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The Planning of Human Life

THERE must be many among the ranks of scientific workers who, from time to time, have been alarmed at the consequences which might attend the further extensions of the restrictions on freedom of scientific thought and investigation already imposed in various European countries and elsewhere, or the continued prostitution of scientific effort on an ever-growing scale on preparations for war. Others have been disturbed at the paradox presented by the heavy incidence of unemployment and distress in a world which science has already endowed with resources undreamed of scarcely a generation ago.

Few, however, as yet have concerned themselves with the underlying causes of the present unhappy and threatening position, and Prof. L. T. Hogben's recently delivered Conway Memorial Lecture* is accordingly the more welcome because of its stimulating challenge to creative thought on new lines about social life, and therefore about politics and economics. His outspoken comments were much more than a plea for a biological basis for social and political thought. The whole lecture was a call for a courageous linking of knowledge and action and seeing life as a whole, in which scientific method finds its use in arriving at new knowledge and solving practical problems, and action is seen as an essential if life is to be achieved in its fullness.

At a time when what Prof. Hogben describes as the retreat from reason is at full flood, it is refreshing and inspiring to meet such a frank exposure of past failures and an exposition of new lines of advance which may yet retrieve the position. Science could desire no better apologist,

* The Retreat from Reason. By Lancelot Hogben. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on May 20, 1936.) Pp. xi+83. (London: Watts and Co., 1936.) Paper, 1s. net; cloth, 2s. net.

and even those who are unconvinced by Prof. Hogben's arguments can scarcely fail to admit the impossibility of tame acquiescence in the present position, unless we are content to see the very spirit of science slowly choked to death.

The retreat from reason, the growing dominance of prejudice and ignorance in public affairs, is attributed to neglect of education. The most expensive products of the educational system of Western civilization are really uneducated for life in the present world; and democracy is becoming a farce, because this expensively educated class, from which Capital and Labour attract the leaders and administrators, is increasingly at the mercy of technical experts whose own training involves no recognition of their social responsibilities.

The training of the statesman or the man of letters gives him no prevision of the technical forces which are shaping the society in which he lives: the education of the scientific worker and the technician may well leave him indifferent to the social consequences of his own activities. If we are to arrest the retreat from reason, we must devise an education which will give us representatives who can co-operate intelligently with technical experts in constructive social enterprise, and teach us how to choose them.

This is the first task, and upon it Prof. Hogben makes many shrewd remarks. He questions, for example, whether we now have as large a proportion of scientific men actively interested in politics as there were at the time of Joseph Priestley and Benjamin Franklin. Moreover, a nation cannot expect men of science to help in times of difficulty unless it elects representatives who know enough about the scope of technical possibilities to enlist their skill. If, however, a man is not

politically educated unless he has some knowledge of natural science, the teaching of natural science has still to be adapted to the requirements of a rational curriculum of humanistic studies. We need more science, but not more science as it is taught for vocational purposes.

The real reason why science must be an important part of education is that intelligent citizenship is no longer possible unless we understand the place of science in the everyday life of everybody. Attention is directed to the closer co-operation between the teaching of history and of natural science in school and university alike which this demands. Co-operation between the historian and the man of science is, in fact, required to make education socially fertile; and the social value and interest of scientific teaching could be further enhanced if the relation of growing knowledge to the developing social needs of mankind were emphasized in the teaching of natural science.

The interest which the British Association has taken in the relation of scientific work to social questions in recent years indicates that Prof. Hogben is not alone in many of his arguments. To reinstate confidence in human reason, however, the teaching of history in such a way as to produce citizens capable of realizing the part which advancing scientific knowledge has played in the material progress of mankind is only one factor. The teacher of science can and should let his pupils understand from the beginning what are the responsibilities in everyday life which scientific discipline lays on all those who have once submitted to it, but that in itself it is not sufficient to secure action in discharge of those responsibilities.

No single point is so strongly stressed by Prof. Hogben as this of action. Quoting T. H. Huxley that "the great end of life is not knowledge but action", he suggests that the divorce of thought from action is one of the prime causes of our present difficulties. The pursuit of the social sciences has not been closely linked with the development of new institutions and the discovery of new modes of social living; and unless knowledge is encouraged as a means to action instead of as a means to more knowledge, we are unlikely to regain control over events and reap the possibilities of plenty which science has put within our reach.

Lack of familiarity with scientific matters has been an important factor in the crumbling away of our social traditions under the stress of economic disaster, but we can only stabilize the new social pattern by securing that action is related to know-

ledge and that the new knowledge to be acquired is pursued in relation to a definite plan of action. We have still to discover the laws of change of human nature, and until in this way we have arrived at a science of human nature, it is idle to expect the public needs of a progressive society to harmonize with the private needs of human nature.

Nor is this all. We are blundering on the threshold of an era of technical changes, the consequences of which can scarcely yet be predicted even by the technical man, let alone visualized by the average administrator. The introduction of the new plastics in building, housing and clothing, the replacement of heavy metals by light metal alloys in constructional work, changes in power production, increased productivity of pastures, field crops and live-stock through the use of fertilizers, soil control, genetic selection and control of pests, hold revolutionary consequences which demand study and reconstruction in all directions.

Equally we are entering on an era of biological inventions, with new possibilities of bodily and mental health if our resources are planned intelligently with the object of satisfying real human needs. A rational basis for human society involves planned consumption to ensure the maintenance of population. The only rational basis for such planning is scientific research into the character of fundamental human requirements and the national resources available for gratifying them. We could then formulate a policy and programme of national reconstruction which would command the irresistible support of the wage-earning and salaried classes, and should be above the squabbles of party politics as we have known them. When the existence of a universal need is recognized, the problem of satisfying it is a joint matter for economists and technicians.

A science of preventive social medicine must have as its first concern the satisfaction of known universal needs, and psychologists should be encouraged to explore the distribution of human capabilities in relation to the idiosyncratic requirements of individual human beings. Prof. Hogben, in fact, boldly calls for an inquiry into the wealth of nations on entirely new lines, including the utilization of social personnel and the study of the social resources available for canalizing a common will to increase the wealth of nations. In regard to the first, the studies of recruitment he suggests, including the large-scale testing of Parliamentary candidates for vocational

aptitudes on similar lines to those worked out for various purposes by the National Institute of Industrial Psychology, though likely to meet with ridicule at the moment, would represent a real contribution to political science and society.

The picture which is thus presented to us does not minimize the dangers of the present situation; rather it reminds us once more that the way of escape is still open if we choose to take it. The planning of human life, in accordance with growing knowledge of the nature of fundamental human needs and the natural forces now at our disposal if we use them intelligently, is not a task which can be or will be undertaken by political leaders, who have little regard for the nature of human needs and are unfamiliar with the technical

resources which can be mobilized by intelligent organization.

The scientific worker, therefore, cannot evade his share of responsibility. He, at least, must lend his aid if anyone is to take stock of the resources of knowledge for social betterment. He as no other can lead the return to the exposition of the simple and well-tried truths of science, and resist the exploitation of speculative, socially insignificant and unproved hypotheses before mystified audiences. Also he can lend his support both to the re-orientation of scientific research in accordance with a real plan of social research, and to the political and social forces necessary to compel action along the lines of knowledge rather than those of prejudice.

Enzyme Studies

Ergebnisse der Enzymforschung

Herausgegeben von F. F. Nord und R. Weidenhagen. Band 5. Pp. xi+378. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 30 gold marks.

THESE "Ergebnisse" once more contain valuable summaries of selected sections in the continually expanding field of biochemistry included under the term 'enzymes'. The contributions are as international as ever, but only the minority are from German laboratories: it is an interesting question whether this denotes a falling off in scientific activity there under present political conditions.

Prof. Alex. McKenzie of Dundee gives the complete story of asymmetric synthesis, a subject to which he has devoted his energies and which has not been monographed as yet. Very opportune is an account written by Folley and Kay, fifty-four pages in length, of the phosphatases, since the substrates on which they act, the phosphoric esters, hold a key position in many of the processes taking place in living organisms: thus they are concerned in alcoholic fermentation, muscular contraction, bone formation and lactation, whilst the many phospho-organic compounds in living matter are probably all dependent on the activity of phosphatases. At present there is no real understanding of the true role of these enzymes, but much progress can be reported in the accumulation of facts: the summary should help to arouse fresh interest in the subject. It is followed by an article on lecithase, the mixture of enzymes which hydrolyse lecithin in a variety of ways: this is

from Milan and is written by Messrs. Belfanti, Contardi and Ercoli. No less than seven different enzymes take part in the simplification of lecithin by a series of steps which thus afford a very interesting biological problem.

Another summary, dealing with a problem which is still unsolved despite its importance, is that on the biochemical synthesis of fats, from the pen of Dr. Smedley Maclean. We know that the pig in particular is able to effect the transformation with ease, but neither the site in the body where it happens, nor the nature of the first products of the synthesis, has been determined. The author inclines to the theory, for which there is some experimental support, that pyruvic acid is the intermediate stage, rather than accepting the alternative formation of fat direct from hexose or through acetaldehyde.

There is a stimulating article on proteases by Grassmann and Schneider, of Dresden. Since Northrop has been so successful in obtaining some of these enzymes in the crystalline state, enhanced interest is attached to their behaviour. It is now possible to lay down exact conditions for the structure of the substrate favourable for the action of the peptidases, and the same applies to the carboxy-polypeptidases, which require also a free carboxyl group in the substrate. Progress is also to be recorded in the identification of some of the active groups in these substances.

A group of enzymes, of which the knowledge is vague, are those that hydrolyze the pectins: a useful summary about them is provided by Kertesz, of Geneva, N.Y. Pectinase appears to be

a complex of enzymes containing at least a polygalacturonase and a pectin methoxylase, the former being a glycosidase and the latter an esterase: other constituents appear to be able to split off arabinose or galactose from the pectin complex. This is obviously a field requiring much further investigation.

Müller, of Copenhagen, describes an oxidase prepared from *Aspergillus* or *Penicillium*, which is able to oxidize glucose to gluconic acid with atmospheric oxygen: the significance of this reaction in the economy of these fungi is discussed.

Space considerations allow only of reference to

one other review, namely, that on chlorophyll photosynthesis, from the pen of Robert Emerson of Pasadena. The review is opportune, for the subject continues to be a very difficult one, and in spite of a lot of work there has been no great progress in it during the last decade. At least the behaviour of enzymes towards carbon dioxide is being studied energetically, whilst a great deal more is known about chlorophyll.

The items which have been picked out for comment serve to indicate the value of the book: the editors once more deserve thanks for providing such stimulating fare. E. F. A.

History of Medicine

(1) *The Story of Medicine in the Middle Ages*
By Prof. David Riesman. Pp. xii+402. (New York: Paul B. Hoeber, Inc., 1935.) 5 dollars.

(2) *A Short History of Talmudic Medicine*
By Dr. J. Snowman. Pp. 94. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 3s. 6d. net.

(3) *Medical Practitioners in the Diocese of London*

Licensed under the Act of 3 Henry VIII, C. II.; an Annotated List 1529-1725. By J. Harvey Bloom and R. Rutson James. Pp. viii+98. (Cambridge: At the University Press, 1935.) 5s. net.

(4) *An Essay on the External Use of Water*
By Tobias Smollett. Edited, with Introduction and Notes, by Claude E. Jones. (Reprinted from *Bulletin of the Institute of the History of Medicine*, Vol. 3, No. 1, January 1935.) Pp. 31-82+1 plate. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1935.) 4s. 6d. net.

(5) *The Story of the Middlesex Hospital Medical School*

Written at the request of the Council of the Medical School on the Occasion of the Centenary. By Dr. H. Campbell Thomson. Pp. xiii+182+20 plates. (London: John Murray, 1935.) 10s. 6d. net.

(6) *American Medicine*

By Dr. Henry E. Sigerist. Translated by Hildegard Nagel. Pp. 316+30 plates. (New York: W. W. Norton and Co., Inc.; London: Oxford University Press, 1934.) 16s. net.

(1) **T**HE work on medicine in the Middle Ages by Dr. David Riesman, professor of the history of medicine in the University of Pennsylvania, contains an admirably comprehensive study of the medical aspects of an age which until recently had received comparatively little attention. As Dr. Riesman points out, we are in the

first place indebted to medieval medicine for the preservation of the writings of the Greeks, Romans, Arabians and Jews, without which progress in medicine would never have taken place. As regards Arabian medicine, he judiciously remarks that it is yet too early to pass a final judgment in view of the probable existence of many undeciphered texts, but he brings forward in its favour the preservation of many texts, many chemical discoveries, good advice concerning diet, a clear account of many diseases, and a considerable number of plant remedies.

The work of the universities, the foundation of which Dr. Riesman regards as probably the greatest achievement of the Middle Ages, next receives attention, special chapters being devoted to the medical personalities and studies at Montpellier, Bologna, Padua, Paris and Oxford and Cambridge respectively.

Considerable attention, of course, is given to the description of the various diseases prevalent in the Middle Ages, of which the most important were plague, leprosy, sweating sickness, St. Anthony's fire, the King's Evil and epilepsy. The vexed question as to the existence of syphilis in medieval times is fully discussed, the author being of opinion that it is not yet possible to say definitely whether the disease was imported from America or not. Other aspects of medieval medicine considered are alchemy, the hospitals of the period, medicine and the guilds, medical text-books in use, hygiene and sanitation, and the lay attitude towards the medical profession with special reference to the unkindly criticisms of Petrarch and Chaucer.

In conclusion, Dr. Riesman points out that the greatest difference between modern times and the Middle Ages in medicine, as in all sciences, is the objective experimental method characteristic of modern times. The text is liberally interspersed with portraits and other illustrations.

(2) In his little book on Talmudic medicine, which is based on the works of Julius Preuss, I. L. Katzenelsohn and M. Pearman, Dr. J. Snowman describes the medical conceptions current among the Jews during the Talmudic period, that is, from A.D. 200 to 600. An excellent account is given of the Talmudic theories as to the causation and cure of diseases, contemporary anatomy and physiology, and the progress made in the various branches of medicine.

The descriptions of superficial anatomy in the Talmud are remarkably accurate, but owing to the absence of dissection little could be learnt about the internal organs, though fanciful views were expressed as to their functions. The medical diseases mentioned in the Talmud include acute intestinal disorders probably due to dysentery, and leprosy, quinsy, cold in the head, worms and headaches, while the surgical disorders consist of superficial wounds, stone in the bladder, abscesses, burns and scalds, bites of mad dogs, snake-bites and fractures and dislocations. A special chapter is devoted to the minor operations of ritual circumcision and venesection, which was used for therapeutic and hygienic purposes.

As regards gynaecology and obstetrics, the diseases of women mentioned in the Talmud are mainly connected with uterine hæmorrhage. Difficult labour is frequently noted; sacrifice of the infant and Cæsarean section appear to have been practised. Diseases of the eye are frequently mentioned, especially cataract and corneal opacities.

The rabbis' knowledge of comparative anatomy, though gained only from the study of certain cattle, sheep and poultry, seems to have been remarkably extensive, being concerned with changes in the lungs, brain, heart, liver, spine, stomach, gall-bladder and intestines.

(3) In their work on medical practitioners in the diocese of London 1529-1725, Messrs. J. Harvey Bloom and R. Rutson James have compiled an annotated list drawn from various sources of those licensed to practise under the Act of 3 Henry VIII, c. II in the diocese of London. The book does not contain the names of all the practitioners in the diocese, as those licensed by the Royal College of Physicians as well as some surgeons and barber surgeons are not included. The Act laid down that no person within the City of London or within seven miles of the same should take upon himself to practise as a physician or surgeon unless he had been first examined, approved and admitted by the Bishop of London or by the Dean of St. Paul's, assisted by doctors of physic and other expert persons in the faculty of surgery. Of the examiners, the only well-known names that have been preserved are those of Sir Hans Sloane, president of the Royal Society and

of the Royal College of Physicians, John Evelyn the diarist, and the infamous Titus Oates.

The list contains in all 360 names, of which 184 have their documents preserved at Somerset House and 176 in the registry of the Bishop of London. The most eminent licencees in the list are William Clowes (1540-1604), the famous Elizabethan surgeon attached to St. Bartholomew's Hospital; Charles Bernard (1656-1710), Sergeant-Surgeon to Queen Anne, surgeon to St. Bartholomew's Hospital and owner of a fine library; Ambrose Dickins (1687-1747), surgeon to Westminster and St. George's Hospitals and Master of the Barber Surgeons' Company; and William Cheselden (1688-1752), surgeon to St. Thomas's and St. George's Hospitals and famous for his operations for stone and cataract. The Act was never repealed, but died a natural death through lack of applicants.

(4) Smollett's essay on the external use of water, which was originally published in 1752, is preceded by an introduction by Mr. Claude E. Jones, who remarks that Smollett's writings are of interest to the student of medical history for two reasons; first on account of his small ventures in the field of medicine proper, of which the present essay is an example, and secondly for the vast number of medical pictures and comments scattered through his other works.

The present essay purports to be a letter addressed to Dr** "on the external use of water with particular remarks upon the present method of using the mineral waters at Bath in Somersetshire, and a plan for rendering them more safe, agreeable and efficacious". After a brief account of the value of the internal use of pure water, Smollett describes its employment in the form of foot-baths, universal baths and fomentations in the treatment of various disorders. In conclusion, he directs attention to certain inconveniences attending the use of the waters at Bath, such as promiscuous admission of diseased persons of all ages, sexes and conditions into an open bath, the confinement of their use to the most severe seasons of the year, and the lack of attendants and proper conveyances, and draws up a series of proposals to remedy these inconveniences.

(5) The history of the Middlesex Hospital Medical School is admirably told by Dr. H. Campbell Thomson, consulting physician to the Department for Nervous Diseases at the Hospital, and from 1908 until 1919 dean of the Medical School. Although the school was not founded until 1835, teaching in the hospital began shortly after the hospital was established in 1745. The inaugural address on October 1, 1835, when the medical school was formally opened, was delivered by Sir Charles Bell, the eminent anatomist and artist, and one of the three surgeons to the hospital. It

is noteworthy that five of his colleagues on the staff were, like himself, fellows of the Royal Society, the most eminent of them being Sir Thomas Watson, the senior physician and professor of medicine in the School, whose work on the principles and practice of physic is a medical classic.

Since that time, the Medical School has had a number of famous men on the staff, the most remarkable co-existence of celebrities at one time being the triumvirate in 1906 consisting of Sir Henry Morris, president of the Royal College of Surgeons, Sir Richard Douglas Powell, president of the Royal College of Physicians, and Sir James Kingston Fowler, dean of the Faculty of Medicine of the University of London.

Two scientific institutes connected with the School deserve special mention, namely, the Bland-Sutton Institute of Pathology opened in 1914, and the Courtauld Institute of Biochemistry opened in 1928, where there are always a number of research workers from Europe and the United States.

(6) In the excellent English translation by Miss Hildegard Nagel of his work on American medicine, Dr. Henry E. Sigerist, professor of the history of medicine at Johns Hopkins University,

who had formerly held the corresponding chair at Leipzig, has given a lively account of the development of American medicine, from the earliest times until the present day as seen by an unprejudiced and sympathetic observer.

The book contains an interesting account of primitive medicine in North America, followed by a description of medicine in the colonial period, biographical sketches of medical pioneers in the United States from John Morgan and Benjamin Rush in the eighteenth century down to Billings and Osler in our own time, the present condition of medical education with special reference to Johns Hopkins University, where attention is focused on science and research, the organization of hospitals and nursing, public health work including campaigns against infectious diseases, maternity and child welfare, mental hygiene and various scientific institutions connected with medical clinics.

Dr. Sigerist rightly claims that whereas fifty years ago American schools counted for nothing in world medicine, to-day the standard of education equals that of most European countries and in many places and in some points is superior.

Theory and Practice of Electrochemistry

(1) **Electrolytic Oxidation and Reduction: Inorganic and Organic.** By Dr. S. Glasstone and Dr. A. Hickling. (Monographs on Applied Chemistry, Vol. 9.) Pp. ix+420. (London: Chapman and Hall, Ltd., 1935.) 25s. net.

(2) **Principles of Experimental and Theoretical Electrochemistry**

By Prof. Malcolm Dole. (International Chemical Series.) Pp. xiii+549. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30s. net.

