^{\text{III}} + n^{\text{IV}},$$

where N , P , e and n stand for neutron, proton, electron and neutrino. The electron e^{β} may further undergo a Jordan transformation depending on its energy in the field of the nucleus. The number of electrons with less than half the transition energy of the nucleus would be greater than that of those with energy greater than half the transition energy as there would be the tendency for the higher energy electron to undergo the Jordan transformation, thus resulting in an asymmetrical curve representing the number of electrons with a given energy.

N. S. NAGENDRA NATH.

Andhra University,
Waltair.
July 11.

An Inexpensive Low-Temperature Thermostat

SINCE the low-temperature thermostats on the market involving an electric refrigerator and temperature regulator are very expensive, it is possible that the following easily constructed apparatus (Fig. 1) may prove of value to many research workers. It was designed for the purpose of subjecting small aquatic animals to a constant temperature over a range of 4° – 10° C. Our present apparatus will maintain a constant temperature $\pm 0.1^{\circ}$ C. Working at 5° C. it will consume approximately $\frac{1}{2}$ cwt. of ice in 100 hours.

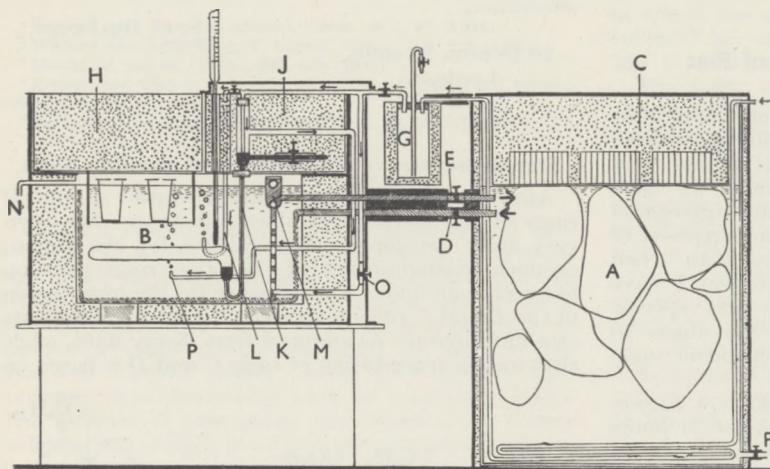


Fig. 1.

It consists of two tanks, A a large reservoir containing ice and water, and a small thermostat bath B , both of which are well insulated with powdered cork. A constant temperature in the bath B is maintained by a controlled circulation of water between it and the ice tank through the insulated tubes D and E . This flow is induced by a stream of air bubbles entering via O and streaming up the tube into the cup M , thus raising the level of the water in the latter and causing a flow via E into the ice tank. This is compensated by a back flow of cold water into the bath through D . The air is first cooled by passage through a coil at the bottom of the ice tank in order to prevent subsequent condensation in the thermo-regulator. Any water condensed in the coil is forced up and retained in the trap G . The air can then pass (1) through O to the circulator already described; (2) via the toluol-mercury gas regulator K to the bubbler P ; or (3) direct to the bubbler L . When the

bath temperature falls lower than that required, the air passage through the regulator is open and the tube diameters and taps are so adjusted that all the air is passing into the bath through the bubbler P , thus keeping the water stirred. When the temperature rises as a result of inevitable heat leakage from the air, the bubbler P is stopped by the rise of the mercury in the regulator and the air passes through the circulator and the bubbler L . The result is that the bath temperature is lowered by inflow of cold water while stirring is still maintained. The well-insulated lid of the thermostat bath is in two halves, one, J , into which are inset the thermometer, thermo-regulator and connexions, and the other, H , which is removable in order to give access to the experimental vessels resting on a wire tray. The lid C of the ice tank is weighted and so arranged that it touches the surface of the water at the required level. This prevents alteration in level due to melting of floating ice; that due to specific gravity changes is not sufficient to affect the apparatus and is readjusted when the ice is renewed. Preparatory to addition of more ice, the tubes D and E must be shut while the water is run off through F . An overflow N from the thermostat bath must be provided.

It is, of course, essential that the insulation should be protected against damp from the air or from possible leakage over the edges of the tanks, and that the tube connexions are thoroughly firm and watertight. There is no doubt that the efficiency and sensitivity of our present apparatus could be increased by improvement of certain details, particularly in insulation and in the form of the thermo-regulator. In the absence of a compressed air supply, we have found a Grafton electric aquarium aerator to be thoroughly satisfactory.

The apparatus could be used as a cold aquarium for larger animals if the bath B were made of glass or porcelain and the water circulated between this and a vessel suspended in A and surrounded by the ice and water. It might also be adapted for use at temperatures below 0° C. if brine were used, cooling being done by the suspension of a vessel in A containing a block of solid carbon dioxide.

L. C. BEADLE.
F. A. BOOTH.

University of Durham College of Medicine,
Newcastle-upon-Tyne.

Production of Thin Gold Films

IN view of the interest attached to the investigation of the physical properties of thin metallic films, a new and easy method for producing such films of pure gold would seem to have special significance.

Certain organo-gold compounds or their derivatives and, particularly the simplest of such compounds, namely, diethylmonobromogold¹, $[\text{Au}(\text{C}_2\text{H}_5)_2\text{Br}]_2$, when dissolved in a suitable solvent such as ethanol to which alkali is added, undergo an interesting

decomposition even at the ordinary temperature; the solutions become deeply coloured like those of colloidal gold and in a short time (seven to nine minutes at the ordinary temperatures) gold is deposited as a coherent film.

Brilliant films have been deposited on suitably prepared glass and other surfaces. By reflected light they appear as massive gold and by transmitted light they show the characteristic colours of thin gold films. The films are capable of being polished, but they can be produced in such a manner as to render this unnecessary. The thickness of the films can be varied by altering the conditions of the reaction and the quantities of the reactants.

The necessary starting material being available, the pure gold films are actually more easily produced than those of silver and are much more chemically inert. In spite of their opulent appearance as mirrors, the films of pure gold produced so readily and deposited on glass, etc., may have considerable scientific application.

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July 21.

¹ Gibson and co-workers, *J. Chem. Soc.*, 2531 (1930); 2407 (1931); 860 (1934); 1024 (1935); 324 (1936). ² Gibson, Provisional Patent Specification, 17261/1937.

Spontaneous Electrical Charge of Fine Coal Dust

In the last paragraph of their letter on "Some New Characteristic Properties of Certain Industrial Dusts" in *NATURE* of May 1, Prof. H. V. A. Briscoe and colleagues state: "On several occasions we have found that fine dusts which have become aggregated by settlement or have been for some time exposed to air appear to be much less reactive than when freshly formed. . . ." In this connexion I have obtained interesting evidence which has specific reference to the varying liability of fine dusts to spontaneous electrical charging also dependent upon pre-treatment.

Two samples of the same coal dust were respectively maintained at 80° C. in an oven for 24 hours and 36 hours, the latter being periodically stirred and turned. Representative results of the voltages generated on circulating these dusts were:

	Voltage of generated charge at same capacity	Weight
24-hour sample	344.0	3 gm.
" "	747.5	5 gm.
36-hour sample	270.0	3 gm.
" "	589.0	5 gm.

The ratio of charge generation is approximately 1.25 : 1 for 24 hour to 36 hour samples.

The residue of the 24-hour sample was then retained in the desiccator at N.T.P., whilst the 36-hour sample residue was further heated in the oven, and the charge divergences were confirmed as follows:

	Voltage of generated charge at same capacity	Weight
Desiccator sample	234.0	2 gm.
Oven sample	64.5	2 gm.

Fresh samples of the same coal dust were then used, and after varying treatments of sub-divided

samples (2 gm. each), were found to generate charge as follows:

Treatment	Voltage of generated charge at same capacity
1. In desiccator overnight	256.9
2. In oven 1 hour	205.4
3. No. 2, after 2½ hours in desiccator	240.8
4. Several days in oven	112.0
5. As No. 4, but turned over many times	87.8

The continuing loss of electrical activity with age of dust is shown.

From 1 and 2, drying with heat produces a lower charge than drying at normal temperature, hence charge variation is probably due to a heating effect, for example, either oxidation or gaseous adsorption on particle surfaces, or both. From 2 and 3, as the regeneration of activity on cooling in desiccator is not likely to be due to reversal of oxidation, it is likely to be due to gas re-adsorbed on cooling in desiccator to replace gas driven off by heating in oven. From 3, 4 and 5, as heating and agitation continue, electrical charge progressively decreases. The decrease, therefore, is probably due to continuing de-adsorption.

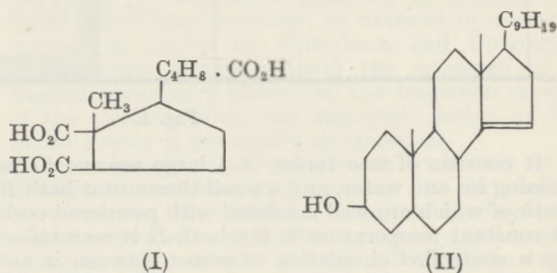
It seems, therefore, that the tendency to spontaneous electrical activity of a coal dust decreases with age of dust and with probable decrease of adsorbed films or molecules on the dust particles, and increases, despite age, with increase of such adsorption.

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Stereochemistry of the Sterols and the Bile Acids

ALTHOUGH the stereochemistry of the *A* and *B* rings of the sterols and allied substances has been very fully developed, the evidence for the stereochemical configurations of the other rings rests on less secure grounds. The evidence for the *trans* fusion of the *B* and *C* rings rests solely on the requirements of a flat molecule as adduced from X-ray data, while that for the *trans* fusion of rings *C* and *D* is based on



the isolation of the tricarboxylic acid (I) by the stepwise degradation of 12-ketocholanic acid¹ and desoxyeholic acid². This acid on pyrolysis gave an anhydride which on hydrolysis furnished an isomeric tricarboxylic acid. It was, therefore, deduced that the former acid had a *trans* configuration, from which it was assumed that the fusion of rings *C* and *D* was originally in the *trans* position. This conclusion would seem to be sound provided that no inversion occurred in the degradation, a loop-hole which cannot be excluded.

Recent work on the relative stabilities of *cis* and *trans* hydrindane derivatives leads to a different

expectation and, in fact, the result of the catalytic hydrogenation of β -ergosterol (II) strongly suggests that rings *C* and *D* are in *cis* relation. Laucht³ has shown quite conclusively that the double bond in this substance occupies the $C_{14:15}$ position. The original stereochemical configuration of the *C* and *D* rings has, therefore, been destroyed, yet, on catalytic hydrogenation in neutral solution⁴ and even in acetic acid⁵ (a solvent known to favour the formation of a *cis* configuration), β -ergosterol yields the same ergostanol as that obtained by the complete reduction of ergosterol. Ergostanol must, therefore, include a *cis* fusion of the *C* and *D* rings. As ergostanol is known to possess the *allo*-cholanolic configuration, it would appear from this line of evidence that the *C* and *D* rings in the sterols and the bile acids are in *cis* relation also.

