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CONTENTS

	PAGE
Everyday Science as a University Subject . . .	329
The G.O.M. of Applied Entomology . . .	331
International Astronomy . . .	332
Towards a New World Order. By R. Brightman . . .	333
Chemistry of Vital Changes. By E. F. A. . . .	334
Short Reviews . . .	335
Intermediate Products and the Last Stages of Carbo- hydrate Breakdown in the Metabolism of Muscle and in Alcoholic Fermentation. By Dr. Otto Meyerhof . . .	337
Ionospheric Investigations in High Latitudes. By Prof. E. V. Appleton, F.R.S., R. Naismith and G. Builder . . .	340
Obituary : . . .	
Dr. T. Rice Holmes . . .	342
Mr. H. F. Tagg . . .	342
News and Views . . .	343
Letters to the Editor : . . .	
X-Ray Interpretation of the Molecular Struc- ture of Gelatine.—W. T. Astbury and W. R. Atkin . . .	348
The Influences of Electrical and Magnetic Fields upon 'Spin' in Gaseous Detonations.—Prof. William A. Bone, F.R.S. . . .	348
Politics and Religion in India.—K. de B. Cod- rington . . .	349
Summation Methods in Noise Problems.—B. G. Churcher, A. J. King and H. Davies . . .	350
A New Spectroheliograph and Spectroheli- ograph.—Dr. A. H. Rosenthal . . .	350
Structure of the Crystals of 12-Phospho- tungstic Acid.—J. F. Keggin . . .	351
Measurement of Frequency of Longitudinal Vibration of a Steel Wire by Magneto- striction Effect.—Dr. T. F. Wall . . .	351
Influence of a Magnetic Field on a Glow-Dis- charge.—T. Takamine, T. Suga and A. Yanagihara . . .	351
Lattice Distortion and Fibre Structure in Metals.—W. A. Wood . . .	352
Photoelectric Absorption of γ -Rays by Heavy Elements.—J. McDougall and H. R. Hulme . . .	352
<i>Limnocyba rhodesiae</i> and its Distribution.— Prof. H. B. Fantham and Dr. Annie Porter . . .	353
Adaptability of the Natal Crawfish.—W. J. Copenhagen . . .	354
Stereochemistry of the Free Triarylmethyl Radicals: A Totally Asymmetrical Synthesis. —Prof. G. Karagunis and G. Drikos . . .	354
Research Items . . .	355
Astronomical Topics . . .	357
Disintegration of Light Atomic Nuclei by the Capture of Fast Neutrons. By Prof. William D. Harkins, David M. Gans and Henry W. Newson . . .	358
Third International Congress for Experimental Cytology. By Dr. B. Woolf . . .	358
Research in the British Non-Ferrous Metal Industries . . .	359
A Continuous Gas Indicator . . .	360
University and Educational Intelligence . . .	360
Calendar of Nature Topics . . .	361
Societies and Academies . . .	362
Forthcoming Events . . .	364
Official Publications Received . . .	364

Everyday Science as a University Subject

A RECENT issue of the *Cambridge University Reporter* contains a new schedule for Part I of the General Examination for the ordinary Bachelor of Arts degree. A subject now included for the first time is entitled "Everyday Science", the syllabus of which ranges from gravitation through invisible radiations, mammalian anatomy and vitamins to epidemics and the control of disease. We imagine that there will be two immediate reactions to this innovation. On one hand, there will be a cry that smattering is to replace scientific training, and on the other there will be approval of an attempt to give the plain citizen-to-be a more or less adequate comprehension of the physical world in which he lives.

Fortunately we are no longer without data upon which to form a judgment. Everyday science has been taught and examined in schools for some years, and has been a subject of examination for younger and older candidates in several examinations conducted by the Civil Service Commission. Without dogma on what is still largely a matter of controversy, it may be stated that experience seems to show that (1) everyday science is very suitable for young children, that is, children from 10 to 13 years of age, (2) it is less adapted to the mental state of boys and girls of from 13 to 16, and (3) that it is extremely valuable for adolescents of 16–19 who are not specialising in science as their main subject. In the last class, however, it is noticeable that the best results are obtained with those individuals who have received some formal training in science in their School Certificate years.

The University of Cambridge is thus probably well advised in the step it has taken. Many undergraduates who attempt the ordinary degree have hitherto been compelled to study a mere dilution of 'tripos science', which, we fear, has often proved of very little value to them, inasmuch as the professional qualification it carries is of no very high order, while it is of too academic a character to bear any close relation to their daily lives. The new subject promises not merely to be interesting and attractive in itself, but also to be eminently fitted for those who, while not scientific investigators, must yet play active parts in a world very largely moulded by scientific thought and controlled by scientific invention. We shall await with careful attention the results of the Cambridge experiment.

It is worth while to inquire into the possible effects upon science teaching in schools of this official status conferred upon a comparatively new subject. Everyday science is still regarded by many teachers as a mere pretender, a backboneless weakling masquerading in the strength of the scientific panoply. That it may easily become invertebrate few will deny, but that it is necessarily so we believe to be a serious error of opinion. As a part of a general education, science may be justified by appeal to the self-same values that apply to those subjects described in a narrow sense as humane. If a study of literature may foster the love of beauty, truth and goodness, so may the study of science: beauty in Nature and in the mind of man, truth in observation and deduction, goodness in the service performed by science and in the light it throws on man's motives, emotions and ideals. That formal science lays principal emphasis on truth merely serves to counterbalance the greater emphasis laid on other values by other subjects; but it has an important bearing upon the question of teaching everyday science in schools. Those who decry everyday science as a school subject are usually among the stoutest supporters of formal science; in other words, they attach paramount importance to the 'truth' value so characteristic of science, and are apt to forget or minimise its content of beauty and goodness.

We feel that the justification—and the opportunity—of everyday science in schools lies in its power to broaden the vision and widen the sympathy of pupils without repelling them by the classically cold formality that few can fully appreciate. Some core of formality it must certainly retain, if it is still to be science, but its orientation should be different from that of the usual schemes in chemistry or physics, botany or zoology. Extensive rather than intensive, it should pay more attention to the results of science than to the theory of science; to a broad appreciation of a few simple instances of scientific method than to a detailed technique; to the history of science than to niceties of contemporary work; and to the contacts of science with common experience than to the recondite problems of the laboratory.

It is for this reason that we cannot yet find full satisfaction in any of the numerous books on general elementary science that have recently become so numerous. A book on everyday science, however accurate in detail or impeccable in style,

cannot be regarded as successful if it consists merely of interwoven abridgments of the various science courses taught, for example, in preparation for the School Certificate. To fulfil its purpose, its whole genius must be different; and it is no doubt partly from this cause that to write such a book appears to offer exceptional difficulty. Lack of suitable books in turn entails a reluctance of teachers to embark upon an everyday science programme, and a scepticism as to its efficacy; to which must be added the unquestionable fact that many, perhaps most, science teachers are accustomed to teach only one, or possibly two, of the principal branches of science and consequently feel diffident of undertaking a course of work that requires a sound, if elementary, knowledge of science as a whole.

The Cambridge plan may serve to improve the situation in several ways. First, it will mean that experienced university teachers must concentrate their attention upon the elaboration of suitable material; second, it will necessitate the thorough exploration of possible methods of treatment; third, it will probably lead to considerable advance in the calibre of everyday science textbooks; and fourth, it will in time provide the educational world with teachers who know, from personal experience, how the subject may be taught. But—and the reservation is an important one—the beneficial results that we expect to follow cannot attain their maximum unless and until everyday science is also made a subject for Part I of the Natural Sciences Tripos. It may appear the most abominable of heresies to suggest that an honours degree in science should be obtainable in "general science", but we are convinced that, at least up to the School Certificate stage, a teacher who had graduated in everyday science would be of inestimable value on the science staff of a school; and from this and every other point of view it seems a pity that the possibility of obtaining such a degree should be limited to those who presumably are not up to honours standard. We are, of course, aware that an undergraduate may, under present regulations, take as many as four or five subjects in his tripos, but that circumstance does not meet the real requirements. Everyday science involves far more than even five subjects, and the tripos course in any one subject at present involves far more than an honours course in everyday science would need.

If the University of Cambridge will take its courage in both hands, and give an honours

degree in natural sciences upon everyday science, we believe that it will deserve well of the country and will eventually effect a very great improvement in the intellectual outlook of the whole nation.

There remains the question of the suitability of everyday science for pupils of 13 to 16 years of age. For them, we think, it would be difficult to improve upon the kind of work already taught, namely a somewhat formal course of physics, chemistry or biology. The years from 13 to 16 are those in which the discipline of scientific thought is most readily acquired, and it seems probable that more benefit is ultimately derived by the average boy and girl from a training in such discipline than from the wider acquaintance with scientific facts given by a course in everyday science. We should, however, like to see less prominence awarded to scientific theory, and regard it as advisable even in these critical years to segregate the more from the less intelligent and to inspire the latter with everyday science rather than confuse them with the more exacting individual subjects.

The G.O.M. of Applied Entomology

Fighting the Insects, the Story of an Entomologist : Telling of the Life and Experiences of the Writer.

By L. O. Howard. Pp. xvii+333. (New York : The Macmillan Co., 1933.) 12s. 6d. net.

HOWARD ended fifty-three and a half years' service "under Uncle Sam" on June 30, 1931. All of this was passed in the Bureau of Entomology, at first as assistant under Comstock and later under Riley, then chief of the Bureau in 1894 and principal entomologist in 1927.

It was when Howard was an assistant that the Bureau attained popularity by a big coup, the introduction of an Australian ladybird into the citrus orchards of California. These were threatened, even to complete extinction, by the fluted scale a bug that carries its eggs in a dense scaly mass of wax, impermeable to liquids. This scale was originally a native of Australia, where it was supposed to be kept in check by a parasitic fly. Entomologists were sent to Australia to collect these, but they found also the carnivorous ladybird larvæ. Both were shipped and in less than a year all threat of damage by the scales was over, perhaps the most spectacular and rapid instance of 'natural control' in the history of economic work. What Howard's part was in this

is not stated, but his first big published research had been on the parasites of the Coccidæ.

It is clear that at this period Howard was peculiarly active, as his help was frequently acknowledged by his chief, in whose name all the research and other publications of the Bureau were issued. As soon as he became chief, Howard altered this, ordaining that each research be published under the responsibility of the actual worker, with the result that the best class of American biologists competed for his service.

Howard's life is largely that of the "History of Applied Entomology", which is also the title of an earlier book published in 1930. He started in 1894 as chief of Bureau with an appropriation of thirty thousand dollars and he developed his operations so that the Bureau's ordinary budget amounted in 1927 to three million dollars with special additional appropriations each year, one of which was a grant of four and a quarter million dollars for an attempt to eradicate the Mediterranean fruit fly from Florida. By tact, Howard avoided State jealousy and soon came to control the largest single agricultural area inhabited by men of the same language and aims. At least two-thirds of the agricultural crops of the United States and of their insect pests proved to be of foreign origin. This necessitated an extension of the operations of the Bureau all over Europe and to a lesser degree in other continents. Wherever a destructive insect was indigenous, it seemed to be kept in some sort of control by parasites, frequently larval stages of other insects. Europe especially was combed for these natural enemies, and a machinery was created for their collection for transshipment to the United States. Thus skilled experts were maintained in eastern Europe to rear and send promising parasites. An example in the other direction is the parasitic fly which controls the American blight of apple orchards—this a present to Europe from the Bureau.

Howard travelled everywhere in the States; if a bad outbreak of any insect occurred, he was usually the first visitor, for he had to plan the defence. In Europe he was known in every country, conducting negotiations for co-operation with his Bureau or advising as to plant growth or quarantine. He loved all congresses, especially international, and he was always welcomed for his geniality and honoured for his scientific researches, which, in spite of his multifarious businesses, he maintained at a high level; his 'common sense', the extra sense required for economic science, was

famous. How he had the necessary leisure to run the American Association for the Advancement of Science and to make it into a potent factor in the scientific life of the States at the same time, it is impossible to imagine. He was also secretary for many years of that extraordinary social club of Washington, the Cosmos, and he was the first to greet the foreign visitor, of whose comfort he was most solicitous.

In such a life is plenty of material for reminiscence, and this 'grand old man' of American entomology is happy in his experiences and stories. He remembers all the accessory facts used by the skilled *raconteur* and the story never falls flat. The trivial ways of great men tell us of their psychology, and Howard's happiness and humour in describing such is a joy. To the publishers must be ascribed the one serious defect in the book—there must be added to the second edition as a frontispiece a good portrait of Howard, whatever he may say.

International Astronomy

International Council of Scientific Unions: International Astronomical Union (Union Astronomique Internationale). *Transactions of the International Astronomical Union*. Vol. 4: *Fourth General Assembly held at Cambridge, Massachusetts, September 2 to September 9, 1932*. Edited by F. J. M. Stratton. Pp. viii+328. (Cambridge: At the University Press, 1933.) 15s. net.

THE International Astronomical Union consists primarily of twenty-seven separate commissions, each of which is concerned with a specialised department of astronomy. The present volume contains the reports of the Commissions for the Harvard meeting in September 1932, held under the presidency of Sir Frank Dyson, together with accounts of the discussions and the recommendations finally adopted. In many respects the volume is a record of the main lines of research undertaken since the Leyden meeting in 1928, and a storehouse of information on work in progress or planned on an international scale.

Astronomy knows no national boundaries, and astronomers, however specialised their interests, make a notable gesture for international co-operation, revealing a spirit which all men of good will would rejoice to see extended in other directions. For example, Dr. Kopff, one of the leaders of German astronomy, expressed a keen desire for

fuller co-operation with French astronomers with regard to the monthly and annual bibliographies, the chief of which are the independent work of French and of German scientific workers.

Several features of general interest may be briefly mentioned. The enterprise of photographing the heavens, inaugurated more than forty years ago, makes fair progress despite several hindrances, due mainly to financial stringency.

The Commission charged with the supervision of researches in dynamical astronomy recommended its own abolition on the ground that the subject does not stand in need of international co-operation. This is, in many ways, a regrettable decision, as there are many indications that the interest in the subject is increasing, one of the noteworthy features being the recent application of planetary and lunar theory to the dynamical study of triple star systems. The defunct commission, and that dealing with stellar constitution, are much on the same plane as regards organised co-operation, but the latter, perhaps because of its youth, has apparently no intention of self-destruction.

There is a very full report of the recent activities of some forty observatories in determining the value of the solar parallax and the mass of the moon from observations of the minor planet Eros. An interesting by-product is the precise value, $5^h 16^m 9^s$, for the period of light-variation of the planet.

A recommendation from the Commission on Planets, Comets and Satellites is specially heartening to the large number of amateur astronomers who keep these bodies under continuous observation; it is "that visual observations of the planets, etc., should not give way entirely to photography".

The Commission on Solar Physics, recognising the very great extension of its province in recent years, has sub-divided itself into four sections to deal more adequately with sunspots, chromospheric phenomena, solar spectroscopy and solar eclipses.

The Commission on Radial Velocities directs attention to the urgent need for more radial velocity observations of southern stars. Both the Cape Observatory and the Chile station of the Lick Observatory have given up this kind of work, leaving the stars south of declination -30° largely unobserved. The principal researches on the rotation of the galaxy and on diffuse interstellar matter, for example, depend at present on

observations extending over little more than half the galactic circle and, until a suitable number of radial velocity determinations for the southern stars are available, these researches cannot be regarded as satisfactorily complete. The Commission proposed the following resolution which was afterwards adopted by the general assembly, "The International Astronomical Union commends any project for obtaining the urgently needed observational data in the southern sky. Particularly, having heard of the project to transfer the Radcliffe Observatory from Oxford to Pretoria and to equip it with a large reflecting telescope, the Union welcomes the proposal most heartily as one likely to furnish very material help towards the provision of the desired data and earnestly hopes that nothing may stand in the way of its fulfilment."

A notice of this volume should not be concluded without a reference to the careful editing of the large amount of specialised and multi-lingual material by the general secretary of the Union, Prof. F. J. M. Stratton.

Towards a New World Order

Successful Living in this Machine Age. By Edward A. Filene, in collaboration with Charles W. Wood. Pp. 350. (London and Toronto: Jonathan Cape, Ltd., 1932.)

TO the scientific worker, one of the most interesting features of Mr. Filene's book is that in it a prominent business man has given us essentially an extended version of Prof. Miles Walker's address to Section G (Engineering) of the British Association meeting at York. Mr. Filene ranges over pretty well the whole gamut of human life and interest; and not merely on industry, politics, unemployment, tariffs or world peace but also on art, religion, education, etc., he writes with an originality which provokes criticism and stimulates thought. He has grasped the essential fact that applied science through the advent of power production has created a new industrial and social order—the machine age—and our present distresses and difficulties are largely to be attributed to our imperfect and halting adjustment, individually and collectively, to the demands of the new order.

Like Mr. Henry Ford, he sees unemployment and poverty as conditions which are unnecessary and can be abolished by wisely directed effort.

He would have us revise our whole conceptions of business, which should be so organised and directed as to secure that wages should be high, leaving the consumer with plenty of money to spend, hours short, prices low, and the standard of living should be continually rising. For economy or thrift he has little use and regards money purely as a medium of exchange—of no value save as it is actually circulating.

In common with other writers on these themes, Mr. Filene is most convincing when he expresses the fallacy or inconsistency of many of our current theories or practice, for example, the reduction of wages, restriction of production, etc., as a stimulant to trade recovery. While advocating wholeheartedly the shorter working day, he does not suggest that this is a cure for unemployment; the latter Mr. Filene sees in the organisation of the production and distribution of more wealth, and he stresses the importance of the development of new industries and indeed regards technological unemployment as an unescapable incident in the improvement of employment all round. In his view, if industry is organised and developed on scientific lines, unemployment is a preventable evil.

Similarly, Mr. Filene places on business and industry a major share of the responsibility for determining the future of world peace. Whether we have another world war or not depends, he suggests, upon how soon the business leaders of the world will substitute fact-finding for their traditional thinking, and world peace is not a problem of changing human nature but of changing human organisation, so that people will act towards all other people as they naturally do act towards those whom they recognise as their own. World peace is the logical outcome of successful business methods, and work for world peace must consist principally of helping the world to grasp and apply the principles upon which business success now depends.

These are unusual views, but Mr. Filene's argument running through the book, that mass production gives selfish human nature an opportunity to express its selfishness in profitable co-operation, is no more to be lightly dismissed than his sane view of education as facing the problem of how to behave like human beings in the specific social conditions set in the machine age. We cannot escape the new world which power production or mass production has brought us; we must plan how to live in it and our planning

must harmonise with the laws of our being and the laws and facts of the new era. So much of our present unrest, so many of our difficulties are due to maladjustment, to the retention of obsolete ways of living or thinking, that we are apt to overlook the unexplored possibilities of the new age to which Mr. Filene's book directs attention. We are as yet too shaken if not terrified by the problems of leisure to determine whether it may not be true that mass production after all is destined to liberate mankind increasingly from a mere struggle for existence and permit the greater satisfaction of life's deeper needs. At least in these pages, without giving us the satisfying details of a solution for our problems, Mr. Filene gives us a glimpse of the possibilities of the new order and presents a challenge to an adventure in co-operation which will ultimately enable us to bring the forces of Nature through science under human control.

R. BRIGHTMAN.

Chemistry of Vital Changes

Chemische Grundlagen der Lebensvorgänge: eine Einführung in biologische Lehrbücher. Von Prof. Dr. Carl Oppenheimer. Pp. vii + 298. (Leipzig: Georg Thieme, 1933.) 22.50 gold marks.

THE study of vital change is becoming more and more a question of chemistry, and biologists, physiologists, as well as the medical profession, are all seeking the help which the chemist is likely to be able to afford them. A stage has been reached when the structure and the properties of all the essential substances which go to build up the living being have been established, though we must still be prepared for surprises, for new views and new interpretations. Essentially, however, we know enough about the fats, the sugars, the proteins and the pyrrhol colouring matters and the way in which they are built up and decomposed, to be able to formulate at least an approximate picture of what is happening in what may be likened to a very busy laboratory. Further, the knowledge of colloids and their behaviour has taught us, or at least made it possible to postulate, that many of the actions in the cell take place at surfaces rather than in pools. Such knowledge has enabled some progress to be achieved in the understanding of the mode of action and significance of the enzymes, or ferments as the Continent terms them, a word which is more expressive perhaps of the turmoil that they are causing in the cell.

From this point onwards there is chaos as we enter the arena of the conflicting views into which modern physical chemical theories intrude, which are in vogue to explain the mechanism of metabolism and the energetics of the living cell. The chaos is that of the battlefield; it conceals an orderly advance on many fronts, each with its co-ordinated supply system: each advance is subject always to the vicissitudes of the battle elsewhere. Just as no general can hope to survey the whole battle from the front line, so the scientific worker is mainly occupied with his specialist problem as he sees it. There arises thus the need and the opportunity for books which will survey a problem from as many aspects as possible, and convey to a worker whose outlook is mainly biological the interpretation of a problem as it appeals to one whose outlook is chemical, or vice versa.

Prof. Oppenheimer's book is largely written from this point of view. The older and more established facts are set out in condensed and summary form, whilst the bulk of the treatise is devoted to the more problematic and disputable points to which we have already made reference. The scope is best indicated by naming the five sections into which it is divided. These are the living substance as a chemical system, the essential components of the living substance, the synthesis and degradation of nutritive and skeletal materials, the chemical mechanism of cell changes, the energetics of the living system. It is mainly in the two latter that the subject is expanded, rival views indicated and considerable reference made to the original literature.

The treatment is involved, perhaps necessarily so; there are so many trees that the wood is seldom visible as such; and though we are in hilly country, the summits give us no views. This is perhaps inevitable but scarcely helpful to the reader. A marked feature is the invasion of mathematical treatment into so much of the field: whatever may be its value, it does not lighten the task of the biologist proper.