(3) **Principles and Applications of Electrochemistry**

By Prof. H. Jermain Creighton. In 2 vols. Vol. 1: Principles. Third Edition, revised and enlarged. Pp. xviii+502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20s. net.

(4) **Principles and Applications of Electrochemistry**

By Prof. W. A. Koehler. In 2 vols. Vol. 2: Applications. Pp. xiv+545. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25s. net.

SOME sections of the broad science of chemistry are purely theoretical, others are essentially practical, but electrochemistry in its modern

developments combines the two aspects. The appreciation of its principles demands an intensive knowledge of mathematics and thermodynamics; the application of those principles to industrial purposes is of fundamental importance, both on the inorganic and on the organic sides. No Chancellor of the Exchequer needs to ask to-day, as Gladstone did: "What's the use of it?"; he has long ago taken advantage of Faraday's reply to the question: "Why, sir, there is every probability that you will soon be able to tax it!"

(1) The monograph by Drs. Glasstone and Hickling illustrates to an unusual degree the close intermingling of present-day electrochemical theory and practice. As the preface states, purely empirical methods are no longer satisfactory in the control of industrial processes, and success in such operations can only follow from an understanding of the fundamental principles involved.

The basic theory of the subject is clearly presented in this book, and a multitude of practical illustrations discussed in detail. Full references to scientific and patent literature are appended at the end of each chapter, and the hope of the authors that "the book will be of value both to research workers and to technical chemists interested in the enormous possibilities of

electrolytic methods" will no doubt be amply fulfilled. The book is one to be highly recommended.

(2) The volume by Prof. Dole, of Northwestern University, Illinois, is more restricted in its scope, dealing as it does only with the theoretical principles of electrochemistry. These principles, however, are introduced throughout from an experimental angle, so that in spite of the fact that the main stress of the book is upon the interpretation of electrochemical phenomena, the student who has conscientiously studied each chapter should be well equipped to put the knowledge acquired to practical use if necessary. The book constitutes a serviceable text for honours students specializing in electrochemistry and for Ph.D. research workers in this branch of the subject.

(3) The fact that Prof. Creighton's "Principles of Electrochemistry" has now reached the stage of a third edition is evidence of its popularity and merit. The treatment is elementary but thorough, and furnishes a most readable introduction for the student of electrochemical theory. In order to bring certain topics into harmony with recent advances, a great many portions of the second edition have been rewritten and new subject matter has been added. The problems inserted

at the end of nearly every chapter and the numerous references to original papers add materially to the value of the book.

(4) "Applications of Electrochemistry", by Prof. Koehler, forms a companion volume to Creighton's "Principles". It is intended for two classes of readers: students in universities, colleges and technical schools for use as a textbook; and persons connected with the industry for use as a reference work. The difficult problem of making the book sufficiently complete and up-to-date without at the same time making it too voluminous for academic purposes has been very successfully met, and the impressive list of experts to whom the author makes acknowledgment for assistance and suggestions bears witness to his assiduity in ensuring accuracy in each section of the field covered.

Practically every point of importance in inorganic electrochemical industry is presented in a clear and compact manner, and the presentation is assisted materially by a large number of plates, diagrams and tables. Organic electrochemistry, presumably for reasons of space, is scarcely touched. A third volume of the series, treating this subject in the same admirable style, would be warmly welcomed.

JAMES KENDALL.

Forests and Flora of British Honduras

The Forests and Flora of British Honduras By Paul C. Standley and Prof. Samuel J. Record, in cooperation with the Conservator of Forests and the Agricultural Officer of the Colony. (Botanical Series, Vol. 12, Publication 350.) Pp. 432+16 plates. (Chicago: Field Museum of Natural History, 1936.)

FOLLOWING a short introduction on the geography, soils, climate, agriculture and forest products of British Honduras, the remainder of this substantial volume is divided into two parts, entitled respectively "The Forests" and "The Flora". In Part I, which occupies about thirty pages, and is contributed by Prof. Record, a description is given of the forests, with a short history of the same, and a reference to and description of most of the timbers of economic importance, including uses as timber and also for pulp, with an interesting account of the Chicle gum industry. Throughout the remainder of the work Prof. Record has also contributed a description of the different woods wherever they are named, and he states that "the wood descriptions are short because all of the more important species

have been covered more fully in 'Timbers of Tropical America' or in special articles in *Tropical Woods*'.

Part 2, comprising the whole catalogue of the trees and shrubs of British Honduras, is the work of Mr. Standley, no doubt greatly assisted by the knowledge acquired by Prof. Record, who "began about ten years ago to compile a list of all of the available scientific and local names of the woody plants of the Colony". This splendid production is of first importance as presenting an authoritative work on a much needed subject, and comes at a timely moment, because—perhaps for the first time—a vigorous reorganization of the Colony's timber production and conservation is at work.

Prof. Record points out that "although British Honduras has been a timber-producing country for 250 years, systematic forestry was started only in 1922 with the formation of the Forest Department". This Department is vested in a Forest Trust with the Governor as chairman, and the policy laid down includes an excellent programme which should very soon yield many results, not the least of which is to find a market for some of the useful secondary woods. The work provides a full list,

enabling the timber expert to trace the vernacular names to the correct identification of the botanical types, and provides the same advantages to the large number of people who are enthusiastic collectors of useful and ornamental flowering shrubs.

A painstaking and conscientiously accurate description is given of the measurement of the trees, leaves, flowers and fruit, together with the districts in which they abound.

The history of this tropical country is full of romance and interest. Why the Maya peoples settled there, or whence they came seems to be undecided. In the beginning, their fight against Nature and the jungle must have been very severe, but at last they succeeded and established their cities. Then again Nature reasserted herself, and in course of time turned them out.

Gann and Thompson say :

"those cities which were ill situated, from an agricultural point of view, would naturally be the first deserted, while the cities in the fertile lands of north-eastern Peten would be amongst the last.

"Whatever the cause, it is certain that by the third Katun of Bactun 10, or 629 A.D., the whole of the Old Empire was almost completely abandoned, and remained so for the next seven or eight centuries, when reforestation of the lands enabled at least a part of the descendants of the original dwellers to return to the home of their ancestors."

The same authors inform us that it took 250 years for the Maya to evacuate the land. They state that the reason for the evacuation is not known, but they mention seven possible reasons, of which the sixth is "exhaustion of the soil". The other reasons are : "1. National decadence. 2. Epidemic disease. 3. Earthquakes. 4. War, internecine or foreign, or both combined. 5. Climatic changes. 7. Religious or superstitious reasons."

The practice followed by almost all primitive peoples was to cut down the trees and shrubs over one area, and move on after a year or two, repeating the same process in another, which must at last have rendered the whole country barren of trees, so that erosion of the soil would have followed in the same way as in other countries. There seems to be little doubt, therefore, that the sixth reason referred to above, namely, "exhaustion of the soil", was the cause of the final evacuation.

The romance of this country did not finish with the departure of the Maya. The story of the early British voyagers who visited these far distant countries is fairly well known. Prof. Record informs us that :

"It was at one time the practice of the class of privateers . . . cruising against Spanish traders to set fire to all vessels they captured which might

be laden with Logwood, having first stripped them of everything valuable.

"But it so happened that a Captain James, the master of a letter of marque, having captured a Spanish vessel the cargo of which consisted of this wood, brought the ship and cargo into the Port of London. On endeavouring to dispose of the latter he was gratified as well as surprised to find for it a ready sale at an enormous price per ton. The crew, who had used up a portion of the precious freight to burn in the galley fire, had little idea that they were using fuel at a hundred pounds per ton during the voyage."

No less romance is attached to the beginning of the trade in mahogany, which is supposed to have begun about 1725. A little later, in 1786, a treaty was made between Great Britain and Spain, which gave the right to British settlers to cut wood "not excepting even mahogany".

Having regard to the importance and value of this colony, it seems incredible that a recognized forestry service should have been started only in 1922, but with the competent activities of the present Governor, and the Conservator of Forests, good results may confidently be expected. There can be no stronger indication of its importance than the interest shown by the two very well-known authors of the present work—Samuel J. Record and Paul C. Standley. Prof. Record had already provided generous contributions to our knowledge of forests and their products, and this new book comes at a most opportune moment.

ALEXANDER L. HOWARD

Das Tierreich :

eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften von Berlin. Lief. 65 : Lepidoptera—Parnassiidae pars 2 (subfam. Parnassiinae). Bearbeitet von Felix Bryk. Pp. li+790. (Berlin und Leipzig : Walter de Gruyter und Co., 1935.) n.p.

THE contents of this extensive work are embodied in the title. It monographs the genera and species of 'Apollo' butterflies forming the subfamily Parnassiinae together with their numerous forms of subspecies. In each case, the synonymy is given, followed by a description of the species and form concerned, its distribution and the location of the type specimens. It is profusely illustrated by means of 698 text-figures of the various species, together with structural details of a diagnostic character. The extraordinary range of forms into which the various species are divisible has made the genus a specialized study among lepidopterists. In the case of *P. apollo*, for example, the index alone of the forms of this species runs to five pages of double columns. A detailed and authoritative work of this kind is likely to remain a standard for a number of years.

The Subject Index to Periodicals, 1935

Pp. xiii+235. (London: The Library Association, 1936.) 70s.

WITH this issue the "Subject Index to Periodicals" completes twenty years of existence, the first volume published being for the year 1915. The volume for 1935 appeared only five months after the close of the year covered. The general editor, Mr. T. Rowland Powel, his staff and the voluntary contributors are to be congratulated on the rapidity with which the work has been carried out. The Subject Index for 1935 comprises entries of about 26,000 articles selected from 590 periodicals. Of these periodicals 540 are English and American, 27 French and Belgian, 21 German, and 2 Italian. The articles selected are arranged under headings such as "Light", "Lighting", "Lightning", etc., but under each heading the order is that of authors' names.

The subjects selected for indexing are by no means confined to science, but cover a wide range. Verse and fiction are excluded. With few exceptions, no attempt has been made to index periodicals already indexed in the following: *Agricultural Index, Engineering Index, Engineering Abstracts, Index Medicus, Journal of the Society of Dyers and Colorists, Photographic Abstracts, Revue de Géologie, Royal Meteorological Society Bibliography, Science Abstracts, Textile Institute Journal.*

All workers in science value these Subject Indexes, and appreciate the care and efficiency which, under the auspices of the Library Association, have been devoted to their production. It is probable that many a valuable paper, published in a journal that is little read, is here introduced to a much larger world.

Pheretima (The Indian Earthworm)

By Prof. Karm Narayan Bahl. (The Indian Zoological Memoirs on Indian Animal Types, 1.) Second edition, revised and enlarged. Pp. x+85. (Lucknow: Lucknow Publishing House, 1936.) 1.8 rupees.

PROF. BAHL, the author of the memoir under notice, is also the general editor of this useful series. It is ten years since the first edition was published, and the relevant work done in the interval has been incorporated. The book has been thoroughly revised and to some extent rearranged. It is printed upon a more satisfactory paper, which does better justice to the illustrations. Five of the figures of the first edition have been omitted, nine new ones inserted and several have been redrawn, resulting in a distinct improvement. The brief account of the development has been omitted but an interesting new chapter on the receptor organs has been put in. The old chapter on habits and distribution has been rewritten and extended, and removed to near the end as "Bionomics, Distribution and Relationships".

The memoir was good when first issued and its usefulness is shown by the demand for a second edition. In its new form, where every chapter has been critically revised and added to, the illustrations improved, and the recent work included, it should be assured of a new lease of life.

C. H. O'D.

Geologie Südamerikas

Von Prof. Dr. H. Gerth. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Teil 2. Pp. vi+201-389+plates 18-30. (Berlin: Gebrüder Borntraeger, 1935.) 19.60 gold marks.

THE second part of Prof. Gerth's exceedingly useful treatise on the geology of South America deals with the geological history of the continent during Mesozoic times and summarizes, in a very concise manner, the rather scattered literature on the subject.

The method of treatment is similar to that employed so successfully by the author in vol. 1, and the regional discussion of each system or formation is followed by a short section dealing with the main events throughout the continent as a whole.

In contrast to the northern hemisphere, the Mesozoic era in the southern continent was a period of intense and widespread igneous activity which reached its maximum expression during the Trias but recurred locally during the Jurassic and Cretaceous. The author brings this igneous activity into line with the tectonic status of the continent and traces the development of the three great, independent zones of sedimentation from which the Tertiary orogenic zone developed.

The numerous correlation tables and abundant references to literature considerably increase the value of this excellent book, which must prove of interest and value to all geologists, and not merely to those directly concerned with the problems of South American geology.

Beiträge zur Herkunftsbestimmung bei Honig

Band 1: Pollengestaltung und Herkunftsbestimmung bei Blütenhonig; mit besonderer Berücksichtigung des Deutschen Trachtgebietes. Von Prof. Dr. Enoch Zander. Pp. 343+80 plates. (Berlin: Verlag der Reichsfachgruppe Imker E.V., 1935.) 18 gold marks.

HONEY contains large numbers of pollen grains of the blossoms visited by bees, and, consequently, a study of the pollen may yield considerable information as to the source of a honey sample—not only the flower-source, but perhaps also of the district or country of origin.

This volume contains an exhaustive account of the pollen forms that have been noted in German honey and also in occasional samples from other lands. Since the German and British floras have much in common, British students may find this work useful. Descriptions of the pollen of nearly six hundred species of plants belonging to 109 families are supplied, and pollen characters such as size, shape, number of pores and furrows are also marshalled in lists. Photographic illustrations of the pollen of nearly 350 species are also included in double-sided plates. These plates are disappointing. Each pollen form is generally shown twice, at magnifications of 160 and 450 times. For all but a small number of the larger pollen grains, the lower magnification is too low to give a picture of any value in a work of this kind, while even at the higher magnification details of diagnostic value are often obscure.

Deterioration of Structures in Sea Water

NOT the least important of the matters which concern the civil engineer engaged on port and maritime works, such as docks, jetties, wharves and piers, is the durability in a marine environment of the materials available for constructional purposes. Timber, iron and steel and concrete immersed in sea water are exposed to the action of agencies producing damage and

both to the profession and to the public at large. An investigation of the kind in question is bound to be prolonged, since certain deleterious processes are slow in action, though their cumulative effect over a number of years may be extremely serious and even fatal. Each year, the Committee has published the results of its inquiries in the form of interim reports, and now it is felt that the time has come when it is fitting to issue a connected account of the whole of the investigations which have been carried out up to date, and the conclusions which, in the opinion of the Committee, may reasonably be drawn from the results so far obtained.

This has been done in a volume which has been published by the Department of Scientific and Industrial Research* embodying the fifteenth report of the Institution Committee, though the Department is careful to state that it is not responsible for the statements made or the opinions expressed therein. A similar disclaimer is made by the Institution as regards endorsing the views of contributors whose names appear in connexion with their work.

The Report comprises four sections, relating respectively to the preservation of timber, the corrosion of steel and iron, the protection of steel and iron by means of paints and other preservatives, and lastly, the deterioration of reinforced concrete.

Omitting decay, the principal cause of damage to timber structures in sea water is the *Teredo* or *Bankia*, commonly known as the ship-worm, and certain allied species (Fig. 1). The ravages of these molluscs were evident in the earliest days of ship-building, and they are recorded to have proved disastrous in the fourth voyage of Columbus, whose ships were "pierced with worm-holes like a bee-hive". At the present day, the damage done to timber piling in various parts of the world may be reckoned in millions of pounds. The Romans are stated to have made the discovery of a species of wood which is immune, but their secret is lost, and so far as current knowledge goes, there is no timber which is indubitably free from liability to be attacked. As the result of the experiments carried out, the Committee came to the conclusion that "no process for the preservation

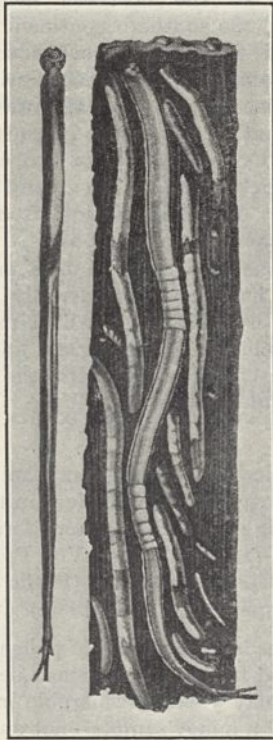


FIG. 1. *Teredo navalis* and section of attacked timber.

deterioration to a far higher degree than those characteristic of a purely atmospheric environment. Timber is not only particularly prone to 'rot' or decay at or about the water-line, especially if that fluctuates in level, but also it is assailed by marine organisms of highly destructive capability, while the chemical action of the salts in sea water is equally potent, under suitable conditions, in causing and fostering corrosion in metals and disintegration in concrete. When, therefore, the Institution of Civil Engineers, in 1920, instituted a Committee of Inquiry into the Deterioration of Structures in Sea Water, it took a step which had long been desirable and which, it may confidently be asserted, has been of inestimable advantage

* Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Fifteenth Report of the Committee of the Institution of Civil Engineers: being a General Description of the Experimental Work carried out by the Committee to date. Edited by S. M. Dixon and H. J. Grose. Pp. xvi+138+80 plates. (London: H.M. Stationery Office, 1935.) 12s. 6d. net.

of timber was more satisfactory than that of impregnation with creosote" and that "the efficacy of the process depended on the completeness with which the penetration of the creosote into the timber had been effected".

In order to increase the degree of penetration, incision of the fibres was resorted to, and the results of the operation are stated to have been satisfactory, the depth of the penetration being governed by the depths of the incisions, which had to be limited "in some cases" because there was a danger of injuring the timbers if the depth of the incisions exceeded $\frac{3}{4}$ inch. The warning is significant, and there are those who will feel that incision is a method to be used with extreme caution, since injury to the fibres can scarcely be avoided, with consequent impairment of strength. The normal process of impregnation with hot creosote does not appear to affect the strength of timber to any material degree, though high temperatures were observed to produce some reduction of strength. The arsenical compound, chlorodihydrophenarsazine, commonly called "D.M.", proved very deadly to *Teredo* when in the state of free swimming larvæ. The experiments did not definitely show creosote to be an efficient protection in the case of crustaceans, such as *Limnoria*, though it appeared to have some useful effect against *Chelura*. Prof. G. Barger contributes a detailed account of his experiments with various toxins, and Prof. S. M. Dixon describes his mechanical tests of foreign timbers, untreated and creosoted, with a note on incising.