This result also supplies confirmatory evidence of the *trans* fusion of rings *B* and *C*, since, in the wandering of the double bond from ring *B* to ring *D*, the former two rings would be expected from known analogies to adopt their more stable configuration. This is further supported by the fact that inversions of 7-keto derivatives analogous to the facile isomerization of dehydroyodesoxycholic acid to 3:6-diketo*allo*-cholanolic acid have never been observed.

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July 8.

¹ Wieland and Dane, *Z. physiol. Chem.*, **216**, 91 (1933).

² Wieland and Schlichting, *Z. physiol. Chem.*, **134**, 276 (1924).

³ Laucht, *Z. physiol. Chem.*, **237**, 236 (1935).

⁴ Reindel and Walter, *Ann.*, **452**, 45 (1927). Heilbron and Wilkin-son, *J. Chem. Soc.*, 1708 (1932).

⁵ Hart and Emerson, *J. Amer. Chem. Soc.*, **54**, 1073 (1932).

The *Cis*-form of Azobenzene

DURING determinations of the solubility of azobenzene, in which a photometric method of analysis was used, an apparent lack of reproducibility was traced to an increase both in the light absorption of standard solutions and in the concentration of saturated solutions, on exposure to light. The increases reached steady values after several days' exposure in a thermostat tank in a north-lit room. The increase of adsorption was shown to be nearly independent of light intensity, solvent and concentration, but was reached much more rapidly in bright sunlight—a few minutes sufficing for a $M/2000$ solution in a glass bottle. The phenomenon, persisting after repeated recrystallization of the azobenzene, seemed consistent only with a reversible formation of a polymer or isomer, both forward and backward reactions being activated by light and the thermal reaction being very slow at ordinary temperatures.

The second form was found to be distributed between immiscible solvents much more in favour of the more polar one than is ordinary azobenzene and a method of separation based on this property was devised. 5 gm. of azobenzene were dissolved in 250 c.c. of acetone and the solution exposed to sunlight for several hours. The following operations were then carried out in dim light. 350 c.c. of water were added, the mixture cooled, filtered and extracted with 40 c.c. of light petroleum. The azobenzene left in the aqueous layer would have been extremely small if the acetone solution had not been exposed to light. That actually remaining was

extracted by chloroform. The procedure was several times repeated and the chloroform extracts united, dried and evaporated down *in vacuo*. The product was crystallized from light petroleum between 25° and -15° C.

Solutions of successive crystal fractions were made up in acetone. The first few fractions had a constant absorption coefficient for the blue light used (that transmitted through a Kodak 'Wratten No. 47' gelatin filter) and this was 2.17 times that of ordinary azobenzene. On exposure to sunlight, the absorption of these solutions fell to a constant fraction, 0.61, of the original value. That of ordinary azobenzene rises on exposure to 1.32 of the original, the exposed solutions thus having identical absorption. It was assumed that the first crystal fractions were the pure second form. The equilibrium mixture would contain, therefore, about 27 per cent of the second form.

The melting point of the second form is at least one or two degrees higher than that of the normal form (68° C.). Successive determinations on the same sample gave melting points progressively lower at first, passing through a minimum at about 35°, and then rising to 68° C. Some thermal reversion may have occurred before the first determination, and the exact melting point is therefore in doubt. Thermal reversion is undoubtedly quicker in the liquid than the solid state, but some reversion had occurred in crystals that had been exposed to strong sunlight. In a sealed tube, with a mercury manometer attached, in which the azobenzene occupied about 1/10 of the enclosed air space, thermal reversion took place at 100° C. without change of pressure.

The polar character of the second form, which proves almost conclusively that it is the *cis*-isomer, a suggestion first due to Prof. S. Sugden, is indicated by its greater solubility, despite the higher melting point, in polar solvents, and smaller solubility in petroleum. Determinations of the dipole moment in benzene solutions, made by Dr. R. J. W. Le Fèvre, give a value of 3.0 Debye units. The apparent moment of the ordinary *trans*-form increased on exposure of a solution to light from zero to 1.4-1.5 while that of the *cis*-form decreased to the same value. The change indicates that the equilibrium solution contains between 20 and 25 per cent of the *cis*-form, in good agreement with an approximate estimate of 21 per cent by the photometric method, this value, in a c. 1 per cent solution in benzene, being somewhat lower than that, 27 per cent, found in much more dilute solution in acetone.

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Transformation of Hydrate Cellulose into Native Cellulose

If cellulose is precipitated from solution or liberated from its compounds with sodium hydroxide, the space lattice ($a=8.14$ A., $b=10.3$ A., $c=9.14$ A., $\beta=62^\circ$) differs from that of native cellulose ($a=8.35$ A., $b=10.3$ A., $c=7.9$ A., $\beta=84^\circ$). In this form it is known as hydrate cellulose, although it is in fact of the same analytical composition as the native form, and is free from water. Hitherto it has not been possible to convert one modification directly into the other; it was possible to pass from native cellulose via alkali cellulose to hydrate cellulose, and from this

(as Barry, Peterson and King¹ showed recently) by way of the ammonia compound back to native cellulose. Moreover, Hess and Gundermann² have described the appearance of native cellulose along with hydrate cellulose during the washing out of alkali cellulose at 100° C. We find, however, that it is possible to convert hydrate cellulose directly into native cellulose.

When strongly stretched hydrate cellulose in the form of viscose silk 'Lilienfeld silk' is heated for half an hour in water at 200° C., the X-ray diagram shows interferences characteristic of native cellulose as well as those of hydrate cellulose. The same diagram is obtained after treating viscose with boiling formamide (200° C. for half an hour). If the fibres are heated in formamide to 140° C., less native cellulose is formed than at 200° C.; after half an hour in glycerine at 250° C. the hydrate cellulose is converted almost completely into the native form. If the fibres are left for eight days in water at 200° C., very little more native cellulose is formed than after half an hour.

The same experiments were made with hydrate cellulose obtained by the mercerization of ramie. It was found that under the same conditions less native cellulose was formed from this material than from Lilienfeld silk.

Dry viscose heated for twenty minutes in a high vacuum at 200° C. remains unchanged; but after ten minutes at 300° C. a little native cellulose is formed. Water and other dipole-containing liquids appear to increase the rate of transformation very considerably.

Native cellulose (ramie) after heating for five days in water at 150° C. remains unchanged. We conclude that at least over the range of temperature covered by these experiments *native cellulose is the stable form, and hydrate cellulose the non-stable*.

As already indicated, Hess and Gundermann obtained native cellulose by the action of water at 100° C. on alkali cellulose. We have been able to detect native cellulose in preparations which were washed out at 60° C. If decomposition and washing out take place at 20° C. and the preparation is afterwards heated, no native cellulose is formed even at 100° C. On dipping fibres of alkali cellulose into formamide at 140° C. the product obtained is almost entirely native cellulose. In all these cases, therefore, the temperature necessary for the formation of native cellulose is considerably lower than that required for the transformation of hydrate cellulose as such into the native form.

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¹ *J. Amer. Chem. Soc.*, **58**, 333 (1936).

² *Ber. deutsch. chem. Ges.*, **70**, 527 (1937); see also Hess and collaborators in *Z. phys. Chem.*, **B**, **7**, 7 (1930).

Isolation of Ascorbic Acid from Urine

HINSBERG and Ammon¹ have been unsuccessful in an attempt to isolate ascorbic acid from urine. Recently E. C. Noyons² has described a method for the isolation of ascorbic acid from tomato juice involving chromatographic adsorption, and has announced his intention of applying a similar procedure to the isolation of ascorbic acid from urine.

We have been engaged for a considerable time on this problem and have finally isolated from urine a small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid. Its melting point (269–271 uncorr.) agrees with that of the similar derivative prepared from pure ascorbic acid (m.p. 270–272) and the crystalline forms appear identical. A mixed m.p. with the dinitro-phenyl hydrazine derivative of the pure vitamin shows no depression (m.p. 271–272). The reliability of the m.p. determinations has been checked by taking a mixed m.p. of the 2:4 dinitro-phenyl hydrazine derivatives of ascorbic acid and salicylaldehyde (m.p. 249). A very marked depression was observed, both in this case and in another where a mixed melting point of two different hydrazones with very similar melting points was taken.

This work is being continued, and we hope shortly to be in a position to give a more complete account of this investigation.

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July 21.

¹ Hinsberg, K., and Ammon, R., *Biochem. Z.*, **288**, 102 (1936).

² Noyons, E. C., *Acta. Brev. Neerlandica*, **7**, 79 (1937).

A Diene Synthesis applicable to the Sterol Group

THIS method is regarded as the most promising yet adumbrated in that it reduces the problem of the synthesis of cholesterol or its stereoisomerides and analogous substances to the much simpler one of preparing a monocyclic and a bicyclic intermediate. It seems to be especially important that the double bond of cholesterol is placed by this synthetic process in the correct position and that unlike many other diene syntheses the method can be used to introduce the angle-methyl groups.

1-Methyl-2-vinylcyclohexene (I), obtained from the known 2-methylcyclohexenylethyl alcohol by an application of the xanthogenate reaction, condenses with maleic anhydride in benzene solution with the formation of the anhydride (II), m.p. 111.5°. This and the related dibasic acid, m.p. 171°, afforded analytical values tallying with theoretical anticipations.

With crotonaldehyde the diene furnishes an adduct the dinitrophenylhydrazone of which has m.p. 192° and analysis of which agrees with the formula C₁₉H₂₄O₄N₄. The 2:4-dinitrophenylhydrazone of the adduct (III) from the diene and cyclohexenone has m.p. 164° and gives satisfactory figures on analysis.

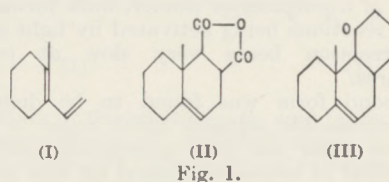


Fig. 1.

The constitutions of the intermediates now required for the synthesis of substances containing the cholane skeleton are obvious on inspection, and attempts to make some of them are in progress.

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July 20.

Antimicrobial Action of Some Aromatic Compounds

NUMEROUS recent researches have directed our attention to the antimicrobial action of various aromatic amino or nitro compounds containing the following functional groups: sulphamide, $R-SO_2NH_2$; thio, $R-S-R'$; dithio, $R-S-S-R'$; sulphone, $R-SO_2-R'$; thiophenol, $R-SH$; sulphinic acid, $R-SO_2H$. By chemical analogy with the arsenic compounds in which the arsenoxide group shows *in vitro* a very high parasitocidal activity, we have been led to a study of the para-substituted aromatic sulphoxides.

Experiments on mice have proved that 4:4'-

diacetylaminodiphenyl sulphoxide (m.p. $292^\circ C$. uncorr.) and also other sulphoxides, symmetrical or asymmetrical, containing the groups OH , NH_2 or NO_2 in the *para*-position, administered by mouth, show an extremely high curative activity not only against *Streptococcus*, but also against experimental gonococcal infection.

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Points from Foregoing Letters

By feeding a dog with oil and with radioactive phosphorus (as sodium phosphate) and then determining the proportion of 'labelled' phosphorus in the lecithin of the blood and of the intestine, Prof. G. Hevesy and E. Lundsgaard find that the additional lecithin found in the blood contains only a small amount of the active phosphorus, and conclude that during the absorption of neutral fats lecithin is formed outside the intestinal tract.