Criticism in detail is obviously impossible; on the whole we are inclined to think that too much has been attempted and that it is preferable for the worker to maintain his contact with his subject in the broader sense through the specialist monographs, particularly those contributed by a number of experts, and through original communications.

E. F. A.

Short Reviews

- (1) *Wörterbuch der Kolloidchemie*. Von Dr. Alfred Kuhn. Pp. iii+179. (Dresden und Leipzig: Theodor Steinkopff, 1932.) 8 gold marks.
- (2) *Pocket Technological Dictionary in Three Languages*. By H. Offinger. Part 1, Vol. 1: *German-English-Spanish*. Tenth edition, revised and improved by H. Krenkel. Pp. viii+322. (London: George Allen and Unwin, Ltd., 1931.) 6s. net.

ALTHOUGH both these publications would fall within the category of what Lamb called "biblia abiblia" or "books which are not books", yet each should prove very useful in its own sphere. In some respects they are superior to more pretentious volumes, for they contain no redundancies, every word pulling its weight; matter sought for can be easily found; and the published prices are well within the purchasing power of the scientific worker even in these times of financial stringency.

(1) Colloid chemistry, as we all know, has acquired a language—the 'die-hards' call it a jargon—of its own, and this, although easy enough to those who move in the jigsaw world of neglected dimensions, is nevertheless a source of difficulty to many. Dr. Kuhn's dictionary will therefore be welcomed by workers in such subjects as biology, medicine and pharmacy. His book is, however, not a mere dictionary of technical terms, for it contains within a small compass plenty of explanatory matter, and at the same time it serves as a useful guide to the original literature. It is too limited in scope to admit many references to technical applications, and its chief merit lies in the simplicity and directness with which it treats the fundamental concepts of this important branch of physical chemistry.

(2) Offinger's pocket dictionary should be valuable to the small, but we hope increasing, number of technical men who realise the value of a knowledge of German. In the part before us the equivalents of technical terms are given in the order, German-English-Spanish. A majority of the words seem to belong to engineering in its various branches, but metallurgical terms are quite abundant.

Chemistry is treated somewhat cavalierly, for, although chemical engineering and to a less extent laboratory apparatus have been fairly well covered, most of the chemical words given are simply the names of well-known substances. We note, in passing, that a glass "Destillierkolben" (distilling-flask) is rendered as "matrass, cucurbite", and that the useful word "eindampfen" (to boil down or concentrate by evaporation) is omitted. Biological and agricultural terms have no place, but there are references to vegetable fibres, and certain commercial terms are given. The word "technological" is vague, and its use alone in the title of such a book is apt to be misleading;

but in this respect the author does not sin alone, for the titles of scientific and technical books are often much too general. E. H. T.

- (1) *Handbuch der Physik*. Zweite Auflage. Herausgegeben von H. Geiger und Karl Scheel. Band 22, Teil 1: *Elektronen, Atome, Ionen*. Redigiert von H. Geiger. Pp. vii+492. 44.70 gold marks. (2) Band 22, Teil 2: *Negative und positive Strahlen*. Pp. iv+364. 34.70 gold marks. (3) Band 23, Teil 1: *Quantenhafte Ausstrahlung*. Redigiert von H. Geiger. Pp. iv+373. 34.70 gold marks. (Berlin: Julius Springer, 1933.)

To anyone seeking to know the present stage of development in any branch of physics, the "Handbuch der Physik" probably provides the readiest source. There is no attempt at continuous authorship, as each section of each volume is written by someone whose name is well known in connexion with the work described. The completeness of the whole work is thus assured and continuous revision brings it always to date. The later part of the work described in these three parts of the second edition refers to work published in the autumn of last year. The great extent of the work covered renders it impossible to give any detailed review, but it may be said that details of the mathematical work are not generally given, but rather the general place of any work in the scheme of growth of the subject. References are given, and to the convenience of the reader, they are given on the page to which they apply, instead of being collected in a mass at the end.

(1) The first volume before us is in five chapters dealing with a critical account of the determination of the fundamental charge, e , and the ratio, e/m . Atomic nuclei, nuclear structure, changes produced in bombardment by α -rays, and neutrons; radioactive changes ending with an application of their effect on our ideas of the age of the earth; ions in gas, mobility, diffusion and the periodic system are dealt with.

(2) The second volume deals with the passage of electrons, of canal rays, and of α -rays through matter. Effective cross-section of gas molecules for slow electrons and ions is described. This chapter is fuller in treatment than the others. It opens with a theoretical account and the reason for choosing 'cross-section' rather than 'mean free path' in presenting the results. Diffraction of material rays, with a short account of de Broglie's work and a comprehensive summary of the experimental work, are given.

(3) The third volume opens with a chapter on the determination of h , giving the best value as $(6.547 \pm 0.009) \times 10^{-27}$. The rest deals with production of quanta by impact, collision, energy levels, light emission caused by radiation, fluorescence, phosphorescence, resonance radiation and spectra, photochemistry.

The Medicinal and Poisonous Plants of Southern Africa: Being an Account of their Medicinal Uses, Chemical Composition, Pharmacological Effects and Toxicology in Man and Animal. By Prof. John Mitchell Watt and Dr. Maria Gerdina Breyer-Brandwijk. Pp. xx+314+25 plates. (Edinburgh: E. and S. Livingstone, 1932.) 25s. net.

THIS work should be of special value to all those in any way interested in the plants of southern Africa and their curative and toxic properties—to both man and beast. Considerable advance has been made in South Africa in recent years in the study of poisonous and medicinal plants, but the literature is for the most part scattered and the need of a general reference work has long been felt. The authors have themselves contributed in no small measure to the advancement of the knowledge of these plants from the pharmacological point of view, and their excellently compiled volume will no doubt be accepted as the standard work on the subject. The authors appear to have worked in close liaison with the technical staffs of certain State Departments in South Africa and the good work that has been done on vegetable poisons in the veterinary field is included in annotated form in the pages of the book. It is pleasing to observe that special care has been taken in securing accuracy of identity of the species they have themselves investigated. Acknowledgment is made in the introduction to the staff of the Division of Plant Industry for having determined more than 2,500 specimens.

The plants dealt with are placed under their respective families and these are arranged according to the natural system, a chapter being devoted to each family. In the list of contents at the commencement of the volume the salient features of the more important plants are indicated. This, combined with the full indexes of botanical names, active principles, European and native names that are included, renders the volume easy for reference. References to literature are freely quoted. Very little of what has already been published appears to have escaped the scrutiny of the authors, and the work contains in addition a mass of generally interesting information that is new or hitherto unrecorded.

Wireless. By W. H. Eccles. (The Home University Library of Modern Knowledge.) Pp. 256. (London: Thornton Butterworth, Ltd., 1933.) 2s. 6d. net.

It is doubtful whether the historical method, with citations of patent numbers, is now really appropriate to the development of 'wireless' before a 'Home University' audience, but Dr. Eccles almost persuades us that the method is, after all, the right one. He recovers the excitements of that headlong progress which made the decade centred about 1918 a miniature Augustan age for radio engineering, and led to the foundation of an industry which has since resisted, more success-

fully than most others, the slings and arrows of economic disturbance. The most serious criticism of the book is that it makes the whole complex business look too easy; there is a dangerously disarming air of simplicity about the first chapter that will probably lead many readers to suppose that they 'understand wireless'. They will find themselves increasingly doubtful as they go on, for the *tempo* accelerates until the later chapters have not infrequent elements of real unclarity.

Apart from under-statement of the pitfalls and difficulties, however, the author is generally a safe as well as a persuasive guide. This is not to say that "Machrihamish" will be found in any map of western Scotland, or that a five-fold over-statement of the height of the mountain of water between these islands and New York is excusable. His derivation of bels and decibels is neither orthodox nor logical, his use of the term billion for 10^9 is unconventional, and his invention of the "controllode" is less happy than his invention of the "triode" and its successors. But these are not essentials, and in essentials the book is cordially to be commended as a worthy member of a fine series, and as very good value indeed for the modest price asked.

Underground South Eastern England: a Three Dimensional Geological Map. By L. J. Chubb. (London: Thomas Murby and Co., 1933.) In sheets to be made up, 12s. 6d.; Card for base and 25 lengths of gummed linen for binding, 2s.; Cut out and made up, 35s.

IN this model, which is likely to prove useful to the student and to the practical geologist, the author has adopted an ingenious method of showing the extent and the order of superposition of the geological formations under east and south-east England. The outcrop of each formation is represented on a separate, coloured, map: the Palæozoic floor forms the base of the model, the successive formation-maps being attached either by their right or left margins. The thicknesses of the beds, as proved in boreholes, are indicated at a number of sites. By these means the unconformities at the base of the Jurassic and the Cretaceous systems, the regression of the Inferior Oolite, and the overlap of the several members of the Cretaceous system, are clearly brought out.

Although the scale is small (1 in. to 10 miles) some useful preliminary information with regard to depths to water-bearing strata over the whole area, and to the coal measures of the Kent Coal-field, can be obtained by the engineering geologist, and as the colours adopted are those used on the published maps of the Geological Survey, more detailed information is readily obtainable.

The utility of the model would be enhanced by the inclusion of a topographical map printed on a 'flimsy' which could be applied to each formation. A few vertical sections would help the student to visualise the structure of the strata. H. D.

Intermediate Products and the Last Stages of Carbohydrate Breakdown in the Metabolism of Muscle and in Alcoholic Fermentation*

By DR. OTTO MEYERHOF

THE esterification of the phosphates may be regarded as the first step of the anaerobic carbohydrate breakdown, not only in lactic acid formation in muscle, but also in alcoholic fermentation. Whereas our earlier studies were principally concerned with the conditions under which this esterification occurs and the quantitative relations connected with it, the stages following esterification lead to the well-known end products, on one hand lactic acid, and on the other hand alcohol and carbon dioxide.

It has gradually become more certain that the hexose *di*-phosphoric acid, isolated by Harden and Young from yeast-press juice, occurs neither in living yeast nor in other intact cells or tissues. A hexose *mono*-phosphoric acid possessing the chemical properties of the ester isolated in 1914 by Harden and Robison is always found; and may be termed the 'Robison' ester. This is particularly true for the hexose phosphoric acid of muscle, discovered by Embden and termed by him 'lactacidogen'. This is, for all practical purposes, identical with the Robison ester. Lohmann and Meyerhof showed, as Robison had already suspected, that this ester is not a uniform single substance, but a mixture, consisting of about three quarters aldose *mono*-phosphoric acid and one quarter ketose *mono*-phosphoric acid. This is worthy of notice in view of the relations existing between these esters and the hexose *di*-phosphoric acid, for the Harden-Young ester is a fructose *di*-phosphoric acid, while the *mono*-ester obtained by Neuberg by splitting off a phosphoric acid group from the *di*-ester is also a fructose ester.

Dr. Lohmann succeeded not long ago in solving the puzzle. The Robison and the Embden esters are nothing other than an equilibrium mixture of both components. This equilibrium mixture is formed in a few seconds from either the pure glucose or fructose ester in the presence of an enzyme found in all cells. Next, the enzymatic conversion of the Harden-Young ester into a *mono*-ester produced in no case the Neuberg ketose ester, obtained by acid hydrolysis, but always the Robison-Embden ester. It was possible to split off *one* phosphoric acid group by using dialysed aqueous muscle extract. The organic component of the co-enzyme, adenylypyrophosphoric acid, was thus dialysed away. Magnesium ion, the inorganic component, was then added. Muscle extract has no effect at all upon hexose *di*-phosphoric acid in the absence of magnesium and adenylypyrophosphate. With magnesium alone, however, *one* phosphoric acid group is split off.

The formation of the Robison ester under this condition may be explained by the following observation: if, instead of hexose *di*-phosphoric acid, one takes the Neuberg ester and adds it to muscle extract, the Robison-Embden ester appears after a few seconds. This last conversion takes place not only in magnesium-free extracts, but also in very dilute, thoroughly dialysed enzyme solutions of any origin. In every case, this conversion leads not to a pure glucose *mono*-phosphoric acid, but to an equilibrium mixture consisting of 70 per cent aldose phosphoric acid and 30 per cent unchanged fructose phosphoric acid. It can be shown that this is a true equilibrium by beginning with a pure or nearly pure glucose-*mono*-phosphoric acid, obtained either according to Lohmann by a partial acid hydrolysis of the Embden ester, or even better by using the method of Robison and Morgan. A part of this glucose

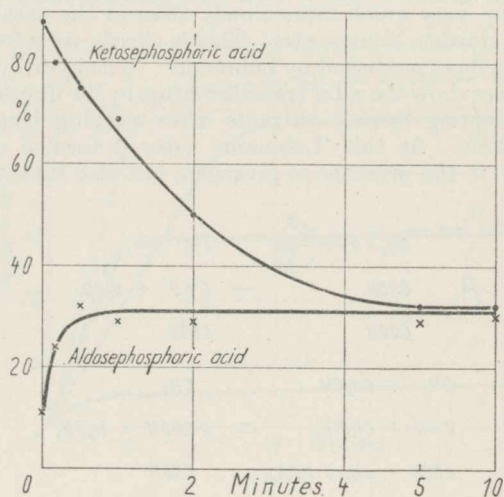


FIG. 1.

mono-phosphoric acid is converted into fructose phosphoric acid. The reaction comes to equilibrium again, when 30 per cent of the fructose component has been formed (see Fig. 1). With this, one of the difficulties which spoke against the mutual conversion of the Harden-Young ester and the Robison-Embden ester was removed. Such conversions in both directions play indeed an important part in carbohydrate metabolism.

The next question is, what is the next intermediary step in carbohydrate breakdown? An excellent technical aid in the study of this problem is the addition of sodium fluoride to the enzyme mixture. Embden observed many years ago that addition of sodium fluoride inhibited the lactic acid production of muscle, but that at the same time the hexose phosphoric acid increased. The

* Lecture delivered in the Biochemical Laboratory, Cambridge, in July 1933.

isolation of the Harden-Young hexose di-phosphoric acid under these conditions led to the suggestion that this acid was perhaps the preformed precursor of lactic acid. This conception must be limited in two ways, first, that the diphosphate is not preformed, but results from conversion of other esters. This conversion is due to the change in the course of the reaction resulting from the mincing of the tissue and the influence of the fluoride ion. Secondly, only a part of the ester accumulated here is the true Harden-Young ester. Lohmann showed in 1930 that a considerable

same time that the phosphoglyceric acid is transformed into pyruvic acid by minced muscle as shown in section C of Table 1. Embden therefore suspected that α -glycero-phosphoric acid appeared at the same time as a reduction product. He did not succeed, however, in isolating this substance. He set up a scheme for the breakdown of hexose di-phosphoric acid to lactic acid, shown in Table 1, which our investigations have shown to be essentially correct.

At the time Embden published his important results we had already succeeded in our laboratory in obtaining α -glycero-phosphoric acid, not only from the Lohmann ester but also as a dismutation product by fixing the pyruvic acid with sulphite. The formation of pyruvic acid under anaerobic conditions in minced muscle has been described by various authors.

Amandus Hahn in Germany and Case in Cambridge have occupied themselves with this problem.

Hahn concluded from his experiments that a quarter of the lactic acid accumulating anaerobically in muscle was converted into pyruvic acid, the oxidation being accomplished by preformed hydrogen acceptors present in the tissue. That this was impossible could be seen from the experiments of Case, to whom we owe an accurate and simple method for quantitative determination of small amounts of pyruvic acid. He found that in an aqueous muscle extract addition of starch and sulphite led to a large increase in the pyruvic acid, whereas addition of sulphite and lactate led only to a very small increase. The pyruvic acid must therefore originate from the carbohydrate, the quantity found being greatly increased by the sulphite used to fix the acid.

In our own work, the quantitative relationships in this formation of pyruvic acid and the origin of the oxygen necessary under the anaerobic conditions were thoroughly investigated. The assumed conversion of a quarter of the lactic acid formed under anaerobic conditions in muscle tissue into pyruvic acid was not in agreement with former observations of mine showing the very close correspondence of carbohydrate disappearance and lactic acid formation. However, upon repeating the experiments under the same conditions, pyruvic acid was found, but only in a quantity of 3-5 per cent of the lactic acid formed at the same time.

The earlier failure to notice this small quantity of pyruvic acid and the consequent maintenance of an approximate equality between carbohydrate disappearance and lactic acid formation are not difficult to understand. The pyruvic acid yield increases, however, when one minces the muscle finer, or adds sulphite as a fixative, or when glycogen, or still better, hexose di-phosphoric acid is added in excess. By using all these together the yield of pyruvic acid can be increased to 30 per cent of the lactic acid formed at the same time. In muscle extract there can even be obtained

TABLE 1. Embden's scheme.

A.	Fructosediphosphoric acid	=	1 Glycericaldehydphosphoric acid + 1 Dioxycetonephosphoric acid
B.	1 Glycericaldehydphosphoric acid + 1 Dioxycetonephosphoric acid	=	1 α -Glycero-phosphoric acid + 1 Phosphoglyceric acid
C.	1 Phosphoglyceric acid	=	1 Pyruvic acid + 1 Phosphoric acid
D.	1 Pyruvic acid + 1 α -Glycerophosphoric acid	=	1 Lactic acid + 1 Triose phosphoric acid

part, and under some conditions even the whole, of the ester present is not identical with the Harden-Young ester; although the elementary constitution is the same. He called it at that time the 'unhydrolysable' ester, because normal hydrochloric acid at 100° splits off a phosphoric acid group very much more slowly than in the case of the Harden-Young ester. This is clearly seen from the curves published by Lohmann¹. The hydrolysis curves show the ester transformation by the fluoride-containing muscle extracts after varying length of time. As this 'Lohmann' ester is formed not only in the presence of glycogen, but also from the

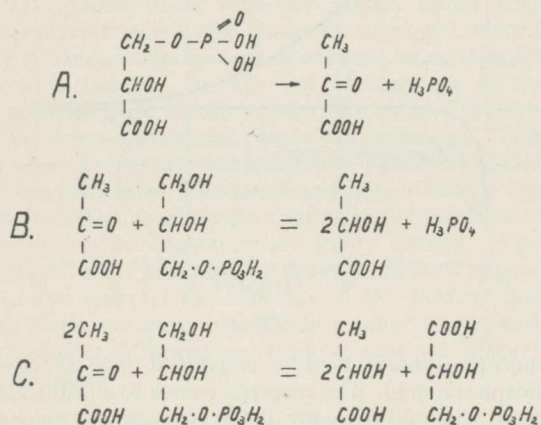


FIG. 2.

Harden-Young ester, without the splitting off of phosphoric acid, it must be a rearrangement product. This rearrangement product was converted enzymatically into lactic acid. More details concerning this ester were not found at the time although one suspected it of being a hexose di-phosphoric acid.

At the beginning of this year, Embden reported the important observation that under the conditions defined by Lohmann, glyceric-acid-mono-phosphoric acid (abbreviated 'phospho-glyceric acid') could be identified. He discovered at the

considerably more pyruvic than lactic acid. This could also be concluded from certain experiments of Case. We came another step further, however, in the search for the source of the oxygen necessary under anærobic conditions. As already mentioned, I found, working with Kiessling, α -glycero-phosphoric acid as a dismutation product.

Emden had already observed that simultaneous addition of phosphoglyceric acid and glycero-phosphoric acid to muscle tissue caused an increased formation of lactic acid. If then the Emden scheme was correct, neither addition of pyruvic acid alone, nor of α -glycero-phosphoric acid alone to carbohydrate-free muscle extract should lead to lactic acid production. On the other hand, addition of both at the same time should lead to the production of lactic acid, whereby twice as much lactic acid should be formed as pyruvic acid disappears. This is actually the case. The phosphate group split from glycero-phosphoric acid and the glycerol group disappears in exactly the quantity necessary to account for half the lactic acid formed. This is equation B shown in Fig. 2.

The α -glycero-phosphoric acid isolated from the muscle is the *l*-component. This compound, as was known from former studies of the glycero-phosphoric acids, shows no measurable rotation. When one investigates, however, the dimethylester of the di-methyl ether, which we prepared according to Karrer's directions, a specific rotation $[\alpha]_D^{20}$ of -4.5° is found. Only this *l*-acid, and not the optical antipode reacts with pyruvic acid to form lactic acid.

Fig. 3 shows the time course of the formation of lactic acid in muscle extract containing an excess of pyruvic acid, when known quantities of the natural or synthetic α -glycero-phosphoric acid are present. The broken lines show the lactic acid formation when the natural *l*-product isolated from the muscle was used. The lower curve shows the experiments when a quantity of acid corresponding to 5.9 mgm. of glycerol was used. The other curve corresponds to 11.9 mgm. glycerol per 10 c.c. extract. For the other experiments, shown by the solid lines, a double quantity of the racemic acid was used, for the lower corresponding to 11.7 mgm. for the upper to 24.0 mgm. glycerol. If we examine the horizontal portions of the curve where the lactic acid production has reached a constant value, we see that, in comparison to the control, for 5.9 mgm. glycerol 12 mgm. of lactic acid have been formed and for 11.9 mgm. glycerol 24.0 mgm. lactic acid; that is, each time two molecules of lactic acid for one molecule of glycerol; exactly as in the equation given. With the synthetic compound, however, only as much lactic acid is formed as there is glycero-phosphoric acid present. One may also show directly, that only half the glycero-phosphoric acid has reacted, from the determinations of the phosphate split off.

The given equation checks exactly, but is only a balance equation. In the scheme of Emden,

pyruvic acid and glycero-phosphoric acid do not react directly to form two molecules of lactic acid, but instead form lactic acid and a triose phosphoric acid, the latter then rearranging to phosphoglyceric acid and glycero-phosphoric acid. The resulting phosphoglyceric acid then yields pyruvic acid, which reacts again with glycero-phosphoric acid until the whole has been converted into lactic acid. That this is the case is shown by the action of fluoride. Sodium fluoride inhibits the formation of lactic acid from carbohydrates. Now it can be seen that the effect is due to the inhibition of one partial reaction, namely the splitting off of phosphoric acid from the phosphoglyceric acid. The other links in the chain of reactions are not influenced by the fluoride ion. If, therefore, we add excess pyruvic acid and α -glycero-phosphoric acid to a muscle extract and add enough fluoride to stop completely the anærobic breakdown of glycogen and hexose di-phosphate, we obtain exactly as much lactic acid as without fluoride. But now the disappearance of pyruvic acid and the formation of lactic acid are exactly equivalent. This is expressed in equation C in Fig. 2.