The corrosion of metals constitutes a wide field of inquiry in itself, and though in the present instance limited to iron and steel, specimen bars of no less than fourteen different materials were selected for experiment: these included three

representative rolled irons, four ordinary steels, two types of cast iron and five special steels. In their choice of specimens, the Committee had the advice of Sir Robert Hadfield, and the examination of the bars after exposure was made by Dr. J. Newton Friend. The test specimens

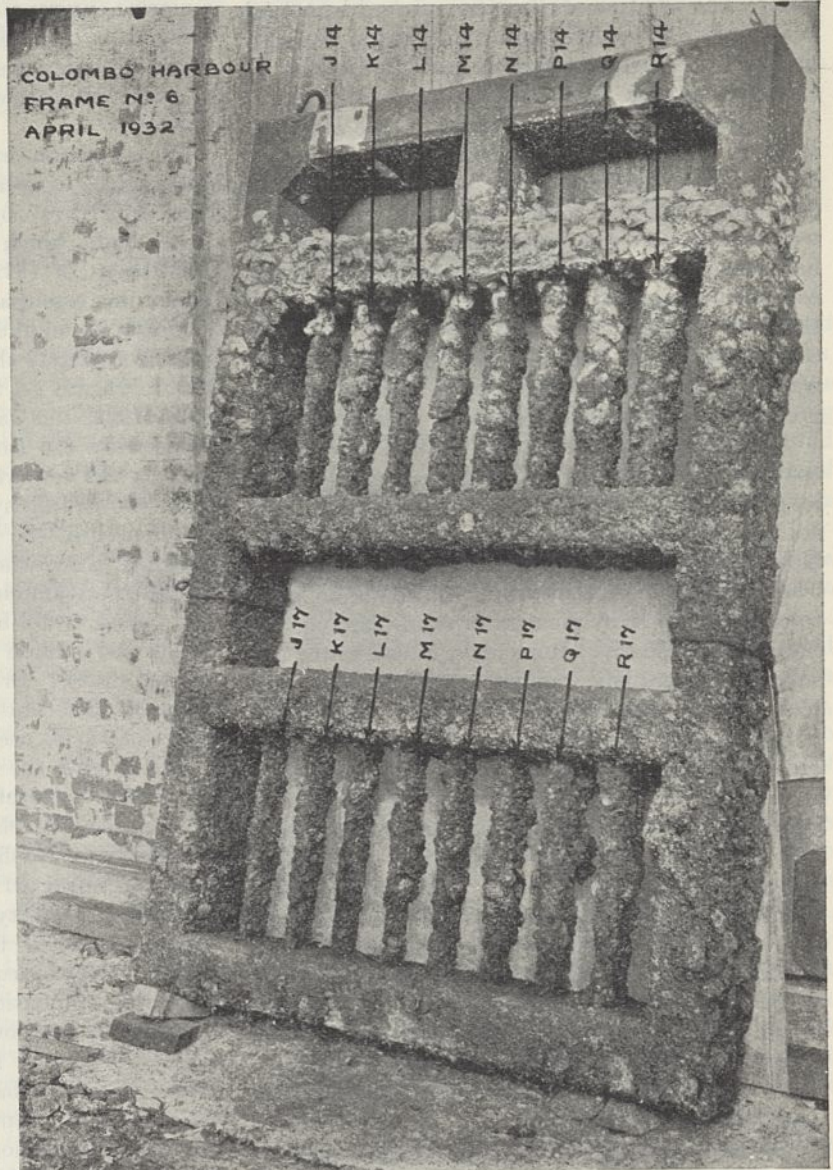


FIG. 2. Frame containing bars exposed to half-tide conditions (upper part) and to complete immersion in sea water (lower part) at Colombo for 10 years. Reproduced by permission of the Controller of H.M. Stationery Office from "Deterioration of Structures in Sea Water". Crown copyright reserved.

were in general 24 in. long by 3 in. by $\frac{1}{2}$ in.

On the whole, there was found to be little to choose between the wrought irons and the ordinary carbon steels used in the research, as regards their mean resistance to the various types of corrosion studied; and increasing the carbon content of ordinary steel from about 0.24 to 0.40 per cent

did not appear appreciably to affect the resistance of the metal against corrosion. The addition of 0.6 and 2.2 per cent of copper to mild carbon steel markedly increased the resistance of the metal to aerial and freshwater corrosion, but this advantage did not appear to be maintained in the half-tide and complete immersion tests in sea water. The addition of chromium proved beneficial in the tests above high-water mark, but in the half-tide and complete immersion tests it resulted in excessive pitting. The best results were obtained by adding a proportion of nickel to the steel, an addition of 36.6 per cent rendering the material exceptionally resistant under all conditions. The cast irons resisted aerial corrosion exceedingly well and fresh-water reasonably well, but in the half-tide and complete immersion tests in sea water, corrosion frequently penetrated to the middle of the bars through pores and casting flaws. It is to be noted that the corrosion of the test bars was complicated by the occurrence of marine growths, including barnacles and oysters (Fig. 2).

The preservative effect of paints and other coatings on a number of mild steel plates (2 ft. long by 6 in. wide by about 0.1 in. thick) was studied, and the tests under the supervision of Dr. Newton Friend yielded results of much interest. The advantage of removing the mill-scale prior to coating, either by pickling or sand-blasting, was brought out clearly. Immersion in sea water and subsequent scraping was not so satisfactory. The plates were treated with red iron oxide paint (adopted as the standard for comparison) and with ordinary red lead paint with various Pb_3O_4 contents. The red lead paints showed distinct superiority in the aerial and half-tide experiments, but not in the total immersion tests. A series of plates were galvanized and a further set covered with tar and bituminous mixtures. Galvanizing proved very successful with a coating of about 20 oz. of zinc per square yard. Coal tar gave excellent results and proved in all circumstances much better than iron oxide and lead paints. Bituminous solution gave poor results in aerial tests, but excellent results in the half-tide and complete immersion tests.

The experimental investigation of the durability of reinforced concrete in sea water has been conducted by Dr. R. E. Stradling. The experiments have involved the preparation of 474 reinforced concrete piles and 5,388 cylinders of different composition and treatment. The longest period of exposure experienced by any of these series as yet is only $5\frac{1}{2}$ years, and it is therefore premature to draw other than merely tentative conclusions therefrom. As further examination may lead to modified views, it is scarcely advisable at this stage to do more than record the continuance

of the exposure tests under various conditions at stations at Sheerness, Watford and the Gold Coast.

The volume, which is well illustrated and accompanied by diagrams and tables of great interest, will be of value to all who are in any way responsible for the maintenance of structures in a marine environment. It should be added that the research is now being carried on by means of the financial assistance received from a large number of dock and harbour authorities. There is a good index.

In connexion with the foregoing review, it is appropriate to notice a paper on "The Corrosion of Iron and Steel" by Sir Robert Hadfield and Mr. S. A. Main which was read at a meeting of the Institution of Civil Engineers on April 7. The paper was essentially an extension and amplification of the Committee's Report, in that it surveyed more completely the field of investigational activities in regard to the corrosion of ferrous metals since 1922, the date of a previous paper on the subject by Sir Robert Hadfield. Emphasis was laid on the importance of the study of corrosion from the testimony of Dr. F. N. Speller, director of research at the National Tube Company, Pittsburgh, U.S.A., who had made a careful estimate of the total amount of steel in use in the world and found it to be about 1,200 million tons, of which 700 million tons is probably in use in the United States. Dr. Speller further estimated that about 75 per cent of the steel requires protection in order to be used.

Alluding to the work of the Committee, it was stated that altogether 1,350 specimens of carbon and special steels were prepared by Messrs. Hadfields of Sheffield for experimental purposes, and that in regard to exposure to air, the order of increasing severity for general wastage at the stations selected for observation was invariably Halifax (Nova Scotia), Auckland, Plymouth and Colombo. Climatic temperature, which is highest at Colombo and lowest at Halifax, evidently must have a definite influence in promoting aerial corrosion. This factor, however, did not operate to the same extent under half-tide conditions or for total immersion: presumably, therefore, the local character of the sea water may be of more importance than its temperature. The evidence of the behaviour of iron and steel under half-tide conditions is especially instructive, being contrary to the widely accepted idea that exposure "between wind and water" is particularly favourable to corrosion. In the great majority of cases among ordinary steels and rolled irons, the wastage at half-tide is intermediate between that experienced under aerial and total immersion conditions.

The authors gave some examples of the severity

of the corrosion experienced in the Gulf of Paria, where the United British Oilfields of Trinidad, Ltd., reported that a 5/16 in. mild steel plate, forming the bottom of a storage tank, was eaten through in nine months. Among the protective measures discussed, special mention was made of oxide films, not more than 1.6 millionths of an inch in thickness, yet capable of providing an armour, or first line of defence against corrosion.

In most cases of general wastage of steel, the removal of the rolling-mill scale, prior to exposure, had the effect of increasing the amount of corrosion, but, on the other hand, as regards pitting, its influence was almost entirely favourable. The wastage of cast iron was generally very much less than that of the rolled irons and steels, and the pitting in a five-year test was negligible.

BRYSSON CUNNINGHAM.

Insect Life of Temporary Rain Swamps in British Guiana

By F. A. Squire, Department of Agriculture, British Guiana

TWICE a year, during the months immediately preceding and following the solstices, the low-lying, badly drained grasslands of the coastal belt of British Guiana are converted into temporary swamps by the heavy rains which fall during those periods. This condition naturally varies a good deal in extent and duration, but generally lasts for at least several weeks. In that time the swamps become the home of innumerable insects of diverse species, some of them of the greatest concern to mankind, and all of them very interesting.

The following account is based on observations made during the mid-year rainy season of 1935. The rains commenced on May 16 and continued with daily precipitations and frequent heavy downpours up to the end of June, when dry spells began to intervene. Up to this point the season was typical, but an opportunity to prolong the investigation was afforded by an unusually wet July and August. The rainfall recorded at the Botanic Gardens, Georgetown, for the months in question was: May, 11.56 in., June, 14.37 in., July, 8.12 in. and August, 13.78 in., totalling 47.83 in. With the cessation of the rains, the swamps drain off and vanish almost as suddenly as they appear, so that there is never any stagnation.

Bearing in mind the abruptness of the onset of the rains, it is perhaps scarcely necessary to labour the point that when these aquatic conditions arise, there is a complete and somewhat sudden change in the savannah population—the dry season dwellers evacuating their territory with a good deal of haste and panic, and often with considerable loss of life. This is quite commonly observed in the case of *Solenopsis*, the red stinging ant. This notorious insect infests, and often monopolizes, the countryside—especially low-lying grasslands. Here it establishes its colonies in ever-increasing numbers, and it would, in a short time, surely become a terrible scourge but for the

blessed ruthlessness of Nature. With the advent of the rains and the flooding of the savannahs, these colonies are promptly inundated. How the ant meets this parlous situation by forming living rafts for the purpose of salvaging the brood and fertile queens is well known. But how many of these castaways ever reach safety, and what is the extent of the subterranean mortality?

Even more disastrous is the effect of the floods on other underground insects, especially the larvæ and pupæ of humous and root-feeding Coleoptera. These frequently have no aquatic adaptations, and are consequently easily overcome by excessive moisture. These inhabitants of the soil have, presumably through natural selection, come to pass their more defenceless stages during the dry seasons. But this arrangement is precarious, for the weather is often capricious, and unseasonable deluges not infrequently occur, creating very unfavourable conditions for the soil fauna. The Dynastids, *Dyscinetus geminatus* and *D. bidentatus*, in particular, are very adversely affected, and may be prevented from making their appearance in pestilential numbers for several years by such an occurrence. Tangible evidence of the havoc caused is not lacking, for the receding waters leave behind them innumerable dead grubs scattered over the countryside.

Above the ground another story is told. The rather populous Orthoptera and Hemiptera that may, in dry weather, be swept up from any patch of grass, are better equipped for flight to higher levels; yet many are trapped, and may be seen clinging to a hopeful blade of grass or making sorry efforts to swim with ill-adapted limbs. There is, indeed, one local grasshopper which, I believe, must be unique, whose life is normally passed in semi-aquatic surroundings and whose hind-tibiæ are curiously suited to this element, being flattened and expanded to form paddles.

The disappearance of the dry season population with the advent of the rains is soon followed by the appearance of a number of bizarre water dwellers, the life of which, for the few weeks of the duration of the swamps, is a fierce internecine war. Among the first to colonize this new environment are the mosquitoes. The females continue to oviposit throughout the season, thus keeping the swamps well supplied with larvæ and pupæ of all ages. Yet this apparently ideal breeding ground is but a death trap for the species. The vast majority never reach maturity, but fall a prey either as larvæ or as pupæ to predacious insects. By far the most numerous species is *Culex similis* Theo. Also present, though in decidedly fewer numbers, is *Urotaenia lowii* Theo. *Anopheles tarsimaculata* Goeldi is found here and there in shady spots.

Chief among the natural enemies of the Culicidæ are dragonfly larvæ, of which about six different species were found. They are the most successful of the swamp fauna. This is due to their great agility, their cryptic patterns, their curious habit of camouflaging themselves with débris when at rest, and perhaps to their repulsive, spidery appearance. That they are not far more predominant is probably due to their deplorable cannibalism. While the young nymphs content themselves with mosquitoes, the larger instars are inclined to disdain this exiguous diet and go for members of their own family, which they disembowel with the movable hooks of their mask. Their cannibalism is, however, facultative; in fact, they have a catholic palate, and their diet includes tadpoles, two species of which swarm in the temporary swamps, young grubs of water-beetles, tabanid maggots and Belostomatidæ.

It is a noteworthy fact that these Odonata pass through their life-cycle quite comfortably during the short duration of the swamps. It seems that the long life-history ascribed to them in textbooks is largely a laboratory fiction, as they do very poorly in captivity, even when natural conditions are closely simulated.

Two species in particular, *Erythrodiplax umbrata* Linn. and *Leptothemis vesiculosa* Fabr. were kept under observation in an aquarium. By far their most striking peculiarity is their habit of camouflaging themselves. They kick up the sediment, which settles in a fine shower on their limbs and body, and covers them like a mantle. In this manner they not only escape the unwelcome attentions of their enemies while resting or during moulting, but are also better able to seize their prey unexpectedly, thus securing an initial advantage in combat which may be sorely needed when the object of their designs is a well-matched nymph or a robust *Hydrous* grub.

Full-grown larvæ of *Hydrous* are never attacked, as they would be rather unmanageable, and a discreet preference is shown for harmless fare like tadpoles. These make easy prey, and are simply seized under the jaw and gnawed to pieces without being able to offer any resistance beyond an ineffectual wriggle. With this defenceless pabulum the dragonflies make merry, and for our immunity from at least one of the seven plagues of Egypt we owe a good deal to the Odonata.

In their turn, however, the Odonata are beset by rapacious foes. Among these the most fearsome is the silver water-beetle *Hydrous smaragdinus*. The adult is an inoffensive vegetarian, so that it is all the more surprising to find the larvæ equipped with a pair of huge crescentic jaws. Dragonfly nymphs, despite their superior agility and cryptic colouring, fall easy prey to these slug-like creatures which, covering themselves with fine mud, and moving slowly but quietly, are able to approach unobserved within striking distance of their quarry. Their favourite food is the tadpole, which is secured in an interesting manner: the tadpole, having the advantage of speed and elusiveness, is first of all rendered *hors de combat* by being deprived of its tail. In many cases this is accomplished by a single sweep of the great jaws, but where the victim is more robust, the amputation is not quite so artistic.

The life-history of the silver water-beetle is of unusual interest. The egg mass is approximately hemispherical and about $\frac{3}{8}$ in. in diameter. It consists of dry froth, with an outer impermeable crust. The flat side has a hardened, triangular pad which floats vertically with the apex up, and is invariably attached to a straw which serves to camouflage it. The eggs are pale yellow and about 4 mm. in length, and are placed vertically in the side of the hemisphere in a single layer of about three hundred. The rest of the space being taken up by froth, the centre of gravity is low, thus stabilizing the egg mass. More remarkable is the rapidity of the embryology: the eggs are laid within a day or two of mating and are quite undeveloped at oviposition; yet within three days the larvæ emerge. The outer envelope is ruptured round the base of the triangular pad and the grubs swim out. There are three casts, the first taking place two days after eclosion, the second about four days later, and the last before pupation, seventeen days after that. By this time the grub has attained a length of two inches. There is a quiescent prepupal stage of six days, followed by a pupal instar of five days. Thus the total life-cycle occupies about thirty-one days. Another water-beetle with similar biology occurring in the temporary swamps is *Tropisternus laevis* Sturm.

Other insects of interest in this association are the Belostomatidæ, of which several species occur. Their prey consists of mosquito, dragonfly and tabanid larvæ, which they seize with their prehensile forelegs.

In conclusion, attention may once more be directed to the rapidity with which the temporary swamps are colonized, and the intense and incessant competition among the colonists and its effect on the mosquito population. The comparative paucity of mosquitoes during the thick of the rains is a common experience in British Guiana, and is

generally attributed to the destruction of larvæ by excessive flooding. While there may be something in this, there is little doubt that it is due in a far greater measure to the mosquito's aquatic associates. These are slower at colonizing at the onset of the rains, and cannot establish themselves at all in the ephemeral puddles that result from the intermittent showers towards the end of the season. This suggests a reason for the prevalence of mosquitoes at the beginning and at the end of the rains, and their scarcity when the rainy season is in full swing.

Obituary

Dr. W. J. S. Lockyer

THE sudden death of Dr. Lockyer has deprived astronomical circles of a familiar and welcome figure. While walking down to his house from the Norman Lockyer Observatory on July 15 he was seen to fall on his face; and when some men close by went to help him up, he was found to be dead. About two years ago he was laid up for several months on account of phlebitis, and his death seems to have been a sequel to this attack.

To all his friends, Dr. William James Stewart Lockyer was affectionately known as 'Jim', and by all of them he will be greatly missed. He was the fifth son of Sir Norman Lockyer and was born on January 3, 1868. His mother died when he was eleven years of age, and the present Lady Lockyer was married to Sir Norman in 1903. The stages of Dr. Lockyer's education at Cheltenham College, Trinity College, Cambridge, the Royal College of Science, South Kensington, and the University of Göttingen, all led naturally to a scientific career and to his carrying on the astronomical studies of his distinguished father. The subject of the thesis for which he received his doctorate at Göttingen in 1896 was the variable star η Aquilæ, all the available observations of which he submitted to full discussion with some interesting conclusions. Among the results obtained was that the epoch of maximum luminosity oscillates to and fro to the extent of five hours on either side, with a period comprising four hundred maxima. The minima are also subject to a similar oscillation, and four secondary undulations were revealed on the curves representing the variability of the star's magnitude, recurring at intervals of forty-three hours, or one-quarter of the main period.

Variability of another kind, namely, that of the spectrum of the star γ Cassiopeiæ, was the subject of Dr. Lockyer's most recent papers to the Royal Astronomical Society. This star has a constant magnitude of 2.25, and its spectrum was also believed to be constant until a close examination of photographs taken by Dr. Lockyer proved it to change in a

very peculiar manner. The spectrum contains hydrogen lines each made up of double emission lines superimposed on a broad absorption line. The two components of each of the double emission lines undergo regular changes of relative intensity; and in his last paper on this star, contributed to the Royal Astronomical Society a little more than a year ago, evidence was presented of some very remarkable variations of this character.

This paper was one of forty dealing with spectroscopic work carried out at the Norman Lockyer Observatory, Sidmouth, since 1920, nearly all of them by Dr. Lockyer himself. The Observatory was founded by Sir Norman with the help of sympathetic friends in 1912, after the decision to transfer to Cambridge the Solar Physics Observatory in which he had carried on astrophysical and astrochemical work continuously since 1875. It was first called the Hill Observatory, but was given its present name after Sir Norman's death in 1920. Four years earlier, the Norman Lockyer Observatory had been formed into a Corporation under the Companies (Consolidation) Act, 1908, with Sir Robert Mond, who was a school friend of Dr. Lockyer's at Cheltenham College, as chairman. Dr. Lockyer succeeded his father as director of the Observatory in 1920, and though he usually had only one assistant observer, the amount of original work done has been remarkable, with the result that the Observatory now possesses as fine a collection of photographs of stellar spectra as any observatory in Great Britain. Such a record is particularly good for an institution maintained entirely by private benefactors and without any State aid.

Both in association with his father, and separately, Dr. Lockyer took part in a number of total solar eclipse expeditions. Among these were Government expeditions to observe the Vadso (Lapland) eclipse of 1896; Viziadrug (India), 1898; Alicante (Spain), 1900; Palma (Majorca), 1905; and Vavau (Tonga Islands), 1911, when he was the chief of the expedition. Other eclipses observed by him were those of 1912 (France); 1921 (Scotland); 1927 (England);

and 1932 (Canada), and whenever weather conditions were favourable he was successful in adding something to our knowledge of solar phenomena revealed during totality. His skill as a photographer, and familiarity with astronomical instruments, made him particularly valuable to every eclipse expedition of which he was a member.

While certain problems relating to the constitution of the sun can only be studied during the brief moments of total eclipse, there are many others which require for their solution the collection of observations over a long period. Among these is the relation between solar changes and terrestrial weather, to which subject Sir Norman and his son contributed some notable papers. Upon the initiative of Sir Norman, a committee for the study of such changes was appointed by the International Meteorological Committee in 1903, and Dr. Lockyer became secretary of it. Periodic plus and minus 'pulses' of rainfall in India were described by Sir Norman and Dr. Lockyer in a paper read before the Royal Society in November 1900, and were shown to be related (sometimes inversely) to similar variations at Mauritius, Cordoba (South America), the Cape of Good Hope, and other places. Attention was afterwards devoted to an examination of the variations of pressure over the Indian and other areas, and a period of 3·8 years was found in the mean variation over the whole of India and the other areas. An inverse variation was found in the pressures at Cordoba; in fact, there was a 'see-saw'. The area affected by this barometric see-saw was extended in a later paper before the Royal Society to Java, Ceylon, Mauritius and Australia.