Drs. J. R. Edisbury, J. A. Lovern and R. A. Morton state that fish viscera other than liver contain vitamin A, and that halibut viscera constitute a very rich and hitherto neglected source of the vitamin. Evidence is adduced that vitamin A in liver is, at least in part, associated with protein.

From the intensity of the components of the hyperfine structure of the resonance line of potassium, Dr. D. Jackson and H. Kuhn deduce that the magnetic moment of K39 is positive, and that the nuclear spin has a value of $3/2$, in agreement with the findings of Millman, Fox and Rabi. The centre of gravity of the components of K41 overlaps the weaker component of K39.

An increase in the number of kicks in a 'neutron' counter when placed inside a lead chamber leads B. Arakatsu, K. Kimura and Y. Uemura to assume that neutrons are liberated from lead by cosmic ray photons. When the lead chamber is filled with paraffin, a further increase in the number of kicks of the counter is observed.

Investigations of oxide films on iron by means of electron diffraction throws further light on the three oxide layers (composed of ferrous, magnetic and ferric oxide). T. Iimori gives a diagram showing the regions of stability of the various forms of iron oxide and concludes that, with rising temperature, iron atoms migrate more vigorously towards the surface and check any further oxidation of the lower oxides.

N. S. Nagendra Nath states that the asymmetry in the curve showing the energy distribution of the electrons emitted by radioactive substances (β -decay) is explainable on the assumption that the final process consists of a shower of neutrinos, the number in the shower depending on the transition energy of the nucleus.

An inexpensive low-temperature thermostat, useful

also as a cold aquarium, is described by L. C. Beadle and F. A. Booth. A constant temperature is maintained by means of a controlled circulation of water from an ice tank, the flow being induced by a stream of air bubbles in a connecting tube.

Prof. C. S. Gibson directs attention to the production of thin gold films or mirrors on glass and other surfaces by deposition from organic gold compounds such as diethylmonobromogold.

Dr. S. C. Blacktin describes experiments indicating that, with a fine coal dust, its spontaneous electrical activity varies with the treatment to which the dust is submitted, and that such activity seems to increase with the increase of adsorbed material on the particles and to decrease with decrease of such adsorbed material.

D. A. Peak discusses the evidence concerning certain aspects of the structure of sterols and bile acids and suggests that the fusion of the *C* and *D* rings is in the *cis* and not in *trans* position as hitherto believed.

The separation of the *cis* form of azobenzene by extracting an acetone solution exposed to light with water and then further extracting the aqueous solution with chloroform is described by G. S. Hartley. The *cis* and *trans* forms come to equilibrium under usual conditions, the change being activated by light. The *cis* form has a greater absorption coefficient for blue light and its melting point is somewhat higher than that of normal azobenzene. In benzene solution it has a dipole moment of 3.0 Debye units.

By heating strongly stretched hydrated cellulose (viscose silk) for half an hour at $200^\circ C$. in water or in formamide, Prof. K. H. Meyer and N. P. Badenhuizen, jun., find that it is changed into native cellulose, as shown by X-ray diffraction patterns. The authors consider that at $200^\circ-300^\circ C$. native cellulose is the stable form and hydrate cellulose is the non-stable.

A small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid has been separated from urine by Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm.

A diene synthesis which may help towards the synthesis of cholesterol and similar substances is described by A. B. Meggy and Prof. R. Robinson.

Research Items

'Woman Marriage' in Dahomey

THE institution of a form of marriage in which one woman takes another to wife has been recorded in Africa among peoples so far distant from one another as in northern and southern Nigeria, the Anglo-Egyptian Sudan and the Union of South Africa. It was observed by Dr. Melville J. Herskovits in Dahomey in 1931 (*Africa*, 10, 3). Dahomean marriages take thirteen different forms, falling into two general classes, in one of which, 'woman-with-money' are comprised all forms in which the marriage dues are paid by the spouse to the bride's father, while in the form 'friend-custody' no such payment is made. A woman may marry another woman, paying the dues and performing all the duties required in the first class; but nevertheless her marriage is spoken of as if it belonged to the second. In the first class of marriage the resultant offspring are under the control of the father; but in the second the mother retains control of her children. Woman marriage is rare among commoners, but frequent in upper-class families, particularly among royalty. It is based on the fact that women frequently become wealthy. They may then wish, especially if barren, to build up a compound of their own. To effect this a wife is married to whom the 'husband' admits a male friend or member of her household, the children who may result being regarded as her own, and competent to inherit the property of the house she has built up on this basis. The marriage does not necessarily imply homosexual relations. The motivating force, the desire for prestige and economic power, reflects the dominant Dahomean patterns of thought and the fundamental forces that underlie their behaviour. No stigma is attached to the parties contracting such marriages, and in fact the woman 'husband' is respected on account of her wealth and the number of persons she controls in her compound.

Prontosil in Puerperal Infections

IN the Section of Obstetrics and Gynæcology of the British Medical Association during its recent meeting in Belfast, Mr. G. F. Gibberd opened a discussion on the use of prontosil and similar compounds in the treatment of puerperal infections caused by hæmolytic streptococci. After a preliminary reference to dosage, he compared a series of 157 cases of puerperal infection treated at Queen Charlotte's Hospital with a control series treated in this hospital during the last two years before the introduction of the new drug. The death-rate was much reduced, and the time spent in hospital was much shorter in prontosil-treated cases. Dr. Doris Brown reported on the use of prontosil in the Royal Maternity Hospital, Belfast. For the three years before the introduction of prontosil the death-rate for cases of septicæmia was 87.5 per cent, and the mortality for all cases due to infection by the hæmolytic streptococcus was 23.5 per cent. Since the use of the drug the death-rate in cases of septicæmia was 28.57 per cent, and for all cases of puerperal infection 6.6 per cent. Prof. Chassar Moir referred to the remarkable effect prontosil had in combating *B. coli* infections of the urinary tract.

Factors of Vocational Guidance

IN an article in the *Human Factor* (11, Nos. 7-8), Dr. Oeser discusses the problem of vocational guidance. He believes that while most people acknowledge its importance, few recognize its complexities. He analyses some of the psychological aspects affecting individual cases, and points out the interrelation between these and social and economic factors. He considers the problem for those who leave school at the age of fourteen years. Economic and social factors, he says, limit the individual's sphere of choice. The child of poor parents must earn an immediate living; an individual may have both the ability and the inclination to enter a certain trade, but may be forced by the condition of the labour market into another for which he has the ability but not the inclination; opportunities of employment vary in different neighbourhoods; the social status accompanying each occupation varies; the tradition of the family circle will give arbitrary value to certain kinds of work. The psychological factors fall into two parts: those that determine technical ability, and that depend on physical, temperamental and intellectual endowments; and those that determine personal choice and preference. Physical and intellectual endowments are measurable; but temperamental fitness is more difficult to assess, and together with the factors determining personal choice has its source in unconscious mental processes. Thus the data that are required for adequate vocational guidance range from the more general psycho-biological through social and economic to the deeply individual.

Sexual Periodicity

IN a paper (*Proc. Roy. Soc., B*, 123, 413; 1937) which is really a supplement to the Croonian Lecture given by him in 1936, Dr. F. H. A. Marshall summarizes evidence of the factors controlling the sexual seasons of various animals. Ruminants breed when the days are getting shorter, whether they live in the northern or the southern hemisphere. Individual ruminants which have been transported across the equator have been known to adapt themselves at once, and have two rutting seasons in one year. Ruminants on the equator usually have no sexual season. Most other mammals breed in the spring, and species transferred from the northern to the southern hemisphere conform to the seasonal conditions of the south. The same is generally true of birds. Rowan showed that, in some birds in any event, the lengthening of daylight was the important factor causing the onset of the sexual season. Similar experiments have been done with various other animals, and although it has frequently been found that light increases sexual activity, this is not always so.

Biology of Plankton Animals

MUCH information of interest is given on the biology of three important plankton organisms, *Calanus finmarchicus*, *Sagitta setosa* and *Sagitta elegans*, in the North Sea by R. S. Wimpenny (*Min. Agric. Fish., Fishery Invest., Ser. II*, 15, No. 3, 1936, pp. 1-53, 1937). The seasonal observations have been

based mainly on a line of stations between Flam-borough Head and the south-west patch of the Dogger Bank. Detailed observations were made on the breeding, growth and feeding of the three species, and have afforded a welcome extension to somewhat similar knowledge gained at Plymouth and Millport. All three species tended to be smaller than at Plymouth; this was thought to be connected with the shallow conditions of the southern North Sea, there being, for example, a decrease in size of *S. setosa* in the North Sea from north to south. The breeding periods of *Sagitta* also appeared to be fewer than at Plymouth. It appears that *S. setosa* is characteristic of mixed North Sea or 'Bank' waters, while the other two species occur in water of more oceanic origin. Additional information is given on the relation between zooplankton and phytoplankton, and the suggestion is put forward that phytoplankton concentrations may play the part of breeding and nursery grounds for zooplankton species.

Bacteriosis of Cherry Trees

THE serious damage caused by bacterial 'die-back' of sweet cherries in many English orchards is described in a recent paper by H. Wormald (*J. Pom. and Hort. Sci.*, 15, 1, 35; 1937). The symptoms consist of stem, crotch and branch cankers, shoot wilt, bud and spur blight, leaf spots and occasionally fruit spots. Certain varieties have proved to be commonly attacked, and some varieties seem to suffer less than others. Two organisms, *Pseudomonas prunicola* and *P. mors-prunorum*, have been isolated from a number of infected trees and are regarded as responsible for bacteriosis of sweet cherries in Great Britain. The latter, which also causes bacterial canker in plums, is more widespread. Control is difficult, but infection may be reduced by avoiding mechanical injury, such as pruning, in autumn, winter and early spring. Infected parts may be excised early in the year and the wounds covered with an antiseptic dressing. Mercury-glycerine or zinc chloride is suggested. Some control has been achieved by spraying with Bordeaux mixture in autumn, but several varieties suffer foliage damage with this treatment. There is no evidence that application of lime to the soil induces resistance to bacteriosis. Stocks as well as varieties vary in susceptibility, and it is possible that suitable resistant stocks may be found on which to graft susceptible varieties. Some interesting observations on the susceptibility of different varieties at East Malling are described (*ibid.*, p. 25) by N. H. Grubb, and certain questions of nomenclature and the effect of local conditions are discussed.

Crosses between Radish and Turnip

RECIPROCAL crosses were made between radish ($n = 9$) and turnip ($n = 10$) by Messrs. L. E. Morris and R. H. Richharia (*J. Genet.*, 34, No. 2). With turnip as female parent, 428 flowers yielded 23 seeds, 19 of which germinated. Their characters indicated that they were diploid hybrids. In the reciprocal cross, from particular parent plants 128 flowers yielded 5 seeds. Two of the resulting plants were like radishes (accidental selfs?), one was like the reciprocal hybrids and one was triploid, having $2n = 28$ chromosomes. It probably came from the fertilization of a diploid radish egg-cell. This triploid hybrid open-pollinated gave a varied progeny, including two hexaploids with $2n = 56$ which resembled the triploid but were almost sterile. The

functional eggs of the triploid plant were chiefly triploid, but some had 9 chromosomes and were genetically like the radish. The pollen of this plant also showed a range from 9 probably up to $3n$, but when used on radish the functioning grains had mostly 9 but some had 10 chromosomes. Triploid pollen grains apparently did not function on the radish stigma.