In this case no phosphate has been split off and the glycero-phosphoric acid in the presence of an

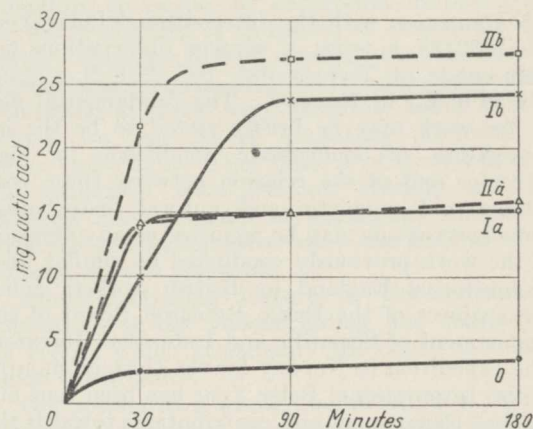


FIG. 3.

excess of pyruvic acid is completely converted into phosphoglyceric acid. This course of the reaction can only then take place, if the pyruvic acid and the glycero-phosphoric acid do not react directly to form two molecules of lactic acid, but if one half becomes triose phosphate which then rearranges. The glycero-phosphoric acid thus formed can again react with pyruvic acid but the phosphate group of phosphoglyceric acid is not split off. That proceeds until all the glycero-phosphoric acid is oxidised to phosphoglyceric acid. Sodium fluoride acts therefore as a trap for the phosphoglyceric acid and thus no inorganic phosphate is set free during the lactic acid production.

It is very interesting that monoiodoacetic acid, which also inhibits the splitting of carbohydrates, affects the reaction at an entirely different point. In muscle extract poisoned with iodoacetic acid

the splitting off of the phosphate of phosphoglyceric acid and the consequent formation of pyruvic acid proceed undisturbed. The pyruvic acid cannot, however, react with the glycerophosphoric acid, so that here no lactic acid formation takes place.

These results could also be explained in another way. The triose phosphoric acid appearing as an intermediate during the reaction between pyruvic acid and glycerophosphoric acid might itself be resynthesised to hexose di-phosphoric acid which then decomposes into an oxidised and a reduced half. This interpretation, that the splitting of the carbon-carbon bond at the 3:4 position is at the same time an oxidation-reduction process, certainly has its merits. However, the behaviour of glyceric aldehyde phosphoric acid lends support to the supposition of a previous decomposition to triose phosphoric acid. H. O. L. Fischer, the son of Emil Fischer, succeeded not long ago in synthesising glyceric aldehyde phosphoric acid. Smythe

and Gerischer, working in O. Warburg's institute, showed that the dextro-rotary component of this racemic compound is easily fermented and Embden has observed abundant formation of lactic acid on addition of glyceric aldehyde phosphoric acid to muscle tissue.

Thanks to the courtesy of Dr. Fischer, I was able to study the appearance of intermediate products in muscle extract during the reactions of this substance. Actually, exactly one half, that is *one* optical component, was transformed into phosphoglyceric acid and glycerophosphoric acid. In the muscle extract with added sulphite, but without fluoride, pyruvic acid and glycerophosphoric acid were formed. The glyceric aldehyde phosphoric acid thus behaves exactly as does the intermediary product. This is thus the first synthetic ester that is converted into lactic acid as easily and by the same path as the biological esters.

¹ *Biochem. Z.*, 222, 337, Fig. 8; 1930.

(To be continued.)

Ionospheric Investigations in High Latitudes

By PROF. E. V. APPLETON, F.R.S., R. NAISMITH and G. BUILDER

IN connexion with the International Polar Year 1932-33, a series of wireless observations has been made at Tromsø (lat. 69° 39·8' N.; long. 18° 56·9' E.) in Norway. The fundamental aim of the work may be briefly stated to be the investigation of ionospheric conditions in high latitudes and of the relation between these conditions and magnetic and auroral disturbance. The observations may be regarded as an extension of the work previously conducted on similar lines in south-east England by British workers under the auspices of the Radio Research Board of the Department of Scientific and Industrial Research. The expedition to Norway for the thirteen months of the International Polar Year has been sent out by that Department and contributions towards the total cost have been made by the British National Committee for the Second Polar Year and by the Council of the Institution of Electrical Engineers.

Special facilities and privileges have been accorded to the expedition by the Norwegian Government and by the Norwegian Committee for Cosmic Physics, while the latter body invited us to make our principal receiving station at the Auroral Observatory, Tromsø, where laboratory and living accommodation has been provided. The sending station was erected at Simavik, about 20 km. north of Tromsø, on the island of Ringvassøy. The choice of these sites and many other helpful arrangements were made for us by Mr. R. A. Watson Watt, who visited Tromsø in March, 1932. It has proved a great advantage to have the receiving site at the Observatory at Tromsø, where the magnetic records have been immediately available and where Director Harang and Mr. E. Tønsberg have given us every other possible assistance. A member of our party, Mr. W. C. Brown, has been

in charge of the sending station at Simavik during the whole period of the observations.

The expedition arrived in Tromsø on July 15, 1932, and the sending and receiving stations were erected and in working order by July 22. Observations according to the programme prepared by the Polar Year Sub-Committee of the Union Radio Scientifique Internationale and in accordance with a special British programme have been carried out since the beginning of August 1932, while corresponding measurements for purposes of comparison have been made in south-east England. A full account of the results obtained must naturally await the completion of the remainder of the series of observations and the full reduction of the data; but since the beginning of the work certain results have been immediately apparent and their continued confirmation prompts this interim statement.

Before proceeding to summarise some of the salient results obtained, it may perhaps be useful to mention the kind of problem which it was hoped would be solved by a comparison of ionospheric measurements in high and temperate latitudes. If ultra-violet light is the ionising agency for either of the two main reflecting regions in the upper atmosphere, we should expect that region to be more strongly ionised by day than by night, and also to be of lower electrical content at Tromsø than in south-east England. On the other hand, if charged particles, entering the earth's atmosphere from outside, constitute the ionising agency, the influence of the earth's magnetic field is such that these particles should be expected to converge near the magnetic poles and also to impinge on the dark side of the earth. In this case it will readily be seen that their effects should be radically different from those produced by ultra-violet

light. On the immediately practical side, it was hoped that the investigations would perhaps also elucidate the special difficulties which occur in effecting communication in circumstances in which the wireless ray traverses the polar caps.

The results summarised below bear directly on both these matters.

(a) *General.* In the first place, it may be stated that the prosecution of ionospheric investigation in a region so liable to magnetic disturbance as Tromsø has emphasised the importance of the result, previously found from measurements of ionisation in England, that an increase in ionisation, as measured by radio methods, is very frequently found to occur with a magnetic storm. In high latitudes, however, the correlation is very much more marked because the magnetic disturbances themselves and the corresponding increases of ionisation are of very much greater magnitude. So far as wireless observations are concerned, the distinction between results on magnetically quiet and magnetically disturbed days is therefore a vital one.

(b) *The Upper and Lower Reflecting Regions in Tromsø.* For undisturbed conditions there are usually the two reflecting regions which have been observed in England. We shall refer to them as the upper and lower reflecting regions. Regarding 'normality' as the behaviour exhibited by the corresponding regions over south-east England, then we can say that the upper region at Tromsø is the more normal of the two. In this connexion it will be remembered that the lower region is at approximately the same height as the most frequent auroræ.

(c) *Undisturbed Conditions.* For undisturbed conditions it is quite clear that the daily maximum ionisation content for both upper and lower regions is less at Tromsø than that in south-east England. We find, on the other hand, that the seasonal variation of normal ionisation is greater in high than in temperate latitudes. As an example of the order of magnitude of the ratio of maximum noon ionisation in Tromsø to that in England, we may quote the equinox value of 60-70 per cent. This ratio is, we imagine, of the order which could be predicted from Prof. S. Chapman's theory of atmospheric ionisation by monochromatic radiation, and suggests very strongly that the ordinary undisturbed ionisation value is that caused by ultra-violet light from the sun. For undisturbed conditions the normal diurnal variation, with the usual sunrise and sunset correlation, is always evident with the upper region.

(d) *Disturbed Conditions.* One of the most remarkable features of the results has been the frequent occurrence of disturbed conditions. This is particularly the case with the lower region. In contrast with England, the greatest ionisation densities measured for this region are encountered not at noon, but during the night (usually from 20.00 hr. onwards). In fact, it may be said—using the very special sense of 'normal' adopted above—that this region is more frequently 'abnormal'

than 'normal'. Now the magnetic records at Tromsø show just the same frequency of abnormality. An evening without some kind of magnetic disturbance is exceptional, and such disturbances usually last from 20.00 to 04.00 (or sometimes from 16.00 to 04.00) local time. The correlation between disturbed magnetic conditions and abnormal ionisation is very close indeed; a small disturbance during the night will be accompanied by an increase in lower region ionisation (this is specially noticeable when the general magnetic activity is low) while during conditions of intense magnetic activity we find a *complete cessation of echoes* on all of the available wave-lengths (from 500 metres to 20 metres) normally in use for the observations. The same complete absence of reflection is found during the daytime both during and for some time after magnetic activity. This absence of echoes on all wave-lengths, which we have previously encountered in our work in temperate latitudes on only one occasion, cannot be due to electron-limitation, for the conditions for this could not occur so suddenly as does the disappearance of the echoes. Moreover, we have frequently been able to follow the increase of nocturnal ionisation during the progress of an individual storm. The absence of echoes must therefore be caused by absorption-limitation due to the production of ionisation at abnormally low levels. We must, in fact, conclude that the ionising agency which causes magnetic storms can produce ionisation at levels very definitely below that at which we can detect ionisation produced by ultra-violet light. This result is of special interest in connexion with Director Harang and Dr. Bauer's measurements of occasional auroræ extending 20-30 kilometres below the level to which normal auroræ penetrate.

Another striking feature of the ionospheric conditions is the violent fading and complexity of echoes which accompany the onset of a magnetic disturbance.

Our results as a whole, therefore, show that to account for wireless phenomena in high latitudes we must take into account both the normal influence of ultra-violet light and the abnormal influence of ionising charged particles. The ionising charged particles produce electrification in and below the normal lower region. The fact that the ionisation is found to occur on the dark side of the earth is explicable on the theory of Birkeland as developed by Størmer. The absorption which occurs during the day is probably due to ionisation caused by particles which are initially uncharged but acquire a charge in the early stages of their journey through the atmosphere. Our observations suggest that such particles are, in general, more penetrating than those which impinge on the dark side of the earth. The practical difficulty of maintaining communication over the polar cap can doubtless be traced to the frequent absence of reflection from the ionosphere which we have found to be so closely associated with conditions of magnetic activity.

Obituary

DR. T. RICE HOLMES

WE regret to record the death of Dr. T. Rice Holmes, the widely known authority on Julius Caesar, which took place at the age of seventy-eight years on August 4 at Roehampton.

Thomas Rice Edward Holmes was born on May 24, 1855, at Moycashel, Co. Westmeath, and was educated at Merchant Taylors' School and Christ Church, Oxford, where he was a junior student. He took second-class honours in classical moderations and a first in the honours school of modern history. After taking his degree he became a schoolmaster and in 1885, having held appointments at Lincoln and Blackheath, he joined the staff of St. Paul's School. Here he remained until his retirement from the teaching profession twenty-four years later.

Holmes had already published two books, one on the Indian Mutiny and the other, "Four Famous Soldiers" (1889), which had received immediate and favourable acceptance from scholars, when his attention was turned to the study of Caesar's "Commentaries" and the campaigns therein described. In 1899 he published "Caesar's Conquest of Gaul" and in 1907 "Ancient Britain and the Invasions of Caesar". In these two books the problems of Caesar's record were attacked with scholarly thoroughness. Their aim was not merely to elucidate the actual text, but also to give a complete picture of the historical background in the areas of Caesar's operations, by a critical interpretation of the whole relevant material, literary, topographical, archaeological and ethnological. In the volume dealing with Britain, Holmes gave an account of the inhabitants of Britain from Palaeolithic times down to the invasions of Claudius in A.D. 43. Although he invariably made an exhaustive examination of the literary material bearing on his problems, his work was no mere exercise of the study. His conclusions, many of which traversed convincingly the views put forward by Napoleon III, were based upon detailed topographical study and a careful investigation of the material evidence. His acute criticism of the interpretations of archaeological, linguistic and ethnological evidence put forward by others, especially by the late Sir John Rhys, whom he attacked with wit as well as scholarly penetration, led him to conclusions, many of which are of permanent value in the study of the prehistory and early history of western Europe, even though much fresh evidence has accumulated, and will continue to accumulate, since he wrote.

Holmes was also the author of other works on Roman history, written in his retirement, of which the most notable is "The Roman Republic", continued in "The Architect of the Roman Empire", published in 1929.

Holmes's work was recognised by an honorary

degree of D.Litt. of the University of Oxford and the D.Litt. degree of the University of Dublin, and he was a member of the British Academy.

MR. H. F. TAGG

THE death on August 9 at the age of fifty-nine years of Mr. Harry F. Tagg, keeper of the Museum at the Royal Botanic Garden, Edinburgh, will be regretted by horticulturists as well as botanists. For a period of nearly forty years he had been associated with Edinburgh. He was appointed immediately after he had completed his training, and during the early years of his service his investigations covered a wide field. He was for a time, at the Botanic Garden, Edinburgh, the only assistant with scientific training, and he took a large share in the examination of material sent in from various sources for report. In the course of this essential work he devoted much of his attention to the diseases of plants and, as an expert upon the defects of timber, his advice was frequently sought.

In the establishment of the museum part of the Garden Mr. Tagg was conspicuously successful. For the purpose of collecting material he undertook, some thirty years ago, a journey to the Antipodes and brought back an interesting and important collection. Especially noteworthy were his methods of mounting and preserving museum specimens. His technique was unique, and his exhibits are monuments to his skill and to the care and pride which he took in his work.

In recent years the outstanding part of Mr. Tagg's work has related to *Rhododendron*, a genus which, during the last quarter of a century, had been enriched by a great influx of new species from western China, Tibet and Burma. Mr. Tagg's intimate acquaintance with this group of plants enabled him to deal successfully with much of this new material. In the *Notes from the Royal Botanic Garden, Edinburgh*, he described many new species, and there and elsewhere published several important original papers on the subject. Problems associated with this genus, and an enormous number of inquiries from all over the world, were dealt with by Mr. Tagg, and his work received recognition from many horticultural institutions. Under the guidance of the late Sir Isaac Bayley Balfour, he assisted in the arrangement of the genus and he was responsible in no small degree for that work of importance both to botanists and to horticulturists entitled "The Species of *Rhododendron*", published by the Rhododendron Society in 1930.

During the last year or two his health had begun to fail, but in the end his passing was sudden. Mr. Tagg was a fellow of the Linnean Society. He was unmarried.

News and Views

Colorado Beetle in Great Britain

THE recent occurrence of the Colorado beetle in an allotment in the parish of Chadwell St. Mary, Tilbury, has received considerable publicity through the Press. The pest is well known as being the most serious insect enemy of the potato in North America, where regular spraying of the foliage with arsenical compounds is necessitated in order to preserve the crop. During the War, the insect was accidentally introduced into France at Bordeaux, where it flourished for a while before its presence was detected. Owing to the nature of the country, and the vast numbers of small gardens and cultivated areas in the vicinity of the city, the pest speedily obtained a foothold. It is now gradually extending its range and has been reported from the Cherbourg district. The infestation at Tilbury is apparently a very slight one, since only three examples of the beetle have been discovered. Prompt action has been taken by the director of the Pathological Laboratory of the Ministry of Agriculture, aided by a staff of inspectors, and all areas under potato within a 10-mile radius of Tilbury have been subjected to close examination. Approximately 2,000 acres of the crop are involved, and we learn from the *Times* that this area is being systematically sprayed with insecticides by Messrs. Solignum, Ltd., who are the contractors for the work. The possible advent of the pest into Britain has been the concern of the Ministry of Agriculture ever since the insect established itself in France. The occurrence of further specimens in the future cannot be ignored and their prompt destruction is a matter of the utmost importance. Anyone, especially potato growers in the vicinity of ports, who finds a striped (not spotted) beetle, or any red or yellowish grub feeding on potato foliage, will render definite service by reporting the same to the Ministry of Agriculture, 10, Whitehall Place, London, S.W.1. The Ministry requests that suspected specimens, securely packed, should be forwarded to the above-mentioned address. If the label bears the instruction "O.H.M.S." no postage need be paid.

Reindeer in Alaska

THE recent arrival at Kittigasuit, near the mouth of the Mackenzie River, from Sewark, Alaska, of the herd of nearly 3,000 reindeer purchased by the Canadian Government for a food supply for the Eskimos, bears witness to the success of the experiment of importing the reindeer (*Rangifer tarandus*) into Alaska from Siberia after the caribou (*R. grœnlandicus*) decreased and the natives were without sufficient food. In 1890, Dr. Sheldon Jackson, of the United States Bureau of Education, made a tour of the Behring Sea in the revenue cutter *Bear*, and noticing the plight of the Alaskan natives and the absence of the reindeer, which so much lightened conditions in Siberia, returned to Washington with the idea of importing reindeer into Alaska. Sixteen reindeer were purchased from Siberia in 1891 and 171 in 1892, and importations continued up to 1902,

reaching the total of 1,280, when the Russian Government stopped the supplies. The reindeer in Alaska were loaned to experienced Lap herders for breeding, and rapidly increased in numbers. By 1905 they had reached 10,000, by 1915, 70,000, by 1920, 200,000 and in 1929 were estimated to number more than 1,000,000, exclusive of more than 300,000 which were killed for food and clothing (C. J. Lomen, *Scientific American*, August, 1929). In 1901, the American Government loaned to an experienced Lap breeder, Alfred Nilima, 24 male and 75 female reindeer. In 1906, Nilima returned 99 animals, keeping their offspring. In 1908 he divided his herd of 800 with his wife, keeping 400 himself. As this herd grew, Nilima employed other Lap herders, paying them in part with reindeer, and in 1914 he sold his herd, which then numbered 1,200. In 1917 his former herders sold 1,717 and in 1921 an additional 1,606, all this the natural increase of the original 99.

THE importation into Alaska occurred chiefly at Port Clarence Bay, near the town of Teller, but later when companies began breeding them at Nome, etc., ranges increased. The Bureau of Animal Biology of the United States Department of Agriculture founded a Reindeer Experimental Farm in 1920 at Fairbanks. At this station, and at sub-stations at Nome and on Nunivak Island, studies are made of feeding, breeding, and management practices essential to the production of reindeer; the diseases and parasites affecting reindeer; and cross-breeding reindeer and wild caribou to increase meat production and to develop a larger and more hardy animal, better adapted to Alaskan conditions, and experiments are being made in the introduction of musk oxen and their domestication (Directory of Field Activities of the Bureau of Biology Survey; Miscellaneous Publications No. 49, United States Department of Agriculture, 1932). Reindeer are found to prefer the highlands to the coastal plain and range inland the greater part of the year, but the warm weather of early summer and the trouble of mosquitoes force them to seek the sea coast.

Broadcasting in India

THE Indian Broadcasting Co. opened a station at Bombay in July, 1927. After suffering many vicissitudes it was taken over by the Government of India in April 1930. On the celebration in the last week in July of the sixth anniversary of the founding of broadcasting, Sir Frederick Sykes, Governor of Bombay, laid stress on the importance of broadcasting in India. The great difficulty the Indian Government has to contend against is to get in touch with the masses in order to explain policies and give authoritative news of public events. The future working of democratic schemes in India depends on accurate news being broadcast. A few experiments with selected sets in up-country centres have been made, but an elaborate organisation is required to develop all-India broadcasting and it will take time to build

this up. A serious difficulty to be overcome is the prevalence of piracy. Although registration and licence fees in Bombay amount to only ten rupees a year, it is believed that about fifty per cent of the listeners-in are 'pirates'. As many modern sets work without an aerial, it is particularly difficult to bring the pirates to book. An officer has power to inspect and search houses and a severe penalty is exacted, but the evil still exists.

An Alternative to the Severn Barrage

IN supplying electrical energy economically, it is very desirable that all the machines in use should be running as nearly as possible continuously at their full load. The overhead costs divided by the output will thus be a minimum. If the machinery were only to run for one hour per day at full load and for 23 hours per day at a tenth load, nine-tenths of the machines would be lying idle most of the time. If a cheap method of storing electrical energy could be invented, we could effect great economies by having only a few machines, all of which would run fully loaded. In an article in the *Times* of August 24, Mr. J. W. Meares criticises the Severn barrage scheme from this point of view. Between the ebb and flow of the tide there are periods when the turbines must necessarily be inactive, and hence the load on them would be far from being continuous. The chief item in the cost of the scheme is the dam itself. Provision would probably be made for utilising the fortnightly spring tides, and so the load would have a fortnightly fluctuation superposed on the usual twice-a-day one. Mr. Meares suggests that, without using the tides at all, a great deal of electric energy might be generated and stored at some of our steam driven stations. All that would be necessary is to use them to pump water to some elevated reservoir, one situated on a hill for example. At times of peak load this water could be used to drive turbo-electric sets, the electricity generated being transmitted to help supply the load. At first sight it appears a much cheaper method of helping the national supply than utilising the tides. In many cases also the necessary works could be completed in a fraction of the time required for the Severn barrage. It is satisfactory to remember that when the price of coal gets much dearer, we have always tidal power in reserve.