These studies of periodic variations in the earth's meteorological elements are closely related to solar conditions. It was shown by Dr. Lockyer that, underlying the ordinary solar cycle of eleven years, there is another of greater length, namely, thirty-five years, or about three cycles of solar activity. This corresponds to Brückner's well-known climatic cycle of about thirty-five years, and thus associates weather changes on the earth with periodic variations of solar phenomena. What exactly is the relationship between the two sets of changes has yet to be determined, and the criterion of correlation coefficients has taken the place of that of curve parallels, but Dr. Lockyer's studies of the problem are still important contributions towards its solution.

Dr. Lockyer was keenly interested in aeronautics, and he made his first ascent in a balloon in 1907, with the late Hon. C. S. Rolls as pilot. For the next few years he was in the air in balloons and aeroplanes as often as his work or chance permitted, invariably accompanied by his camera and frequently with other scientific instruments, such as experimental direction finders and similar gadgets. During the Great War he was commissioned in July 1915 as a lieutenant in the Royal Naval Volunteer Reserve, attached to the Royal Naval Air Service, and two years later was promoted to the rank of lieutenant-commander. He served as commanding officer at several anti-Zeppelin stations and also in other capacities, such as intelligence officer to H.Q. Manston and Westgate R.N.A.S., ground instructor Nether-

avon (Wilts), and meteorological officer at Burnham Newton (Norfolk) and Orfordness (Suffolk). He became full major in the Royal Air Force in 1918 and was demobilized in August 1919, when he again took up his astronomical work.

Dr. Lockyer served on the Council of the Royal Astronomical Society from 1927 until 1929, and again from 1931 until the present year; he was also a vice-president of the Society in the period 1933-35. He was honorary lecturer in astronomy at University College, Exeter, but most of his active life was devoted to observational work at South Kensington and later in the Observatory founded by his father on the top of Salcombe Hill, overlooking Sidmouth. He was married, and his widow survives him, but he leaves no children to continue or extend the work which has given the name of Lockyer a permanent place in the history of astronomical science. He will, however, not only be remembered in these records, but also by a large circle of personal friends, who will long cherish his memory with affection and esteem.

Baron Axel von Klinckowström

THE death of Baron Axel von Klinckowström, which occurred in the month of May at his home, the family estate of Stafsund on the island of Ekerö near Stockholm, removes one of the few remaining links with Nordenskiöld, the explorer. Klinckowström, who was born in 1867, accompanied Nordenskiöld to Spitsbergen in 1890 as a young zoologist, and in 1891 himself undertook a zoological expedition to Surinam. After his return, he devoted himself to biological research first at Stockholm and later at Würzburg under Sachs and Boveri. During these years he published a number of contributions to embryology, anatomy, variation and inheritance.

In 1895 Klinckowström was appointed University lecturer at Stockholm, and later undertook a number of expeditions to the Arctic and Antarctic. On his return he enriched the museums of Sweden by the presentation of his valuable collections. In his later years he devoted himself to bacteriological research carried out in his private laboratory at Stafsund. His many-sided interests embraced poetry and the history of art, and he was well known in Sweden as a writer of books of travel and adventure. His many friends will cherish the memory of a charming personality.

E. KLIENEBERGER.

WE regret to announce the following deaths:

Dr. Charles E. Johnson, director of the Roosevelt Wild Life Station at the New York State College of Forestry, on June 6, aged fifty-six years.

Prof. A. P. Karpinsky, president of the Academy of Sciences of the U.S.S.R., well known for his work in geology and palæontology, on July 14, aged eighty-nine years.

Prof. J. H. Müller, professor of chemistry of the University of Pennsylvania, an authority on the chemistry of germanium, on June 18, aged fifty-three years.

News and Views

The Medical Profession and Chemical Warfare

WE are glad that the British Medical Association, during the session held at Oxford on July 17-25, gave consideration, at the annual representative assembly on July 17, to the subject of chemical warfare. The Council of the Association reported that the question of the protection of the community against the effects of poison gas is being examined in connexion with the Air Raid Precautions Department of the Home Office before any definite proposals are made. After discussion of a resolution submitted by the North Glamorgan and Brecon Division of the Association, the following amendment was adopted: "That this meeting condemns unreservedly the use of poison gas in warfare as inhuman in its results and degrading to civilization, and relies upon the council to do everything in its power with a view to securing the co-operation of the medical profession in all countries in order to prohibit the use of poison gas." In the course of the discussion, an appeal was made to men of science generally, as well as to members of the medical profession, to protest collectively against the destruction of civilian populations through the use of poison gas, and to try to secure international co-operation with this end in view. Even though politicians may consider it impracticable to do anything to prohibit the destruction of human life by indiscriminate chemical warfare, yet scientific workers should let the community know that they dissociate themselves from the use of such methods. We hope therefore, that at the forthcoming meeting of the British Association at Blackpool the lead given by the British Medical Association will be followed; so that science may not be understood by silence as acquiescing in the application of its discoveries to the degradation of civilized life.

Native Territories and the Union of South Africa

QUESTIONS in the House of Commons on July 16 indicated that no little consternation had been aroused in certain quarters by Mr. Pirow's statements on his return to South Africa as to the trend of opinion in Great Britain on the question of the future of African mandated territories. To some extent, this was allayed by the Prime Minister's assurance that Mr. Pirow's opinions are personal and that in any event, the question falling outside the scope of his mission, his view has no basis in official discussion. The House further elicited from the Under-Secretary of State for the Colonies an explanation of a somewhat cryptic statement by General Hertzog in the Union Parliament in making provision for an expenditure of £35,000 for "development and improvement in native territories", which has been taken, not unjustifiably, as pointing to the transfer of the native territories of Bechuanaland, Basutoland and Swaziland to the Union Government at no distant date, although the precedent condition of native consent, to which the British Government is

pledged, is not yet fulfilled. Mr. MacDonald's reply clarified the situation. General Hertzog, it would appear, was defending an offer of the Union Government to contribute towards certain development schemes as a step towards the co-operation with the native authorities which has been agreed upon as a desirable policy. On July 15, Mr. MacDonald stated in a written reply that the offer of the Union Government is directed to three objects: (1) anti-soil erosion work in Basutoland, (2) provision of water supplies in Bechuanaland, and (3) conservation of water in Swaziland. Notwithstanding assurances that acceptance of the offer would not impair the pledges of His Majesty's Government in the United Kingdom, the uneasiness of the native authorities in the Protectorates is such that this offer is now in abeyance; but Mr. MacDonald stated that the question of assistance out of United Kingdom funds is under consideration by the Colonial Funds Development Committee.

World Fellowship

A GENERAL meeting at Caxton Hall, Westminster, on July 18, concluded the proceedings of the World Congress of Faiths, which had been in session in London since July 3. On a broad view of the numerous contributions to discussion of world fellowship made by the delegates from the various faiths, it is evident that there is in each a body of opinion which is prepared to build upon the foundation of a common ethical element in an effort to co-operate in the solution of problems of a wider general application in present-day conditions. A spirit of good will and general agreement was perhaps more marked than any movement towards specific application at the moment; but it is, in any event, a distinct gain that an opportunity has been afforded a mixed assemblage to appreciate at first hand the distinctive outlook on, and approach to, the problems of the organization of life under different creeds and in various environments. Neither pious enthusiasm, however, nor even profound conviction, such as usually finds expression on these occasions, necessarily leads to tangible results; and to keep alive and give effect to the spirit of which the Congress has been a manifestation demands some channel through which it may be directed in order to avoid waste of energy. This aspect, happily, has not been overlooked in the present instance; and, at the last general meeting, the delegates decided to institute machinery to continue the work of spreading world fellowship through religion. It was agreed that all who presented papers, acted as chairmen, or led discussion, should form a council, and that a continuation committee should be appointed. The members then elected included Sir Francis Younghusband, Sir Herbert Samuel, Sir Sarvepalli Radhakrishnan, Mr. H. N. Spalding and Sir Abdul Qadir, with Mr. A. Jackman as secretary.

New Heating Laboratory at the Building Research Station

A NEW laboratory for research on the heating of buildings has been completed at the Building Research Station of the Department of Scientific and Industrial Research so that work can go on all the year round, instead of only in the winter. The laboratory was opened on July 22 by Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, on the occasion of the annual visit to the Building Research Station of the Institution of Heating and Ventilating Engineers, which is providing a sum of £1,500 to enable the studies, at the Station, of heating problems to be speeded up and extended. The laboratory is one room within a larger room. The smaller room, which is 18 ft. × 12 ft., is the test-room which is to be heated in all the different possible ways. It has a ceiling which can be screwed up or down so that both low rooms and high rooms can be studied. The larger room in which the test-room is situated isolates it completely from outside weather effects. The various walls of this outer enclosure can each be refrigerated and their temperatures can be controlled to 0.1° F. Modern heating methods have been utilized in the control of the outer enclosure. Every surface is panel-heated or panel-cooled by brine which circulates in pipes in the walls, floor and ceiling. For cooling the brine which refrigerates the walls, a 4½-ton ammonia compressor is installed in the engine-room at one end of the laboratory. At the other end of the laboratory is an instrument room, where records are made of the conditions in the test-room and its enclosure. The new laboratory provides unique facilities for research and will undoubtedly mean a great speeding up of heating research.

Research and Finance

IN the leading article in NATURE of July 11, there were, we regret to say, two inaccuracies which should be corrected. The system of grants in aid of the research associations and styled "the datum line system", described on p. 52, was superseded, some two years ago, by another system which, for the sake of brevity, may be called "the block grant system". The Department of Scientific and Industrial Research now makes an annual block grant to an association, provided that a definite sum is assured, in the form of subscriptions, by the industry concerned. The block grant and the industrial income have no rigid mathematical relationship; the ruling principle being that, added together, they must provide such a sum as will, in the opinion of the Advisory Council of the Department, form an adequate financial nucleus for a co-operative research organization for the industry in question. In order to encourage further expansion, the Department offers £ for £ on sums subscribed over and above the initial industrial income, up to a stated maximum, which, again, is fixed on the advice of the Advisory Council. This new system was the outcome of the big appeal made to industry a few years ago to play its part in expanding the operations of the research

associations. The other inaccuracy was the parenthetical statement, on p. 52, that the woollen industry raises its contributions to co-operative research by means of a statutory levy. It is a fact that for some years now the woollen industry has been conducting propaganda in favour of the institution of such a statutory compulsory levy, but no measure for the attainment of this object has yet been introduced into Parliament. On the other hand, it may be remembered that a Rubber Industry Bill, having for its object the institution of a statutory levy, was introduced into Parliament and finally dropped owing to the defection of a prominent firm in the industry.

Chamberlain Memorial at the University of Birmingham

IN connexion with the centenary celebrations of the birth of Joseph Chamberlain, the first Chancellor of the University of Birmingham, Sir William Waters Butler has given £10,000 to provide scholarships, to be known as the Joseph Chamberlain Memorial scholarships. The University has also received a generous benefaction from Sir Charles Hyde, Bart., who has offered £10,000 towards the museum of the new Medical School, with the suggestion that this part of the new building should be known as the Chamberlain Memorial Museum. It is felt that this gift, like that of Sir William Butler, is very appropriate to the occasion; for it is well known that the University, of which Mr. Chamberlain was the founder and first Chancellor, occupied a foremost place in his regard, as being an essential part of the city for which he had done so much. His foresight in placing the new buildings in Edgbaston, where there would be ample room for expansion, has been notably justified in the event. It may well be that the most enduring monument to his name will be the University of Birmingham. Mr. Chamberlain's interest in medical research was made evident in the part he took in the establishment of the London and Liverpool Schools of Tropical Medicine.

Roman Sites and the National Trust

A NEW museum of Roman antiquities from Hadrian's Wall at Housesteads Camp, north-west of Hexham, was opened on July 23 by Prof. G. M. Trevelyan, vice-chairman of the National Trust. The cost of the building has been defrayed out of funds which have accumulated as a result of the greatly increased number of visitors, who now go to inspect the camp. In 1935 they numbered no less than 15,000. Housesteads, or Boreovicus, which on its north side abuts on the Wall, covers an area of five acres. It is not only one of the finest sites on the wall, but it is also one of the most completely excavated Roman camps open to view in Great Britain. During the excavations, a number of important finds were made, and these, with other antiquities, will be housed in the new museum. The site of five acres, a milecastle and three quarters of a mile of the wall itself were presented to the National Trust in 1930 by the owner, Mr. J. H. Clayton, a well-known Northumbrian antiquary. The site is now under the

management of a committee, the members of which include Prof. G. M. Trevelyan and Mr. J. A. Richmond, who for some years has been one of the most active of excavators on Roman sites in Britain. In this connexion may be mentioned another addition to the Roman sites held by the National Trust. Segontium, a Roman fort in Caernarvonshire, has been bequeathed to that body by Mr. John Roberts of London, a native of Caernarvon. The antiquities, pottery, coins and implements, which were found when the fort was excavated by Dr. R. E. Mortimer Wheeler in co-operation with the Office of Works, are housed in a museum which is bequeathed with the site.

The National Trust

THE forty-first Annual Report of the National Trust for Places of Historic Interest or Natural Beauty for the year ending June 30, 1936, again chronicles a record increase in its work. Two years ago the Council reported a record addition to the properties of the Trust, and although the properties added to the holding this year are less spectacular in acreage, they are more numerous. In the two years taken together, the acreage owned or protected by the Trust has increased by nearly fifty per cent. While it may be concluded that this expansion in the operations of the Trust is an indication of an increase in public interest in the preservation of the natural beauty and historic interest of England, it is unfortunately also a gauge of the rapidity with which the threat of modern development is advancing over the countryside. Although it is true that many properties come to the Trust as the result of private benefaction by far-sighted owners, those which are acquired as the result of public appeal almost invariably are face to face with a threat of early destruction. As the Trust is able under its constitution to acquire and hold properties which are still in occupation, a sphere from which the Office of Works is barred by statute in the exercise of its function in protecting ancient monuments, the work of the National Trust is a very necessary supplement to official action, while the Trust itself is the most important, and in some cases the only, organization through which a national appeal can be launched effectively. It is gratifying to note that the Council is able to report the initiation of a scheme for the preservation of historic country houses and their contents, which adapts to English conditions the main principles of *La Demeure Historique* for the preservation of châteaux in France and Belgium.

The Science Museum, South Kensington

THE Report of the Advisory Council of the Science Museum for 1935 has recently been published (London: H.M. Stationery Office. 1s. net). For the first time, the Report is signed by Sir Henry Lyons, who succeeded the late Sir Richard Glazebrook as chairman. Sir Richard served on the Council for twenty-three years and was chairman from 1931 until 1935, and the Report contains a tribute to the work he did for the Museum. There are to-day perhaps few Government institutions doing more within the scope of their activities, for education,

scientific research and industrial progress, than the Science Museum, which has become a recognized centre for special exhibitions and scientific gatherings, and a place of popular instruction. During 1935, the total number of visitors rose to 1,327,190, the highest ever reached; 25,337 persons attended the public lectures, and 8,682 the special lectures, while in the galleries were held at various times excellent exhibitions relating to rubber, welding, noise-abatement, electro-deposition and air transport. The Report contains much evidence of the thought and work devoted to the acquisition and arrangement of the exhibits and of the logical illustration of the developments of physical science in all its branches. A special feature of the Report for 1935 is a detailed review of the collections in Division V, which include objects relating to physical phenomena, the structure of matter, magnetic, electrical, thermal and acoustical instruments, and the many branches of geophysics. Once again, the Council emphasizes the need for more accommodation, and the reconstruction of the central block. The present buildings in this portion of the Museum were built so long ago as 1862, and then only formed part of the temporary buildings for the Exhibition of that year. They are quite out of date, and their replacement is a matter of urgency if the Museum is to continue to make progress as it has done in the past.

A New Fruit Juice Factory

FOR the past four years, intensive research work has been carried out at the University of Bristol Agricultural and Horticultural Research Station at Long Ashton into the possibility of utilizing surplus fruits from the various varieties of soft fruit grown in Great Britain by means of their conversion into liquid fruit products. The research work, which has been under the direction of Mr. V. L. S. Charley, B.Sc., has resulted in the production of a series of attractive products. H. W. Carter and Co., Ltd., of The Old Refinery, Bristol, 2, and 52 Queen Victoria Street, London, have now equipped the first factory of its kind in the country at North Street, Bedminster, Bristol, 3, to prepare these fruit syrups from English fruits, and a representative gathering met on July 15 to view the factory. The retention of the fresh flavour of English soft fruits when processed into a liquid form has been shown at Long Ashton to be largely a question of the amount of sugar which is incorporated with the juice. Fruit syrups with 65 per cent of sugar have been shown to be stable and to retain to a remarkable degree the true flavour of the fresh fruit. Such syrups, however, are not of general utility on account of their excessive sweetness, but if the sugar content is reduced to any appreciable extent, grave risks of fermentation and mould growth are incurred. However, it has been shown that pasteurization at 160° F. for half an hour, a treatment which is essential to obtain stability, does seriously affect the attractiveness of the finished product.

A PROCESS has therefore been evolved in which the fresh fruit juice is incorporated with sugar until

50–55° Brix is registered, and this unstable syrup is then preserved with 200–300 parts per million of sulphur dioxide in the form of potassium metabisulphite. The present syrups are intended for use primarily with milk, and it is necessary to avoid an excessively sweet product as this detracts not only from the milk flavour, but also tends to mask the fresh flavour of the fruit. The question of curdling is not serious until any addition of acid is carried out. Even with the highly acid juices of the loganberry and blackcurrant there is very little fear of curdling when the normal concentrations, which are generally accepted in the milk bars, are used. A further process of interest is the adaptation of the carefully controlled fermentation in the fruit. This fermentation is effective first in completely disintegrating the cells which thus yield a richer, sweeter juice and, secondly, in decomposing a certain amount of pectin which would otherwise be deposited in the filtered product. Remarkable results have recently been obtained by the use of pectin-decomposing enzymes in which an addition of 0.2 per cent of enzyme has reduced the calcium pectate content of the juice from 0.134 per cent to a mere trace.

The Kauri

A SMALL pamphlet, Leaflet No. 26, on "The Properties and Uses of Kauri", *Agathis australis*, by A. R. Entrican, has been issued (Government Printer, Wellington, N.Z., 1935). This timber is one of the most useful of the coniferous softwoods, and has been known in international trade for more than a century. The kauri is the monarch of the New Zealand forests, dwarfing all other species. The bole in mature trees has singularly little taper; thus, although it does not attain the height of the North American redwoods (*Sequoia*) and the Australian eucalypts, it ranks among the largest timber-producing species in the world. It is said that in yielding flawless timber of exceptionally large size, the tree is unsurpassed by any other known species. The extensive virgin forests of the early European occupation have been severely depleted, but it is of good hope for the future to hear that the remaining stands are being placed under a system of forest regulations whereby a sustained yield of this valuable softwood will be assured. Owing to its evenness of texture and ease of working, to its small shrinkage powers, medium density and excellent strength properties and high durability, the timber is able to meet the most exacting requirements. It is made use of in all classes of building and general construction, in shipbuilding, car and wagon construction, tank and vat manufacture, military bridging, and the production of dairy and agricultural machinery and so forth. It is not surprising, as has been the case with fine species in other countries, that the brunt of the fellings for ordinary utilization by the increasing population of the country fell upon this beautiful tree.