Roaring Sands of the Kalahari Desert

MR. A. D. LEWIS has recently given an interesting account of these sands (*S. African Geog. J.*, 19, 33-49; 1936). They lie at the south end of an elongated patch of whitish sand dunes near the south-east corner of the Kalahari desert, and the roars are heard most intensely along the southern face, which rises nearly 100 ft. at a slope of about 1 in 2. Compared with the rest of the desert sands, the grains are perhaps more rounded and of a more uniform size and shape. Mr. Lewis describes two types of noise, a roar caused by pushing the sands forward in a heaped-up manner and a hum by keeping the sand moving slowly down the slope. A very loud roar is produced by sitting on the slope and sliding down it in slow jerks. In the still of the early evening or morning, such a noise is easily heard, like the rumbling of distant thunder, at a distance of 600 yd. Merely moving the fingers up and down the sand produces a roar, the upward motion giving a higher note than the downward. Samples of the sand were taken in bags to Pretoria, and it was found that a roar was obtained by tilting the bag over sharply when half empty. If the bags were left open, the roar was lost after a few weeks, though it could be restored for a short time by heating the sand in an oven.

Mineral Position of the British Empire

A REMARKABLY comprehensive and instructive publication on the mineral industries of the British Empire has recently been issued under the above title, by the Mineral Resources Department of the Imperial Institute (pp. 166, price 4s.). Commencing with a comparison between world and Empire outputs of all the more important minerals used in 1929 and 1935, the work goes on to survey the many changes bearing on production that have occurred during this period. Graphical illustrations of the variations in annual outputs of twelve essential commodities are given. It appears that the Empire as a whole is largely dependent on foreign sources of supply for eight mineral products only—antimony, borates, molybdenum, petroleum, potash, pyrites, mercury and sulphur. Many interesting facts are brought to light by the authoritative statistical data presented. Thus, in 1935 the Empire produced 86.6 per cent of the world's nickel and 68.2 per cent of the world's asbestos, but both these percentages are considerably lower than in 1929. Also, in spite of a greatly increased output of gold, the Empire proportion fell from 72.7 per cent in 1929 to 58.3 per cent in 1935. There have also been decreases in the Empire percentages of chrome ore, manganese ore and diamonds. On the other hand, there have been decided increases in the Empire percentages of copper and lead ores. The total value of the Empire's mineral output during 1935 was about £400,000,000, of which the United Kingdom contributed nearly 42 per cent, South Africa a little more than 21 per cent and Canada 16 per cent. It is a striking fact that the value of the coal output of the United Kingdom represents about 37 per cent of the total value of the whole of the

Empire output of all minerals. All who are concerned with mineral industries or with Empire problems in relation to world affairs will find this volume indispensable.

Cyclone Series in the Caribbean Sea

At a meeting of the Royal Meteorological Society on May 26, a paper was read by E. Kidson entitled "The Cyclone Series in the Caribbean Sea, October 17-24, 1935". The author mentioned the view held by some who have attempted to apply frontal methods of analysis to tropical cyclones that air which has passed across the equator acts as the cold air. He referred to fronts found by K. R. Ramanathan and K. P. Ramakrishnan in Indian depressions of July and August, in which old monsoon air heated over India performed the role of the warm air-mass and fresh monsoon air the role of the cold air-mass; but stated that in the south-western Pacific the colder air of tropical cyclones undoubtedly came from higher southern latitudes and not from the far side of the equator. The paper is concerned with cyclonic developments encountered by the author on two occasions when he was crossing the Caribbean Sea after passing through the Panama Canal, and is illustrated by a series of synoptic charts with frontal analysis. In these he found more than one case where the warm air-mass clearly arrived from the south or south-west after having crossed the equator, in contradiction to the theory mentioned above, but in support of the observations in the south-west Pacific. It was noted, however, that air entering the Caribbean Sea from the south-west has first to cross the cold waters south of Panama and that such air will tend to be chilled in its lowest layers in consequence. This may easily lead to the warmth of the current as a whole being overlooked and thence to its being mistakenly regarded as the cold supply in any frontal development on account of its relatively low surface temperature.

Cyclol Theory of the Structure of Insulin

UNTIL recently the only comprehensive theory of protein structure was the polypeptide chain theory put forward by Emil Fischer. This is somewhat difficult to reconcile with the globular character of the soluble protein molecules first indicated by Svedberg's ultra-centrifuge measurements and later also supported by X-ray measurements on pepsin and insulin, and it is evidently of the greatest importance that other theoretically possible arrangements of amino-acids should be considered. One such has been examined in detail by Dr. D. M. Wrinch, who has shown that it might be possible to unite amino-acid residues through imino links in a laminar pattern—the cyclol structure. This laminar structure may then be folded into a restricted number of geometrically plausible space enclosing networks. For insulin, Dr. Wrinch proposes a cyclol structure built out of 288 residues united in a network of this kind which covers the surface of a truncated tetrahedron (*Science*, 85, 566; 1937). This polyhedral configuration would give the molecule the globular character required by Svedberg's data, and also the trigonal symmetry suggested by the X-ray evidence, provided that the actual amino-acid residues are symmetrically distributed over its surface. Along the trigonal axis the dimensions of the cyclol molecule would fit it fairly closely into the crystal unit cell, but at right angles to this there is very much more space, and it is suggested that this is filled by tyrosine residues held together by zinc or

other cations. Very much more experimental evidence is, of course, necessary before such a structure could be considered established, but in any event the construction of the models proposed is of great interest.

Projection Television

At a convention of the Institute of Radio Engineers held on May 10-12, several papers were presented dealing with recent developments in television. Two of these, by Dr. V. K. Zworykin, Mr. W. H. Painter and Dr. R. R. Law, described the development of a new electron tube by means of which an enlarged, projected image may be obtained of the picture normally seen on the fluorescent screen of a cathode ray tube. Some brief details, with an illustration of the device, are given in the June issue of *Electronics*. The tube illustrated contains an electron gun capable of delivering about 1.5 milliamperes at the cathode, of which about 0.4 milliamperes is actually delivered to the beam itself. The beam is accelerated by a potential of 10,000 volts on the last anode, and the resulting picture on the fluorescent screen itself, although only 2 in. \times 1½ in. in size, is of exceptionally high brilliance. The tube is intended for use with a lens of $f/1.5$ aperture, and the standard size for the projected picture is 18 in. by 24 in., for which the illumination compares favourably with that of the ordinary 16 mm. home cinema picture. The screen material used in this tube is principally zinc orthosilicate of carefully controlled crystalline structure, which gives a brilliant yellow-green light and which is very stable under prolonged heavy bombardment. At the meeting referred to above, a demonstration of the operation of this projection tube was given by the engineers of the Radio Corporation of America. A video signal was obtained from a still picture using 30 frames a second and 343 lines without interlacing. A special screen, about three by four feet in size, was employed, and the picture obtained was of high brilliance and quality. As an additional demonstration, the small screen was removed and the image projected on to the standard screen used for lantern slides. In this case, the picture was 8 ft. \times 11 ft. in size and was stated to be readily visible to all those present in the room, which was about fifty feet long.

Masses and Parallaxes of Binary Stars

DR. C. BARNES has published a paper on the statistical determination of masses and parallaxes of binary stars (*Mon. Not. Roy. Astro. Soc.*, 97, 6; April 1937), in which he submits the mean values of $\rho\omega^2$ and $(\rho\omega^2)^{\frac{1}{2}}$ for orbits of given eccentricity, these quantities appearing in the equations used for determining the combined mass and the parallax respectively. In addition, he gives the mean values for $(\rho\omega^2)^2$ and $(\rho\omega^2)^{\frac{1}{3}}$ which are required for the estimation of the probable errors. From 124 orbits as computed by Prof. R. K. Young, it is found that with the mean value of e between 0 and 1, $\overline{e^2} = 0.322$ and $\overline{e^4} = 0.14$; from which $\overline{\rho\omega^2} = 16.9(a^3/P^2)$ and also $(\overline{\rho\omega^2})^{1/2} = 2.38(a^3/P^2)^{1/2}$. In the first case, the probable error in a single determination is 49 per cent, and in the second case it is 21 per cent. If a somewhat different mean value of e be taken, the numerical results are essentially unchanged. For example, if $\overline{e^2} = 0.263$, $\overline{e^4} = 0.11$, the coefficients given in the above equations become 17.3 and 2.42 respectively, very small changes for a considerable change in e .

Royal Society of Canada

ANNUAL MEETING AT TORONTO

THE annual meeting of the Royal Society of Canada was held at the University of Toronto on May 25-28, under the presidency of Mr. Lawrence J. Burpee of Ottawa, who took as the subject of his presidential address "The Discovery of Canada". The Flavelle Medal for 1937 was awarded to Dr. F. D. Adams, the Lorne Pierce Medal to Prof. Stephen Leacock, and the Tyrrell Medal to Mr. Aegidius Fauteux. Prof. A. G. Huntsman, consulting director of the Biological Board of Canada and editor of its publications, and professor of marine biology in the University of Toronto, was elected president for the year 1937-38.

In Section 1 (French, Literature, History, etc.) fifteen papers were read, and in Section 2 (English Literature, History, etc.) twenty-one papers.

In Section 3 (Chemical, Mathematical and Physical Sciences) 142 papers were presented, 47 by title only. One third were presented to the whole Section, the remainder to four subsections (Astronomy, Chemistry, Mathematics, Physics). Three new fellows were elected to the Section: Profs. A. R. Gordon, of the University of Toronto; R. L. Jeffery, of Acadia University, and W. H. Watson, of McGill University.

The feature of the meetings of Section 3 was its presidential address by John Patterson, director of the Meteorological Service of Canada, in which he outlined recent advances made in this service. The necessity of a continuous forecasting service for the recent expansion in aviation has given a new impetus to research, has led to increase in the number of observation centres, and has increased the personnel. The address was followed by a symposium by A. Thomson and various members of the meteorological staff, in which the results of temperature, water vapour content, and pressure distribution in the upper atmosphere at various Canadian stations were given. Observations at the National Research Laboratory, communicated by D. C. Rose, showed that the advance of polar front is the cause of variations in potential gradient.

Prof. L. Gilchrist presented a paper on resistivity measurements at the Chickamauga Dam site, Tennessee, where underground caverns were located by the proper use of 'Megger' instruments. A survey of methods used to determine overburden above magnetic deposits by magnetic methods with field examples was given by Prof. D. A. Keys. Dr. W. H. Martin dealt with the Raman spectra of some oximes, and pointed out the shift of one Raman line due to addition of hydrochloric acid to certain amines and to mercuric chloride in solution. Prof. J. A. Gray gave the results of the scattering of X-rays at small angles by charcoal, and presented further evidence that some β -rays lose energy when scattered through large angles by nuclei.