Electric Lighting in the Isle of Man

IN 1928 a commission was appointed to inquire into the best methods of supplying the Isle of Man with electric light and power. This resulted in the appointment of an Electricity Board in 1932 to carry out a scheme of supply which is not unlike that adopted in the English 'grid'. The scheme covers the whole of the island except 17 square miles supplied by the Douglas Corporation. It consists broadly of an overhead ring main at 33 kilovolts from which tappings can be taken for the consumers. According to the *Electrical Times* for August 10, the first part of the line was inaugurated on August 3. Considering that the first pole of the line was erected on April 18, this shows how expert

electricians have become in overhead construction. There are now approximately seventy miles of steel-cored aluminium conductors erected. The supply is taken from the Douglas Corporation works, the supply being stepped up from 3,300 to 33,000 volts at a sub-station before it comes to the high tension ring main. The overhead lines are carried on creosoted fir poles, but H poles are used in special positions. Although the lines operate at 33 kilovolts, they satisfy the British Standard Specification for 66 kilovolts. The low-tension substations connected with the ring main supply consumers at 400 volts for power and 230 volts for lighting. The normal span adopted between poles is 400 feet but in a few cases it was necessary to resort to much longer spans on account of the contour of the ground and way leave difficulties. The longest span of 1,013 ft. is at the well-known Laxey Glen. The supports on each side of this span are three poles, each pole carrying one of the three phase conductors.

Synthetic Corundum for Jewel Bearings

IN 1904 Prof. A. Verneuil published an account of his successful experiments on the artificial reproduction of ruby. He pointed out at the time that his method of crystallising was of considerable commercial interest, but at first most attention was paid to producing decorative gems. The watch-making industry was the first to adopt these gems for the bearings in watches. Their uniform colour and moderate price have led to their general adoption in this industry. In a paper on "Synthetic Corundum for Jewel Bearings" by E. G. Landmeier, published in the *Journal of the Institution of Electrical Engineers* for May, a description is given of the manufacturing processes used in the production of rough synthetic corundum and of jewel bearings for electric meters and other measuring instruments. A description is also given of the methods now used for the synthesis of sapphire. It was stated that it is difficult to obtain natural stones as hard and as uniform as synthetic ones. A few years ago, practical men found it difficult to believe that synthetic stones grown in the chemical laboratory in a few hours could equal natural stones. It has to be remembered that special processes have now made it possible to obtain for the synthesis of corundum raw material of the highest purity, which is only rarely found in Nature. Numerous photographs are shown illustrating the effect of a rotating pivot on the jewel. Communications from several engineers discussing the author's conclusions are published at the end of the paper. Manufacturers of meters apparently are not yet agreed as to the relative lengths of the lives of the synthetic and natural jewel bearings.

World Oil Production

THE Petroleum Economics Division of the United States Bureau of Mines has recently published results of its annual statistical survey of the world crude petroleum production for 1932 (Mineral Market Reports No. 183). During this year the total amount produced was 1,305 million barrels, representing a

decrease of nearly 67 million barrels, or 5 per cent, of the total recorded for the previous year. The analysis of production by countries is interesting. For example, in 1930 the second largest producer was Venezuela, while in 1931 Russia came second on the list, the United States taking as hitherto prior place. In 1932 the production of Venezuela still further decreased, Russia again taking second place to the United States, the total output of which was 781 million barrels, or about 60 per cent of the world's total. Of the British Empire resources, Trinidad is tenth on the list with a production of 10 million barrels. British India was responsible for 8 million barrels; Sarawak for a little more than 2 million barrels; Egypt for $1\frac{1}{2}$ million barrels; Canada for 1 million barrels, a noteworthy decline. The output of oil from Persia showed an increase over the previous two years with a total of 49 million barrels, while that from Iraq remained much the same at a little less than 1 million barrels. It is probably safe to say that the general decrease in production for the year of some 67 million barrels is due rather to such measures of conservation as may have been satisfactorily adopted and also to general marketing conditions, rather than to any noteworthy decline in the actual natural resources of petroleum.

Forecasting Rainfall in Queensland

MANY parts of Australia lie on the marginal zone in which the rainfall is sufficient in good years but in bad years drops below the level required to maintain the pastures. Disastrous droughts have occurred from time to time in the past, and may be expected to recur in the future, but hitherto no satisfactory method of forecasting them has been found. Mr. Inigo Jones, director of the Bureau of Seasonal Forecasting in Brisbane, has been investigating the problem, and as a basis for study, he has collected all the available long records of rainfall in Queensland, including 159 stations, which he has published in the form of monthly tables. The lines on which Mr. Inigo Jones is attacking the problem of foretelling these droughts are set out in another pamphlet, entitled "Seasonal forecasting" (Brisbane, 1932). He believes that the weather of Australia is dominated by solar influences, but that these cannot be expressed simply and directly by the sunspot curve. In some way the solar activity is governed by the revolutions of the planets, resulting in a multiplicity of cycles, but the author's ideas on the subject are vague. This would not matter so much if the meteorological data were handled scientifically, but he proceeds to "prove" this hypothesis by picking out the occasions on which the facts agree, more or less, with the theory. Perhaps a more thorough test is now in progress, based on the extensive rainfall data for Queensland referred to above. It may be remarked that one result of the planetary hypothesis is that the main sunspot cycle should be the period of Jupiter, 11.86 years, but the meteorological evidence is almost wholly in favour of the shorter cycle of just over 11 years, as shown, for example, in the fluctuations of level of Lake George in Australia (NATURE, 112, 918, Dec. 22, 1923).

The Collecting Net

THE *Collecting Net* is a flourishing weekly publication belonging exclusively to the biological institutions of Woods Hole. Nos. 1 and 2 of vol. 8 (July 1 and 8, 1933) are now before us. The purpose of the journal is to assemble material of special interest to workers in the Marine Biological Laboratory, the Woods Hole Oceanographic Institution and the United States Bureau of Fisheries. The editorial contents are divided into four parts: results of the scientific work reported during the summer of Woods Hole; items reporting the activities of members of the scientific institution of Woods Hole; world-wide news of the activities of institutions and individuals working in the field of biology; the more important local news. There is a directory for 1933 containing the names and addresses of investigators in the laboratories beside short articles on various researches and apparatus and laboratory notes. Interesting accounts of the Scripps Institution of Oceanography and of the Biological Laboratory of Cold Spring Harbor are written by their respective directors, Dr. Thomas Wayland Vaughan and Dr. Reginald G. Harris. The annual subscription is only two dollars and the magazine is well printed and illustrated.

Marine Studies in South Africa

REPORTS 8 and 9 of the Marine and Biological Survey of the Union of South Africa for 1929-31 include two special reports as well as a large collection of important fishery statistics. The latter is the result of extensive investigation over the 2,500 miles of coast from St. Lucia Bay to Walvis Bay. In a valuable paper on the "Post-Brephalus Development of South African Macrura", W. von Bonde describes the various phyllosoma and puerulus larvæ of the Palinuridae, Panuliridae, and Scyllaridae of this region. The work is well illustrated, and contains interesting notes on the development of the nervous system. It is unfortunate that the method of describing larvæ from the plankton samples does not permit of identification of species. Much experimental work on these lines remains to be done. In the second paper, on "Hydrographical Investigations in South African Seas", J. M. Marchand makes a survey of the variation in temperature and salinity throughout the years 1929-31. He notes the effect of the Mosambique and Benguela currents on the coast of the sub-continent, but it is naturally impossible at present to make more than very broad generalisations when working over such a large area.

Marine Biological Station at Ghardaga

THE faculty of science of the Egyptian University has issued a report in English for 1931-32 containing a description of researches by members of the staff and a somewhat detailed account of the marine biological station at Ghardaga, which is situated on the edge of a group of extensive coral reefs. Corals of hundreds of different species, especially Madreporaria and Alcyonaria, cover the edges of most of the reefs to a depth of 5-6 fathoms and are in such

profusion that all the biological institutions of Europe and the United States can, it is said, be supplied without stint from this source.

New Antarctic Expeditions

Two American expeditions to the antarctic are announced in the *Polar Record* for July. The Ellsworth expedition has for its object a trans-antarctic flight to discover the nature of the land between the Ross and Weddell Seas. From a base, which it is hoped to establish in the Bay of Whales, Ross Barrier, in December, it is proposed to fly to the south of the Weddell Sea and back, without landing on the way. This flight of 2,900 miles is expected to take ten hours. The expedition does not expect to spend more than a week at its base and is not to winter. On the other hand, Admiral R. E. Byrd proposes to winter in the south, taking with him a large number of dogs and several motor tractors besides an aeroplane. His expedition will have a personnel of about forty and is planned to sail this autumn. Details are not yet announced but the plans include a flight to the south pole and exploratory work to the east of the Ross Sea.

New Islands in the Arctic

THE Society for Cultural Relations has issued a report stating that a new group of islands has been discovered in the arctic by the expedition aboard the icebreaker *Sibiryak*. The news was conveyed by a radiogram from Prof. Wiese, head of the expedition, to the Arctic Institute in Leningrad. The islands lie to the south-west of the Izvestia, a group of islands south-west of Solitude Island discovered last year by the icebreaker *Rusanov*.

Carnegie Institution of Washington

THE report of the President of the Carnegie Institution of Washington for 1932 contains a brief account of the broad lines upon which the Institution has organised its distribution of grants. It aims at the greatest service through investigation, and at the same time the fullest use of the advances made. "Attainment of the highest values in an institution devoted to research depends in a measure upon the extent to which touch can be maintained with the fields of application, stimulation, and spiritual refreshment through which they may contribute to life." Keeping this aspect in view, the Carnegie Institution has recognised three lines along which it may aid the use of research contributions. First, it has formulated a scheme for permanent and detailed record of results coming from researches, so that they may be available to specialists in all fields of science. Secondly, continued effort has been directed toward study of the broader interpretation of work accomplished, and toward statement of conclusions in such manner that they may have the widest possible research and educational value. Thirdly, there is now being developed a series of studies, designed to review research activities having application aspects so important that united effort of all contributing agencies may be desirable.

Agricultural Publications

THE third annual report (1931-1932) of the Executive Council of the Imperial Agricultural Bureaux (London: H.M. Stationery Office. 1s. net) shows that important developments have taken place during the year under review. The outstanding feature of the report is that it marks for the first time the regular issue of journals from practically all the eight bureaux. These journals embody information abstracted from scientific periodicals in almost every language and from almost every country. *Horticultural Abstracts* is issued by the Bureau of Fruit Production at East Malling, the *Veterinary Bulletin* monthly from Weybridge, *List of Publications Relating to Soils and Fertilisers* monthly from Rothamsted, *Plant Breeding Abstracts* quarterly from Cambridge, *Herbage Abstracts* quarterly from Aberystwyth, *Bulletin on Animal Genetics* quarterly from Edinburgh. Abstracts on agricultural parasitology, which are prepared by the Bureau at St. Albans, appear in the *Quarterly Journal of Helminthology*, whilst the journal from Aberdeen—*Nutrition Abstracts and Reviews*—reveals co-operation between the Medical Research Council, the trustees of the Reid Library and the Executive Council of the Imperial Agricultural Bureaux. The analysis of the year's expenditure bears testimony to the large part played by these journals in the work of the Bureaux. More than ninety per cent of the gross expenditure has been incurred in the examination, abstraction and distribution of scientific information, in the purchase of necessary scientific books and periodicals and in the publication of a number of special bibliographies on subjects of particular interest.

Epidemiological Studies on Scarlet Fever

THE deaths from scarlet fever in England and Wales in 1851 numbered 13,634, whereas in 1931 with a larger child-population they numbered only 540. This remarkable change in mortality is the subject of a study by Miss Hilda Woods (Med. Res. Council, Sp. Rep. Series, No. 180. 1933). The diminution of scarlet fever deaths appears to be due essentially to lessened severity of the disease, and not to any general diminution in prevalence, and no evidence has been found to prove that hospital isolation has been effective in reducing either the prevalence or the mortality. The spread of scarlet fever has been attributed to various factors, but none seems to be generally applicable. Thus, in London scarlet fever is more prevalent in overcrowded areas, in Birmingham the greatest incidence is among the better class artisans, in Glasgow as overcrowding increases the attack-rate tends to diminish. In London there is a significant association between wet years and low prevalence, but no such association obtains in Liverpool, Manchester, or Birmingham.

The Pasteur Institute of Southern India, Coonoor

THE annual report for 1931 of the Director, Major Iyengar, of the Pasteur Institute of Southern India,

which has only recently been received, states that Semple's carbolised sheep vaccine was in use throughout the year, and that 130,821 doses of anti-rabic vaccine were issued. The number of patients treated at the Institute was 545, and 8,056 persons were treated at the centres. The deaths from hydrophobia in these two groups numbered 7 and 60 respectively, giving mortality rates of 1.28 and 0.74 per cent. Hydrophobia is still very prevalent in the Madras Presidency, no less than 661 deaths from this disease being reported during 1931. The remainder of the report gives a complete analysis of the work of the Institute and of results obtained in a series of statistical tables.

Medical Radiology in Canada

THE promotion of co-operation between radiologists and physicists was discussed at a Conference which met recently at Kingston, Canada, and the formation of an 'associate committee' on medical radiology by the National Research Council of Canada was recommended. The Council was asked to maintain standards of radiation in its laboratories at Ottawa, and to construct portable sub-standards for use in treatment centres, as well as to undertake the distribution of important technical information to Canadian radiologists.

Coventry Public Libraries

THERE are seven public libraries in Coventry which are free to all who live, work or attend school in the city. It is important to have the latest textbooks in engineering and technical science in these libraries. Judging from a booklet entitled "Modern Technology" giving a list of recent books on these subjects, the Libraries Committee has to be congratulated on its selection. In the Central Library (Gulson) the standard books of reference, patent specifications, up-to-date trade returns and statistics and trade catalogues can be consulted. Information relating to local and other industries is also supplied on application, which may be made in person, by letter or by telephone.

Announcements

A COLLECTION of Stoneworts (*Charophyta*) has been presented to the herbarium of the University of Leeds by the Rev. G. R. Bullock-Webster, who has for many years specialised in this most interesting group of submerged aquatic plants, and who, in collaboration with the late James Groves, wrote a monograph of the family, which was printed by the Ray Society in 1920-24. The collection includes 42 sheets issued as Fascicles I and II, 1924, and 200 additional sheets collected in Great Britain, Ireland, France and Switzerland with a number of authors' proof plates of illustrations.

THE Buromin Company of Pittsburg, which has made wide application of molecularly dehydrated phosphates of the alkali metals in water conditioning and washing, has founded an industrial fellowship at the Mellon Institute for the purpose of investigating broadly the

properties of these chemicals and of extending their uses in the industries, in medicine, and in the home. Special attention will be accorded to 'Calgon', which is essentially sodium metaphosphate. Dr. Bernard H. Gilmore, who has been selected as the incumbent of this fellowship, started his research programme on June 15 and it is proposed to publish his findings as the researches progress.

WE have received from the Eastman Kodak Co., Rochester, New York, its leaflet "Synthetic Organic Chemicals", vol. 6, No. 4, May, 1933. In addition to a list of thirty-five organic chemicals recently added to stock, the leaflet describes the use of certain reagents for detecting platinum and palladium, with references to the original literature. Half the leaflet is occupied by a short but interesting article on the microscope as an aid to organic chemistry. An 'anti-creep' distillation flask for use with organic liquids which boil at high temperatures is also described and illustrated. The essential feature of the apparatus is the insertion of a comparatively large bulb (1 litre) in the side neck of a modified Claisen flask (3 litres) so that the vapour escapes at right angles to its entrance; the condensate returns to the distillation flask.

WE have recently received vol. 9 of the *Japanese Journal of Engineering* published by the National Research Council of Japan. This volume contains abstracts, mainly in English, of 28 papers on civil engineering, 12 on naval architecture, 14 on the technology of ordnance, 12 on metallurgy and 141 on various branches of electrical engineering. The original papers were practically all in the Japanese language and were contributed to technical societies or journals in 1929. The abstracts are often of considerable length and enable the reader to follow the work being done in engineering research in Japan. One of the electrical papers deals with the test of a 30,000 k.v.a. asynchronous condenser installed in a Tokyo substation. The condenser was not only the first of its kind made in Japan, but was also the largest of its kind built in the world.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master for chemistry, physics and mathematics at the Mining and Technical Institute and Junior Technical Day School, Pontardawe—Director of Education, County Hall, Cardiff (Sept. 5). Assistant lecturer in applied mathematics at University College, Swansea—Registrar (Sept. 5). Assistant marketing officer—Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (Sept. 11). General manager and engineer of Halifax tramways and motor omnibus undertaking—Town Clerk (Sept. 11). Public analyst for the County Borough of Bournemouth—Town Clerk (Sept. 12). A physical chemist and an engineer for service either at the Building Research Station, near Watford, or at the Road Research Laboratory, Harmondsworth—Secretary, Department of Scientific and Industrial Research (Sept. 12).

Letters to the Editor

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

X-Ray Interpretation of the Molecular Structure of Gelatine

In a recent communication¹ it was shown how X-ray studies indicate that the average dimensions associated with an amino-acid residue in an extended protein chain are of the order of $3\frac{1}{2}$, $4\frac{1}{2}$ and $9\frac{1}{2}$ Å., the first being the length in the direction of the main-chain, the second the thickness of the main-chain, and the third the lateral extension of the side-chains: it was shown also how these three quantities account for the observed average density of proteins and the weight per unit area of mono-molecular protein films. More recently² the arguments have been applied with some precision to the case of β -keratin, for which the dimensions in question are found by X-rays to be 3.38, 4.65, and 9.8 Å., respectively, while the density³ is 1.30 and the weighted mean residue weight about 115 (so far as can be estimated from available chemical analyses⁴). We can thus set out the following relation:

$$\frac{3.38 \times 4.65 \times 9.8 \times 1.30}{115 \times 1.65} = 1.06 = 1 \text{ (approx.)}$$

which is a reasonably strict demonstration of the point we wished to make, namely, that the dimensions 3.38, 4.65, and 9.8 Å. in β -keratin are on the average those of one amino-acid residue.

In general, interactions between the side-chains, both of one and the same main-chain and of neighbouring main-chains, distort the protein molecule and therefore diminish the average length of an amino-acid residue.¹ For example, we have 3.5 Å. in silk fibroin, 3.38 Å. in β -keratin, 3.3 Å. in stretched feather keratin, 3.1 Å. in unstretched feather keratin, and 1.7 Å. in α -keratin. The question now arises as to what are the fundamental dimensions per residue in gelatine (and in collagen, too, since the X-ray photographs are so similar). It was suggested¹ that the strong meridian arc, of spacing about 2.8 Å., gives the length, while the side-dimensions are roughly those of the general postulate above. From a detailed consideration of the most recent chemical analyses we are now in a position to confirm this view. The appropriate numerical relation is as follows:

$$\frac{2.84 \times 4.56 \times 10.0 \times 1.346}{96 \times 1.65} = 1.1 = 1 \text{ (approx.)}$$

X-ray photographs of wool or hair stretched in steam show clearly how the attack of water molecules is confined almost entirely to the protein side-chains², and thereby give support of a purely geometrical kind to such ideas concerning swelling and organisation as have been put forward by Jordan Lloyd⁵ and others. We have lately observed analogous effects in the X-ray photographs of a number of other proteins—details will be published in due course—so that it now seems fairly certain that the allocation of side-spacings given above is in general correct, or at least offers a valuable guide among the difficulties encountered. In particular, gelatine and

collagen show on water absorption a very marked increase in what we have called the side-chain spacing, and it is suggested here that this is the simple interpretation of the spacing changes which have been investigated systematically by Katz⁶ and others. In making the calculation given above we have used Katz's values of the spacings of nearly anhydrous gelatine, and the density (1.346) of anhydrous gelatine given by Frank (1912). The weighted mean residue weight (96) has been derived from chemical analytical data which will be discussed at length elsewhere: they are based on the results of Dakin⁷ modified so as to take account of the presence of the new amino-acid reported by van Slyke⁸. It will be seen that the calculated number of residues (1.1) associated with the chosen X-ray dimensions agrees well with the number (1) predicted.

The mean residue weight of the amino-acids in gelatine still not accounted for turns out to be about 123: this number has been derived by linking up the total nitrogen content and that of the acids found with the fact that the analytical procedure adopted makes it probable that the remaining acids are mono-amino-acids. If they are not, this only serves to bring the calculated value, 1.1, still nearer the predicted value of unity, and is therefore all to the good.

Further molecular investigations along the above lines are being continued.

W. T. ASTBURY.

W. R. ATKIN.

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University of Leeds.
Aug. 7.

¹ W. T. Astbury, *Trans. Far. Soc.*, **29**, 193; 1933: also pp. 146 and 217.

² W. T. Astbury and H. J. Woods, "The Molecular Structure and Elastic Properties of Hair Keratin" (*Roy. Soc.*, in press).

³ A. T. King, *J. Text. Inst.*, **17**, T53; 1926.

⁴ See, for example, S. G. Barker, "Wool Quality" (E.M.B., 1931).

⁵ D. Jordan Lloyd, *Biol. Rev.*, **7**, 254; 1932; "The Swelling of Proteins", p. 74 (Conference of the International Society of Leather Trades' Chemists, 1932); D. Jordan Lloyd and H. Phillips, *Trans. Far. Soc.*, **29**, 132; 1933.

⁶ J. R. Katz and J. C. Derksen, *Rec. des Trav. Chim. des P.B.*, **51**, 513; 1932.

⁷ Dakin, *Biochem. J.*, **12**, 290; 1918; *J. Biol. Chem.*, **44**, 499; 1920.
⁸ D. D. van Slyke and A. Hiller, *Proc. Nat. Acad. Sci.*, **7**, 185; 1921. *Proc. Soc. Exptl. Biol. and Med.*, **23**, 23; 1925.