The National Institute of Agricultural Botany

At the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 16, the chairman of the Council, Sir

Daniel Hall, in the course of his address, stated that one of the primary objects of the Institute is to serve as a medium for introducing new varieties of farm crops to the public. For this purpose its trials are organized so as to provide an accurate measure of the relative merits or de-merits of each variety tested. These trials extend over three years or more, in order to level out weather differences, and are carried out at six different centres in order to eliminate differences due to soil variations. The improvements already effected in the yield of cereals make it unlikely that any new variety will show a 20 per cent improvement upon the existing varieties. Improvements in the nature of 5–10 per cent are more probable, but even a 5 per cent improvement would make a considerable financial difference to farmers. Farming is never at a standstill, and the Institute meets the changing agricultural situation by extending the scope of its trials. Trials of picking peas and chicory are now being carried out, and it is hoped that useful information will be derived from them. The potato trials at Ormskirk have done much to check the spread of wart disease by the encouragement given to the introduction of new immune varieties. Sir Daniel went on to say that close co-operation with the seed trade would be beneficial to both bodies. In serving the farmers, the Institute also serves the best interests of the seed trade, which has the highest degree of confidence in the Official Seed Testing Station. This is testified by the fact that the number of samples tested by the Official Seed Testing Station is steadily increasing year by year, and nearly 30,000 samples have been tested in the current year. In conclusion Sir Daniel expressed concern at the shrinkage in the number of fellows of the Institute: he hopes the Institute will never become a purely bureaucratic body, responsible only to the Government.

Prevention of Tuberculosis

SIR KINGSLEY WOOD, the Minister of Health, inaugurated the twenty-second annual conference of the National Association for the Prevention of Tuberculosis at the County Hall, London, on July 16. He stated that great progress has been made in the fight against tuberculosis. For the first time on record, the total number of deaths in England and Wales from all forms of tuberculosis fell in 1935 below 30,000. The standardized death-rate from tuberculosis has fallen from 1,915 to 687 per million in less than forty years. This striking record of progress is due in the first place to remarkable improvements in methods of treatment. Much also is due to the example given by the establishment, as a result of greater knowledge and active propaganda, of voluntary sanatoria and dispensaries. It is significant that no sanatorium in the modern sense existed in Great Britain before 1898. Improved standards of living and hygiene, better housing, better nutrition, purer milk supply and general public health measures have played and will continue to play a considerable part in the attack upon this disease. But there are many opportunities for further advance. There is a great need for encouraging those who were suffering or

suspected to be suffering from tuberculosis to take advantage at the earliest possible stage of the facilities provided for diagnosis and treatment. The importance also of eliminating tuberculous cattle from the herds of Great Britain is obviously very great. Bovine tuberculosis is responsible in Great Britain for a large number of deaths, probably more than 2,500 per annum, and for a still larger amount of serious illness. Much remains to be done before we can be satisfied that the whole of our milk supply is safe.

British School of Archæology at Athens

ON October 13, the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation by holding at the Royal Academy of Arts, Burlington House, an exhibition to illustrate the discoveries in Greece and Crete which have resulted from the work of the School, together with a special exhibit devoted to the Minoan civilizations of Greece, and the excavations of the School's honorary student, Sir Arthur Evans, at Knossos, in which the School's architects took part. This exhibit is being prepared by Sir Arthur Evans himself, with facilities kindly given him by the Keeper and Visitors of the Ashmolean Museum. It is understood that the exhibition will be inaugurated by His Royal Highness the Duke of Kent, on October 13 at 3 p.m., and will be open to the public from October 14 until November 14. In connexion with the jubilee of the School, it is proposed also to raise a special fund to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduate students who, in increasing numbers, are sent to Greece for advanced study by the universities.

Indian Vital Statistics for 1933

THE chief vital statistical figures for British India for 1933 are: (1) total births, 9,678,876, giving a crude birth-rate of 35.5 per mille, (2) total deaths numbered 6,096,787, giving a crude death-rate of 22.4 per mille, (3) infantile deaths numbered 1,650,973, an infantile death-rate per 1,000 births of 170.5 (Ann. Rep. of the Public Health Commissioner with the Government of India for 1933. Government of India Press, New Delhi. Rs.6 as.4 or 10s.). The birth-rate is more than double, the death-rate nearly double, and the infant mortality about two and a half times, the corresponding figures for England and Wales. It is remarked that, contrary to some recent statements, the population of India is increasing at an alarming rate, and by 1941 will probably reach 400 millions. The total land area of British India amounts to only 2.44 acres per head of the population, but allowing for forest, uncultivated and fallow lands, only 0.72 acre per head is under food crops—quite insufficient for even the present population. Birth-control is viewed sympathetically, but only seven hundred medical women are available to instruct Indian women about it. Cholera deaths (68,318) and plague deaths (43,000) are not nearly so high as in some years, but smallpox deaths numbered 103,000, compared with 45,000 during the previous year—a disconcerting rise.

Anti-Rabic Treatment in Southern India

THE Annual Report of the Director, Major Iyengar, of the Pasteur Institute of Southern India, Coonoor, states that during the year ended December 31, 1934, 414 persons underwent the complete, and 77 an incomplete, treatment at the Institute after bites by animals supposedly rabid. For the second time in the twenty-eight years of the Institute's existence, there were no deaths from hydrophobia among those treated. Paris fixed virus was in use in the form of Semple's carbolized five per cent sheep vaccine, and at the end of the year was in its 937 passage. The vaccine was also issued from several out-centres—12,316 courses for nearly 13,000 cases, with 26 deaths from hydrophobia. In addition, anti-rabic vaccine was issued for the prophylactic treatment of 259 animals. In spite of what the Institute is doing, 412 deaths from hydrophobia were recorded in the Madras Presidency during 1934.

Northern Lights

PROF. CARL STÖRMER has directed attention to a prevalent confusion between the north magnetic pole and the point on the earth where the magnetic axis meets the surface. Thus, in the supplement to NATURE of May 16, 1936, it is stated on p. 813 that "It is the distance from the magnetic axis of the earth that counts, and that axis meets the surface of the earth at the north magnetic pole, which is in the island of Boothia in Canada"; this should read as follows: "It is the distance from the magnetic axis of the earth that counts and that axis meets the surface of the earth about midway between the north magnetic pole and the north pole". This point is near North-Western Greenland, and it might be named the north axial pole. The zone or belt of greatest auroral display has this point for centre on the earth.

The Night Sky in August

THE nights during August are still rather short to afford much opportunity for a close scrutiny of the rich fields about the galactic equator, which in the British Isles passes overhead from north-east to south-west about midnight at the beginning of the month. Even at nightfall, however, the sky is distinctive with Arcturus still fairly high towards the west: Jupiter a brilliant object in the south-west: Vega, Deneb and Altair not far from the meridian: Saturn rising with Pisces in the east, whilst Capella may be picked out towards the northern horizon. Full moon occurs on August 3^d 3^h 47^m and new moon on August 17^d 3^h 21^m. The brightest star to be occulted this lunation is κ Piscium (magnitude 4.9)—the re-appearance may be observed on August 6^d 1^h 59.7^m (U.T.) at position angle 267° from the north point of the lunar disk. Other occultations of stars, ranging in magnitude from 6.3 to 6.7, may be observed on August 5, 6, 10 and 13. Between August 9 and 12 occurs the maximum of the Perseid meteor shower, the radiant of which is in Perseus at R.A. 3^h 0^m and Dec. 57° N. The meteors of this shower are yellowish in colour and move with medium velocity. The orbit of the shower is well determined and coincides with

that of Tuttle's Comet of 1862. On August 4, Peltier's comet (discovered on May 15 last by Mr. L. Peltier of Delphos, Ohio) is at its nearest approach to the earth at a distance of $15\frac{3}{4}$ million miles. Its computed position on August 4^d 0^h is R.A. 21^h 45^m 10^s; Dec. 4° 8' S., which places it in the constellation Aquarius, but the moon being full will prevent its being easily observed; otherwise it should be faintly visible to the naked eye. The comet is then travelling south rapidly and will reach 70° S. on August 24. Nova Lacertæ, which was discovered on June 18^d 21^h $\frac{1}{2}$, probably reached its maximum brightness of about mag. 2.2 on June 20 and is now slowly fading. Its magnitude on July 17 was 6.3 according to Steavenson, so that the nova can be seen with binoculars; its position (R.A. 22^h 11^m 5^s; Dec. 54° 59' 42" N.) is about 2° south of ϵ Cephei. The character of the nova's spectrum suggests a more rapid progress than is normally the case through the typical evolution stages of a nova.

Announcements

IN view of the Coronation festivities next year, the dates of the Royal Society soirées have been fixed well in advance. The men's soirée will be held on Tuesday, May 4, and the ladies' soirée on Thursday, May 6; it is possible that a third soirée will be arranged, but the date is not yet fixed.

IN connexion with the Second International Congress for Microbiology being held at University College, London, on July 25–August 1, an exhibition of scientific instruments has been arranged at the College. The exhibition will be open to all scientific workers, irrespective of whether they are members of the Congress or not, on July 27–29, from 10.30 a.m. until 5 p.m.

AT the Annual Summer Conference of Advisory Plant Pathologists at the University of Leeds, Dr. Geo. H. Pethybridge, mycologist to the Ministry of Agriculture and Fisheries for the last twelve years, and previously for many years in the Department of Agriculture in Ireland, was presented with a wireless receiving set, etc., as a mark of appreciation on the occasion of his approaching retirement from official service.

THE Jones-Bateman cup of the Royal Horticultural Society, which is awarded triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, is available for award in 1936. Candidates should submit accounts of their work by October 31 to the Royal Horticultural Society, Vincent Square, Westminster, S.W.1. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years.

THE thirteenth Annual Conference of the Association of Special Libraries and Information Bureaux (ASLIB) will be held in Oxford on September 18–21. On September 18, at 8.30 p.m., the president-elect, Dr. Cyril Norwood, will deliver his address entitled

"The Library in the School". On September 19, at 9.30 a.m., a symposium on "Library Instruction for University and Research Students in America" will be held. Further information can be obtained from the General Secretary, ASLIB, 31, Museum Street, London, W.C.1.

PROF. E. ABDERHALDEN, professor of physiology in the University of Halle, has been nominated an honorary member of the Society of Biological Chemists at Bangalore.

THE following have recently been elected members of the Imperial Leopold Caroline German Academy of Science at Halle: Dr. Paul Buchner, professor of zoology at Leipzig; Dr. Hermann Loescheke, professor of pathology at Greifswald; Dr. C. Gösta A. Forsell, professor of medical radiology, and Dr. S. E. Patrik Haglund, professor of orthopædics at Stockholm; Dr. Knud Faber, professor of medicine at Copenhagen; Dr. A. H. M. J. Van Rooy, professor of gynæcology and obstetrics at Amsterdam; Dr. E. Leclainche, director of the international office of epizootics in Paris; and Dr. Karl Wegelin, professor of general pathology and morbid anatomy at Bern.

THE following scientific awards have recently been made by the American Medical Association: Gold Medal to Drs. Charles B. Huggins, S. W. J. Noonan and B. H. Blockson of the University of Chicago for their work in connexion with increasing blood production in the arms and legs by means of increased temperature; Silver Medal to G. C. Supple and S. Ansbacher of the research division of the Borden Company for their method of obtaining lactoflavine from milk; Bronze Medal to Dr. Alvin L. Barach of the Presbyterian Hospital, New York, for his method of providing an artificial light air in which helium is substituted for nitrogen.

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

A teacher of engineering (mechanical) in the Norwich Technical College—The Principal (July 28).

A lecturer in civil engineering in Armstrong College, Newcastle-upon-Tyne—The Registrar (July 30).

A statistician for a War Department establishment—The President, Royal Engineer Board, Regent's Park Barracks, London, N.W.1 (August 5).

Chemists at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (August 7).

A senior lecturer in physiology in the University of Aberdeen—The Secretary (August 15).

A technical editor at the Technical Institute, 16 St. Mary's Parsonage, Manchester, 3—The General Secretary (September 7).

An assistant lecturer in the Department of Electrical Engineering, Mathematics and Physics (with engineering degree) in the Natal Technical College—Mr. H. W. Gray, 17 Claydon Avenue, Southsea.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 169.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Order of Affinity of Metals for Copper, Iron, Cobalt and Nickel

EACH of the metals aluminium, zinc, cadmium, tin, mercury and lead is known from X-ray and thermal data to form intermetallic compounds with copper. Some of these may be prepared also by obtaining the two metals in dilute solution or suspension (1-4 per cent) at the ordinary temperature in mercury and removing excess of the more reactive metal by oxidation and the mercury by filtration and distillation¹. In mercury, under such conditions, there is in each system a binary compound much stabler than the others, namely, AlCu_6 , Sn_4Cu_5 , ZnCu , CdCu_4 , Hg_3Cu . The question arises: Suppose we have two of the above metals competing for copper in the medium of mercury, do both combine with copper or does one only? Or, suppose we add one metal to the compound of another metal and copper, is there a partial reaction, or does the reaction go either completely or not at all?

The analytical difficulties of this problem are not serious, and it is possible to obtain unambiguous answers to these questions. There seems to be a definite order of the above metals with respect to their power to combine with copper. It is aluminium, tin, zinc, cadmium and mercury, lead. If copper be competed for by two of these metals, the one earlier in the list combines with it, the other remains uncombined. If a metal earlier in the list be added to a compound of copper and another of these metals, the former displaces the latter completely. If the positions are reversed, no reaction occurs. Thus, when aluminium is added to any tin, zinc, cadmium or lead compound of copper, in mercury, it combines with the copper and sets the other metal free. The resulting binary is AlCu_6 or, more often, the stabler ternary $\text{Al}_3\text{Cu}_3\text{Hg}_6$. From neither of these can the aluminium be displaced by any of the metals mentioned. So for the action of tin on zinc-copper compounds. Ternary and even quaternary complexes are temporarily formed², but in the end the zinc is wholly displaced and the tin combines with the copper. Ternaries throughout complicate the issue.

Similar experiments have been done with these metals and the metals iron, cobalt and nickel, with which each of them is also known to combine. With iron the stablest compounds formed are AlFe_3 , SnFe_2 , ZnFe_2 , and HgFe_4 (cadmium and lead do not readily combine in mercury with transition elements). The order here is aluminium, tin, zinc, mercury, cadmium and lead. Thus, neither tin nor zinc can displace aluminium from AlFe_3 , whereas the easiest way of preparing this compound is by adding aluminium to a tin-iron or a zinc-iron compound in mercury.

With cobalt the stablest compounds formed are AlCo , SnCo_2 , ZnCo and HgCo ; with nickel the stablest compounds are AlNi , Sn_4Ni_5 , ZnNi and HgNi . With both these metals the order is that obtained with iron and slightly different from that obtained with copper. The corresponding experiments with manganese and silver have still to be done. The inverse problem—How does one of the metals aluminium, tin and so on, distribute itself among the other metals of the class copper, silver, iron and so on?—is analytically very hard and has not yet been solved.

The order of metals obtained in these experiments is not, and would not be expected to be, that of the electrode-potential series, because in entering into intermetallic combination the atom does not undergo the simple process of ionization of the type $X \rightarrow X^+$. It is likely to be connected with atomic diameters and interatomic distances and forces in the crystal patterns formed.

A. S. RUSSELL.

Christ Church, Oxford.

July 4.

¹ Russell and others, *J. Chem. Soc.*, 841, 852, 857, 2340 (1932); 1750 (1934).

² Russell, *NATURE*, **133**, 217 (1934).

Formation of Carbon Dendrites

PARTICLES of colloidal graphitic oxide dispersed in water have a negative charge, and under a potential gradient move relatively rapidly towards the anode¹. Under certain conditions, however, reduction of the oxide occurs at the cathode, with the formation of long carbon dendrites. This phenomenon was shown in striking manner under the following conditions.

Graphitic oxide was prepared from finely divided Ceylon graphite by treatment with the usual sulphuric, nitric acid, potassium chlorate mixture and the product washed with water. After five washings, the colloidal, supernatant, slightly viscous, brown opalescent solution (pH 2.88) was decanted into an inclined glass tube provided with two platinum electrodes (see Fig. 1). On applying a potential of approximately 200 volts between the electrodes, the disordered micellar lamellæ orientated themselves so that their faces were at right angles to the path between the electrodes (cf. Thiele¹), and immediately thin carbon dendrites commenced to grow from the cathode, and the colloid started to collect round the anode.

These effects are clearly shown in Fig. 1 (A), which was made one second after switching on the potential. They have become much more pronounced 25 sec.

later, as is shown in *B*. *C* is a reproduction of a photograph of another tube through which current has passed for five minutes. The region of high colloid concentration can now be seen extending from the anode to the deposited carbon. Soon after this phase, the region of high colloid concentration assumed an almost rope-like appearance, connecting anode and cathode. Dendrite growth then became extremely rapid and in a few seconds the colloidal mass was reduced to carbon. *D* shows the final phase; some of the deposited carbon has floated to the top of the tube. During the whole process the potential across the tube did not vary by more than 20 volts, nor did the current exceed more than a few milliamperes. A few small bubbles of gas were liberated at both electrodes during the experiment. *E* shows carbon dendrites which have been formed in a vertical tube.

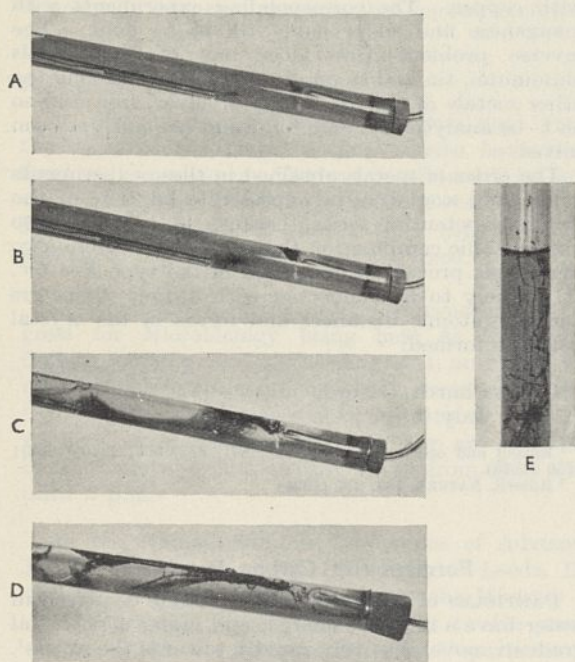


FIG. 1.

It is remarkable that in spite of the high repulsive force which the cathode must exert on the graphitic oxide particles, the latter can remain for a sufficiently long period in contact with the electrode for reduction to occur and for the resulting carbon to attach itself to the electrode. A more detailed examination of the phenomenon is being made.

Armstrong College,
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K. D. LUKE.
W. M. MADGIN.
H. L. RILEY.

¹ H. Thiele, *Z. anorg. Chem.*, **190**, 145 (1930); *Koll. Z.*, **56**, 129 (1931).

A New Process of Negative Ion Formation

WHEN a stream of electrons is passed through a monatomic gas, negative ions are supposed to be formed by direct electron attachment to atoms of the gas with radiation of the excess energy. When the gas is molecular, the process generally presumed to

occur is simultaneous dissociation of the molecule and attachment of the electron to one of the products of dissociation, the energy of the electron in excess of that necessary for dissociation together with the

Process	Probability $\times 10^4$	Process	Probability $\times 10^4$
$\text{Hg}^+ \rightarrow \text{Hg}^-$	6.4	$\text{CO}_2^+ \rightarrow \text{CO}_2^-$	2.31
$\text{H}^+ \rightarrow \text{H}^-$	0.104	$\text{CO}_2^+ + \text{CO}^+ \rightarrow \text{CO}^-$	10.8
$\text{N}^+ \rightarrow \text{N}^-$	1.07	$\text{CO}_2^+ \rightarrow \text{O}_2^-$	2.51
$\text{O}_2^+ \rightarrow \text{O}_2^-$	0.42	$\text{CO}_2^+ + \text{CO}^+ \rightarrow \text{O}^-$	3.37
$\text{O}_2^+ \rightarrow \text{O}^-$	1.10	$\text{CO}_2^+ + \text{CO}^+ \rightarrow \text{C}^-$	0.1

electron affinity of the atom being carried away in kinetic form by the products of dissociation.

I have made an investigation of negative ion formation in mercury vapour, hydrogen, nitrogen, oxygen and carbon dioxide, and I find that the large majority, if not all, the negative ions detected are formed by a new process, and not by either of the processes mentioned above. The negative ions are formed from positive ions which extract two electrons from any negatively charged electrode, including the filament, to which they are driven. This process is energetically possible provided the sum of the ionization potential of the positive ion and the electron affinity of the negative ion that is formed is greater than twice the work function of the surface upon which the conversion takes place. The excess energy is probably dissipated by a collision of the second kind with an electron or atom of the surface.