The Rev. A. Vachon presented an interesting account of the salinity of the water at different points in the estuary of the St. Lawrence River; from these measurements, arctic currents can be traced, especially along the north shore, and also the course of the water from the Saguenay after it enters the St. Lawrence. Prof. E. H. Boomer, speaking on

phase equilibria in hydrocarbon systems, showed that the behaviour of the systems relative to one another can be predicted qualitatively from the chemical and physical properties of the liquid hydrocarbons used. Results of experiments by Prof. C. C. Coffin on the effect of molecular structure on the rate of uni-molecular gas reactions show that the replacement of hydrogen by chlorine atoms produces a slight decrease in rate, while introduction of a double bond gives a fourfold increase. Prof. W. Lash Miller presented a group of papers on Wilders' bios and yeasts. Of fourteen papers presented by Prof. O. Maass and his students, one on the measurement of the specific heat of propylene in the critical pressure - critical temperature region contained an account of a new type of adiabatic calorimeter, and it was shown that the liquid state of aggregation persists above the critical temperature. Prof. H. Hibbert (with F. B. Pickett and G. F. Wright) reported on the relative acidity of carbohydrate hydroxyl groups; they find that the hydroxyl group attached to the C_4 atom in glucose is more acid than those attached to the C_2 , C_3 and C_6 atoms.

Prof. W. H. Watson presented a paper on the electron and the limits to the precision of electromagnetic field specifications, in which the uncertainty relations of the electromagnetic field are applied to determine the corresponding uncertainties in the motion of an electron in the field. Prof. J. L. Synge presented several papers by his associates, of which one on the problems of the beam and the plate in the theory of elasticity, by J. N. Goodier, was of particular interest, as it proved that the engineering theories of beams and plates are good to a high order of approximation under the conditions of use. Prof. A. F. Stevenson gave a paper on a generalization of Oseen's equations for steady flow past a fixed obstacle, with application to the sphere, and Prof. R. L. Jeffery another on sequence integration and non-absolutely convergent integrals for functions of two or more variables. A paper by Prof. W. L. G. Williams and M. S. MacPhail on functions of the complex variable $z = x + jy$, where $j^2 = c^2$, was of particular interest, and mention may also be made of a paper by Prof. S. Beatty and D. C. Murdoch on routine for determining the numbers e, m associated with a cycle $f = o(p)$ of an algebraic equation $F = 0$.

Prof. H. A. McTaggart demonstrated the ellipticity of the light reflected at the surface of films of oriented molecules. Prof. A. L. Clark gave the result of the experimental determination of the probability of a steel ball falling through one of a number of holes in a plate. Prof. E. F. Burton presented a number of papers describing work done in the McLennan laboratories. The specific heat of tributyrin at low temperatures has been measured by J. O. Wilhelm and A. H. Woodcock, who find that it varies from 0.4 cal./gm. at room temperature to 0.012 at 16° K. H. E. Johns and J. O. Wilhelm have determined the refractive indices for $\lambda 5461 \text{ \AA}$. of liquid oxygen (1.2242), liquid nitrogen (1.1990) and liquid hydrogen (1.1120). J. M. Anderson has determined the half

lines of several lines in the spectrum of argon II by a modified canal-ray method; all so far measured have a half life of less than 10^{-8} second.

In the Geological Section (4) eighteen papers were presented. Three new fellows were elected: Dr. G. W. H. Norman, of the Geological Survey of Canada; Prof. F. F. Osborne, of McGill University, and Dr. J. F. Walker, provincial mineralogist of British Columbia. Among the interesting papers presented the following may be mentioned.

Prof. G. H. Henderson (of Section 3) described two new types of pleochroic haloes in biotite, and showed that they are invariably associated with minute fissures through the mineral. He indicated that they originated from certain members of the radium family of very short life-period, and suggested that precipitation of minute grains of radium-bearing minerals from the fissure-filling solutions probably accounts for the localization of the haloes.

The last paper of the late Dr. W. H. Collins, formerly director of the Geological Survey of Canada, was presented by H. C. Horwood, who had assisted him with much of his field work. Results of several years of detailed study of the Sudbury district strongly confirm the original conclusions of Dr. A. P. Coleman as to the magmatic origin of the ores, and indicate that secondary processes play a relatively minor part in ore deposition. Dr. Coleman, now eighty-five years of age, was present at the meeting to hear this vindication of his conclusions.

H. C. Cooke presented new data on the age of the Dore series of Michipicoten district, Ontario, based on determinations of the structure of the Keewatin lavas, and concluded that the Dore series is probably of Temiskaming age, and is not interbanded with the Keewatin as previously supposed. W. C. Gussow presented the results of his work during tenure of one of the Carnegie fellowships administered by the Society. These indicate that the gold deposits of the Rouyn area, Quebec, are not primarily related to the granitic stocks, but were deposited from soda-bearing solutions introduced along fissures at some later date. The solutions albitized the intrusives and caused profound petrographic changes in them.

In Section 5 (Biological Sciences) sixty papers were presented, in part before the whole section, and in part to two subsections (Zoology and Botany, and the Medical Sciences). Profs. D. L. Bailey and G. F. Marrian of the University of Toronto and Dr. J. H. McDunnough, of the Division of Systematic Entomology of the Dominion Department of Agriculture, were elected fellows of the Section.

Prof. E. M. Walker gave the sectional presidential address on "*Grylloblatta*, a Living Fossil", and showed a very interesting cinematograph film of this prehistoric beetle from the Canadian Rockies, proving, *inter alia*, that the heat of the hand rapidly causes its complete prostration, while contact with ice leads to slow recovery. Prof. A. G. Huntsman traced the cause of the scarcity of salmon which occurs periodically in the Atlantic provinces every nine or ten years, as due to a succession of dry summers (also occurring periodically) which result in such lowering of the water of salmon streams that the young salmon parr are clearly exposed to kingfishers and mergansers, which take an unusually large toll. He also communicated an account of W. H. Johnson's study of the effect of light on the marine copepod *Acartia clausi*, which shows that movement is brought about by changes in intensity

of light (upwards with diminution, downwards with increase of intensity), rather than by the degree of intensity itself; under static light conditions, the animals gradually become uniformly distributed.

Dr. J. W. MacArthur reported from his studies of finger and palm prints that left and right hands are as different in identical as in fraternal twins, while hands of the same side are quite similar in identical twins, but show large and increasing differences in the series: fraternal or sib pairs, parents and children, and unrelated persons. By such comparisons, the twin type can be correctly diagnosed in about half the pairs from their own prints alone, and in nearly all when prints of their parents and sibs are also available.

Prof. G. W. Scarth presented a paper by D. Siminovitch showing that the cells of plant tissues frozen internally with intra-cellular ice formation always die, while those dehydrated by external (inter-cellular) ice will survive, even after extreme dehydration of the protoplasm. Prof. Marie-Victorin and the Rev. J. Rousseau gave a paper extending the former's theory of the development of the flora of the St. Lawrence valley. R. B. Thomson described comparative studies of the 'inversed' bundles of male and female cone scales in a series of conifers, confirming the view that these are homologous structures which during growth come to assume different positions in association with the function of the scales as sex organs. Prof. W. P. Thompson presented several papers by himself and co-workers dealing with genetic problems in wheat and other cereals. Prof. A. H. R. Buller reviewed the life-history of the wheat rust, and reported new discoveries concerning the fusion in pustules on the barberry leaf of pycnia with a hypha of opposite sign.

Prof. J. W. MacArthur presented a paper by C. K. Gunn giving an account of a strain of rats which has, as a monofactorial autosomal recessive mutant character, acholuric jaundice resembling that in man in its chief clinical and genetic features. A paper by A. E. Allin (presented by Prof. D. T. Fraser) showed that, in general, skin sensitivity to diphtheria toxoid develops within three weeks during an attack of diphtheria in those who are initially non-sensitive, and increases at this time in those initially sensitive in some degree.

Prof. G. F. Marrian (with G. C. Butler) showed that an ether-soluble fraction from two women with adrenal tumours contained unusual amounts of pregnandiol, and also a triol, $C_{21}H_{36}O_3$, melting at $243-244^\circ C$. R. G. Sinclair adduced evidence that the red blood cells of the dog and the cat do not take part in fatty acid transport. E. G. Young gave an interesting account of prolonged study of purine metabolism in the Dalmatian coach hound from early age to adolescence.

Prof. C. C. Macklin described the detailed histology of the pulmonic alveolar walls of the adult cat, illustrating his paper by beautiful slides from photomicrographs, and stressed the presence of many 'bare areas' devoid of nuclei.

Prof. F. G. Banting presented a number of papers from workers in the Banting Institute of the University of Toronto. W. R. Franks and H. J. Creech have succeeded in forming chemo-antigens by coupling 1:2:5:6-dibenzanthracene and similar compounds to proteins, and injecting the products into rabbits, guinea pigs, and rats; formation of haptene specific antisera was demonstrated by precipitin reactions and by specific inhibition with

the prosthetic substances. H. F. Richardson showed that death from intra-venous air embolism in dogs depends on the rate of injection; at very slow rates surprisingly large amounts of air can be injected before death ensues (through failure of the pulmonary circulation). B. C. Coles showed that the type of death in cases of criminal abortion, commonly ascribed to small amounts of air found in the heart at post-mortem, may be due rather to lethal amounts

of toxic substances (such as potassium soaps) in the douche solution having entered the blood stream from the uterine cavity. According to D. Irwin, the tissue response to different samples of quartz is practically identical. W. R. Franks, L. D. Proctor and A. Duncan described a photo-electric dust estimator, designed to measure accurately and rapidly dust retainable by the lungs and therefore to estimate the dust hazard.

Recent Aeronautical Research

THE report of the Aeronautical Research Committee, issued recently*, deals with a period of nearly two years, from April 1935 until December 1936. This is to cover a change of procedure, future reports being issued for the calendar year. The report opens with a well-merited tribute to the memory of Sir Richard Glazebrook and Sir Joseph Petavel, who died during the period under review. They were both original members of the Advisory Committee for Aeronautics, appointed in 1909, and all who have had any connexion with aeronautics will appreciate how much the development of the science owes to them.

The outstanding feature of the period under review has been the increase in, and the still further demands for, high performance of aircraft. The major part of the Committee's activities are obviously directed towards this object. It is emphasized that the more recent equipment at the National Physical Laboratory and the Royal Aircraft Establishment, although elaborate and expensive, have made possible advances in the fundamentals of aircraft aerodynamical design to an extent that could never have been accomplished by the trial-and-error methods of full-scale experimental flight alone. The compressed air tunnel and the one-foot high-speed tunnel at the former, and the 24-ft. wind tunnel at the latter, are cases in point.

The 24-ft. tunnel at the R.A.E. has been used principally for the investigation of engine-cooling problems. At high translational speeds, theory shows it should be possible to provide enough cooling without adding at all to the drag of the complete aeroplane, and this prediction has been supported by experimental results. As the induced drag at high speeds is very small, it follows that a well-designed aircraft travelling at high speed need have a drag very little higher than that due to the friction between its exposed surfaces and the air.

Aeroplane speeds are now almost approaching the range in which compressibility becomes important, and the Committee, by undertaking research on compressibility effects, is taking steps to have information available by the time it is required. The apparatus used for this work is a one-foot high-speed tunnel, run from the exhaust of the compressed air tunnel. Tests on thick aerofoils have been done, and suggest that it may be necessary to take account of 'compressibility drag' when speeds of flight exceed four hundred miles per hour.