The Influences of Electrical and Magnetic Fields upon 'Spin' in Gaseous Detonations

IN continuation of our researches upon the phenomenon of 'spin' in gaseous detonations, during the past year or more Messrs. R. P. Fraser, W. H. Wheeler and myself have been studying the effects of strong electrical and magnetic fields thereon, with results indicating that the 'head' of detonation is a locus of an intensive ionisation of the medium.

In one series of experiments, photographs were taken of $2\text{CO} + \text{O}_2$ detonations in a tube of 1.25 cm. internal diameter fitted with a glass section in which a strong electric field could be maintained between two electrodes—one of which was a ring-shaped silver mirror specially deposited on the inside of the tube—30 cm. apart.

In several 'blank' experiments with no field, the detonation flame passed through the glass section with a constant velocity of 1755 metres per second showing a quite normal 'spin' with a frequency of *circa* 45,000

per sec. On the same flame entering and crossing a field of 3,000 volts per cm. in the + to - direction, its velocity fell to 1,720 in crossing but rose again to 1,760 metres per sec. on leaving the field, being thus slightly retarded between the electrodes; the 'spin' was not, however, appreciably affected. But on reversing the polarity of the field, so that the flame entered by its - boundary and crossed it from - to +, not only was the 'spin' quickly and entirely suppressed, but detonation ceased, the flame speed being rapidly reduced from 1,755 to 910 metres per sec. In the last-named case, moreover, the magnitude of the effect depended on the strength of the field applied; and in other experiments decisive evidence was forthcoming that it was due to the 'field' as such and not to any discharge through the burning medium.

Experiments on the influence of magnetic fields upon the phenomena concerned are more difficult to carry out; and, inasmuch as 'time' is required before any appreciable effect can be observed, the field must be applied over a much greater length of the explosion tube than is necessary with an electrical field. Indeed the magnitude of the effect observed seems to depend both on the strength of the field and the time during which the flame is exposed to it. Thus, for example, while unable to detect any appreciable effect on applying a longitudinal field of 40,000 gauss over a length of 1.5 cm. (with a weakening field for 10 cm. on either side thereof) to a $2\text{CO} + \text{O}_2$ detonation flame—the time of passage of which through the region of maximum field-strength would be about $1/120,000$ sec. and through the whole field not exceeding $1/8,000$ sec. only—on applying a longitudinal field of about 20,000 gauss over a length of about 60 cm., there was always an appreciable fall, averaging about 60 metres per second, in the forward speed of detonation in crossing the field without, however, materially affecting the 'spin'.

We are still continuing these experiments, and extending them to other cases of gaseous detonations in which 'spin' has been observed, and before long we hope to publish full details concerning them, including what seems to us to be their interpretation and significance. Meanwhile, however, we desire through the columns of NATURE to make this preliminary announcement of our results.

I think it only due to my colleague, Mr. R. P. Fraser, to add that the success of our experiments is largely attributable to the wonderful new high-speed camera which in 1931 he designed, and with the aid of a generous grant from Nobel's Explosives Co., Ltd., of Imperial Chemical Industries, Ltd., installed for the purpose in our research laboratories, where it may be seen by anyone interested in such high-speed photography. In it an 8 lb. stainless steel mirror is revolved *in vacuo* at any desired constant speed of up to 30,000 r.p.m. and projects the image of the explosion flame on to a stationary film. Its analysing power is four or five times that of any previous instrument, being equivalent to that of a film revolving inside a camera (the former method) with a vertical speed of a kilometre per second; and it enables us to measure with precision periodic flame movements with frequencies up to a million per second.

WILLIAM A. BONE.

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Aug. 3.

Politics and Religion in India

THE comments, published under "News and Views" in NATURE of August 12, upon Mr. M. K. Acharya's evidence before the Indian Joint Select Committee, concerning the views of the orthodox Hindu upon such subjects as *Suttee*, are most welcome, for the matters dealt with are anthropological and essentially scientific. However, the statement that the 170,000,000 Hindus, whom Mr. Acharya is said to represent, are not only orthodox (and therefore 'theologically' rather than 'politically minded'!) but are, furthermore, inarticulate, requires explanation.

No one has yet succeeded in defining Hinduism satisfactorily to the many millions who answer to the name; nor do all the inhabitants of India, who are not Muslim, Jain or Christian claim to be Hindus, which is the explanation of the introduction of the strange term *animist* in the Census of India schedules. Nor are the gods of the Telegu villager those of the Mahratta country. It is, therefore, to all intents and purposes impossible to understand the intended meaning of the term 'orthodox Hindu'. However, it is quite clear that the bulk of those who put themselves forward, self-confessed, as orthodox Hindus, are not in the least unpolitically minded, or inarticulate. It must be realised that in the end any political party, appealing to sentiments of orthodox superiority in Hinduism, must be largely Brahman. The meat-eating, widow-marrying cultivator is automatically ruled out, though some Brahmans do eat meat. The village and small-town artisan are likewise to be ruled out almost entirely. The various classes of Brahman and various writing and trading castes remain. In fact, the literate classes. Mr. Acharya's support of *Suttee* cannot be bolstered up with any pseudo-scientific talk concerning 'culture'. *Suttee* is new as things go in India, and at no time has been a general practice. No amount of 'cultural' sentimentality can obscure its well-authenticated horrors.

The final reference to the superiority of the village council to any future enlargement of the franchise, is in direct contradiction to my experience, which has been fairly wide, geographically, in the sub-continent, and was acquired as an invited guest, not as a Government official. No *panchayat* which I have witnessed, compounded on a village basis, and consisting of various castes, would, or could have met, until things had come to such a pass that its judgment was a foregone conclusion. Normally a *panchayat* is merely a means of arbitration, and consequently its finding is only too frequently set aside by an appeal to the proper court on the part of the loser. Caste *panchayats* still have sway in social affairs over the good caste-man, but the evil takes a ticket to the next station and, by means of it, removes himself some hundreds of miles from the society he has offended.

Increased franchise alone can put the Indian peasant in the position of being able to control those who are supposed to represent his interests. Unfortunately, few of India's professional politicians come from villages, or care to spend a hot weather under such conditions. The enforced leisure of that season provides an excellent opportunity for talking things over. I can only say that the experience of the peasant has obviously been such that I have found myself hard pressed to defend the democratic ideals for which it is so difficult to find a substitute. Certainly there is no disguising the hard-headed, common-sense and well-intentioned practicalness of the

Deccan cultivator. I must further bear witness that in my opinion the recent undeniable advance in village opinion concerning the practical issues is of enormous significance. Congress has taught the villager non-co-operation. Unless he is given a fair hearing the weapon will assuredly prove a boomerang to those who will have to accept responsibility for the governance of the new India. The problem is: Who is to speak for the villager? Exactly how much, or how little, do we know of rural India? Is anyone qualified to clothe the official statistics with life and individuality?

Anthropology is the knowledge of *life as it is lived*, which is also the only foundation for sound politics.

K. DE B. CODRINGTON.

Claire Cottage, North Road,
Highgate Village.
Aug. 13.

Summation Methods in Noise Problems

THE method of assessing the overall loudness of a complex noise by taking into account the frequencies and amplitudes of the component notes, and weighting and summing them, by calculation or instrumentally, has always been open to the suspicion that it may not apply to all types of noise. This suspicion has been confirmed as a result of noise measurements on electromagnetic apparatus such as transformers. Apparatus of this type constitutes a special case, as all the components have frequencies which are harmonically related. In contrast to this, the frequencies of the components of most other noises have no such special relation, being distributed irregularly over the audible range. This relation often exists, however, between a few components of other types of noise, such as that emitted by rotating machinery.

Source of Noise	Equivalent 800-cycle level in decibels above threshold		Difference
	Calculated	Measured	
Geared Turbo Alternator Set, 225 kw.	89.8	91	1
A. C. Motor, 120 h.p., 1,500 r.p.m.			
No load	79.1	84	5
Full load	82.2	89	7
Transformer, 110 kva., 3-ph. 50 cye es	45.2	76	31
" 150 " " " "	57.8	86	28

With the object of investigating the validity of the summation methods as applied to engineering noise problems, summation measurements have been made on typical noises and the values compared with those obtained by direct aural comparison with an 800-cycle reference tone. The same effect has been observed with reference tones of other frequencies.

In the summation method the procedure was as follows. The components of the noise were determined by an accurate sound analyser giving acoustical pressures in absolute units. The levels of the components in decibels were then calculated in terms of their respective threshold pressures¹. These levels were then converted to a common 800-cycle basis, using Kingsbury's equal loudness relations. The energies of these equivalent components were then summed and expressed in decibels above the 800-cycle threshold. In the reference tone measurements a pure 800-cycle note of adjustable amplitude was applied to one ear by means of a telephone receiver and the other ear turned towards the noise under observation. The results in the accompanying table are typical of those obtained.

It is seen that in the first example, in which there are no special relations between component frequencies, there is close agreement between the two methods. In the case of the induction motor examples there are known to be a few harmonically related components and the agreement, while substantial, is not so good. However, in the case of a transformer, where all the components form a harmonic range having a fundamental frequency of 100, there is marked disagreement. The reason for this peculiarity of the harmonic range is not known with certainty but it is probably associated with the non-linear response of the ear, which gives rise to subjective sum and difference tones. There is clearly the possibility of the reinforcement of physically existing components by subjectively formed tones of the same frequencies, giving a directly additive effect. Where no such relation exists, the subjectively formed tones are not directly additive to those already present and so have a minor effect. It is hoped to discuss this matter in more detail elsewhere.

B. G. CHURCHER.

A. J. KING.

H. DAVIES.

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Manchester.
July 25.

¹ NATURE, 131, 760, May 27, 1933.

A New Spectroheliograph and Spectroheliograph

THE spectroheliograph of Dr. G. E. Hale¹ allows one to observe in the light of a single spectral line the extremely rapid variations occurring on the sun's surface. But this spectral line has to belong to the visible region of the solar spectrum. (*H α* especially is used.) The spectroheliograph on the other hand allows one to photograph solar phenomena in the light of any photographically active spectral line, but it is not able to record the very rapid changes.

In the apparatus which I have designed, the light emitted by the sun, instead of producing the observable image itself in the monochromatic light of the spectral line chosen, controls only by way of electro-optical methods, as used in the technique of television, the light of a second artificial light-source.

The image of the sun produced by a sufficiently powerful optical system is divided into a grid of little surface elements by the help of a rotating wheel, say, a 'Spiegelrad'. The white light modulated in time by this device passes through a monochromator of large dispersion. The monochromatic light leaving its second slit enters a photocell, the currents from which, after being amplified, act on a Kerr cell. This latter controls the light of an artificial light source of any intensity and colour suitably chosen for visual observation or photographic record. The light of this source, thus varying synchronously in intensity with the light-beams entering and leaving the monochromator, may be recombined by means of a second or the same rotating wheel arrangement to form an image which represents the structure of the sun's surface in the monochromatic light chosen.

A detailed theory of this apparatus has been worked out.

In this way the sun's surface may be made visible in the monochromatic light of a spectral line, even

if this line should belong to the invisible region of the solar spectrum, as in the case of the important *H* and *K* lines of ionised calcium. The rapid movements may also be recorded by instantaneous photographs or by moving-picture exposures.

A. H. ROSENTHAL.

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¹ G. E. Hale, *Astrophys. J.*, **70**, 265, 1929; **71**, 73, 1930; **73**, 379, 1931; **74**, 214, 1931.

Structure of the Crystals of 12-Phosphotungstic Acid

IN a recent communication¹, the structure of the molecule of 12-phosphotungstic acid was described. The formula of the acid was found to be $H_3PW_{12}O_{40} \cdot nH_2O$. This structure was worked out from powder photographs of the partially dehydrated acid, containing 6 or 7 molecules of water per molecule of acid, which is obtained by drying the more highly hydrated crystals to constant weight over P_2O_5 in *vacuo*.

The structure of the crystals of 12-phosphotungstic acid, which crystallise from aqueous solutions at room temperature as colourless octahedra, has since been investigated. Chemical evidence indicates that this hydrate contains 30 molecules of water per molecule of $H_3PW_{12}O_{40}$. The powder method was again used. The structure is cubic, the edge of the unit cube being 23.281 ± 0.002 Å. There are 8 molecules of acid in the unit cube, the centres of the acidic anions being arranged in positions corresponding to the diamond structure. Comparison of observed and calculated intensities of reflection proves that this hydrate also is composed of the anions $PW_{12}O_{40}^{3-}$ which were described recently in NATURE. This work will shortly be published in more detail.

J. L. Hoard² has recently published an investigation of the structure of similar hydrates of some salts of the 12-phosphomolybdic and 12-silicomolybdic acids. He was able to show that the unit cell is cubic, with an edge of approximately 23 Å., containing 8 molecules. He also suggested, as a possibility, the diamond-like arrangement of the units which I have confirmed, but he was unable to find a structure for the acid radical which would explain the experimental results.

J. F. KEGGIN.

The University,
Manchester.
Aug. 1.

¹ NATURE, **131**, 908, June 24, 1933.

² J. L. Hoard, *Z. Krist.*, **84**, 217; 1933.

Measurement of Frequency of Longitudinal Vibration of a Steel Wire by Magneto-Striction Effect

IN a recent investigation of the relationship of stress and magnetic permeability for steel wires, the following experiment was made.

A steel wire $\frac{1}{4}$ in. in diameter was suspended in a solenoid, the upper end of the wire being rigidly fixed. A search coil of 3,100 turns surrounded the wire and was arranged at the middle of the solenoid, which was excited with direct current, the magnetic intensity in the neighbourhood of the search coil

being 68 gauss. The search coil was connected in circuit with an oscillograph through a valve amplifier. When the wire was stroked by means of a resin-coated piece of soft leather, longitudinal vibrations were set up and the oscillogram reproduced as Fig. 1 shows a record of these vibrations. The sine curve which is also shown in Fig. 1 was obtained from a 50-frequency supply and provides the time scale. It is found from the oscillogram that the frequency of the longitudinal vibrations is 626 cycles per second. The free length of the wire was 204 cm.

For the gravest mode of longitudinal vibration of a wire which is clamped at one end the frequency is related to the velocity of sound *c* by the expression $f = c/4l$ cycles per second where *l* is the length of the wire.

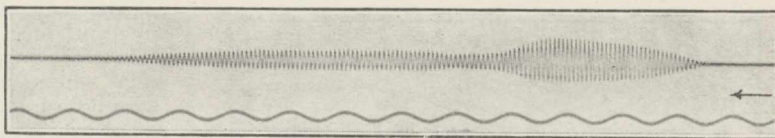


FIG. 1.

By substituting $f = 626$ in this formula, it is found that $c = 5,110$ m. per sec., that is 16,800 ft. per sec. Since the velocity *c* is related to Young's modulus by the formula $c^2 = E/\rho$, where ρ is the density, it is found that $E = 2.05 \times 10^{12}$ dynes per sq. cm. or 29.5×10^6 lb. per sq. inch.

It is hoped that a detailed account of this investigation of the relationship between stress and magnetic permeability will be available for publication shortly.

T. F. WALL.

Department of Electrical Engineering,
University, Sheffield.
July 12.

Influence of a Magnetic Field on a Glow-Discharge

IN continuation of the work on the intermittent emission of the anode spot in a neon tube¹, we have been studying the effect of a longitudinal magnetic field on the glow discharge, in the case of helium as well as neon.

We found that, within a certain range of pressure, both the cathode glow and the anode spot increased their intensity considerably when subjected to a magnetic field, and, further, the use of a falling-plate camera has shown that the number of stronger flashes shot out from the anode spot per unit time was thereby greatly increased².

An interesting change takes place at the anode of a helium tube, namely, the sudden appearance of a bright pink-coloured ring around the anode spot as soon as the magnetic field is applied.

The experimental arrangements were nearly the same as before, except that each of the electrodes, or at times the anode part only, was placed between the gap of a large electromagnet giving fields up to a few thousand gauss.

A photograph of the discharge taken with 1/15 sec. exposure is reproduced in Fig. 1. The distance between the electrodes was 11 cm., the diameter of the tube being 4 cm. The pressure of helium was 35 mm., and the field strength, which was fairly uniform along the axis of the tube, was about 1,800 gauss. The current in the tube, supplied from a 2 kw. direct-current generator, was 185 ma. with a terminal voltage of 425 volts.

The intense spot in the middle of the ring is the anode spot, while the cathode glow is only partly shown at the other end. The difference in colour at different portions of the discharge tube was most characteristic, both the anode spot and the straight glow proceeding from it being yellow, the cathode glow yellow mixed with pink, while the ring at the anode was bright pink.

The interesting feature of the experiment is that a spectrographic study has shown that whereas the anode spot gives mainly the atomic (line) spectrum of helium, the pink ring is very rich in the molecular (band) spectrum of helium.

It has been known that the band spectrum of helium comes out strongly when a condensed discharge is passed through a helium tube having a fairly wide bore and filled at the proper pressure,

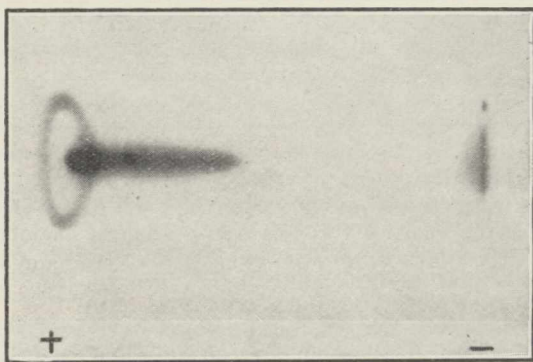


FIG. 1.

or in the cathode glow of a D.C. discharge where the yellow colour of helium is mixed with pink, but the present case of the appearance of a pink ring, only when the magnetic field is put on, seems to be novel and may provide us with another way of getting a fairly strong source of light for the study of the band spectrum of helium.

Details of the experiment will be published soon in the Scientific Papers of this Institute.

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T. SUGA.
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The Institute of Physical and
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July 12.

¹ T. Takamine, T. Suga and A. Yanagihara, *NATURE*, **131**, 584, April 22, 1933.

² T. Takamine, T. Suga and A. Yanagihara, *Sci. Pap. Inst. Phys. Chem. Res.*, **425**, 26; 1933.

Lattice Distortion and Fibre Structure in Metals

IN recently published work¹, I have shown that the cold-working of most metals produces, first, a stage of crystal disruption which is accompanied by growth of lattice distortion, and then, after the lattice distortion limit is reached, the second stage in which the crystallites take up a preferred orientation. Normally, therefore, a metal which possesses this fibre structure also exhibits lattice distortion.

It is now found that as the temperature of the metal is raised, the removal of lattice distortion takes place prior to the removal of fibre structure; and that this intermediate state, in which fibre structure exists to the exclusion of lattice distortion, persists as the metal is slowly cooled.

The observation may explain the unsuccessful

attempts of many workers to establish a relation between the changes in properties induced in a metal by cold-working and the onset of fibre structure. For the properties of a metal which possesses a fibre structure will differ according to the presence or absence of lattice distortion. Thus, in the present cases, disappearance of distortion was accompanied by marked diminution of the work-hardening, although the fibre structure remained. Also, the work modifies a common assumption² by showing that the state of fibre structure does not necessarily represent a state intermediate between that of the normal metal with its randomly oriented grains, and that of the large metallic crystal. The properties of the fibre structure state are, normally, bound up with the presence of a marked lattice distortion from which the large perfect crystal is free.

Lattice distortion is used here to denote the factor which produces diffusion of the X-ray spectral lines, as in the case of cold-worked copper, and also that which causes an abnormal weakening of the relative intensity of high order spectra, examples of which are provided by aluminium and nitrided steels.

W. A. WOOD.

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Teddington, Middlesex.
July 31.

¹ *Phil. Mag.*, **14**, 656; 1932.

² For example, Drier and Eddy, *Trans. Am. Inst. Met. Eng.*, p. 140; 1930.

Photoelectric Absorption of γ -Rays by Heavy Elements

THE photoelectric effect for γ -rays in heavy elements has not yet been treated satisfactorily, as it has always been found necessary to assume that $Z/137 \leq 1$, where Z is the atomic number, or else that the wave function of the photoelectron could be replaced by that of a free electron. These approximations render the result rather uncertain, and, in view of the problem of nuclear absorption, it is very desirable to have some calculation of the photoelectric effect without any uncontrolled approximation.

It is possible to do this by analysing the plane wave, representing the γ -rays, into its component spherical waves. These waves induce transitions to final states where the electron is free and the state characterised by an azimuthal quantum number k . The integrals representing the number of electrons in each state may then be calculated numerically by an extension of the method used in calculating the internal conversion coefficient of RaC .¹

The numerical work is considerable, and so far only one case has been treated—that for $h\nu = 11.3 \times 10^5$ e.v., $Z = 84$. We find for the coefficient of absorption

$$\tau = 4.0 \times 10^{-24} \text{ cm.}^2 \text{ for the } K\text{-shell.}$$

To compare this with experiment we shall use the result that τ per K electron $\sim Z^4$ approximately.

This gives for lead

$$\tau \text{ } K\text{-shell} = 3.6 \times 10^{-24} \text{ cm.}^2 \text{ (theoretical)}$$

The experimental value, *per atom*, taken from L. H. Gray's empirical formula² is

$$\tau \text{ per atom} = 4.9 \times 10^{-24} \text{ cm.}^2$$

The chief difficulty in comparing the two is to know what fraction of the absorption is due to the K -shell. Rutherford, Chadwick and Ellis³ state that the L electrons absorb between $\frac{1}{4}$ and $\frac{1}{5}$ as much as the K electrons, and we shall assume here that about $\frac{1}{4}$ of the total absorption is due to K electrons, as the relative importance of the outer electrons seems to

increase with Z , at any rate, in the X-ray region. This gives

$$\tau \text{ K-shell} = 3.9 \times 10^{-24} \text{ cm.}^2 \text{ (experimental)}$$

The agreement is very satisfactory, considering the nature of the experimental data.

It is hoped to calculate further values of τ for this and other values of Z .

J. McDUGALL.

Cambridge.

H. R. HULME.

Aug. 3.