Sometimes the positive ion is dissociated by its collision with the surface. The negative ion then formed is one of the products of dissociation. For example, the negative ions detected in carbon dioxide are CO_2^- , CO^- , O_2^- , O^- and C^- . In oxygen, both O_2^- and O^- are found. Mercury vapour, hydrogen and nitrogen gave only the atomic negative ion.

The probability of conversion of positive ions into negative ions on a nickel surface has been measured as a function of the kinetic energy of the positive ions. In each gas the probability increases as the energy of the positive ion is increased. The probability of conversion of a 180-volt positive ion into a negative ion is given in the accompanying table in units of 10^{-4} .

The negative ions come off the surface on which they are formed with a wide range of energy. From the energy distribution curves, values of the mean and the minimum accommodation coefficients for positive ions have been obtained. The energy distribution curve itself represents the probability distribution of the accommodation coefficient.

The fact that positive ions are converted into negative ions on negatively charged electrodes with the comparatively high probability shown in the above table introduces a serious, and hitherto unrecognized, source of error into many experiments, such as the recent work of Davies¹ on ionization produced by positive ions.

A complete account of this work will be published in the *Proceedings of the Royal Society*. The work on mercury vapour is already in the press, and should appear shortly.

F. L. ARNOT.

University,
St. Andrews.

¹ A. C. Davies, *Proc. Roy. Soc., A*, **155**, 123 (1936).

The Form of Nuclear Levels

RECENT experimental work has proved the existence of selective absorption for neutrons the kinetic energy of which amounts to a few volts by certain nuclei¹⁻⁵. Bohr⁶ assumes that in these cases the kinetic energy of the captured neutron is equal to the difference between the energy of a level of the newly-formed nucleus and the mass defect for a neutron with zero velocity. This provides an ideal compensation method for the determination of the distance⁷, breadth^{8,7} and form of nuclear levels. The total energy of the level, which amounts in all these cases to some millions of volts, does not interfere with the determinations in question, since only the kinetic energy of the absorbed neutrons is measured.

When working with the cadmium filtered radiation of a source of slow neutrons, we observed big deviations from the exponential law for the absorption of resonance neutrons of rhodium (45 sec.) by rhodium and of resonance neutrons of iodine by iodine. In the accompanying table, μ means the mass absorption coefficient for the total absorption, μ' the mass absorption coefficient for each additional absorbing sheet :

Absorber gm./cm. ² Absorption per cent μ μ'	Detector Rh (45 sec.), absorber Rh					Detector I, absorber I				
	0.01	0.02	0.04	0.08	0.18	0.2	0.5	0.8	1.8	3.1
	16	24	31	44	52	27	45	53	58	62
	17	14	9	7	4	1.6	1.2	1.0	0.5	0.3
	17	10	5	5	1.6	1.6	0.9	0.5	0.1	0.07

Since the cross-sections of boron for radiation filtered by 0.2 gm./cm.² of rhodium and detected by rhodium (45 sec.) or filtered by 3 gm./cm.² of iodine and detected by iodine, were identical with the cross-sections for the unfiltered radiations, the observed deviations cannot be explained by the existence of a second level for selective neutron absorption, as in the case of silver^{1,7}. We think the explanation lies in the self-reversal of the nuclear line. When both the absorption coefficient and the intensity of emission have a maximum for exactly the same energy, the middle of the line will be totally extinguished after passage through a sufficient layer of the absorber, that which penetrates consisting only of the weakly absorbable tails. By determining the absorption coefficient for each additional layer of the

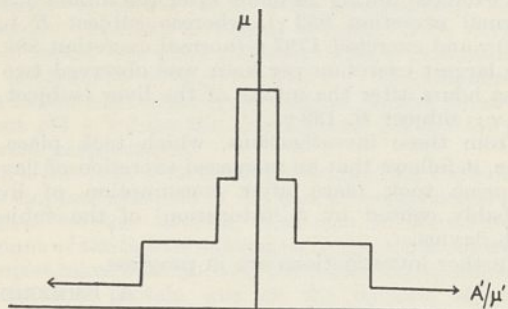


FIG. 1.

absorber, the whole range of values for the absorption coefficient between the middle of the line and the tails is obtained. We are thus able to determine the form of the nuclear levels. A detailed analysis and a comparison with the theoretical results of Breit

and Wigner⁸ will be given later. Qualitatively, the intensity distribution in the line is already obtained by plotting μ against A'/μ' , A' being the fraction of the total radiation which is absorbed by each sheet. Fig. 1 shows the result for rhodium (45 sec.) plotted in this way. The real form of the line shows somewhat bigger differences of intensity. The half-value breadth amounts, as was shown by other experiments, to about 0.25 volt.

Errata : There was a mistake in the calculations for μ_B and the energies of the levels iodine and bromine (18 min.) in our letter in NATURE of May 30, p. 905. The correct values are : Iodine, $\mu_B = 0.7$, energy = 75 ± 15 volts. Bromine (18 min.) $\mu_B = 0.35$, energy = 300 ± 80 volts. The results for silver and rhodium are correct.

PETER PREISWERK.

HANS VON HALBAN, JUN.

Institut du Radium,
Laboratoire Curie,
Paris.
June 6.

- ¹ Amaldi and Fermi, *Ric. Scient.*, VI, 2, 346 and 443 (1936).
- ² L. Szilard, *NATURE*, 136, 950 (1935).
- ³ Frisch, v. Hevesy and McKay, *NATURE*, 137, 149 (1936).
- ⁴ Frisch and Plazcek, *NATURE*, 137, 357 (1936).
- ⁵ v. Halban and Preiswerk, *Compt. rend.*, 202, 133 and 849 (1936). *NATURE*, 137, 905 (1936). *Helv. Phys. Acta*, 318 (1936).
- ⁶ N. Bohr, *NATURE*, 137, 344 (1936).
- ⁷ E. Amaldi and E. Fermi, *Ric. Scient.*, VII, 1, n. 7-8.
- ⁸ G. Breit and E. Wigner, *Phys. Rev.*, 49, 519 (1936).

The Crystal Photo-effect and Rectifying Action in the Bulk of the Crystal

ATTEMPTS have been made to discover how far a rectifying action is connected with the crystal

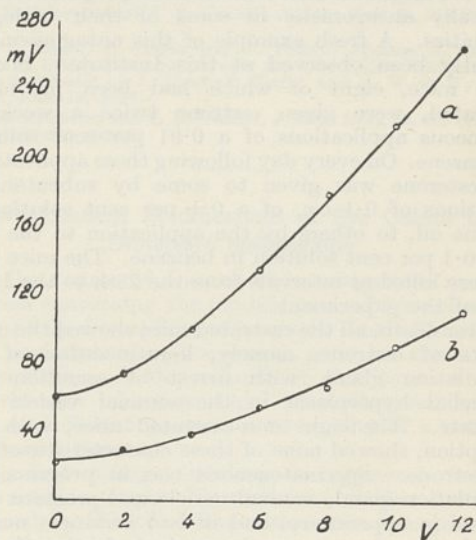


FIG. 1.

photo-electric effect (Dember effect). A. and A. Joffé have already suggested¹ asymmetry of the photo-electric current due to the illumination of one electrode.

In our investigations, two electrodes, free from any obstructing layer, were attached to a cuprite crystal so that by the illumination an E.M.F. appears on them in consequence of the Dember effect. These electrodes were connected through two condensers with an alternating current source; the current flowing through the crystal caused an additional direct voltage as soon as the crystal was illuminated. In darkness, however, the alternating current did not cause any direct voltage. By exchanging the direction of the light both the Dember effect and the direct voltage, caused by the alternating current, changed their direction.

In Fig. 1, the resulting voltage, measured with an electrometer, is shown in relation to the alternating voltage applied to the crystal. In curve *b* the intensity of illumination was a quarter of that of curve *a*. Hence the intensity of the new appearance is related to that of the Dember effect. The value of direct voltage at the alternating voltage zero corresponds to the crystal photo-effect.

Several trials have proved that this appearance is caused by events in the bulk of the crystal (bulk-rectification) and not by the obstructing layers between the planes of the crystal and the electrodes. Moreover, rectifying action, caused by exposure to light, could not be formed in synthetic cuprous oxide, in which the Dember effect does not appear.

GERHART GROETZINGER.
JOSEF LICHTSCHNEIN.

Third Physical Institute,
University,
Vienna.
May 14

¹ *Z. Phys.*, **82**, 754 (1933).

A Protective Action of Progesterone on the Genital Organs of Male Mice

It is recognized that œstrone and progesterone are mutually antagonistic in some of their biological capacities. A fresh example of this antagonism has recently been observed at this Institute. Sixteen male mice, eight of which had been previously castrated, were given œstrone twice a week by cutaneous applications of a 0.01 per cent solution in benzene. On every day following these applications, progesterone was given to some by subcutaneous injections of 0.1 c.c. of a 0.1 per cent solution in sesame oil, to others by the application to the skin of a 0.1 per cent solution in benzene. The mice died or were killed at intervals from the 28th to the 120th day of the experiment.

After death, all the castrated mice showed the usual effects of œstrone, namely, keratinization of the coagulation gland, with arrest of secretion and epithelial hyperplasia in the seminal vesicle and prostate. The eight non-castrated mice, with one exception, showed none of these characteristic effects of œstrone. Spermatogenesis was in progress, the coagulation gland, seminal vesicle and prostate were normal in appearance, and in two instances normal ejaculation plugs were observed at death. In the exceptional case the mouse, which had been treated by cutaneous applications of progesterone, was killed on the 73rd day, and showed defective spermatogenesis, keratinization of the coagulation gland and loss of secretory function with epithelial hyperplasia in the seminal vesicle and prostate.

The difference between the results in the castrated and the non-castrated mice may perhaps be attributable to a combined effect in the latter of progesterone plus the testicular hormone. However this may be, it seems clear that progesterone can protect the genital organs of non-castrated mice from the injurious effects of excessive dosage with œstrone. In this connexion the similarity of molecular structure between progesterone and testosterone will be recalled.

For the progesterone used in this experiment we have to thank Prof. Schoeller of the Schering-Kahlbaum, A.G. of Berlin.

HAROLD BURROWS.

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The Royal Cancer Hospital (Free),
London.
July 3.

Determination and Excretion of Flavins in Normal Human Urine

KOSCHARA¹ has demonstrated the presence of flavins in urine, and has been able to isolate a crystalline flavin (uroflavin). I have carried out an investigation to determine if large doses of flavins (ox liver), similar to vitamin C (Harris² and van Eekelen³) and B₁ (Harris⁴), caused an increased urinary output.

The quantitative determination of the flavins in urine was carried out in the following way (details will be published elsewhere):

(1) Adsorption with lead sulphide. The lead sulphide was previously prepared, washed out and added to the urine. This was found to be preferable to the method generally used (addition of lead acetate to the flavin solution and introduction of hydrogen sulphide).

(2) Elution with a mixture of water-pyridine-glacial acetic acid (8 : 2 : 0.2).

(3) Oxidation with potassium permanganate in acetic acid solution and determination of the resulting colour with the staphometer (*S* 47).

In normal urines (males), a daily urinary output of 819–1250 γ was found. The excretion per hour during the different periods of a day was found to vary between 30 γ and 50 γ .

Two subjects *A* and *B* (analysts) consumed cooked ox liver (100–140 gm.). Subject *A* took 5710 γ flavin⁵ and excreted during 24 hours after the intake 3283 γ (normal excretion 952 γ), whereas subject *B* took 4240 γ and excreted 1797 γ (normal excretion 885 γ). The largest excretion per hour was observed two to three hours after the intake of the liver (subject *A*, 378 γ ; subject *B*, 139 γ).

From these investigations, which took place in June, it follows that an increased excretion of flavins in urine took place after consumption of liver, probably caused by a 'saturation' of the subjects with flavins.

Further investigations are in progress.

A. EMMERIE.

Laboratory of Hygiene,
University,
Utrecht.
June 22.

¹ *Z. physiol. Chem.*, **232**, 101 (1935).

² *Biochem. J.*, **27**, 2011 (1933).

³ Dissertation, Utrecht (1936).

⁴ *Lancet* (1936).

⁵ *Acta Brev. Neerl.*, **5** (1935).

Ultracentrifugal and Electrophoretic Studies on Antibodies

MANY attempts have been made to obtain from immune sera, substances carrying the antibody function. Protein solutions specifically precipitable to the extent of 40-60 per cent (nitrogen precipitated by pneumococcus specific polysaccharide/total nitrogen) have thus been prepared by the Felton method¹. By dissociation of specific precipitates with strong sodium chloride, antibody solutions precipitable to the extent of 90 per cent have been prepared². An investigation of the physico-chemical properties of these systems, especially of those bearing upon chemical homogeneity and the relation to the components of normal sera, would seem to be of interest.

To this end, preparations of horse and rabbit antibodies against pneumococcus type specific polysaccharides, as well as rabbit antibody against crystallized egg albumin, have been studied by ultra-centrifuge and electrophoresis methods^{3,4}, together with whole and fractionated normal sera. The simplest behaviour was shown by a horse serum preparation of type I pneumococcus antihydrolyte² in which 61 per cent of the nitrogen was specifically precipitable. This showed almost homogeneous sedimentation, with sedimentation constant $s_{20} = 17.2 \times 10^{-13}$ as compared with that of normal globulin from mammalian sera, s_{20} about 7×10^{-13} , previously found at Uppsala. However, normal sera regularly contain small amounts of a minor component of sedimentation constant about 17×10^{-13} . The electrophoresis of the above antibody preparation was homogeneous, with an isoelectric point as acid as pH 4.8.

In the case of rabbit sera, homogeneous sedimentation was found with no appreciable difference between the sedimentation constants of the globulin fractions of normal serum and immune serum, or of normal globulin and immune globulin containing up to 50 per cent of anti-egg albumin, or of antibody to the type III pneumococcus polysaccharide containing 90 per cent of precipitin², all showing s_{20} about 7×10^{-13} . Only the last mentioned preparation was investigated electrophoretically, giving inhomogeneous migration and an isoelectric point of about pH 6.6.

Preparations from antipneumococcus I horse sera (Felton) showed the same principal component as did the horse antibody above, together with varying amounts of slower and faster sedimenting components; whereas a Felton solution from normal horse serum was quite different, with a predominating component of $s_{20} = 7.8 \times 10^{-13}$. Electrophoresis was rather inhomogeneous, with isoelectric points of about pH 5.5-5.2 for the immune and pH 5.7 for the normal preparations.

In a few runs with horse antibodies, the centrifuge was stopped when all of the heavier components had settled to the bottom, although a considerable amount of the lighter substances were still in solution. Samples taken out indicated that almost all specifically precipitable protein was on the bottom, showing that the antibody function is connected with the heavy component. This is also in accordance with previous experiments^{5,6}.

Preparations made from antipneumococcus horse sera, preserved with phenol and ether, although containing up to 87 per cent specifically precipitable nitrogen, were characterized by their inhomogeneity both in the ultracentrifuge and in their electro-

phoretic behaviour. The isoelectric point was pH 5.9, but a component of an isoelectric point of about pH 4.9 was also present.

From these data it is evident that protein preparations from immune sera carrying a high percentage of the antibody function may show all the signs of being chemical individuals, so far as the methods referred to are decisive. Nevertheless, methods of preparation and preservation may considerably influence the result (by denaturation?) and give rise to less uniform systems, which, however, may still show a very high specific precipitability. It is also clear that different fractions of the serum proteins carry the antibody function in the horse and in the rabbit. It would thus appear that the rabbit produces antibody from the principal globulin component, while the horse develops pneumococcus I antihydrolyte, at least, from an otherwise minor component.

The analytical methods for determining the antibody content of the solutions have been described in earlier publications⁷. Details of the experiments will be given and some of the many questions raised by this work will be discussed in forthcoming communications.

MICHAEL HEIDELBERGER.

(John Simon Guggenheim Memorial Fellow, Spring of 1936.)

KAI O. PEDERSEN.

ARNE TISELIUS.

Institute of Physical Chemistry,
University,
Uppsala.
Presbyterian Hospital,
New York.
June 22.

¹ L. D. Felton, *J. Immunology*, **21**, 357 (1931), and other papers.

² M. Heidelberg and F. E. Kendall, *J. Exp. Med.* (Aug. 1936).

³ See for example, T. Svedberg, *Chem. Rev.*, **14**, 1 (1934); *Kolloid Z.*, **67**, 2 (1934).

⁴ A. Tiselius, *Nova Acta Reg. Soc. Scient. Upsaliensis*, Ser. IV, **7**, No. 4. See also Pedersen, K.O., *Kolloid Z.*, **63**, 268 (1933).

⁵ M. Heidelberg and F. E. Kendall, *J. Exp. Med.*, **61**, 559 (1935); p. 570.

⁶ W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, **30**, 92 (1936). As this goes to press we note also very similar sedimentation constants obtained by J. Biscoe, F. Herčík and R. W. G. Wyckoff, *Science*, June 19, 1936.

⁷ M. Heidelberg and F. E. Kendall, *J. Exp. Med.*, **50**, 809 (1929); and subsequent papers.

Two Unusual Modifications of Eye Colour in *Drosophila melanogaster*

In the course of a series of investigations now in progress concerning the modification of eye colour in the fruit fly *Drosophila melanogaster* under X-irradiation, undertaken in connexion with an attempted determination of the volume of the locus 'white', two changes of colour have been observed which seem of sufficient interest to be worthy of a note at the present time.

The first change involves an apparent reverse genovariation, under X-irradiation, similar to those observed by Timofeev-Ressovsky¹, the change being from white to red eye.

The white stock concerned was obtained by suitable breeding from a few white individuals arising as spontaneous mutants in a pure culture of Florida wild-type *Drosophila* obtained about two years ago through the courtesy of Dr. Demerec. It has been bred for three months in this laboratory in pure

culture, and has behaved in every way like typical white. It is, characteristically, completely recessive.

In the course of an investigation of morphological effects arising under X-irradiation, eggs and young larvae from this white stock were exposed in considerable numbers to the unfiltered radiation of a Coolidge X-ray tube operated at 85 kvp. and 10 ma., the focal distance being five inches, with a wood backing. The tube was of lead glass with a thin sodium-glass window. The output of the tube was determined as 79.0 r./min. at the point of exposure of the material, a Victoreen dosimeter being employed. We are indebted to Dr. J. C. Hudson, of Cruft Laboratory, for this dosage measurement.

A total of 786 flies was examined from irradiated eggs and young larvae. Among these were found two full reversions to Florida wild-type. It is believed that sufficiently elaborate precautions were observed in the technique adopted for irradiating and culturing the flies, so that the possibility of contamination from wild-type individuals was eliminated with reasonable certainty. No such reversions were observed in more than five thousand control individuals.

The second modification of interest arose in the stock of a culture of eosin *Drosophila* obtained from Turtlox Service. Among more than 30,000 individuals examined, four were found in which a mutation to a colour considerably darker than eosin, but lighter than wild-type, was observed. We do not feel competent to name the colour modification. A single individual of the four constituted a mosaic representing a change which must have occurred very early in the development of the optic *anlage*, one eye of the fly being completely modified to the darker colour, the other typically eosin. Three of these individuals occurred in stock which had been irradiated under the same conditions as those stated above, but one was obtained from control populations grown on very old and highly infected molasses - corn meal agar medium. A very similar modification was independently observed by Dr. A. G. Richards, of the University of Rochester, and one of us, in control stock of a pure culture of eosin, obtained through the courtesy of Dr. Pincus, of Harvard University, and similarly held over old, depleted and infected banana - agar medium.

The modification seems of considerable interest in its further confirmation, not only that changes of whole eye colour may proceed from lighter to darker shades, but also that the wild-type condition is not necessarily the end-point of such a change. Again, sufficient care was used in handling the cultures, it is believed, to have eliminated the possibility of any contamination from an outside source with reasonable certainty. The change, indeed, was detected independently in three laboratories, at Rochester, Cambridge and Schenectady, and in none of these were stocks of similar eye colour present.

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C. P. HASKINS.

Biological Laboratories,
Harvard University,
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and the
Haskins Laboratory,
Schenectady, New York.
June 1.

¹ Timofeef-Ressovsky, N.W., *Nachrichten von Ges. d. Wiss. Göttingen*, N.F., 1, 190.