Much of the time of the compressed air tunnel has

been devoted to investigations of surface friction. At the Reynolds numbers of flight a surface roughness corresponding to excrescences of the order of one-thousandth of an inch in height may be enough to increase the friction substantially. This measure of roughness is inappreciable at Reynolds numbers corresponding to those in ordinary atmospheric tunnels, so that although roughness may produce a difference in the behaviour of an actual aeroplane, the cause was not appreciated until this problem had been worked out.

Drag measurements have also been made in flight by means of a comb of small pitôt tubes which determine the difference in relative velocity between the air in the wake of the wing and the free air. It can also be applied in the compressed air tunnel, which will enable profile drag to be determined at Reynolds numbers of the order of those reached by fast modern aeroplanes.

Another problem has been to determine where on aeroplane wings the change from laminar to turbulent flow in the boundary layer takes place. As the drag associated with the turbulent boundary layer is considerably greater than that of the laminar layer, it is important to keep the transition point on the wing as far back as possible. It is suspected that protuberances in the surface of a wing near its leading edge may promote an early transition point and so increase the drag.

Modern high-speed machines have introduced other problems, particularly of stability. For example, directional stability is often unexpectedly good, although longitudinal stability is not so satisfactory. Further, increasing speed inevitably implies higher wing loading and thus introduces landing problems. The properties of flaps and other aids to stability, particularly when landing and taking off, have been studied, and work on gusts in the atmosphere is continuing.

Structural problems following upon the recent development of 'stressed skin' bodies and wings have shown that stabilizing members for flat, or slightly curved, sides of bodies need to be carefully studied for optimum efficiency. Tubular members are stronger for a given amount of material, but their use presents practical difficulties.

In aero-engine work, attention has been paid to the development of bi-fuel systems, which at the moment appear to be necessary with the use of 100 octane fuel. Direct fuel injection, supercharging, high boiling point liquids for cooling, spark ignition, and the compression ignition engine have been subjected to investigation in various details, but nothing revolutionary is proposed.

* Aeronautical Research Committee. Report for the years 1935-36. Pp. 60+7 plates. (London: H.M. Stationery Office.) 4s. net.

The question of the size of sea-going aircraft has been studied in a general way, and the Committee expresses the opinion that no new scientific problem seems probable with flying boats of up to a hundred tons in weight.

The technical supplement to the report is sub-

divided into sections dealing with: aerodynamics, fluid motion, stability and control, oscillation, spinning, structures, elasticity and fatigue, alloys, engines, aircraft noise, seaplanes, meteorology, accidents, administration including (a) list of publications and (b) membership of sub-committees and panels.

"Discovery" Investigations*

DURING the years 1935 and 1936 three volumes have been published containing reports on material collected by the "Discovery" expeditions, on many subjects by various workers. Vol. 11 is devoted entirely to plankton, and forms an introduction to the study of the plankton of the Antarctic, embodying as it does, a detailed discussion of methods and their value, besides extensive accounts of the distribution and migrations of plant and animal plankton, pre-eminently important for the understanding of the natural history of the Blue, Fin, Sei and Humpback whales. It is noteworthy that the first instance of vertical migration of phytoplankton is here shown in certain species of *Coscinodiscus* which ascend during the daytime, the reverse of the usual animal migration. It is constantly seen in the "Discovery" reports that *Euphausia superba* appears to be a key animal with regard to the distribution of Antarctic plankton, forming directly the food of the Blue and the Fin whales, and indirectly influencing the plankton in a variety of ways. A consideration of the relationship between the distribution of the whales and that of the plankton, and between the zooplankton and the phytoplankton, has led to the recognition of certain general principles of pelagicecology.

The remarkable patchiness in distribution of many of the plankton animals is emphasized, and Prof. Hardy's hypothesis of animal exclusion, showing that the more important plankton animals avoid the areas of dense phytoplankton, is dwelt upon at length. In this connexion, the phosphate values are shown to be of extreme importance, and relative reduction in phosphate content appears to be a better index in studying the zoo-phytoplankton relationship than the phytoplankton itself, giving a measurement of phytoplankton over a little time in the past. The appearance of exclusion from regions of low phosphate (high phytoplankton) applies to animals belonging to widely different groups, and it is considered that if the distribution of the animals is being modified by the phytoplankton, this modification must be brought

about by variations in the vertical migration in conjunction with differing water movements at different levels. All the animals which show the exclusion effects have marked vertical migrations. This first report is intended to form an introduction to pelagic ecology of the Antarctic seas. The plankton community is considered in relation to its hydrological background, and to the distribution of the Blue and Fin whales which feed upon the plankton and form the object of such an important fishery in these seas.

The second plankton report deals with the continuous plankton recorder invented by Prof. Hardy. This has now been much improved, and a full account is given of its construction, method of working and the advantages and limitations of the results obtained in its use. The third paper deals with observations on the uneven distribution of oceanic plankton, and describes records of plankton taken in the open ocean during the voyages of the R.R.S. *Discovery* and R.R.S. *William Scoresby* in the years 1925-27 with the original form of continuous plankton recorder. They were made with the view of studying the main fluctuations in the planktonic density along uninterrupted lines of observation. These lines varied from 23 miles to more than 100 miles in length, and were made in different oceanic regions from the tropical to the antarctic zone. The records demonstrate marked fluctuations in the distribution of the main planktonic groups of animals, no less marked in the tropics than in the antarctic zone. The existence of a rhythm in the distributional fluctuations is tentatively suggested, a rhythm which varies on different occasions.

Vol. 12 embodies a variety of subjects, the first being the coast fishes from the South Atlantic by J. R. Norman. The term 'coast fishes' includes not only the littoral forms, but also fishes that may occur at no great distance from the coasts in-water down to two or three hundred fathoms deep, and that are not pelagic or bathypelagic. C. C. A. Monro continues his description of the polychaete worms (2), Dr. Th. Mortensen reports on the Echinoidea and Ophiuroidea, R. A. B. Ardley on the birds of the South Orkney Islands and Dr. R. Gurney begins his study of the decapod larvae (*Stenopidea*, *Amphionidæ* and *Phyllosoma*).

In Vol. 13 A. Earland continues the Foraminifera (4), R. A. B. Ardley describes the R.R.S. *Discovery II*, its construction and design, accommodation for research, scientific equipment and laboratory methods, E. R. Gunther writes on oceanographical investigations in the Peru coastal current, and Dr. F. D. Ommanney contributes an extensive paper on the copepod *Rhincalanus gigas* (Brady) which is very important in Antarctic waters and is reported on fully in every aspect as a representative plankton animal in these regions.

* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 11. The Plankton of the South Georgia Whaling Grounds and Adjacent Waters, 1926-1927. By A. C. Hardy and E. E. Gunther. Pp. iv+456. 50s. net. The Continuous Plankton Recorder. By A. C. Hardy. Pp. 457-510+4 plates. 9s. net. Observations on the Uneven Distribution of Oceanic Plankton. By A. C. Hardy. Pp. 511-538. 4s. net. Vol. 12. Coast Fishes, Part 1: The South Atlantic. By J. R. Norman. Pp. 58. 5s. net. Polychaete Worms, II. By C. C. A. Monro. Pp. 59-198. 18s. net. Echinoidea and Ophiuroidea. By Th. Mortensen. Pp. 199-348+9 plates. 27s. 6d. net. The Birds of the South Orkney Islands. By R. A. B. Ardley. Pp. 349-376+plates 10-12. 6s. net. Larvæ of Decapod Crustacea. By Dr. Robert Gurney. Pp. 377-440. 9s. net. Vol. 13. Foraminifera. Part 4: Additional Records from the Weddell Sea Sector from Material obtained by the S.Y. *Scotia*. By Arthur Earland. Pp. 76+3 plates. 12s. net. The Royal Research Ship *Discovery II*. By R. A. B. Ardley and Dr. N. A. Mackintosh. Pp. 77-106+plates 3-13. 9s. net. A Report on Oceanographical Investigations in the Peru Coastal Current. By E. E. Gunther. Pp. 107-276+plates 14-16. 26s. net. *Rhincalanus gigas* (Brady), a Copepod of the Southern Macropod. By Dr. F. D. Ommanney. Pp. 277-384. 15s. net. (Cambridge: At the University Press, 1935-1936.)

Science News a Century Ago

A Pigmy Cemetery

THE issue of the *Gentleman's Magazine* of August 1837 contains the following information: "A short distance from Cochocton, Ohio, U.S., a singular ancient burying-ground has lately been discovered. It is situated, says a writer in Silliman's Journal, on one of those elevated, gravelly alluvions, so common on the rivers of the West. From some remains of wood, still apparent in the earth around the bones, the bodies seem all to have been deposited in coffins; and what is still more curious, is the fact that the bodies buried here were generally not more than from three to four and a half feet in length. They are very numerous, and must have been tenants of a considerable city, or their numbers could not have been so great. A large number of graves have been opened, the inmates of which are all of this pigmy race. No metallic articles or utensils have yet been found to throw light on the period or the nation to which they belonged."

Monument to Gutenberg

THREE hundred and sixty-nine years after his death, a large statue in bronze of Gutenberg, the inventor of printing from movable type, was unveiled at his birthplace, Mainz, the inaugural proceedings extending over the three days, August 14-16, 1837. The statue was by the Danish sculptor Thorwaldsen, and it bears the inscription "Joannem Gensfleisch de Gutenberg Patricium Moguntinum, ære per totam Europam collato posuerunt cives 1837".

Hare and the Oxy-hydrogen Blow-pipe

ON August 14, 1837, Prof. Robert Hare (1781-1858) wrote from Philadelphia to Dalton, saying: "I beg leave, through you, to communicate to the British Association for the Advancement of Science, the fact that by an improvement in the method of constructing and supplying the hydro-oxygen blow-pipe, originally contrived by me in 1801, I have succeeded in fusing into a malleable mass, more than three-fourths of a pound of platina. In all, I fused more than two pounds fourteen ounces into four masses averaging, of course, nearly the weight above-mentioned." After further notes on the application of the blow-pipe, he said: "I need not say how much I regret that the Atlantic rolls now between myself and those respected and esteemed brethren in science, whom, this time last year, I had the honour and pleasure to meet and to greet at Bristol, and to whom I shall ever be grateful for their kind reception. How much would it gratify me, could I exhibit to them, and their enlightened visitors, that splendid concentration of heat and light which I have lately employed, by which a metal infusible in the air-furnace or forge is made as fluid as mercury, so as to be blown off in globules."

Gossage and the Alkali Industry

ON August 17, 1837, William Gossage secured a patent for "certain improvements in the processes of operation connected with the manufacture of alkalis from common salt"; a patent which anticipated the later and successful processes of Weldon, Mond and Chance for the recovery of manganese and sulphur. Gossage, who was born in 1799, had begun

life in a chemist's shop at the age of twelve years; but by 1830 was a partner in a salt and alkali works at Stoke Prior, Worcestershire, and it was there that in 1836 he invented the 'Gossage' condensing tower for preventing the escape of hydrochloric acid gas, a "simple contrivance which saved from extinction a trade, the growth of which has contributed largely to the nation's prosperity". From Stoke Prior Gossage removed to Birmingham, establishing there a white lead works, and then to South Wales, where he engaged in copper smelting. In 1850 he settled at Widnes and became the largest soap manufacturer in the country. In 1861 he contributed a paper on "The History of Alkali Manufacture" to the Manchester meeting of the British Association. He died at Bowden, Cheshire, on April 9, 1877 (see "Some Founders of the Chemical Industry" by J. F. Allen).