¹ H. R. Hulme, *Proc. Roy. Soc., A*, **133**, 643; 1932.

² L. H. Gray, *Proc. Camb. Phil. Soc.*, **27**, 103; 1931.

³ "Radiations from Radioactive Substances", p. 464.

Limnocoidea rhodesiae and its Distribution

WHILE resident in Johannesburg, South Africa, we often made inquiries regarding the possible occurrence of the interesting medusæ belonging to the genus *Limnocoidea* in the subcontinent, and searched many rivers, dams, ponds and pools for them. On personal visits to various parts of Southern Rhodesia in 1920 and 1927, unfortunately, specimens could not be obtained. However, at Hartebeestpoort Dam, on the Crocodile River, the chief tributary of the Limpopo, about 22 miles from Pretoria, Transvaal, on March 23, 1926, at the end of the summer season, one of us found three medusæ, 18–20 mm. in diameter. These specimens we considered to be *Limnocoidea rhodesiae*, Boulenger.

In September and October, 1931, we were fortunate in receiving definite information of the occurrence of jelly-fish in the Prince Edward Dam on the Hunyani River, a tributary of the Zambesi, near Salisbury, Southern Rhodesia. Our informant was Mr. G. A. Stewart, the engineer who had recently built the dam. Mr. Stewart came to see one of us at the South African Institute for Medical Research, Johannesburg, inquiring whether the medusæ would be deleterious to the stored water, and promised to obtain specimens for us. Thirty medusæ were duly dispatched from Salisbury on October 18, 1931, and reached us in good condition.

On October 26, 1931, Mr. Stewart wrote us as follows:—"As promised, I have pleasure in sending the sample of jelly-fish from the Hunyani River, Prince Edward Dam, Salisbury. This dam was built recently under the instructions of the writer: has a capacity of approximately 500,000,000 gallons: it is situated in a granite country: the flow of the river is large and is practically perennial. The presence of this form of life was brought to my notice by the Town Engineer while on a visit to Salisbury in September and I immediately proceeded to the Dam and endeavoured to obtain specimens but in a 3 hour search I failed to do so, although I saw a few in the water at different places. It appears that at certain times of the day, not always the same time, they all descend to the bottom, whereas at other times they appear in myriads at the surface in certain of the bays of the reservoir. From what I saw they appear to be of various sizes and resemble floating Marguerites but exhibited the action and form of marine jellyfish."

We examined the medusæ and reported to Mr. Stewart on November 7, 1931, that the medusæ were almost certainly *Limnocoidea rhodesiae*, though we regretted that some of the relevant references in literature were not easily accessible to us in South Africa. One of our colleagues, who saw these specimens, informed us that he had seen similar organisms in ponds in the Bezuidenhout Valley, Johannesburg, and another colleague in 1932 re-

ported that he had seen medusæ in pools in the neighbourhood of Waterval Onder, Transvaal. Further, early this year, while one of us was still a member of the staff of the South African Institute for Medical Research, medusæ from a fish pond in the Bezuidenhout Valley were sent to the Institute for identification.

Since our arrival in Montreal, with the magnificent facilities of the Blacker Library of Zoology at McGill University at our disposal, we have been able to obtain the scattered literature on the subject, to compare our results with those of previous workers, and an illustrated account has been prepared by us. So far as we can find, very little has been written on *Limnocoidea* since 1915 and no new species recorded since 1912.

Limnocoidea rhodesiae examined by us from Hartebeestpoort Dam and from the Hunyani River were much the same in appearance and dimensions. The range of diameter of the umbrella of preserved specimens was 13–25 mm., the majority being 18–20 mm. The depth of the umbrella varied from 3.5 mm. to 5.5 mm., most being about 4 mm. in depth. The manubrium was characteristically short and varied in diameter from 9 mm. to 15 mm. The mouth was wide open in all specimens. Four radial canals and a circular canal were present in all the medusæ. The tentacles varied in number from 24 to 96 in quadrants of different specimens; this latter number is greater than previously described for the species. The perradial tentacles were long, varying (when straightened) from 12.5 mm. to 25 mm. in length. The interradials and adradials were nearly as long as the perradials. Tentacles of the fifth and succeeding orders were shorter, those of the eighth order being very small and difficult to count. The bases of the tentacles had characteristic basal swellings, the so-called tentacle bulbs, but the bases of the larger tentacles were not deeply embedded in the jelly. The sense organs were crowded, two to each of the larger and one to each of the smaller tentacles, the smallest ones being devoid of them. Batteries of nematocysts occurred on the tentacles and the narrow nettle ring was crowded with them. The gonads, which presented a fluted appearance, were manubrial and all the specimens, on microscopical examination, proved to be females. Manubrial bud-formation was not common.

A species of *Trichodina* was found on some of the medusæ.

The specimens of *Limnocoidea rhodesiae*, which we have received and examined from Prince Edward Dam, came from relatively near where C. L. Boulenger's type specimens¹ were collected in 1908, the localities being within the Zambesi system. Arnold² in 1913 obtained specimens from the Norquane River, in the Bembezi district, near Bulawayo, the river running southward into the Limpopo system. Our South African specimens from Hartebeestpoort Dam also occurred in the Limpopo drainage area, the dam being on the Crocodile River, which flows northward into the Limpopo. A further locality for the medusæ in the Union of South Africa is the Bezuidenhout Valley.

It may be of interest to note that all the aforementioned localities, from which *L. rhodesiae* has been collected, occur at altitudes of 4,500–5,800 ft. Specimens of this medusæ have been observed in the summer season of the southern hemisphere, in the months of September–March, and the rains occur during this period.

Two other species of *Limnocnida*, namely, *L. tanganicae* occurring in Lake Tanganyika, Victoria Nyanza and the River Niger, and *L. indica* in the Krishna Valley in the Western Ghats, have been recorded. Extending a suggestion of G. A. Boulenger, apparently supported by Cunningham and Annandale, it is possible that the three species may prove to be varieties of one species, which inhabited a sea connecting Africa and India in Middle Eocene times.

Department of Zoology,
McGill University,
Montreal, July 8.

H. B. FANTHAM.
ANNIE PORTER.

¹ C. L. Boulenger, *Quart. J. Micro. Sci.*, **57**, 427.
² G. Arnold, *NATURE*, **91**, 111, April 3, 1913. G. Arnold and C. L. Boulenger, *Proc. Zool. Soc. Lond.*, **71**; 1915.

Adaptability of the Natal Crawfish

IN connexion with the South African Marine Biological Survey carried out off the Natal coast, while operating at Station 770 on August 12, 1925, fifty-three specimens of *Palinurus Gilchristi* were obtained. Three individuals (males) were brought into Durban harbour alive, and put into a wire cage which was lowered to a depth of approximately 2 fathoms. (This obviated the need of constantly changing the water.) The cage rested on the bottom and at regular intervals the crawfish were fed and examined. (The food consisted of fish.) The behaviour of the specimens throughout a period of almost two months appeared to be perfectly normal. The colouring of the shell and eyes, however, appeared to have undergone slight changes.

Certain chemical and physical observations were conducted and the comparatively wide variations of certain conditions of life are of interest.

The actual depth where the specimens were obtained was 209 fathoms, and the bottom consisted of dark green mud. These crawfish are only found in certain areas in depths of 150–250 fathoms. At a depth of 200 fathoms in sea water of average salinity, the pressure is approximately 36 atmospheres (500 lb.) per square inch. The hauling up of the net from this depth, that is, 200 fathoms, took approximately twenty minutes, and was done in one direct haul.

At depths of the order of 200 fathoms there is a noticeable diminution of red rays. Also the intensity of the light is considerably affected. Where the captive specimens were kept, they were exposed to the full intensity of the morning sun, through a depth of twelve feet.

A series of observations on the temperature, salinity and hydrogen ion concentration were conducted near the floor of the ocean in the immediate vicinity of where the crawfish were obtained and also in the harbour.

The average figures obtained are shown in the accompanying table.

Depth	Depth of water samples	Bottom	Temp. °F.	Salinity, parts per thousand	pH
212 fathoms	185 fathoms	Green mud	51.3	35.35	7.97
2 „	Surface	Sand	71.1	35.66	8.25

On October 3, as the ship was proceeding to Cape Town, the specimens were taken out of the cage and placed in a large galvanised iron tank on board. The water was changed every four hours throughout the voyage. Owing to stress of weather and engine

defect, the ship was delayed for thirteen days at East London. Here the crawfish were again placed in the cage and lowered over the side. On October 18, the ship resumed her voyage and the specimens were again placed in the tank. On October 19, the ship encountered heavy weather and the tank containing the specimens was damaged. Two of the specimens were washed overboard, the one remaining being found in the damaged tank. It was probable, however, that this specimen had been injured. On October 25, this specimen died.

Two specimens of the crawfish were under observation for 59 days, and one specimen for 65 days.

It is highly probable that the specimens would have survived a considerably longer period if it had not been for misadventure.

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Stereochemistry of the Free Triarylmethyl Radicals: A Totally Asymmetrical Synthesis

THE problem of the steric configuration of the free triarylmethyl radicals is as old as the discovery of the radicals itself. In spite of many attempts, no experimental evidence has been brought until the present to show whether the valencies of the free radical are directed towards the basis of a pyramid or whether they lie on a plane.¹

Many years ago, one of us² tried to prepare an optically active triarylechloride with the intention of proving the possibility of the existence of optical activity in the free radical itself. The attempts did not succeed.

In a systematic investigation on this subject, it is now possible by means of illumination of asymmetrical triarylmethyl radicals with circularly polarised light to activate one of the two antipodes so that by the addition of chlorine optical activity appears.

Phenyl-ethylphenyl-methylphenyl-methyl was exposed to circularly polarised light of wave-length 4300 Å., while diluted chlorine was led to the illuminated parts at a temperature of 0°. We observed the appearance of an optical rotatory power of 0.1°.

In the case of the phenyl-biphenyl- α -naphthylmethyl which was treated in the same manner, an activity of 0.2° was observed. By illuminating the last radical with 5890 Å., the wave-length of the corresponding absorption band in the red region of the radical, the opposite optical activity was created. This is in agreement with the fact that the anisotropic factors of the different absorption bands may have an opposite sign.

These results make it clear that the three valencies of the carbon atom of the radical *do not lie on a plane*. By these experiments an example is provided of a completely asymmetrical synthesis of an optically active substance from inactive material by means of circularly polarised light.

The apparatus used and the theoretical conclusions drawn from the experiments will be described in detail shortly.

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July 22.

¹ Wallis, *J. Amer. Acad. Sciences*, 1929.

² G. Karagunis. Dissertation, Freiburg i. B., 1926. "Über Einige asymmetrische Triarylmethyle."

Research Items

Excavations at Tepe Hissar, Persia, 1931. The work of the joint expedition of the University Museum and the Museum of Art, Philadelphia, at Tepe Hissar, near Damghan in northern Persia during the season of 1931 is described by Dr. E. F. Schmidt, with numerous illustrations in the *Museum Journal* (Philadelphia), 22, No. 4. The Damghan region contains a number of occupation sites, but, so far as at present ascertained, the only prehistoric site is Tepe Hissar. Three phases of culture were distinguished in the period of occupation, which, as equated with the contemporaneous culture epochs in Mesopotamia, extend from the early Sumerian to early Kassite times, or in Anatolia from the Red Pottery Age to the consolidation of the Hittite Empire. Occupation ceased at about the middle of the second millennium B.C., when Period III abruptly came to an end, and the site was unoccupied for about two thousand years until the palace of a Sassanian noble was erected on the marginal debris of the ancient towns. Stratum I was sounded in platforms cropping out from below the later deposits. It is characterised by wheel-made painted pottery, and already belongs to the metal age, as is indicated by daggers, points and pins. Many stone objects were still in use. The pottery is decorated with simple geometrical designs and conventionalised animal designs. Great numbers of seal-shaped ornaments are characteristic. The burials were contracted, and in all periods adorned with an incredible number of small beads. In Stratum II a foreign grey ware displaces the painted pottery; but Period I forms persist, though the decoration disappears. Metal work increases, copper mace-heads, nails, bracelets and anklets of wire appearing. Period III appears to grow out of Period II, but with the addition of western culture traits. Tentatively this period is attributed to the first half of the second millennium B.C. Silver vessels are found only in this stratum, and, with them, exquisitely moulded vessels of alabaster and other stone. Copper seals show elaborate patterns and cylinder seals point to a connexion with the west. Animal figurines faithfully represent the originals. Conventionalised female effigies are also found. The mortuary equipment of certain graves is lavish and suggests a dominant social caste.

Peruvian Gastropods. An interesting small collection of land snails has been described by Henry A. Pilsbry ("South American Land and Freshwater Mollusks, 8: Collections of the Carriker-Roberts Peruvian Expedition of 1932". *Proc. Acad. Nat. Sci. Philadelphia*, 84, Dec. 1932). These are mainly from the Carriker-Roberts Peruvian expedition but a few species are included from other sources. Some rare and new species were obtained. All the regions investigated are little known and one of them, along the Rio Jelashte stream, is uninhabited and unexplored. The new genus *Newboldius* is proposed for certain rare and handsome Peruvian Bulimuloid snails allied to *Drymaeus*, the type *Newboldius inca* from south eastern Peru being a fine shell with wrinkled whorls. In this case, as in a few of the other species described, some of the internal organs could be made out by soaking the dried-up animal, and the form of the radular teeth was determined. There are three species of *Newboldius* so far known and all apparently live on trees, the dark coloration and

rough surface enabling them to be well hidden when on the bark. *Drymaeus varians* (Brod.) was collected on cacti and scrubby dry-country vegetation at 6,000 ft. There were many colour varieties, browns, pinks and yellows with streaks and stripes and many specimens. It would be instructive if snails from these little-known regions could be brought back alive. Too many are only described from the shells.

Structure of Enchytræids. S. Hrabě (*Publ. Fac. Sci., Univ. Masaryk*, 1932, p. 159) gives an account of his observations on the structure of the buccal region, pharynx, septal glands and sympathetic nervous system of enchytræid worms, especially of *Enchytræus albidus*. The various opinions of different authors on the structure and function of the septal glands are explained by the fact that the structure of the glands has not hitherto been studied in correlation with the feeding of the worms. The glands are sacs formed of a single layer of pyriform cells the 'stalks' or ductules of which are towards the lumen of the gland. The nuclei of the cells have large nucleoli and are poor in chromatin; the cytoplasm stains so deeply with hæmatoxylin as to suggest the presence therein of extra-nuclear chromatin, but the Feulgen reaction gives a negative result. In young worms, neither in the centre of the gland nor in the ductules is there any secretion. When morsels of bread are put on the soil the worms swallow them, and five hours later the ductules of the gland cells and the lumen of the gland are full of granular secretion which is also found in the pharynx. The nervous system of the pharyngeal region is described in detail, including a pair of nerves which pass from the cerebral ganglia dorsal to the pharynx into a pair of post-pharyngeal ganglia previously interpreted as reduced proto-nephridia.

Self-Sterility in Red Clover. Self-incompatibility in red clover is the subject of an interesting investigation by Messrs. Williams and Silow (*J. Genetics*, vol. 27, No. 2). Using a local variety, Montgomery late-flowering red clover, they find seven allelomorph self-sterility factors which produce their effects by inhibiting the growth of pollen tubes in the style. The conditions are very similar to those described by East in *Nicotiana*, but self-sterility is almost absolute and pseudo-fertility seldom occurs. Also as in *Nicotiana* a self-fertility factor is found. This originated in the clover experiments, apparently as a mutation from a cross between two self-sterile parents, the sterility gene having lost its inhibitory potency. It has been found that in any self-incompatible combination the pollen tubes grow at the normal rate for more than half the length of the style and then undergo sudden retardation to an extremely slow rate of growth, so that fertilisation fails to take place before the flower withers. In the self-fertile plant and its descendants this inhibition does not take place. When crossed with a self-sterile plant, four genotypes are produced in equal numbers, two of which are self-sterile and two self-fertile. Probably the species of red clover as a whole will be found to contain a far higher number of self-sterility factors.

Camptostroma, a Lower Cambrian Floating Hydrozoan.—Under this title R. Ruedemann (*Proc. U.S. Nat. Mus.*, 82, Art. 13, 1933) describes two specimens

from the Lower Cambrian of Pennsylvania and one specimen from that of New York, for which he establishes a new genus with two species. The specimens are only moulds or impressions, but are enough to indicate a sub-circular concavo-convex body 45–75 mm. in diameter, with an outer coat strengthened by spicules of uncertain chemical composition, and an interior possibly of jelly (mesoglea) containing air-spaces. The spicules build up a structure reminiscent of the surface of the Palaeozoic stromatopores or the more recent hydrocorallines. The disc-like body is surrounded by a ring of radiating ribs with granular surface. Dismissing an obvious resemblance to sponges and to certain echinoderms, Dr. Ruedemann compares the fossils with the strange Devonian *Paropsonema* of New York and the Ordovician *Discophyllum*, both of which he regards as floats of Hydrozoa, probably siphonores. From these also *Camptostroma* differs and seems to present closer resemblances to the tubularian hydroids. Dr. Ruedemann suggests that it was a colonial stock of primitive character, which had not yet progressed from the floating pelagic habit to the fixed benthonic—had not yet discovered the sea floor. It is to be hoped that more of these obscure, and therefore interesting, fossils will be discovered now that attention has been directed to them.

The Hutton Coal Seam, Durham. The Fuel Research Section of the Department of Scientific and Industrial Research has published a paper, No. 27 of the Physical and Chemical Survey of the National Coal Resources (Pp. vi+126+3 plates. London: H.M. Stationery Office, 1933. 2s. 6d. net), being an account of the Hutton seam. There are, in County Durham, two separate and distinct Hutton seams, one in the Wear area and the other in the Pontop district, which has been called the Pontop Hutton. It is a curious coincidence that at practically the same time, two papers were read before the North of England Institute of Mining and Mechanical Engineers, one, on the "Correlation of the Northumberland and Durham Coal Seams", by Dr. Hopkins, the other, by Dr. Raistrick and Mr. Simpson, suggesting a new method in this district, which has, however, been successfully applied in other parts, namely, the identification of seams by coal microspores. It has not yet been proved with certainty that this method will in every instance be applicable, but it would be interesting to have it applied as promptly as possible to the Hutton seam. In any event, the report is an exceedingly valuable one, and shows that the Wear-Hutton, with which the report is mainly concerned, is a very valuable and useful coal.

γ -Rays of the Volcanic Tufa of Naples. The electrical phenomena of the atmosphere of Naples and its neighbourhood present certain peculiarities, which have long been the subject of study. The work carried on by Palmieri at the Naples Institute of Terrestrial Physics has been continued by Rizzo, to whom it appeared that the peculiarities referred to might depend, partly at least, on the action of the radioactive substances contained in the volcanic products widely distributed over this whole region. In the *Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche* of Naples for 1932, Rizzo gives the results of measurements of the intensity of the γ -radiation in a chamber situated at a depth of 20 metres in the volcanic tufa on which stands the San Marcellino building of the University of Naples. The

intensity of the penetrating radiation is found to be 19.43 J, which indicates greater penetration than that of the pitchblende of St. Joachimstal. Comparison of this value with the intensity of the radiation traversing an iron screen gives for the coefficient of absorption referred to unit mass $(\mu/\rho)_{Fe} = 0.0416$. From this result the conclusion is drawn that such radiation is due partly to thorium-C.

Solar Radiation Measurements at Poona. The observations made by S. S. Kohli in "Solar Radiation Measurements at Poona in 1931", published as Part 10 of vol. 20 of *Memoirs of the Indian Meteorological Department*, fall into two groups: (1) measurements of solar radiation at normal incidence made with an Ångström pyrheliometer, both without any filter, and with a Schott red filter F 4512, 2 mm. thick; and (2) measurements of total energy received from the sun and sky on a horizontal surface with the aid of a Callendar pyranometer. Both instruments were installed on a tower of the Poona Meteorological Office, and were in action from March 1931 until February 1932. The difficulties of estimating for various angular elevations of the sun the different losses to which solar radiation directed towards the earth's surface is subject, for example by scattering and absorption by air molecules, by water drops, dust haze, smoke particles, etc., and absorption by water vapour, are present in all countries. Mr. Kohli has a good deal to say about them at Poona, and about their various seasonal variations corresponding with monsoonal changes in the general drift of the wind there. As an example of the latter, the ratio of red to total radiation shows minimum values during the prevalence in summer of south-westerly winds from the sea, as these bring moisture that absorbs the red more than the shorter waves. The low latitude of Poona ($18^{\circ} 30' N.$) gives an added value to the measurement, because such measurements have not been made so much in the tropics as in higher latitudes. The results have been compared with similar figures for other regions, for example, Egypt, Java, Germany.

Displacement of the Crust near Ito, Japan. During the first half of the year 1930, the town of Ito and the surrounding district on the east coast of the Idu peninsula were visited by an unusual number of small earthquakes, the total number felt at Ito from February 13 until August being more than 4,880 (NATURE, 126, 326 and 971; 1930). Precise levels were run three times during 1930 along a line about twenty-five miles in length close to the east coast of the peninsula. At the end of 1930, the greatest upheaval (close to Ito) was 220 mm. or 8.7 in. Early during the present year (ending on March 16), a fourth line of levels was carried out, the results of which, compared with the preceding series, have been worked out by Prof. C. Tsuboi (*Proc. Tokyo Imp. Acad.*, 9, 258–261; 1933). The curve that represents the displacement of the crust during the interval of two years is similar in form to its predecessors, the greatest uplift being 137 mm. or 5.4 in. in the immediate neighbourhood of Ito. As the region has been almost free from earthquakes since 1930, it follows that there is here no apparent connexion between seismic activity and rate of crustal deformation.