The 'Road Runner' of North America

ONE of the most remarkable and interesting birds of the arid portions of North America is the road runner (*Geococcyx californianus*), a ground cuckoo, which is often seen running in the road, sharing this habit with the killdeer plover (*Oxyechus vociferus*). The genus extends southward to Nicaragua, being represented in that region by another species (*Geococcyx affinis*). The accompanying illustration

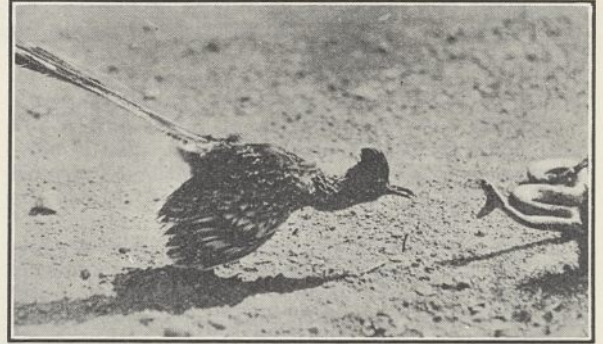


FIG. 1.

(Fig. 1) of a road runner attacking a rattlesnake, was furnished by Mr. G. A. Pearl of Garden City, Kansas. He got it from a travelling photographer whose name he does not know. Mrs. Merriam Bailey states that in the stomach of a single road runner, taken in New Mexico, were a large black cricket, a number of big grasshoppers, remains of a caterpillar and some beetles, a centipede six inches long and a garter snake a foot long.

The road runner was described by Lesson in 1829, but Pike in 1810 refers to a strange new bird, which from his vague account must apparently have been the road runner.

T. D. A. COCKERELL.

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Ascent of Air in Cyclones

A RECENTLY completed investigation on cyclones has led, amongst other results, to one which throws an interesting light on a long-standing problem. One of the deductions of W. H. Dines from soundings of the upper air was that the air in the troposphere in depressions, particularly between 4 km. and 9 km., is on the average cold for its level, though this air is, on the whole, ascending. The paradox is to explain by what agency the ascent of relatively cold air is maintained. Dines's results related to depressions crossing the British Isles or Western Europe, that is, to depressions which as a rule were in the later stages of their existence.

The present investigation shows that in a number of such depressions the structure comprises an outer region in which the average air speed varies inversely as r (r being distance from isobaric centre), and an inner region (at least in the polar air part) in which air speed varies directly as r . The existence of the outer simple vortex region is consistent with motion developed by convergence towards a central area:

the mathematical theory of the motion developed in this way was given by Rayleigh¹ in 1917, in explanation of the model cyclones devised by Aitken²; the mathematical theory was extended by Brunt³ in 1921 to apply to motion on a rotating earth.

The inner regions generally are found not to be examples of 'solid spin', at least in the lowest 2 km. of the atmosphere, but rather, in certain parts, regions of specially marked convergence. In brief, it is found that—below the 2 km. level—convergence towards the centre goes on, roughly with complete conservation of moment of momentum up to a certain distance (which in different cases varies from 300 km. to 500 km.) from the centre, and then—in place of conservation—there is, instead, as the air enters the inner region, a gradual fall of speed with closer approach to the centre.

The total inward flux of kinetic energy across the periphery of the inner region is so considerable—speeds at this periphery being commonly of the order of 40 m.p.h.—that a question naturally arises as to what work is being done to account for the loss of kinetic energy by the air in the course of its closer approach to the centre. The obvious explanation is that here is the work required in the later stages of the depression's life to raise bodily the large central core of troposphere which, by reason of continued ascent, has become colder, level for level, than its environment. Calculation in a typical case indicates that about half the probable inward flux of kinetic energy below the 2 km. level would suffice to keep the core above this level moving upward until it had become on the average about 7° C. colder, level for level, than surrounding regions. This result, therefore, explains the manner in which depressions can continue in being until they acquire temperature characteristics which have hitherto seemed paradoxical, more especially in regard to any theory of origin in which convection may have played a part.

In one exceptional case—a vigorous and still developing system with a long course still to run—the feature characteristic of the inner regions of the other depressions was not developed, at least at the time when the depression crossed the British Isles. In this depression by contrast, a high wind speed was found up to relatively near the centre.

A. H. R. GOLDIE.

Meteorological Office,
Edinburgh.

¹ *Proc. Roy. Soc., Lond., A*, **93**, 148 (1917).

² *Trans. Roy. Soc., Edin.*, **40** (1900-01); *Proc. Roy. Soc., Edin.*, **36** (1915); and *Proc. Roy. Soc., Lond.*, **94** (1917-18).

³ *Proc. Roy. Soc., Lond., A*, **99**, 397 (1921).

Transmission of High-Voltage Impulses at Controllable Speed

SIR J. J. THOMSON¹ first observed that if a difference of potential was applied to the ends of a long discharge tube (by an induction coil) the luminosity traversed the tube with a finite velocity. When either a positive or negative impulsive potential is suddenly applied to one end of a discharge tube while the other end is maintained at ground potential, one of us² found that the luminosity traversed the tube from the high-voltage electrode to ground. Immediately following this, a luminosity frequently

traversed the tube from the ground back to the high-voltage electrode. A similar type of propagation of luminosity has been observed in a million volt spark between point and plane by Allibone and Schonland³ and by Schonland and others⁴ for certain types of lightning flashes. In order to obtain more information about the initial breakdown in gases, we have undertaken an investigation of the propagation of potential in long discharge tubes when impulsive voltages are applied to one end of the tube while the other end is earthed.

By means of a high-speed cathode ray oscillograph, it was found that in the case of both positive and negative applied impulses, a definite potential wave traversed the tube from the high-voltage electrode to the earthed electrode, immediately followed by a much faster return wave from ground back to the high-voltage electrode. In the case of the initial impulse, the wave velocity, wave form, voltage attenuation and energy carried in the wave front were measured and found to vary with both pressure and applied potential. A few values for the speed of the initial impulse in a 5 mm. glass tube containing air are shown in the accompanying table.

Applied Voltage (kv.)	Pressure (mm. Hg.)	Speed of Impulse (cm./sec.)
+127	0.08	9 × 10 ⁸
+127	0.24	43 × 10 ⁸
-125	0.03	15 × 10 ⁸
+171	0.17	27 × 10 ⁸
+ 74	0.017	5.4 × 10 ⁸
+ 74	0.24	14 × 10 ⁸

For the greater applied potentials the voltage wave showed no observable distortion or attenuation, at least for lengths of tube less than 10 metres. However, at 74 kv. and the higher pressure (0.24 mm.), the voltage wave was very much flattened. For the 170 kv. and 74 kv. applied impulses with 0.025 mm. pressure in the tube, the maximum current during the initial wave was 429 amp. and 146 amp. respectively. In addition to the information the above results give as to the nature of the initial breakdown in gases, they show that a discharge tube may be used as a transmission line in which the velocity of propagation of the voltage wave is easily controllable over quite wide ranges. This type of transmission line should be of use in many problems⁵ where it is necessary to transmit high-voltage impulses from point to point at predetermined velocities less than that of light.

The detailed results of this experiment will be submitted for publication elsewhere. We wish gratefully to acknowledge a grant from the American Philosophical Society, which has made this work possible.

L. B. SNODDY.
J. W. BEAMS.
W. T. HAM, JUN.
H. TROTTER, JUN.

Rouss Physical Laboratory,
University of Virginia.
June 20.

¹ "Recent Researches", 115 (1893).

² Beams, *Phys. Rev.*, **36**, 997 (1930).

³ Allibone and Schonland, *NATURE*, **134**, 736 (1934).

⁴ Schonland, Malan and Collins, *Proc. Roy. Soc., A*, **152**, 595 (1935).

⁵ Beams and Snoddy, *Phys. Rev.*, **44**, 784 (1933).

Narrow Continuous Band of Potassium in the Extreme Red

ALTHOUGH the absorption bands which appeared, as reported by Kuhn¹ and Datta², near the principal series lines of potassium at high vapour pressures were interpreted on the assumption of polarisation of the molecule, the bands which may have appeared near the resonance lines $\lambda\lambda 7699, 7665$ were not observed.



FIG. 1.



FIG. 2.

With the view of searching for these bands, the extreme red absorption spectrum of potassium vapour was investigated. By heating the potassium metal in a steel tube filled with hydrogen to a pressure of about 10 cm. mercury, spectral photographs of the potassium vapour were taken at the first order region of the 1.5 m. concave grating. When the continuous light from a carbon arc passed through the vapour, keeping the temperature sufficiently high, a remarkable broadening of the resonance lines, as shown in Fig. 1, was observed. At higher temperatures a narrow continuous band appeared at about $\lambda 7220$ (Fig. 2), while Fig. 3 shows its photometer curve. In the absence of hydrogen this band was also observed, but with difficulty.

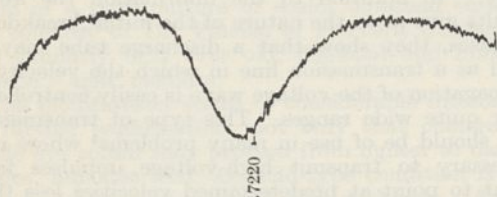


FIG. 3.

Wurm³ reported a narrow band of sodium appearing on the shorter wave-length side of the *D*-lines, explaining it by assuming polarization of the molecule. Hamada⁴ observed the fluctuation of a continuous band in the same region, considering its origin as the sodium quasi-molecule. The potassium $\lambda 7220$ band may be interpreted in the same manner.

Though the longer wave-length side of the potassium resonance lines was also photographed, the absorption of the $A^1\Sigma \rightarrow B^1\Sigma$ band was so strong that any narrow continuous band was difficult to observe.

T. OKUDA.

Department of Physics,
Osaka Imperial University,
Japan. May 12.

¹ H. Kuhn, *Z. Phys.*, **76**, 782 (1932).² S. Datta and B. H. Chakrovarty, *Ind. J. Phys.*, **7**, 273 (1932).³ W. Wurm, *Z. Phys.*, **79**, 736 (1932).⁴ H. Hamada, *Phil. Mag.*, **15**, 574 (1933).

Liquids of High Refractive Index

IN a previous letter to NATURE¹ under this title, we gave values for the refractive index of phenyldi-iodoarsine as measured by us. Our attention has now been directed to the fact that the properties of this compound had already been accurately measured and published in a valuable paper on "The Optical Properties of Arsenic" by Gryszkiewitz-Trochimowski and Sikorski² which had appeared six years previously. We had unfortunately overlooked this paper owing to the fact that in none of the abstracts or collective indexes which we consulted as a guide to the relevant literature was there any mention of the above compound in connexion with these authors. The figures for phenyldi-iodoarsine given by the Polish workers ($n_D^{14.5} 1.8527$; $d_4^{14.5} 2.6264$) are higher than those we communicated, but agree closely with those we have recently obtained with the purer samples now commercially available.

We take this opportunity to add a warning note. Though we occasionally use phenyldi-iodoarsine when refractometer readings of high index are required, the action of this liquid on the soft glass hemisphere of the instrument is distinctly deleterious. The chief usefulness of this remarkable compound will thus probably be as an immersion medium.

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¹ NATURE, **133**, 66 (1934).² Gryszkiewitz-Trochimowski and Sikorski, *Roczniki Chemji*, **8**, 405 (1928).

Structure of Bromine III

IN a previous letter¹ it was reported that the structure of Br III was detected, the intervals of the fundamental term $5s \ ^4P$ being 2589 cm.^{-1} and 2253 cm.^{-1} . A further comprehensive investigation, carried out particularly to distinguish between the lines of Br II and Br III, has led to a considerable extension of the scheme, which consists of doublets and quartets of the $4p, 5p, 5s, 4d$ and $5d$ configurations. On account of the large intervals of the $4d$ and $5d$ configurations, it is difficult to assign the *L*-values to these terms. Assuming an arbitrary value of $300,000 \text{ cm.}^{-1}$ for $4p \ ^4S_{1/2}$, some of the chief term values are:

$5p \ ^4D_{3/2}$	126823	$5p \ ^4P_{1/2}$	121875
$5p \ ^4D_{1/2}$	126165	$5p \ ^4P_{2/2}$	119751
$5p \ ^4D_{2/2}$	124095	$5s \ ^4P_{1/2}$	154588
$5p \ ^4P_{3/2}$	123335		

The intervals of $4p \ ^2D$ and 2P are found to be 1259 cm.^{-1} and 1665 cm.^{-1} respectively. About 200 lines of Br III have been classified altogether.

The complete analysis is being communicated to the Royal Society of London.

K. R. RAO.

Andhra University,
Waltair.
May 27.

¹ NATURE, **135**, 309 (1935).

Preparation of Lithium Alum

DURING some work on the mass susceptibility of the alums, a successful attempt was made to prepare lithium alum, despite the fact that its existence and even the probability of its existence has been repeatedly denied.

Molecular proportions of the monohydrate of lithium sulphate and the octadecahydrate of aluminium sulphate were dissolved in the minimum quantity of cold water. The solution was concentrated considerably by evaporation on a sand bath and cooled in a freezing mixture of ice and salt with vigorous stirring, when it crystallized suddenly and deposited a mass of very soft small crystals, which were filtered and dried at the pump and afterwards on porous plates. The mother liquor after a further slight concentration deposited small hard transparent crystals on keeping in the freezing mixture.

Both crops of crystal contain 49.00 per cent of water ($\text{Li}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ requires 48.93 per cent water). The crystals are isotropic, a combination of cube and octahedron. On keeping at ordinary temperature, or on warming a few degrees, they decompose and the salts dissolve in the liberated water. They are exceedingly soluble in water; they lose the whole of the water at 200°C . and swell to a bulky friable mass. The mass susceptibility is -0.541×10^{-6} and molecular susceptibility -479×10^{-6} . The properties of the alum are under investigation.

JAMES F. SPENCER.

G. T. ODDIE.

(Sister Mary Cecilia, O.P.)

Bedford College,
London, N.W.1.
July 3.

Points from Foregoing Letters

DR. A. S. RUSSELL describes work which suggests that metals of the class which forms compounds with metals of the copper, iron, cobalt and nickel class may be arranged in a list analogous to the electrochemical series. Any metal in this list can displace from intermetallic combination one lower in the list.

The formation of long carbon dendrites has been observed by K. D. Luke and Drs. W. M. Madgin and H. L. Riley in the cathodic reduction of colloidal solutions of graphitic oxide. Colloidal particles of graphitic oxide are negatively charged, and the reduction occurs in spite of the strong repulsive forces which must exist in the neighbourhood of the cathode.

The large majority of the negative ions formed during electric discharge in mercury vapour, hydrogen, nitrogen and carbon dioxide, Dr. F. L. Arnot finds, do not arise by the attachment of one electron to a neutral atom, but by the attachment of two electrons to a positively charged ion. The author calculates the probability of such conversion from positive into negative ions, for the gases mentioned above, at the surface of a negatively charged nickel electrode.

From the energy of the neutrons selectively captured by rhodium, Drs. P. Preiswerk and H. von Halban, jun., deduce the distance, breadth and form of the nuclear levels in that element. The data required were obtained by determining the absorption coefficient for each additional layer of rhodium.

Light falling upon a cuprite crystal in contact with two electrodes through which an alternating current is passing, produces an additional direct voltage. Dr. G. Grotzinger and J. Lichtschein submit curves showing how the resulting direct voltage varies with the alternating current, and its relation to the crystal photo-electric effect. They consider that this additional current is connected with events taking place in the interior of the crystal.

Experiments on mice carried out by H. Burrows indicate that progesterone, a substance related to the male sex-hormone testosterone, can protect the genital organs of the non-castrated animals from the injurious effects of large doses of the female sex-hormone, oestron.

An increased excretion of the yellow pigments, flavins, in the urine, after eating cooked ox-liver, is reported by A. Emmerie.

From the rate of sedimentation and the movement in an electric field (electrophoresis) of the protein particles from horse serum carrying an anti-body, Prof. M. Heidelberger, Kai O. Pedersen and Arne Tiselius conclude that the particles are of uniform size and possibly a definite chemical compound. The sedimentation constant is 17.2×10^{-13} , and the anti-body is apparently formed from a heavier minor component of the protein. The rabbit anti-body against crystalline egg-albumin, on the other hand, is produced from the principal globulin component.

Two unusual modifications of eye colour in the fruit fly, under X-ray irradiation, are reported by Dr. E. V. Enzmann and C. P. Haskins. In one case the change was from white to red, involving apparently a reverse genovariation; in the second case mutations in a culture of eosin *Drosophila* produced eye colour considerably darker than eosin, showing that wild-type condition is not necessarily the end-point of change from light to darker shades.

In the centre of a 'depression', in the later stages of its existence, the air at a height of 4-9 km., though colder and therefore heavier than surrounding layers, is nevertheless ascending. The energy needed to lift it, Dr. A. H. R. Goldie suggests, is provided by the winds, which give up part of their energy and slow down as they converge spirally towards the centre of the depression.

The propagation of voltage impulses in long discharge tubes has been investigated by Dr. L. B. Snoddy, Prof. J. W. Beams, W. T. Ham, jun., and H. Trotter, jun. The tube was found to be an excellent transmission line for high-voltage impulses. The velocity of propagation was easily controllable over quite wide ranges of the order of 10^8 - 10^9 cm. per sec.

A broadening of the resonance lines in the extreme red of the absorption spectrum of potassium vapour in the presence of hydrogen gas is described by T. Okuda, who considers it due to the polarization of the molecules.

ERRATUM. Dr. C. H. Douglas Clark, referring to the paragraph in this column (July 18) on his letter "Optical Polarization Ellipsoids of the Hydrogen Halide Gases", states that it is the polarizability along the long axis which is equal to that of the corresponding negative ion.

Research Items

Pre-Crag Flint Implements

THE evidence bearing on the age of the implements of flint which since 1909 have been found in the Suffolk bone bed has been reviewed by Mr. J. Reid Moir in the light of the conclusions to be drawn from patination, from forms and flaking, and from condition (*J. Roy. Anthropol. Inst.*, 65, Pt. 2; 1935). It is argued that just as in a Pleistocene deposit implements can be sorted out according to their types and assigned to their appropriate age, so in a Pliocene deposit it is legitimate to treat them in a corresponding way. By observing the differences in patination and the refashioning of the pre-Crag flints, it is possible to divide them into five groups; and this classification is supported by an examination of form. Group 1, for example, is rich in implements of the Harrisonian eolithic type, made chiefly from primitive and coarsely shaped implements; but being made from primitive flake implements, they show an advance in technique on the true Harrisonian eolith, which was made from pieces of naturally broken tabular flint. In all the other groups, implements of this type are rare, showing that the production of artefacts of eolithic character ceased after the epoch in which implements of Group 1 were made. Of the rostrocarinates, the same proportion is present in Groups 1, 2, 3, but in 4 the proportion is much less, while in Group 5 none appears. In Group 2, where rostrocarinates occur in the same proportion as Group 1, the eolithic form, which is rare, is replaced by a whole series of racloirs, points, scrapers, choppers and other types. Group 5 is remarkable in being composed of 50 per cent racloirs and 50 per cent unclassifiable specimens. In the 363 specimens, only eight hand-axes are present, though the presence of one specimen in Group 1 shows that the knowledge how to make the hand-axe goes back a very long way. Taking the evidence as a whole, it is maintained that there are few who would deny that Group 1 is of very great antiquity but cannot represent the first attempt of man to shape flints; while Groups 2, 3 and possibly 5 are the most advanced. Group 4 seems to show a slight but very definite regression.

Fishes from the Pawnee Second Oceanographic Expedition

FOLLOWING his first and second reports (1928 *a* and *b*) in the same publication, Mr. C. M. Breder, jun., deals with the Heterosomata to Pediculati from Panama to Lower California (Scientific Results of the Second Oceanographic Expedition of the "Pawnee" 1926. *Bull. Bingham Oceanographic Coll.* Peabody Museum of Natural History, Yale University, 2, 1936). There is much interesting matter in this report, which includes many new species and observations. The new genus *Hubbsiella* is created to include *Menidia clara* Evermann and Jenkins, which differs from *Menidia* proper in several important characters, as has already been noticed by Jordan and Hubbs. Remarks on *Alectis hopkinsi* (Jordan and Starks) suggest that the Pacific representatives may lose their juvenile filaments of the dorsal fin normally by breakage, the stubs simply healing up and not regenerating. A useful key to the Eastern Pacific Hamulidae is given, containing twelve species belonging to nine genera.