The Magazine of Zoology and Botany

THE *Athenæum* in its issue of August 19, 1837, referring to the above journal, which was conducted by Sir William Jardine (1800-1874), P. J. Selby (1788-1867) and Dr. G. Johnson, said: "To the naturalist this periodical affords a most valuable repository of the current facts and opinions of writers upon all points relating to zoology and botany; and it quite answers to our notion of what such a production should be, if it be of great general utility. There are excellent original papers by Swainson, Henslow, Westwood and other men of high scientific reputation, independently of the authors whose names stand upon the title page; there is a brief and very honest indication of the most interesting matters treated of in other periodical works on natural history, well brought down to the period of publication; and to these are added well-written sensible critiques on many of the more important works upon this branch of knowledge. Moreover, and this is not to be overlooked—the botanical department is conducted with reference to modern views and with a commendable disregard of prejudices."

University Events

CAMBRIDGE.—Dr. J. H. Schulman, of Trinity Hall, has been appointed assistant director of research in colloid science.

D. J. Bauer, of Trinity College, has been elected to the Michael Foster studentship in physiology; the E. G. Fearnside's scholarship is awarded to A. M. Barry, of Pembroke College; the Wrenbury scholarship is awarded to P. T. Bauer, of Gonville and Caius College; the John Winbolt prize is awarded to D. W. Ginns, of Emmanuel College, for a dissertation on "The Mechanical Properties of some Metals and Alloys broken at Ultra High Speeds".

G. H. A. Wilson, master of Clare College, vice-chancellor of the University, has been appointed, in succession to the late Sir E. C. Hoskyns, to represent the University on Sept. 27-28 at the four-hundredth anniversary of the foundation of St. Mary's College in the University of St. Andrews. Dr. F. W. Aston and Dr. J. D. Cockcroft have been appointed to represent the University in Bologna on October 18 at the celebration of the bicentenary of the birth of Galvani. Prof. R. G. W. Norrish and Dr. J. D. Cockcroft have been appointed delegates from the University to a congress to be held at the Palais de la Découverte, Paris, on September 30-October 7.

Societies and Academies

Dublin

Royal Irish Academy, June 14

JOSEPH ALGAR and ISABELLA P. CAREY: The synthesis of flavonols: oxidation of flavinogenides. The oxidation in acetone solution of the flavinogenide 3-benzylidene flavanone by means of acidified potassium permanganate appears to give 3-hydroxy-3-benzoyl flavanone (I). The latter forms a monoxine and a monacetate. Gentle hydrolysis of (I) gives flavonol and benzoic acid. Products similar in constitution to (I) are obtained by the oxidation of the following flavinogenides: 3-anisylidene flavanone; 3-piperonylidene flavanone; 3-benzylidene-3',4'-methylenedioxy flavanone.

H. S. W. MASSEY: Creation of electron pairs by nuclear capture of neutrons. The probability of creation of electron pairs by the materialization of the energy freed in the capture of a neutron by a nucleus is calculated by a method not involving explicit introduction of light quanta.

C. B. MOFFAT: The mammals of Ireland. A catalogue is given of the species supposed to have any claim to inclusion in the fauna, with notes on the distribution and status of each. The list differs from Thompson's in including a much larger number of marine (chiefly oceanic) animals. Novelties among terrestrial mammals are few. They include, however, the Irish stoat (*Mustela hibernica*) and the Irish hare (*Lepus hibernicus*), both now marked as practically endemic. Three bats have been added to Thompson's list. There are also five new species of Rodentia. The pine-marten (*Martes martes*), is still known from ten counties; and the red deer (*Cervus elaphus scoticus*), though now confined as a strictly native species to a protected area in Kerry, has recently been shown to be living a perfectly wild life in a new home to which it has found its way among the Wicklow Mountains. The question of the admissibility of the wild cat (*Felis silvestris*) to a historic place in the Irish fauna is regarded as having been lately placed by Major Barrett-Hamilton in a new light.

Edinburgh

Royal Society, Edinburgh, July 5.

C. FORSTER-COOPER: The Middle Devonian fish fauna of Achanarras. This is the first section of a report on five seasons work in the flagstone quarry of Achanarras in Caithness and deals with the fishes of the genus *Dipterus*. Hitherto two forms, *Dipterus valenciennesi* and *D. platycephalus* have been considered as separate species differing in the structure of the scales and in the extent to which the skull is ossified. It is now shown that the difference is due to seasonal changes, as described by Westoll for the contemporary Crossopterygians, and that the two conditions alternate during the life of the fish, so that there is only one species represented and not two. The abundance of material has rendered possible a full restoration of the fish.

FLORA COCHRANE: A histological analysis of eye pigment development in *Drosophila pseudo-obscura*. A detailed examination of unstained histological sections of the eyes of wild type and various mutants of *D. pseudo-obscura* at various stages of development was made. This revealed that pigment in the form of granules appears in two types of pigment cells at two definite times during development

and that genes which alter the colour of the eyes do so by affecting these granules in three distinct ways: (1) by suppressing the formation of all or part of the granules laid down in one or both types of pigment cells during either or both phases of development; (2) by altering the rate of granule development; (3) by causing a qualitative change in the granules.

A. R. WATERSON and H. E. QUICK: *Geonemertes dendyi* Dakin, a land nemertean in Wales. Since 1935, a land nemertean had been known from several localities near Swansea. The external and internal characters are described. Details are given of the habits, mode of feeding, and reproduction. The habitats are all damp places near streams or trees, and the nemerteans occur under stones and fallen branches. The sites seem to be free from contamination from exotic sources. Land nemerteans have not previously been found living under natural conditions in Europe.

R. S. BROWN: The anatomy of *Ophelia cluthensis* McGuire. An account of a polychaete worm which seems to be fairly common in the sand just below high water neap tide, not only in the Clyde estuary, from where it was originally described, but also in other parts of Great Britain and northern Europe. The species was created by McGuire in 1935, but her description was very incomplete, and the present account gives much fuller details of its specific characters and also a discussion of its affinities with other members of the genus. The description of the anatomy includes an account of the lymphatic corpuscles, which in this genus consist of two types of cells: (i) small disk-shaped cells 15-20 μ in diameter, with radiating processes; and (ii) larger irregular cells, 40-150 μ in diameter, containing a dense central body usually in the form of a club. Reproductive cells are also found in the coelomic fluid.

Paris

Academy of Sciences, June 14 (C.R., 204, 1769-1848).

ANDRÉ BLONDEL: The search for short light signals by navigators. Discussion of the effects of the duration of the light signals from the physiological point of view.

GEORGES CHARPY: The definition of the *nuance* of steels.

JACQUES DE LAPPARENT: The mineralogical nature of the clays of El Golea (Sahara).

OTTOKAR BORŮVKA: Multiplicative systems.

MICHEL GHERMANESCU: A problem of Laguerre.

RICHARD BRAUER: The multiplication of the characteristics of continued and semi-simple groups.

KUNTZMANN: Multiform operations. Hypergroups.

M. KELDYCH and MICHEL LAVRENTIEFF: The problem of Dirichlet.

P. DUPUIS, H. GUILLEMET and ANDRÉ MARTINOT-LAGARDE: The determination of the trajectories of the water particles in the flow through a centrifugal pump.

JACQUES VALENSI: A new method for the measurement of the delivery through a tube placed in a current of air of uniform velocity.

RENÉ HIRSCH: The automatic stabilization of aeroplanes.

PIERRE AUGER, PAUL EHRENFEST, JUN., ANDRÉ FREON and MME. THÉRÈSE GRIVET: The mechanism of the production of cosmic bundles. The experimental results described support the mechanism of production indicated by Bhabha and Heitler for the soft cosmic rays, that is, the group of electrons and photons present in the lower atmosphere.

NICOLAS PERAKIS and LÉANDRE CAPATOS: The thermomagnetic study of the complex compounds $(Ag_xCd_y4C_6H_5N)_2S_2O_8$.

MARCUS BRUTZCUS: The heat of formation of hydrocarbons.

J. TIMMERMANS and H. BODSON: The surface tension of water and that of heavy water. The variation of the surface tension of water with temperature shows an anomaly at 13° C.; with heavy water this appears at 17° C. This anomaly has not been detected by other workers on this subject.

G. DUCH: The variations of the mechanochemical constants of the benzene hydrocarbons along the vaporization curve with origin at 74.5 cm. mercury.

PAUL BARY and JEAN HERBERT: The transformation points of glasses.

ALBERT TIAN and EDOUARD GAND: The ionic dissociation of the alkyl halides. Experimental evidence that, contrary to the view usually accepted, alcoholic iodides in aqueous solution behave as weak electrolytes.

CARSTEN HOLTERMANN and PAUL LAFFITTE: A new oxide of lead. The existence of Pb_7O_{11} has been proved from a study of the composition of the oxide as a function of the temperature under a pressure of 200 atmospheres. The only other oxides indicated on the curve are PbO_2 and the red Pb_3O_4 .

VICTOR AUGER and Mlle. NINA IVANOFF: The molybdenum blues. Amorphous colloidal molybdenum blue. The only molybdenum blue appears to be that described by Guichard with a formula $Mo_9O_{17} \cdot 7H_2O$. This blue is amorphous and colloidal.

MME. NATHALIE DEMASSIEUX and LOUIS ROGER: A complex compound formed by lead iodide and lithium iodide in aqueous solution. This has the constitution $PbI_2LiI \cdot 4H_2O$.

LOUIS HACKPILL and GEORGES WOLF: The thermal decomposition of the barium carbonates.

MICHEL LESBRE: Some halogen organic derivatives of lead.

ANDRÉ MEYER and HENRI DRUTEL: Salts and complex compounds of 6-methyl- and 8-methyl-4-hydroxyquinolines.

GUSTAVE VAVON and JEAN BOLLE: The condensation of the benzene hydrocarbons with chlormethyl ether. Method of alkylation of aromatic nuclei.

ANDRÉ DEMAY: The role of static and dynamic phenomena in the genesis of the Crisallophyllian.

JACQUES FLANDRIN: The attribution to the Oligocene of a part of the Nummulitic strata of the Kabylie of Djurdjura and its western prolongation (Algiers).

JEAN CUVILLIER: The presence of the marine Carboniferous in the ouadi Abou Darag (Arabian desert).

EDMOND ROTHÉ and MME. ARLETTE HÉE: Prospecting by the penetrating radiations in the trap and granite quarries of Raon-l'Étape.

LOUIS BOUNOURE: The fate of the germinal line in the russet frog after the action of ultra-violet rays on the lower pole of the egg.

TCHOU-SU and CHEN-CHAO-HSI: The spontaneous activation of the egg of the russet frog (*Carassius auratus*) in contact with fresh water.

MAURICE LEMOIGNE, PIERRE MONGUILLON and ROBERT DESVEAUX: The reduction of nitric acid to hydroxylamine by the higher plants. The role of ascorbic acid. The juice of lilac reduces nitrites to hydroxylamine and under the same experimental

conditions ascorbic acid behaves similarly. Ascorbic acid is always present in the leaves and hence is probably the cause of the reduction of nitrite by the juice.