Nuclear Disintegration. Lewis, Livingston, and Lawrence (*Phys. Rev.*, July 1) have used in their high-speed ion apparatus hydrogen enriched in the isotope

H^2 , and have studied nuclear disintegration by the ion H^1H^2+ . This ion behaves as a combination of a proton with an H^2 nucleus which the authors call a deuteron. Striking results were obtained from lithium and from nitrogen used as NH_4NO_3 . From lithium, particles were obtained with a range of 14.5 cm. corresponding to an energy of 12.5×10^6 volts. A possible formulation of the process is $Li^6 + H^2 \rightarrow 2He^4$ —this giving an approximately correct energy balance. An alternative possibility is that the process involves Li^7 with the emission of a neutron. Nitrogen yielded α -particles for which no satisfactory explanation was found. From beryllium, particles were obtained with range similar to those excited by protons, though the ion efficiency was much higher. The authors suggest that the processes in these cases may be the disintegration of the unstable Be nucleus without capture of the bombarding particle. The authors also observe the production of protons of about 18 cm. range when their molecular ions strike any target whatever, and they suggest that the H^2 nucleus may break up into a proton and a neutron. If this is correct, the energy balance requires a lower mass for the neutron than that estimated by Chadwick.

The Molecular Weight of Erythrocrurin. The investigations of Svedberg and his collaborators by the ultra-centrifuge method have, as has been reported from time to time in NATURE, shown that stable

native proteins can be divided into two large groups: (i) the hæmocyanins with molecular weights of the order of millions, and (ii) all other proteins, with molecular weights of 35,000–200,000. Preliminary investigations on the respiratory blood protein chlorocruorin of marine worms showed that it, like the hæmocyanins, has a molecular weight of the order of millions, so that the high molecular weight is not conditioned by the presence of the copper-containing active hæmocyanin group in the protein molecule. In a further paper (*J. Amer. Chem. Soc.*, July) the hypothesis is put forward that a very high molecular weight may be characteristic of respiratory proteins in the blood of invertebrates. The red blood proteins of some marine worms (*Arenicola marina*) and also of *Lumbricus terrestris* are found to have molecular weights of the order of $2\frac{1}{2}$ – $2\frac{3}{4}$ millions, the two proteins being distinct. The name erythrocrurin, proposed by Ray Lankester in 1868 for the red blood pigments of invertebrates, is revived, Ray Lankester's later name hæmoglobin, suggested by Hoppe-Seyler in 1864 for the blood pigment of vertebrates, being obviously inappropriate. The name cruorin was suggested by Stokes in 1864 for respiratory blood pigment in general. Preliminary investigations show that several varieties of erythrocrurin exist in the blood of invertebrates, some with low molecular weights, but true hæmoglobin has not been met with (compare NATURE, 131, 325, March 4, 1933).

Astronomical Topics

The Sky in September. There is only one planet conveniently situated for observation this month, and that is Saturn, which is a conspicuous object rather far south in the heavens. Apart from its southerly declination, it is well placed for observation this month as it crosses the meridian about an hour before midnight. Saturn is an object of great beauty on account of its singular rings, which can easily be seen with a small telescope: it has become of particular interest at the present time by developing a large white spot, which can easily be seen with a modest telescope. The spot rotates with the planet and accordingly becomes alternately visible and invisible, the period of rotation being about ten hours. It is not known how long the spot will persist, but it may remain for a matter of a few weeks.

Dynamical Parallaxes of Stars. This method is based on the amount of curvature deduced from measures of double stars extending over some years; this, combined with the apparent magnitudes of the components, enables estimates of their distance to be made, assuming the mass-luminosity law. Lick Obs. Bull. No. 451 contains dynamical parallaxes of 323 of the double stars discovered by Prof. Aitken; they were deduced by R. G. Aitken and Miss C. E. Moore. The parallaxes are mostly small, but for 36 of the 323 stars they exceed 0.02". It is chiefly for the more distant stars that the method is valuable; it cannot compete with direct measures of parallax for the nearer stars.

Wolf's First Periodic Comet. This comet was discovered by the late Prof. Max Wolf in 1884; it has been observed at every return since then, with the exception of 1905; it made a close approach to

Jupiter about 1921, which moved the orbit farther from the earth, and made it a very difficult object. Nevertheless it was detected in 1925, and now again in 1933, thanks to the very accurate calculations of Prof. M. Kamienski, the director of Warsaw Observatory. Dr. Jeffers found it at the Lick Observatory, July 25^d 6^h 27.9^m U.T., in R.A. (1933.0) 20^h 7^m 57.2^s, N. Decl. 20° 40' 6", magnitude 18. Prof. Kamienski's predicted elements are as follows:

Epoch 1933 Sept. 28.5 U.T.	
M	341° 57' 44.1"
ω	160 49 23.8
Ω	204 10 18.8
i	27 15 50.0
φ	23 48 17.0
n	426.0658"

The deduced date of perihelion is 1934 February 27.908 U.T. The above observation indicates that perihelion will be about 0.1 day earlier than predicted. Though perihelion is in 1934, the comet will be chiefly observed this year, as it is too near the sun for observation after the beginning of January.

A prediction for this comet was also given in the B.A.A. Handbook for 1933, calculated by W. P. Henderson and J. D. McNeile. It was not computed with the same rigour as that of Kamienski, but does not differ greatly from it; it gave the time of perihelion 0.7 day later than Kamienski. In view of the faintness of the comet it will be better to use Kamienski's ephemeris, which is given in *Acta Astronomica*, vol. 2, series C, July 21, 1933. A portion of it is reproduced in *U.A.I. Circular* 445. The comet is well situated for observation, being on the meridian before midnight in N. Decl. 20°. But as it is too faint for ordinary instruments, the ephemeris is not given here.

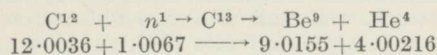
Disintegration of Light Atomic Nuclei by the Capture of Fast Neutrons

By PROF. WILLIAM D. HARKINS, DAVID M. GANS and HENRY W. NEWSON

ABOUT thirteen disintegrations of neon nuclei have been obtained in 3,200 pairs, and approximately 100 disintegrations of nitrogen nuclei in 7,600 pairs of photographs of a Wilson chamber through which neutrons were passing. The source of the neutrons consisted of beryllium powder intimately ground with a mixture of mesothorium and thorium-X. The neutron source used was on the average more powerful in the experiments with neon than with nitrogen. If all the factors are taken into account, it is found that with identical atomic concentrations of neon and of nitrogen in the chamber, the neon nuclei are disintegrated much less often than those of nitrogen.

The average energies of the neutrons which have been found to disintegrate light nuclei are, in millions of electron volts, 5.8 for nitrogen, 7.0 for oxygen, and 11.6 for neon. Here the value for oxygen is taken from the work of Feather. The mass data indicate that the energy needed to supply mass increases in just this order, and is respectively -1.4×10^6 , 0 and $+2 \times 10^6$ electron volts, if the mass of the neutron is assumed to be that given by Chadwick, 1.0067, which is probably too high. Obviously the value assumed does not affect the differences between the energy values.

In a gas, ethylene, which consists of hydrogen and carbon, three disintegrations were obtained in 3,200 pairs of photographs. If carbon (12) is disintegrated by capture of the neutron the reaction is



or, if the mass assumed for the neutron is correct, $\Delta m = 0.0074$, which is equivalent to 6.9×10^6 electron volts.

This corresponds to a velocity of 3.6×10^9 cm. per sec., so only neutrons of a velocity higher than this should be effective in disintegrating carbon of mass 12. The smallness of the yield of disintegrations which we have obtained with carbon is thus to be expected, especially since probably less than one-

fifth of the neutrons have velocities higher than this.

A remarkable relation which has been found to hold without exception is: in disintegrations by capture of a neutron the kinetic energy almost always decreases, is sometimes conserved, but in no case increases.

It has been pointed out previously by Harkins that the values for the energy which disappears suggest definite energy values for the γ -rays into which this energy is converted, but the accuracy of the work is not yet sufficient to prove that this is true.

It may be assumed that the neutrons in the stars are scattered by the atomic nuclei and thus take part in the temperature distribution of velocities of the atoms. If the neutrons of higher velocity are captured much more often than those of lower velocity, the distribution will be affected. Our experiments give no information concerning the capture of neutrons without disintegration, but only for those cases in which the capture is revealed by the accompanying disintegration.

It is of interest in this connexion to consider the minimum energy of the neutron which has been found to give a disintegration. The values, in millions of electron volts, are 1.9 for nitrogen, and 7.8 for neon. The corresponding maximum values are 16.0 and 14.5, the lower maximum for neon being due to the smallness of the number of disintegrations which have been obtained in this gas. An energy of 1.9×10^6 corresponds to a mean temperature of the order of 10^{10} degrees, but at 10^8 degrees a considerable number of neutrons should have this energy, and a moderate number even at 10^7 , so it is not unreasonable to suppose that nitrogen nuclei are disintegrated by this process in the stars.

A part of this work was presented by Harkins on June 23 at a symposium on nuclear disintegration under the auspices of the Century of Progress Exposition, Chicago. Other papers were presented by Cockroft, Lawrence and Tuve, and a general discussion of the theory was given by Bohr.

Third International Congress for Experimental Cytology

THE Third International Congress for Experimental Cytology, which was held in Cambridge on August 21-26, under the presidency of Prof. Th. Huzella, of Budapest, was attended by more than two hundred members from all parts of the world. Some seventy papers were read, grouped under the headings of cell respiration and metabolism, electrophysiology, secretion and digestion, tissue culture, *Entwicklungsmechanik*, and virus cultivation.

One of the main impressions left by a most interesting Congress is the successful use of the technique of explantation and tissue culture by cytologists, embryologists, and medical research workers for the study of problems of the most diverse nature. This note was struck by Prof. Huzella, in his presidential address on tissue culture in relation to the problems of biology and medicine, and it constantly recurred in the papers read to the Congress. Another feature of modern biological

research which was well brought out was the emphasis on the study of cell functions as they actually occur *in vivo*, rather than by examination of fixed and stained preparations, and the variety and ingenuity of the methods that have been evolved for this purpose. The proceedings also showed how wide a 'no-man's-land' there still is between experimental cytology, which is limited by the resolving power of the microscope, and biochemistry and biophysics, which deal with the phenomena of the cell on a molecular scale. It was a specially valuable feature of the Congress that cytologists and biochemists and biophysicists were able to learn one another's points of view, and to hear of some of the progress being made towards linking up physiological with physico-chemical events. Lastly, mention must be made of the moving pictures, which showed what a valuable instrument of research is provided by the speeded-up micro-cinematograph film.

In the discussion of tissue culture, Prof. Huzella described experiments on the effect of magnetic fields on heart cultures. His pupil, Dr. Julia Lengyel, showed that constant magnetic fields affect the intracellular substance, but have no effect on the cells themselves. Prof. Huzella dealt with the effect of intermittent magnetic fields. The cells are found to grow along the lines of force. Prof. Huzella attributes the effect to induced electric currents in the medium. In the discussion, the alternative explanation was suggested that the living cell is the seat of circulating electric currents, and so has a magnetic moment. These results link up with previous findings by Prof. Huzella and others that cells always tend to grow along lines of strain, whether caused by stretching, crystallisation in the culture medium, or in other ways.

Prof. J. de Haan and K. J. Feringa, of Groningen, have devised a method by which comparatively thick explants can be grown while being perfused with a physiological fluid. They were able to demonstrate the differentiation of wandering cells from a rabbit exudation into typical lymph tissue, and even the formation of non-nucleated cells resembling red blood corpuscles. Their experiments were illustrated by a cinematograph film.

Prof. C. C. Speidel, of Virginia, has also found the cinematograph of great value in studying the growth, irritation, and repair of nerves. He works on anaesthetised tadpoles, which are fixed under the microscope. The tip of the tail is cut off, and in the rapid process of regeneration the details of nerve outgrowth can be followed *in vivo*. By his remarkably clear and detailed observations, Prof. Speidel has been able to settle many doubtful points in neural physiology.

Dr. H. Okkels, of Copenhagen, described work on the dynamic cytology of the thyroid gland. When called into sudden activity, the cells undergo a cycle of changes. There is a phase of synthesis of the secretion, in which the mitochondria play the decisive part, and then a phase of discharge, which is governed by the so-called Golgi apparatus. Dr. E. S. Duthie, of Dublin, has found similar phenomena in the cells of various digestive glands.

In the discussion on virus growth, there was universal testimony to the value of tissue cultures as a means of virus propagation. Dr. G. H. Eagles, of London, indeed, maintained that viruses can be grown in cell-free media, and his paper provoked a long and interesting discussion. He agrees, however, that the presence of living cells is favourable to virus growth. Tissue cultures not only form a convenient substitute for animal propagation in the culture of viruses, but also, as was shown in a series of papers from different workers, allow of observations on cell pathology and immunity phenomena that would be impossible on the living animal.

In the field of *Entwicklungsmechanik*, there were a

series of important communications. Dr. H. B. Fell, of Cambridge, has obtained differentiation of knee-joints in explants of chick limb-buds taken from the egg at a stage when no differentiation is visible. Dr. R. G. Canti showed a fascinating film of the process of differentiation in Miss Fell's preparations. Prof. R. Chambers, of New York, has found that explants of mesonephric tubule segments are converted into closed tubules. When this stage is reached, phenol red accumulates in the lumina of the segments. This effect depends on the maintenance of the cell respiration, and is an instance of cells taking on their physiological functions *in vitro*.

J. Holtfreter, of Berlin, described work on the amphibian embryo, which he has succeeded in cultivating *in vitro*. C. H. Waddington, of Cambridge, who has devised a method for keeping the warm-blooded chick embryo alive out of the egg for a few days, also described the result of experimental interference with normal development. Both workers have been able to show the determining effect of the endoderm for differentiation in a number of beautiful experiments. Holtfreter, describing his work on the 'organiser', showed that it is present in all adult tissues, and in a latent form in the egg and in embryo tissues. In the latter, no organising power is shown until the tissue is boiled. Needham, Waddington and Needham have made it practically certain that the organiser is a chemical substance by obtaining neural tube formation in the embryo with petrol-ether extracts (see NATURE of August 12, p. 239).

This demonstration of what may be called an intra-embryonic hormone is of great interest. Nevertheless, its ubiquitous occurrence tends to throw the emphasis on the innate properties and responses of the embryonic tissue, rather than on the chemical stimulus from without, as a determining factor in differentiation.

The present Congress differed from previous ones, in that the scope was widened to include cell respiration and metabolism and cell electrophysiology, to each of which a whole day was devoted. Prof. E. D. Adrian, of Cambridge, opened the discussion on electrophysiology, and papers were read on biological potentials and currents, and the mechanism of selective passage and concentration of ions by cell membranes. Dr. M. Dixon, of Cambridge, opened the discussion on cell respiration. Prof. A. Szent-Györgyi, of Szeged, read a provocative paper on non-enzymic catalysts of cellular oxidation. One useful feature of the day's discussion was the demonstration of the wide variety of oxidation mechanisms, and the differences in response to cyanides and other respiratory inhibitors, that occur in the different phyla of the plant and animal kingdom. This must have been especially valuable to the biochemists, who have perhaps confined their attention to too few kinds of organisms. B. WOOLF.

Research in the British Non-Ferrous Metal Industries

THE annual meeting of the British Non-Ferrous Metals Research Association was held at Birmingham on June 19, and the report for the past year shows that, in spite of the difficulty of the times, the expenditure on research has been slightly increased to £17,000 a year.

Brighter homes should result from the choice of suitable metals and alloys arising from the study

which is being made of the resistance to tarnishing of polished surfaces of metals used for finger plates, door knobs, shop fronts and the like. Much work has also been done on an investigation dealing with the factors involved in the bursting of water pipes due to frost, concerning which little is at present known. The mechanism of ice formation and the behaviour of freezing water in pipes of different

materials are being studied in detail. New lead alloys, containing small quantities of cadmium and tin or antimony, developed by the Association for cable sheathing, are now finding increasing application in other fields. Tests are also being conducted with new materials for water pipes in which lead is alloyed with 0.05 to 0.06 per cent of tellurium. The effect of various soils on pipes of copper and these new alloys is also being investigated with the view of discovering the most suitable material for use in particularly corrosive soils.

A large amount of work of value in other directions is also recorded in the report. Methods have been devised by which small quantities of impurities in tin and lead can be determined spectroscopically in a few minutes and with considerable exactness. Further work has also been done on copper and nickel and a start has been made with aluminium.

New materials for service at high temperatures are being developed by the addition of small quantities of various elements to copper-nickel alloys. The effects of the addition of aluminium and silicon to cupro-nickel containing 20 per cent or more nickel are being studied, and alloys have been found which give promise of useful commercial application both with regard to maintenance of strength and resistance to steam corrosion at elevated temperatures.

An extensive service trial is being carried out by the London Midland and Scottish Railway Co. of new materials developed by the Association for fire-box construction. In a locomotive the copper fire-box is held in position by a number of rivetted copper stay rods, and it is estimated that, on the average, half the time a locomotive spends in the repair shops is due to failures in these stays. The trouble has now been traced to corrosion caused by boiler water leaking through the rivetted heads. By alloying the copper with small quantities of other substances and utilising a special heat treatment, the cause of the trouble is likely to be removed.

The utilisation of certain types of Empire copper for special purposes will be facilitated should investigations in progress on the removal of small quantities of bismuth from copper be successful.

The report records the practical completion of the researches which led to the production by the Association of aluminium brass condenser tubes. Their adoption practically solved the problem of the corrosion of condenser tubes in cases in which cupro-nickel tubes would be too costly. Other investigations in progress include those on the casting of aluminium and brass. The latter research has led to considerable improvements in the production of rolled brass sheet, of which tens of thousands of tons a year are produced in Great Britain.

A Continuous Gas Indicator

THE technique of accurate gas analysis by chemical analysis is difficult, and expertness in the art can be acquired only by long apprenticeship. Moreover, the chemical method of analysis is not directly and readily adaptable to indicating and recording with accuracy the extent to which a constituent gas is present in a gaseous mixture. Such information is of very great importance in many industrial operations, and although chemical indicators and recorders, more especially for indicating and recording the presence of carbon dioxide and

carbon monoxide, are available, their performance is, in general, not very satisfactory.

It is not surprising therefore that, in the last twenty years or so, physical principles have been employed in the design and construction of such instruments. These have included instruments dependent for their indications on density, calorific intensity, thermal conductivity, and in the case of an indicator recently devised by I. Fagelston, a combination of viscosity and velocity of effusion.

The principle of this last instrument is simple. The gaseous mixture and a standard gas flow through two similar capillary tubes, the outlet ends of which are enlarged and closed by two platinum plates pierced with similar orifices. The gases are sucked through the respective capillary tubes and orifices by a pump, and any difference of pressure at the exit ends of the capillary tubes, arising from difference in composition of the gases flowing in the tubes, is indicated by the difference of level of liquid in the limbs of a U-tube manometer connected with the respective ends.

Two forms of instrument incorporating this principle have been put on the market by Messrs. Griffin and Tatlock, Ltd. The first form, known as the "Air Type", uses air as the standard comparison gas; in the second form, known as the "Petrol Type", the comparison gas is made from the gas being analysed, by removing the constituent being determined. Generally an accuracy of indication of the order 0.05 per cent is possible with the instruments; very small vapour concentrations can be indicated to within 0.005 per cent. The instruments have numerous technical and scientific applications, including, for example, the indication of organic solvents, petrol vapour in air, the evaluation of adsorbents, in coal carbonisation for indicating carbon dioxide and hydrogen sulphide, and for the analysis of industrial gases, including the rare gases, for determining safety in connexion with chemical and engineering plant, and for indicating the humidity of gases.

University and Educational Intelligence

RESEARCH work in Slavonic countries is listed in catalogues which are being compiled and issued by the Russian Department of the University of Birmingham. Pamphlets relating to work (a) in progress and (b) already published in Czechoslovakia and Poland in 1931-32 have already been issued and these will be followed by catalogues of work in three other Slavonic countries. The lists are arranged according to universities and faculties.

SUPERVISED correspondence study of a new type has been introduced in the State of Nebraska with the object of widening at a minimum of expense the range of the curricula of the smaller high schools. The system is described in an article contributed by Prof. Platt of the University of Nebraska to the June number of *School Life*. The school time-table provides periods for the work and the scripts are regularly dispatched to the correspondence centre for examination and criticism. The supervising teacher does not need to be a specialist in all the subjects of the correspondence courses. It is his business to see that the pupils have the proper materials, attitude and environment, to interpret the questions, guide the pupils in the use of encyclo-

pædias, supplementary literature and periodicals and in other ways to correct the techniques of study. Among the advantages claimed for the system are: that it facilitates meeting the needs of gifted and other unusual students; that a large variety of vocational subjects can be made available; that the teaching load of the staff can be lightened; that educational costs per pupil can be decreased and that courses on the college level can be offered to high-school students who cannot attend college. So promising were the results apparent in the schools in which the system was being tested in 1929-1931 that the Carnegie Corporation and the Carnegie Foundation for the Advancement of Teaching made a grant to the University of Nebraska of five thousand dollars in November 1931, for the purpose of carrying on research in this field. Further publicity was obtained for the experiment by an address delivered at a meeting of the American Council on Education in May last by Prof. Reed of the University of Nebraska. While specially adapted for meeting the needs of small rural high schools the system might, it is believed, prove a valuable aid in large schools also.

EDUCATION in India in 1929-30 is reviewed by the Educational Commissioner with the Government of India in a pamphlet recently published by the Government Central Publication Branch, Calcutta (pp. 76; Re. 1-4 or 2s.). Statistics show some advance, but at a lower rate than in the preceding year. The number of scholars in institutions of all kinds increased by three per cent and amounted to approximately five per cent of the entire population. Distributed by communities, the school enrolments expressed in percentages of the total population of each community were: Parsees 22, Europeans and Anglo-Indians 19, Indian Christians 14, Sikhs 7, Buddhists 5.6, Mohammedans 5.4, Hindus 4.8, others 2.5. As an indication of the state of education of the Mohammedan community (59 millions) as compared with that of the Hindus (164 millions) these percentages are misleading, for it is almost solely in the lowest two grades of the primary schools that the Mohammedans outnumber (in proportion to total populations) the Hindus. In university and intermediate education, including the professional schools, there are six Hindus for every Mohammedan. The increase in the number of students in the teaching departments of the sixteen Indian universities was at the rate of twelve per cent. Enrolments in technical and industrial schools, in which a large proportion of the scholars were Mohammedans, showed a decrease of more than ten per cent, and agricultural colleges and schools a decrease of five per cent. Medical colleges and schools showed an increase of ten per cent and there were small increases in commercial, engineering and veterinary colleges and schools, and in schools of art. A statistical summary of education in the United States of America for 1929-30, published as Bulletin 20 of 1931, provides some striking contrasts with the Indian statistics. The total enrolment in schools of all kinds was 25 per cent of the entire population, as compared with India's 5 per cent; teachers numbered 8 per cent of the population and women teachers outnumbered men by four to one, whereas in India they numbered 0.2 per cent and the women are in a minority of one to nine; the number of girls under instruction in the United States was approximately the same as the number of boys, but in India there were four boys to one girl.

Calendar of Nature Topics

Greatest Frequency of Typhoons in the China Seas

The typhoons of the China Seas are revolving storms of great violence. The majority originate among the island groups of the western Pacific, between about 6° and 20° N. lat., and especially among the Ladrone and Western Caroline Islands. Their tracks lie at first towards the west-north-west; they generally pass near or across the Philippine Islands and either strike the coast of China or 're-curve' over the ocean and continue north-eastwards towards Japan, growing in size and decreasing in intensity. They may occur in any month, but are most frequent from July to October and especially in September. Many ships have been lost during typhoons, and over the land they cause violent rains and disastrous floods. The tropical cyclones of the Bay of Bengal also reach their greatest frequency in September, but individual storms are rarely so severe as later in the year.

Delayed Salmon

Absence of sufficient water in rivers, due to prolonged drought in very dry summers, causes autumn-running salmon to congregate in numbers in the sea off the river mouths. The changes normally associated with river life, however, may still proceed—abstinence from food, the assumption of the spawning coloration, the growth of the jaws of the males and the erosion of scales. During such a period of enforced waiting, the numbers are reinforced by fresh arrivals from seawards. Experimental netting in the north of Scotland in 1915 and 1920 showed that in waiting salmon, marked and later recaptured before being able to ascend into fresh water, loss of weight was an accompaniment of other bodily changes. Six fish averaging 11.5 lb. in July showed an average loss of 1.33 lb. when recaptured during August and September. A 14 lb. male fish lost 3 lb. in 67 days waiting. The proportion of fish showing scale erosion reached 84 per cent in August and 99.5 per cent in mid-September. The actual erosion of scales in the beginning of August was slight. In the middle of September it "extended round the whole of the periphery of the scales of male fish, and quite two-thirds of the edge of the scales of female fish were disintegrated" (Menzies, 1925).

Control of the Tsetse Fly

One of the greatest barriers to progress in Africa is the tsetse fly (*Glossina pallidipes*) and the nagana disease of cattle which it spreads. The presence of the fly is linked with the vegetational type of the region and with the game animals which subsist upon the vegetation; so that the destruction of vegetation and of game animals have both been advocated and in some areas carried out. In Zululand, in clearing the buffer belt surrounding the Umfolozi Reserve, 26,162 game animals, including 15,130 zebra, 2,987 duiker, 2,173 bush-buck and 3,456 warthog, were killed between June 1, 1929 and November 15, 1930.

A method of catching the flies in large specially designed traps has been devised by R. H. T. P. Harris, and promises to solve a difficult problem without recourse to whole devastation of flora and fauna. September is the month when the tsetse flies are most numerous, and in September 1931, 2,088,508 were caught in the traps, reckoning by measure at

6,000 flies to a quart measure (*South African J. Sci.*, 29, 495; 1932). The year's total catch was much more than 7 millions, and that in spite of the fact that only for the last four months of the period had the traps approached their full number of just over one thousand.

It is clear that the fly population can be enormously reduced by trapping flies in their habitat amongst game animals; and the author suggests as a sound method of control, first, the creation of special game reserves in fly areas, so that the flies may be concentrated in definite localities in association with the game; second, the removal of most game animals in the territory surrounding the reserve, so that the flies may be isolated as well as concentrated; and third, the trapping of the flies in the concentrated reserve.

Luminescence in Nature

Now that darkness falls earlier and the plankton population of the shallow waters of the sea is still at a high level, opportunities increase for observing luminescence from the shore, due to the presence of *Noctiluca* or ctenophores or many other common forms. At the opening session of the American Philosophical Society's meeting at Philadelphia on April 15, 1932, Prof. E. Newton Harvey suggested that luminescence had been evolved from one of the biochemical reactions underlying ordinary respiration. Between luminescence, most familiar in the light of fireflies or the glow of bacteria, due to the reaction of luciferin and oxygen through the intermediary of the enzyme luciferase, and the hydrogen acceptor mechanism involved in the oxidation of food substances, he found a close analogy. But in the latter case carbon dioxide is set free, whereas in the former no carbon dioxide is released and the oxidised luciferin quickly loses its oxygen and is once more in a condition to react. Most luminescence is intermittent and is generally caused by some stimulus (for example, the breaking of waves, the stroke of an oar, the disturbance caused by the movement of a boat) and under natural conditions it may have protective value, may serve as a signal between members of a species, or in the darkness of the deep sea may illumine the depths, but these are unproved guesses. But what purpose the continuous, non-stimulated glow of bacteria may serve, not even the credulous naturalist has ventured to guess.

Stubble Cultivation

An early harvest gives a great opportunity to attack the weed population, already weakened by the shading action of the straw crop. Unfortunately, on heavy land the tearing up of hard-baked stubble has been no easy matter with the farmers' own implements, although hired steam traction sets have long been used to fulfil this need. With modern tractors and implements of sturdy construction, it is possible to make sufficient tilth on the surfaces of the stubbles to germinate weed seeds at the first shower, and at the same time the established weeds are uprooted and checked. One of the great advantages of the tractor is that it provides the power to carry out these operations thoroughly and rapidly, making the best use of the restricted time available. If dry conditions continue, the runners of grassy weeds may be combed out and burnt. The growth of seedling weeds is allowed to proceed for some time, when the green stuff is ploughed in and has a

certain manurial value. An alternative to the above procedure is to plough up the stubbles at once without attempting to get rid of any viable weed seeds. This has the advantage that heavy land is at any rate safe for the winter, whereas if merely broken there is the risk that it may lie too wet for ploughing for long periods late in the year.

Societies and Academies

DUBLIN

Royal Irish Academy, June 26. F. D. GREEVES: An investigation on the penetrating radiation from potassium. Measurements of the absorption of the γ -radiation from potassium chloride by use of a Geiger tube counter. The value obtained by Mühlhoff was confirmed with a different geometrical arrangement. The background of cosmic and local radiation was found to vary with weather conditions, being less intense during rain. H. O'NEILL HENCKEN and H. L. MOVIVUS: The cemetery cairn at Knockast, Co. Westmeath. In August and September 1932, the first Harvard Archaeological Mission in Ireland, under the direction of Dr. H. O'Neill Hencken, assistant curator of European archaeology in the Peabody Museum of Harvard University, excavated at Coolatore, Co. Westmeath, a large cemetery cairn of the Bronze Age. This contained in all 44 burials of which 4 were skeletons and the remainder cremations. Unlike most such grave-mounds, this contained no central burial with 'secondary interments' grouped about it, but an unprecedented number of graves scattered through it. From the pottery, bronze knives, etc., found with the burials, it was evident that they covered a considerable part of the Bronze Age from about 1500 B.C. to somewhat after 1000 B.C. The human remains have been studied by Mr. H. L. Movius of Harvard. He has found that the skeletons conform on the whole to the general type of Irish Bronze Age skeletons, but believes that the cremating people probably belonged to a different physical type. J. DOYLE and W. T. SEXTON: Contributions to the life-history of *Fitzroya*. *Fitzroya* is an interesting link between the cupressinean and callitrichean conifers. It possesses an apical archegonial complex with a pollen tube directed to the top of the prothallus. The tube grows early and invaginates the prothallus deeply while the latter is still vacuolate. The pro-embryo is variable and the variations are discussed. They seem to be derivatives of two types of early pro-embryo, a four-celled pro-embryo completely filling the archegonium and one with four cells occupying a considerable part of the archegonium with a fifth free nucleus in the upper part. The mature pro-embryo commonly fills the archegonium and is fully septate. J. J. NOLAN and P. J. NOLAN: Further observations on atmospheric ionisation at Glencree. In a survey of more than four years' observations, it is shown that the control exercised by the condensation nuclei on the equilibrium of ionisation is very weak. Certain diurnal variations in the ionisation are found and the question of a diurnal variation in the rate of ion production is examined. R. W. DITCHBURN and Miss C. J. POWER-STEELE: Notes on resolving power (2). The resolving power with a microphotometer. The paper describes experiments on the resolving power of an optical system (for example, telescope or spectrograph) when photographic methods are used. The

effect on the resolution produced by exposure, time and other factors is examined. The resolving power of lines of different intensity ratio is investigated. An increase of resolution is obtained by stopping out the central portion of the aperture. A new 'characteristic' is suggested for use in connexion with the deflection microphotometer. R. W. DITCHBURN: Notes on resolving power (3). The resolving power of the method of focal isolation. The paper discusses the resolving power and the geometrical optics of the method of focal isolation (see R. W. Wood: "Physical Optics". Second edition, p. 414). The relation of this method to the Christiansen filter is considered.

PARIS

Academy of Sciences, July 17 (*C.R.*, 197, 205-284). A. CALMETTE, A. SAENZ and L. COSTIL: The effects of cobra poison on cancerous grafts and on spontaneous cancer (adeno-carcinoma) of mice. Cobra poison has an undoubted curative effect on spontaneous or grafted adeno-carcinoma in mice. S. WINOGRADSKY: The disengagement of ammonia by the nodules of the roots of the Leguminosæ. Young nodules borne by plants in full growth give off measurable quantities of ammonia. SERGE BERNSTEIN: Remark on a note by R. Salem. AUGUSTE LUMIÈRE: The method of heterogeneous test statistics. A new method of investigating statistics in cases unsuitable for the application of mathematical methods. P. RACHEVSKI: The infinitesimal interpretation of the system of dual vectors. G. B. GOUREWITCH: An algebraical equation in polyvectors. SILVIO MINETTI: The geometry of the holospace of holomorph functions in a given domain and its relations with the theory of ordinary differential equations. LICHINE: Controls. A system of controlling motors without mechanical contact. MAX SERRUYS: Knocking and auto-ignition in internal combustion motors. Knocking and auto-ignition in internal combustion engines are separate phenomena. THADÉE PECZALSKI: The cause and effect of the solution of salt in metal. EUGÈNE DUPUY and L. HACKSPILL: The law of thermal expansion of boron. The linear coefficient of expansion of boron between 20° C. and 750° C. is 8.3×10^{-6} : the expansion is a linear function of the temperature and no anomalous point was found. D. BODROUX and R. RIVAUT: Some distant receptions of television broadcasts from London. Account of experiments on television reception at Poitiers. E. THELLIER: A magnetometer insensitive to the disturbed magnetic fields of large towns. PIERRE LAMBERT and JEAN LECOMTE: Infra-red absorption spectra of organic compounds possessing two chromophores. Mlle. J. CLAVIER: The influence of the temperature on the chromatic sensibility of some photographic plates. The results depended largely on the make of the plate, but the sensibility in several cases was much increased (three to four times) by raising the temperature of the plate to 60°-80° C. MME. IRÈNE CURIE and F. JOLIO: The complexity of the proton and the mass of the neutron. It is suggested that the proton may be considered as containing a neutron and a positive electron: the energy of combination is of the order of 5×10^6 ev. and the stability is consequently very high. T. GRAF: The magnetic spectrum of the β -rays emitted by $\text{AcB} + \text{C} + \text{C}' + \text{C}''$. HENRI MULLER: The lowering of the ternary eutectic point ice - potassium nitrate - ammonium chloride. H. HERING: Heterogeneous equilibria in the system cadmium iodide,

potassium iodide and water. FR. HAHN: The determination of traces of bromine in the presence of a large excess of chlorine. The method, which is based on the production of eosin from fluorescein, can be used to determine quantities of bromine of the order 0.1-2 micrograms. JULES GUÉRON: The spontaneous evolution of aqueous solutions of stannic chloride. H. DELOMENTIE: Contribution to the study of ferrosilicons. A. TRAVERS and PIERRE LEDUC: The evolution of the hydrated calcium aluminates. H. COTTIN: Pentenylamine. MARCEL SOMMELET: The synthetical preparation of chloromethyl derivatives of phenols. J. DÉCOMBE: The condensation of formol, amines and phenols. ANTONIN LANQUINE: The lengthening of the edge of the Jurassic massif of Thèmes and of its approaches in the neighbourhood of Rocbaron and Carnoules (Var). D. SCHNEEGANS: The relations between the Flysch zone in the Embrunais and the sheet of the Briançonnais. R. GUIZONNIER: The gradient of electric potential and atmospheric pressure. An important relation holds between the gradient of the electric potential and atmospheric pressure. This is shown by the parallelism of the curves exhibited by these elements as a function of the time. J. RIBÉREAU-GAYON: The solubility of the copper compounds of anti-cryptogamic mixtures. CHARLES PÉREZ: Some sexual differences in the crab *Pachygrapsus marmoratus*. C. MATHIS and L. BERLAND: A domestic African spider, *Plexippus paykulli*, a natural enemy of *Stegomyia*, living in houses. This spider hunts and kills mosquitoes: it is inoffensive to man and should be cultivated as a useful auxiliary for the destruction of the female *Stegomyia*, the active agent in the propagation of yellow fever. B. TROUVELOT, LACOTTE, DUSSY and THÉNARD: Observations on the trophic affinities existing between the larvæ of *Leptinotarsa decemlineata* and plants of the Solanaceæ family. W. S. REICH and A. F. DAMANSKY: Contribution to the study of starch. New esters obtained by cinnamylation. The method of acetylation of starch described in an earlier paper has been applied to the cinnamylation of starch. Natural starch gives a dicinnamate, amylose a tricinnamate. L. VELLUZ and P. SAULEAU: The biochemical synthesis of the fatty esters of some cyclohexanols. MME. ANDRÉE ROCHE: Nitrogen loss and protein starvation. The experiments described agree with the hypothesis of the partial disintegration of a muscle protein in the case where the need of nitrogen is not met by the food. PIERRE ROSENTHAL: Regenerescence cure by interhuman serotherapy. A. MOUGEOT and V. AUBERTOT: Intratissue oxidations and thermal carbonic acid baths.

GENEVA

Society of Physics and Natural History, June 15. R. GALOPIN: Outline of the study of the opaque minerals of the Azéjour deposit (Morocco). The author studies the metallic minerals of the Azéjour deposit by reflected light. With the view of finding out the most promising direction for his work, he has examined some specimens taken at various localities and has found, in addition to minerals already known in this deposit, a certain number of others. These preliminary researches show that the mineralisation is more varied and complex than had hitherto been supposed. G. GUTZEIT and R. DUCKERT: The aminoformate of copper and zinc. The authors have prepared these two salts and have studied their

electrical conductivities, from which they have been able to give constitutional formulae to these salts. G. GUTZEIT: Remark on a relation between the apparent volumes of the atoms and the centres of co-ordination of internal complex compounds.

SYDNEY

Royal Society of New South Wales, May 3. W. R. BROWNE: Post-Palaeozoic igneous activity in New South Wales (Presidential Address). The Mesozoic era was one of comparative freedom from volcanic activity, but Triassic volcanic ash and Jurassic basalts are known. About 11,000 square miles are covered with Tertiary basalts, etc., and the original area was probably much greater. Two groups of eruptions are recognised: (1) an older, of basic flows and sills, followed by alkaline intermediate lavas and intrusions; (2) a newer, of basic flows and intrusions, with a few acid flows, followed by a series of narrow basic dykes and sills. The basic lavas comprise calcic and plateau-basalts, with alkaline basic and ultrabasic types. The older basic intrusives are teschenitic, the newer theralitic. Dolerite intrusions may represent portions of the calcic basalt magma. The eruptions were connected with vertical crust-movements and the whole series is comagmatic with the Tertiary rocks in Queensland, Victoria and Tasmania.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
(LEICESTER MEETING).

Tuesday, September 5

At 8 p.m.—Sir Henry Fowler: "Transport for a Century" (Public Lecture at Edward Wood Hall).

Wednesday, September 6

At 8.30 p.m.—Sir Frederick Gowland Hopkins: "Some Chemical Aspects of Life" (Presidential Address at De Montfort Hall).

Thursday, September 7

At 10 a.m.—Prof. R. Robinson: "Natural Colouring Matters and their Analogues" (Presidential Address to Section B).

Prof. W. G. Fearnside: "A Correlation of Structures in the Coalfields of the Midland Province" (Presidential Address to Section C).

Dr. J. Gray: "The Mechanical View of Life" (Presidential Address to Section D).

Mr. R. W. Allen: "Some Experiences in Mechanical Engineering" (Presidential Address to Section G).

Major the Hon. Richard Coke: "A System of Forestry for the British Isles (Chairman's Address to Department of Forestry (K*), Section K).

Dr. A. Lauder: "Chemistry and Agriculture" (Presidential Address to Section M).

At 11.30 a.m.—Prof. J. H. Jones: "The Gold Standard" (Presidential Address to Section F).

The Right Hon. Lord Raglan: "What is Tradition?" (Presidential Address to Section H).

At 2.0 p.m.—Dr. R. E. Mortimer Wheeler: "Centralisation and Control of Research in its Relation to Learned Societies" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, September 8

At 10 a.m.—Sir Gilbert Walker: "Seasonal Weather and Its Prediction" (Presidential Address to Section A).

Prof. F. Aveling: "The Status of Psychology as an Empirical Science" (Presidential Address to Section J).

At noon.—Prof. E. D. Adrian: "The Activity of Nerve Cells" (Presidential Address to Section I).

At 8.15 p.m.—Sir Josiah Stamp: "Must Science ruin Economic Progress?" (Evening Discourse at Wyggeston Boys' School Hall).

Saturday, September 9

At 8.0 p.m.—Prof. Julian S. Huxley: "Ants and Men" (Public Lecture at Edward Wood Hall).

Monday, September 11

At 10 a.m.—The Right Hon. Lord Meston: "Geography as Mental Equipment" (Presidential Address to Section E).

Prof. F. E. Lloyd: "The Types of Entrance Mechanisms of the Traps of *Utricularia* (including *Polypompholyx*)" (Presidential Address to Section K, at Vaughan College).

At 5.30 p.m.—Sir Richard Gregory, Prof. W. J. Pugh, Prof. W. B. Brierley, Dr. Allan Ferguson, Prof. J. L. Myres, Sir Josiah Stamp. Symposium on "Cultural Value of Science in Adult Education" (Open to the Public).

At 8.15 p.m.—Prof. J. F. Thorpe: "The Work of the Safety in Mines Research Board" (Evening Discourse at Lancaster Hall).

Tuesday, September 12

At 10 a.m.—Mr. J. L. Holland: "The Development of the National System of Education" (Presidential Address to Section L).

Official Publications Received

GREAT BRITAIN AND IRELAND

Mines Department. Eleventh Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1932. Pp. 112+15 plates. (London: H.M. Stationery Office.) 2s. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1509 (Strut. 113): Stability of Static Equilibrium of Elastic and Aerodynamic Actions on a Wing. By Dr. H. Roxbee Cox and A. G. Pugsley. Pp. 20+2 plates. 1s. net. No. 1514 (T.3286): Full Scale Experiments with Servo Rudders. By J. E. Serby. Pp. 8+12 plates. 9d. net. No. 1526: Abstract, Calculation of Stresses in Braced Frameworks. By R. V. Southwell. Pp. 1. 2d. net. (London: H.M. Stationery Office.)

Proceedings of the Royal Society. Series A, Vol. 141, No. A844, August 1. Pp. 281-493. (London: Harrison and Sons, Ltd.) 12s.

Proceedings of the Royal Society of Edinburgh, Session 1932-1933. Vol. 53, Part 3, No. 16: Studies on the Reproductive System in the Guinea-Pig: Variations in the Oestrous Cycle in the Virgin Animal, after Parturition, and during Pregnancy. By Thomas Nicol. Pp. 220-238. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s. 6d.

OTHER COUNTRIES

U.S. Department of the Interior: Geological Survey. Bulletin 849-A: Progress of Surveys in the Anthracite Ridge District, Alaska. By Ralph W. Richards and Gerald A. Waring. (Investigations in Alaska Railroad Belt, 1931.) Pp. ii+27+2 plates. (Washington, D.C.: Government Printing Office.) 5 cents.

Geological Memoirs. Series A, No. 11: Fossil Man in China. The Choukoutien Cave Deposits with a Synopsis of our Present Knowledge of the Late Cenozoic in China. By Davidson Black, Teilhard de Chardin, C. C. Young and W. C. Pei. Edited by Davidson Black. Pp. x+166+6 plates. (Peking: Geological Survey of China.)

Japanese Journal of Physics. Transactions and Abstracts. Vol. 8, No. 3, June 30. Pp. iii+109-163+53-79. (Tokyo: National Research Council of Japan.)

Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University. 1932, Part 4 (October 1-December 31, 1932). Pp. 19-24+plates 16-20. (Tokyo.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1932. Pp. 15. Verhandeligen No. 24: Regenval in Nederlandsch-Indie (Rainfall in the Netherlands Indies). Door (By) Prof. Dr. J. Boerema. Deel (Vol.) 3: Kaarten van den gemiddelden jaarlijkschen en maandelijkschen regenval op Borneo (Maps of the Mean Annual and Monthly Rainfall in Borneo.) 13 maps. (Batavia.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1932. Pp. iv+39. (St. Lucia: Government Printing Office.) 6d.

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