MICHEL A. MACHEBOEUF, MMES. GEORGETTE LÉVY and MARGUERITE FAURE: Researches on the chemical nature of the lipid-fixing haptene of tubercle bacilli. Chemical study of the purified active fraction.

PIERRE LÉPINE, PIERRE MOLLARET and BORIS KREIS: The receptivity of man to the murin virus of lymphocytary choriomeningitis. The experimental reproduction of benign lymphocytary meningitis.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 251-294, May 15).

F. ZWICKY: A new cluster of nebulae in Pisces. During September and October last year, more than a hundred photographs with exposures of ten to thirty minutes were obtained at Mount Palomar with the new 18-inch Schmidt telescope of the Carnegie Institution of Washington; characteristic features of the instrument are effective aperture 18 inches, focal ratio $F/2$, diameter of field used about 9.5°, limiting magnitude about 17.5. A large swarm of nebulae in Pisces of large extension and asymmetrical shape suggesting rotation of the whole was observed.

R. A. GORTNER and H. B. BULL: Electro-kinetics. (19) Interfacial energy and the molecular structure of organic compounds. (v) The electric moment of Al_2O_3 : benzene-nitrobenzene interface.

JENNY E. ROSENTHAL and LLOYD MOTZ: Application of a new mathematical method to vibration-rotation interaction.

K. G. SCOTT and S. F. COOK: Effect of radioactive phosphorus upon the blood of growing chicks. Growing White Leghorn chicks were given substantial doses of radioactive phosphorus (prepared by irradiation of red phosphorus) in the form of phosphoric acid. It gave rise to effects not obtained with X-rays. Lymphocytes, which are sensitive to X-radiation, were little affected; polymorphonuclear leucocytes, which are not much affected by X-rays, were much decreased in number. These effects are attributed to deposition of the radioactive phosphorus in the bones, which allows bombardment with radiation of the bone marrow, the source of the polymorphonuclear leucocytes, whereas X-rays only reach the marrow with difficulty.

J. VAN OVERBEEK: Effect of the roots on the production of auxin by the coleoptile. If the root systems of *Avena* seedlings are removed, after 15-20 hours the auxin production is much reduced, causing decreased growth. When both roots and seed are removed, the plants do not 'regenerate' and their curvatures increase steadily. It is suggested that auxin itself and a precursor are present in the seed; the latter is transported independently of the root system, and the former in the transpiration or root-pressure stream.

F. D. MURNAGHAN: The irreducible representations of the symmetric group.

G. A. MILLER: Groups of order less than 2^m having $m-1$ or $m-2$ independent generators.

H. WHITNEY: Products in a complex.

A. GLEYZAL: Linear orders.

C. H. DOWKER: Hopf's theorem for non-compact spaces.

Appointments Vacant

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

STRUCTURAL ENGINEERING ASSISTANTS in the Directorate of Fortifications and Works of the War Office—The Under-Secretary of State (C. 5), War Office, S.W.1 (August 16).

ASSISTANT LECTURER IN PHARMACY in the Technical College, Bradford—The Principal (August 28).

TECHNICAL OFFICER in the Signals Experimental Establishment, at Woolwich—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (August 27).

LECTURER IN PHYSICAL CHEMISTRY in the Battersea Polytechnic, London, S.W.11—The Principal (September 6).

LECTURER IN PATHOLOGICAL BIOCHEMISTRY in the University of Glasgow—The Secretary of the Court (September 11).

DIRECTOR OF RESEARCH of the Institute of Brewing—The Secretary of the Institute, Brewers' Hall, Addle Street, London, E.C.2 (October 15).

CIVIL ENGINEER in the Public Works Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Report on the Phenological Observations in the British Isles from December 1935 to November 1936. (No. 46.) By Ivan D. Margary. (Quarterly Journal of the Royal Meteorological Society, No. 270, Vol. 63.) Pp. 219-275. (London: Royal Meteorological Society.) 3s. [97]

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 19, 1936. Pp. iii+218+16 plates. (Sheffield: The University.) 7s. 6d. [97]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 18 (Mycology Series, No. 2): The Causes of Stain and Decay in Imported Timber. By K. St. G. Cartwright. Pp. ii+15+7 plates. (London: H.M. Stationery Office.) 6d. net. [127]

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, Ministry of Agriculture for Northern Ireland and Agricultural Research Council. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1934-1935. Pp. v+338. (London: H.M. Stationery Office.) 5s. net. [127]

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1937. Pp. 68. (Aberdeen: North of Scotland College of Agriculture.) [147]

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt. Twenty-second Annual Report, 1936. Pp. 104. (Cheshunt: Nursery and Market Garden Industries' Development Society, Ltd.) [147]

Make the Lake District a National Park. Pp. 16. (Ambleside: Friends of the Lake District.) [147]

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1936. Vol. 71, Part 1: Acreage and Production of Crops, Number of Live Stock and of Agricultural Workers, and Output and Prices of Agricultural Produce in England and Wales. Pp. 109. (London: H.M. Stationery Office.) 1s. 6d. net. [157]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1735 (2184): Wind Tunnel Tests on Slotted Flaps on a Low Wing Monoplane; Flap Angle 0° to 90°. By D. L. Ellis and M. B. Morgan. Pp. 14. 2s. net. No. 1749 (2017): The Strength of Lugs. By Wm. D. Douglas. Pp. 21. 3s. net. No. 1755 (1976): Notes on Stubs for Seaplanes. By L. P. Coombes and D. W. Bottle. Pp. 32. 5s. net. No. 1756 (2584): The Distribution of Stress in Monocoque Wings. By Dr. H. F. Winny. Pp. 12. 2s. net. No. 1757 (2719): A General Method of Calculating the Effect of Axial Constraint on Torsion on Different Forms of Two-Spar, Skin-covered Wings. By A. E. Russell. Pp. 16. 2s. 6d. net. No. 1762 (2425): The R.A.E. Mark Va Torsigraph. By the Staff of the Engine Department, R.A.E. Pp. 14. 2s. 6d. net. No. 1763 (2539): A Note on Roughness. By Dr. S. Goldstein. Pp. 2. 6d. net. No. 1768 (2766): Some Experiments with Cascades of Aerofoils. By A. R. Collar. Pp. 7. 1s. 3d. net. No. 1772 (2747): Tests of R.A.E. 34 at Negative Incidences and of the Effect of Surface Roughness on R.A.E. 34 with Split Flap in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 11. 2s. net. (London: H.M. Stationery Office.) [177]

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1936 May 1—1937 April 30. Pp. 4. (Cambridge: Cambridge Observatory.) [197]

National Central Library. 21st Annual Report of the Executive Committee, 1936-37. Pp. 70. (London: National Central Library.) [197]

National Veterinary Medical Association of Great Britain and Ireland. The Veterinary Profession and its Organisation for the Control of Animal Diseases: Report of a Committee of Investigation of the National Veterinary Medical Association of Great Britain and Ireland. Pp. 113. (London: National Veterinary Medical Association.) [207]

Papers from the Geological Department, Glasgow University. Vol. 19 (Octavo Papers of 1935-1937). (Glasgow University Publications, 43.) Pp. viii+17 papers. (Glasgow: Jackson, Son and Co., Ltd.) [217]

Vocational Guidance. Pp. 20. (Exeter: University College of the South West of England.) [217]

Other Countries

Traub-Stieching. Erste Verslag 1936. Pp. 29. (Buitenzorg: Archipel Drukkerij.) [97]

Indian Lac Research Institute. Annual Report for the Financial Year 1936-37. Pp. 37. (Namkum: Indian Lac Research Institute.) [97]

Journal of the Indian Institute of Science, Vol. 19A, Part 8: Studies in the Proteins of Indian Foodstuffs. Part 10: *In vitro* Digestions of the Globulins from Aconite Bean (*P. aconitifolius*, Jacq.) and Bengal Gram (*Cicer arietinum*, Linn.). By Kamala Bhagvat. Pp. 67-73. (Bangalore: Indian Institute of Science.) 10 annas. [127]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 104: Investigations on the Occurrence and Inheritance of the Grass Clump Character in Crosses between Varieties of *Triticum vulgare* (Vill.). By J. R. A. McMillan. Pp. 68+8 plates. (Melbourne: Government Printer.) [127]

India Meteorological Department. Meteorological Organisation for Airmen, 1937. Pp. iii+62. (Delhi: Manager of Publications.) 1.6 rupees; 2s. 3d. [127]

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1933. Pp. xiv+219. (Cairo: Government Press.) P.T. 40. [127]

Cawthron Institute. Annual Report, 1936. Pp. 18. Cawthron Lecture, 1936: Links in the New Zealand Flora with the Remote Past. By the Rev. J. E. Holloway. Pp. 28+2 plates. (Nelson, N.Z.: Cawthron Institute.) [127]

Henry Lester Institute of Medical Research. Annual Report, 1936. Pp. 95+5 plates. (Shanghai: Henry Lester Institute.) [127]

Royal Observatory, Hong Kong. Meteorological Results, 1936. Prepared under the direction of C. W. Jeffries. Pp. iv+146+18. 3 dollars. Report of the Director of the Royal Observatory, Hong Kong for the Year 1936. Pp. 8. (Hong Kong: Royal Observatory.) [127]

Smithsonian Miscellaneous Collections. Vol. 96, No. 2: Wave Lengths of Radiation in the Visible Spectrum promoting the Germination of Light-sensitive Lettuce Seed. By Lewis H. Flint and E. D. McAlister. (Publication 3414.) Pp. 8+1 plate. (Washington, D.C.: Smithsonian Institution.) [127]

Colony of Mauritius. Annual Report of the Board of Directors of the Mauritius Institute for 1935. Pp. 16. Mauritius Institute Bulletin, Vol. 1, Part 1: Catalogue of the Flowering Plants in the Herbarium. Revised edition. By Dr. R. E. Vaughan. Pp. 120. 2.50 rupees. (Port Louis: Government Printer.) [127]

U.S. Department of Agriculture. Miscellaneous Publication No. 270: Post-Mortem Examinations of Wild Birds and Mammals. By J. E. Shillinger and William Rush. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [127]

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1936. (No. 774.) Pp. iii+186. (Ottawa: King's Printer.) [127]

Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. 96. (Cairo: Government Press.) [137]

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 89. Notes on Fishes from the Gulf Stream and the New Jersey Coast. By Henry W. Fowler. Pp. 297-308. A Collection of Haytian Fishes obtained by Mr. Stanley Woodward. By Henry W. Fowler. Pp. 309-315. A Second Study of New and Little-known Madagascan Grouse-Locusts (Orthoptera, Acrididae, Acrydinae) with a Key to the Species of Thymochares. By James A. G. Rehn. Pp. 317-329. (Philadelphia: Academy of Natural Sciences.) [137]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 152: The Moment of the Fluid Pressure acting on a Flat Plate in a Semi-infinite Stream bounded by a Plane Wall. 1: Case of Lower Boundary (the Ground Effect). By Susumu Tomotika and Isao Imai. Pp. 421-471. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 60 sen. [157]

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