Land and Freshwater Molluscs of Colorado

PROF. JUNIUS HENDERSON has enlarged greatly and corrected his original report of 1924 on this subject, and the present monograph, "Mollusca of Colorado, Utah, Montana, Idaho, and Wyoming—Supplement" (*Univ. Colorado Studies*, Vol. 23, No. 2, 1936), includes much new material. Careful work has been done upon Rocky Mountain molluscs during the past decade, resulting in a better understanding of many species and the addition of a number to the fauna, some of them new to science. In the comprehensive work now before us, we find a very large number of both land and freshwater forms listed and criticized, with valuable notes and, in some cases, figures and plates. All workers on mollusca in these districts will benefit by the publication of this most useful paper.

Animal Products

CHAPTERS vii and viii of the second part of the first volume of "Die Rohstoffe des Tierreichs" (Berlin: Gebrüder Borntraeger, 1935. 21.50 gold marks) deal with the hard substances produced by animals, ranging from fish scales, otoliths, tortoise shell and bird's claws to rhinoceros horns, antlers, bone and ivory. The second chapter treats of glue, gelatine and slime. Each product is considered historically, and its characteristics and treatment given. The data concerning its trade and the uses to which it is put are discussed. The full bibliography at the end of each chapter is subdivided into sections for each product. It is a most useful source of information.

Pathogenic Actinomyces

"THE Pathogenic Aerobic Organisms of the Actinomyces Group" is the title of a report by Dagny Erikson (Medical Research Council, Special Rep. Series, No. 203. London: H.M. Stationery Office. 1s. net). The study of fungi of medical importance has been hindered in the past by inadequate examination and description and by confused nomenclature. In this report, Miss Erikson has examined a number of strains of *Actinomyces* collected by Dr. A. G. Gibson from enlarged spleens in various clinical conditions, and a series of strains—variously labelled *Actinomyces*, *Streptothrix*, *Nocardia*, etc.—contained in the National Collection of Type Cultures, maintained by the Medical Research Council at the Lister Institute, London. The cultural, morphological and biochemical characters of twenty-five species are described, including fifteen that appear to be entirely new forms.

Testing Green Karri Timber

UNDER the auspices of the Council for Scientific and Industrial Research of the Commonwealth of Australia, the Division of Forest Products is undertaking an extensive series of tests on the mechanical and physical properties of the timber of karri (*Eucalyptus diversicolor*). Several special tests have so far been carried out ("A Discussion of Special Tests on the Compressive Strength of Green Karri" by Ian Langlands, Division of Forest Products, Pamphlet No. 61—Tech. Paper, No. 19. Government Printer,

Melbourne, 1936). It is shown in this paper that green karri will withstand greater stresses perpendicular to the grain when the load is applied to the tangential face than when it is applied to the radial face. The modulus of elasticity of karri is also much higher when the load is applied to the tangential face. The influence of the width of the loading plate on the compressive strength perpendicular to the grain is considered in detail. The results are given of a series of tests on green karri which were carried out to check the applicability to this species of a rational formula suggested by the U.S. Forest Products Laboratory for northern hemisphere timber. The tests showed that the formula applies very closely when the stress at 1/10 in. deflection is considered; but if the stress at the limit of proportionality is taken as the criterion, the agreement is not so good because of unavoidable eccentricities in loading.

The Japanese Earthquake of February 21, 1936

THOUGH it did not attain more than semi-destructive intensity, the Kawati-Yamato earthquake of February at 10h. 8m. (1h. 8m. a.m., G.M.T.) ranks as the strongest felt in central Japan since the Tango earthquake of 1927. It is described in three short papers published in vol. 14 of the *Bulletin of the Earthquake Research Institute*. Messrs. N. Nasu and T. Hagiwara (pp. 285-289) study the early after-shocks, of which there were 77 during the first 24 hours. A network of five seismological stations was formed around the epicentre near Mt. Hutagami, from the records at which it was found that the focal depths of five after-shocks during the first fortnight were less than six miles. Mr. N. Miyabe (pp. 297-306) remarks that earth-sounds were heard at many places, but they seemed to come as a rule from the nearest mountain rather than from the epicentre. Lights were noticed with the earthquake by several persons, but it is not certain that they were connected with it. Mr. T. Saita (pp. 307-317) examines the relation between the amount of damage and geological structure. He states that, on hard ground, heavy buildings collapsed seriously, while, on soft ground, old and poorly built houses were much damaged.

A Piezoelectric Ultra-micrometer

THE ultra-micrometer is an instrument for the measurement of linear displacements smaller than those which can be measured by optical interferometry; these are limited by the wave-length of light. Whiddington in 1920, using two oscillating electrical circuits tuned so as to produce an audible beat tone, was able to extend the sensitivity of measurement to a value smaller than 10^{-8} cm. Later on, W. G. Cady and D. W. Dye used a piezo-electric quartz plate instead of a resonant electrical circuit. In *Science* of May 15, Prof. J. C. Hubbard describes how by using a quartz plate of 600 kilocycles resonant frequency, a frequency change of one sixtieth of a cycle may be detected. This corresponds to a frequency change of about three parts in one hundred million. To test the method, a micrometer condenser has been constructed so that each plate is attached to a separate support clamped to a heavy steel rod. Adjustments are provided for making the plates parallel and for making relatively large variations of plate distance by means of a micrometer screw. A variable condenser in parallel is provided so as to operate the micrometer condenser at any desired plate distance and thus secure a wide range of

sensitivities. In the experiments which have hitherto been carried out, displacements of 10^{-9} cm. have been measured with an inaccuracy less than a few per cent, although no special precautions were taken against mechanical disturbances. It is hoped that by taking such precautions, displacements of 10^{-10} cm. may be measured. The attainment of a sensitivity of this order should open a new avenue of approach to many important and interesting problems in atomic and molecular physics.

Bakelized Bearings

AN extraordinary development in the kind of bearings used in machinery intended for heavy service is described in the *Metropolitan-Vickers Gazette* of July. The provision and maintenance of bearings in rolling mills is more difficult probably than in any other industry. The pressures are high, the conditions are usually dirty, and maintenance and replacements are difficult and expensive, both in cost of spares and in time lost while repairing or changing. For the heaviest service, white metal bearings have been found quite inadequate. Bronze bearings, usually called brass, are commonly used, but the wear is very rapid. Much thought has been given to this problem, and after many attempts an apparently most unlikely solution has proved the best. It has been found that a bearing material consisting of a fibrous substance like paper or cloth bonded with 'bakelite', a synthetic resin, is far better for this service than any metal. Also, no oil is used, but the bearing is fed continuously with a stream of water. The water has a dual function; in the first place it acts as a lubricant, and in addition it fulfils a more important function by keeping the bearing cool. Cooling is specially required in bearings of this kind, owing to the fact that the heat conductivity of the bakelized bearing material is very much smaller than that of metal. A stream of water is found the best means to carry away the heat generated by friction. A very large number of these bearings are already in service and give good results. The saving in power varies from 30 to 60 per cent, the life is increased about ten times, and there is a saving in the workers' time, as there is seldom need to adjust the rolls.

Relativistic Problem of Two Bodies

THE present verifications of the general theory of relativity deal only with gravitational fields due to a single body. For example, in the case of the advance of the perihelion of Mercury, the field is considered as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun. Prof. T. Levi-Civita (*L'Enseignement Mathématique*, 34, 149; 1935. Paris: Gauthier-Villars), deals with the corresponding problems for two bodies of comparable mass. The equations of relative motion, to a certain degree of approximation, show that we may speak of a central force separable into a Newtonian attraction and an Einsteinian perturbation, which produces an advance of perihelion. This might have been expected, but it is strange to find that the centre of gravity oscillates slightly instead of being at rest or moving uniformly in a straight line. There seems no hope of testing this by observation, but the new formula for the advance of perihelion (slightly different from that applicable in the case of Mercury) may possibly be verified by observation of double stars.

Museums Association

ANNUAL CONFERENCE AT LEEDS

THE forty-seventh annual conference of the Museums Association was held at Leeds on July 6-10. The meetings were held in the Museum, and the usual trade exhibition and members' exhibits were in the entrance hall of the Art Gallery. The conference attracted a record attendance; more than three hundred members and delegates met under the presidency of Sir Eric Maclagan, director of the Victoria and Albert Museum.

Sir Eric, in his presidential address on "Museums and the Public", gave a summary of the various services afforded children and adults by the museums. He is not convinced that children's museums, as separate entities, are a wise ideal, and preferred that children's exhibits should constitute a bait rather than a permanent diet. He would like to see the abolition of many petty restrictions upon adults, such as the ban upon walking-sticks and umbrellas; yet, on the other hand, there is the danger of coddling the public owing to the excellent seats, gardens, refreshment rooms and guide lecturers now at the service of the visitor. Too little, perhaps, is being left to the public, and museums are not peep-shows and need not degenerate into them. In view of the little that museums do which has any real news value, Sir Eric thinks that great credit should be given to the newspapers, which are so often among the museum's best friends.

Following the presidential address, Col. Kitson Clark told the interesting story of the various Leeds museums and the persons responsible for their foundation. The morning session concluded with an address by Sir Harry Lindsay, director of the Imperial Institute, upon the various methods of visual instruction developed and used for adults and children in the Institute.

In the afternoon, Mr. F. R. Worts, headmaster of the City of Leeds School, dealt with museums and secondary schools, a subject which elicited a lively

discussion, from which it was apparent that too much is expected from the museums and too little co-operation offered by the schools. The session concluded with a somewhat detailed, but important, discussion on nomenclature in natural history collections, opened by Dr. F. J. North, and a description of the new Perth Museum and Art Gallery by its director, Mr. J. Ritchie, who illustrated his remarks with lantern slides and a cinematograph film.

The opening paper on Wednesday morning was by Mr. Leigh Ashton, of the Victoria and Albert Museum, who described the display methods he used so successfully in arranging the recent Chinese Art Exhibition at Burlington House. He was followed by Mr. Philip Hendy, director of Leeds City Art Gallery, who had much to say about the lack of civic encouragement to art galleries. He deplored the lack of visual imagination at the present time and the tendency to "think in print". He regrets the decay of craftsmanship, and looks upon the art gallery as a remedy to industrialism, but he thinks that art galleries might profitably exhibit more manufactured objects. Mr. S. F. Markham followed with an account of the museums in India, based upon his recent survey, and the morning session concluded with an important discussion on the copyright of paintings in museums and art galleries.

Thursday morning was occupied largely by the annual general meeting but there was a vigorous discussion on the future of the Association. Finally, Dr. Mortimer Wheeler read an account, by Mr. Iliffe, of the folk museum movement in Palestine.

Excursions were made to various places of interest including Temple Newsam Mansion, Kirkstall Abbey, Harewood House and Fountains Abbey.

The new president of the Association is Alderman Charles Squire, of Leicester, and the next conference will be held at Newcastle-upon-Tyne.

Society of Chemical Industry

ANNUAL MEETING AT LIVERPOOL

THE programme of the annual meeting of the Society of Chemical Industry at Liverpool, July 6-10, in itself provides an excellent illustration of the way in which chemical industry is linked up with almost every aspect of our national life, and of the extent to which chemical science enters into questions not only of industry but also of transport, food supply and the like.

The Messel Memorial Lecture, "Works as I have seen them Grow", delivered by Sir Robert Mond on July 8, gave an impressive account of the development of the Winnington works of Brunner, Mond and Co., as well as of the Mond Nickel Co. and the

Mond Gas Companies, which well illustrates the creative power of science in developing new industries or adapting old ones to changed conditions. It might also be regarded as a dissertation on the theme that the mental process of pure research, the way of asking Nature the right question and of obtaining adequate responses, is as applicable to applied as to pure science. Knowledge of progress depends on trustworthy and continuous measurements of all the many factors involved, and these measurements can be effected as well on a works as on a laboratory scale, and with intelligent designing no great or specially expensive methods are required. Acting on

this principle, Dr. Ludwig Mond not only made the Solvay ammonia-soda process a commercial and technical success, but also showed by what means the science of physical chemistry could be studied practically and developed in a works instead of in a laboratory.

Sir Robert Mond suggested that this was his father's great contribution to human progress, and those who took part in the numerous visits to works and factories during the week found much to justify Sir Robert's assertion. It was equally supported by papers presented to the meeting such as Dr. R. Houwink's address to the Plastics Group on "Synthetic Resins, their Formation, Properties and Possibilities", Dr. L. H. Lampitt's on "Food Package and the Consumer" at the Food Group Congress held jointly with the Royal Sanitary Institute at Southport, or Mr. R. G. Batson's address to the Road and Building Materials Group on "Scientific Research and the Highway Engineer".

All these papers and discussions emphasized the way in which exact measurements by physical methods are laying the foundations for future advance. Dr. Houwink, discussing future developments, said that one of the most urgent requirements is for stronger, more elastic, more shock resistant and electrically improved products, and referred to the possibility of improving the properties of shellac so that competition with resins like those of the phenol-formaldehyde type become possible again. Dr. Lampitt referred to the way in which growing public appreciation of the importance of hygiene has led to fresh demands for packing materials which the chemist has been able to meet.

The address for which the Liverpool meeting will be most remembered, however, is that of the president, Mr. W. A. S. Calder, on July 7, on "The Chemist as World Citizen". Mr. Calder linked up the chemist and his training to acquire and face facts with his wide responsibilities in the world to-day. One of the chief causes of the dangers to freedom and progress is the utter ignoring of facts, and Mr. Calder protested strongly that the chemist is not the destroyer which the irresponsible Press represents him to be. It is a lamentable fact, however, that we are all susceptible to the poisonous virus of newspaper propaganda. No one capable of thought can fail to admit that no one nation is ever entirely responsible for a war, and Mr. Calder pointed out that the training of a chemist should teach him the impossibility of being always right. Chemists cannot escape the responsibility of seeing that the danger of refusing to face facts is duly impressed upon our politicians.

Another direction in which the chemist can play a part as a world citizen is that of the prevention of accidents. The chemist and engineer are qualified by their training to be of special service in anticipating risks and thus preventing accidents. Many accidents still occur which could not be possible if those in charge of affairs fully realized their responsibility. Men are even exposed to unnecessary risks which they are expected to avoid by compliance with impossible orders for their own safety, and Mr. Calder expressed the hope that the interchange of details of accidents already taking place between several countries might become world-wide.

Coral Reef Ecology at Low Isles

THIS fine contribution* to the series of reports on the Great Barrier Reef Expedition of 1928-29 is chiefly concerned with accounts of three traverses across the reefs at Low Isles. Its production is the result of a collaboration between several workers; Prof. T. A. Stephenson originally chose the traverses; physical and chemical data were provided by Mr. A. P. Orr, and level sections by Mr. M. A. Spender. The bulk of the work, however, fell to Dr. Fraser and Dr. S. M. Manton, who jointly enumerated the organisms present, while the latter is responsible for drawing up this report.

Along each traverse a strip of reef one yard in width was examined. The first traverse, more than 1,000 feet long, started from a Thalamita flat inside the reef and crossing a shallow moat, passed over a boulder tract to descend the seaward slope of the reef to the muddy sea-floor at about twenty feet below datum. The second traverse, about half the length of the first, crossed a portion of the reef where the contour of the sea-floor was rather irregular. The third traverse on the windward side of the reef could not be worked in detail on account of the roughness of the water; but such observations as were made are nevertheless of much interest.

The results of these surveys are given in a number of graphs that permit easy comparisons to be made of the distribution of corals and algae, both as regards abundance of individuals and of species. Algae were abundant only in the moat and on the inshore part of the second traverse; they were almost absent from the seaward slopes of all three. Coral growth was vigorous in the deeper part of the moat—where there is always nearly a foot of water at low tide—as well as on the seaward slopes of the traverses below the datum line. In the moat physical conditions were extreme, especially as regards temperature and to a considerable extent silting; the association of species living there was hence not the same as that outside. *Montipora ramosa* was the dominant coral in the moat, indeed being restricted to that situation, whereas the *Acroporas*, species sensitive to heat and silt, were almost entirely confined to the seaward slopes.

One of the more important points brought out is the influence of silt on the distribution of corals. It seems clear that whereas some species are well able to withstand a fair amount of silting, others are killed off by very little. Silt is evidently a limiting factor, and it is in turn correlated, of course, with water movement.

In addition to the traverses at Low Isles, small isolated areas on the Outer Barrier Reef were examined and are described here for comparison.

* British Museum (Natural History). Great Barrier Reef Expedition, 1928-29. Scientific Reports, vol. 3, No. 10: Ecological Surveys of Coral Reefs. By Dr. S. M. Manton. Pp. 273-312 + 16 plates. (London: British Museum (Natural History), 1935.) 10s.

The different physical conditions there are primarily responsible for the change in the character of the fauna as compared with that at Low Isles.

This report is most beautifully illustrated by a series of large-scale maps in picture form, showing in detail the distribution of corals and other organisms on small selected areas of the traverses or on portions

of the Outer Barrier Reef. These maps show evidence of lavish care and attention both in the preliminary drawings and in the measurements necessary to produce them, as well as in the skilful draughtsmanship that has produced the finished plates. They should be of great value to all students of coral reef ecology.

Diesel Fuels and Engineering

AT the first overseas meeting of the Institution of Petroleum Technologists held in Holland on May 8-11, a series of papers was read on diesel fuels and diesel engineering.

Among papers presented for discussion was one by Ir. W. Hupkes on "Diesel-Electric Traction on the Netherlands Railways". Of particular interest in this paper is a clear exposition of facts leading to selection of diesel-electric trains for the frequent and regular conveyance of passengers in the Netherlands. The triple-articulated diesel-electric engine chosen was designed specifically to meet circumstances of accommodation, coupling, speed, rapid acceleration and open-air storage when not in service. Full details are given of the car arrangement ultimately decided upon, motive power, performance, braking, automatic coupling, heating and ventilation.

Ir. G. J. Lugt in his paper on the "Design of Fuel Injectors for Diesel Engines" described the two methods of fuel injection, mechanical and pneumatic, and indicated the function of the injector as being the distribution of the fuel over the air in the compression space of the cylinder. He then devoted

himself to closed mechanical injectors as being almost exclusively used by diesel engineers. He concluded with the remark that there is now little need for individual design of injectors for diesel engines as they have become to all intents and purposes a standard fitting.

Mr. C. H. Barton in his paper on "Diesel Fuel Specifications" pointed out the necessity for such specifications in the classification of fuels into grades and in the indication of desirable properties in particular grades. He described tests commonly adopted in fuel specifications and indicated their significance.

A joint paper by Ir. G. D. Boerlage, Ir. J. J. Broeze, L. J. Le Mesurier and R. Stansfield, on the "Correlation of Tests on the Ignition Quality of Diesel Fuels, carried out at Delft and Sunbury", was the outcome of differences found in the two laboratories regarding the rating in terms of cetene numbers of some commercial fuels. A great deal of work was involved before agreement was reached, and the results of this collaboration are of major importance as providing a feasible technique for the accurate determination of ignition quality of diesel fuels.

Training of the Engineer in the U.S.A.

A PAPER on the training of the young engineer by R. E. Hellmund, of the Westinghouse Company, just published by the American Institute of Electrical Engineers, takes into account the changing conditions of the industry recovering from the great depression. It was discussed at the summer convention of the American Institute of Electrical Engineers at Pasadena on June 26, 1936.

The disorganization of industry brought about in the United States and elsewhere by bad times has resulted in many radical suggestions being made in connexion with engineering education, and Mr. Hellmund has noted a tendency to discard good methods with bad. Even if it were desirable for the good of humanity to retard the introduction of labour-saving devices with the object of avoiding unemployment, it would not be advisable. Every engineer employed in any competitive industrial enterprise must, if the business is to survive, reduce costs by every means in his power. Even the greatest advocates of Government control have never suggested the elimination of competition in industry. He states that the only way the engineer can help to diminish unemployment is to create new products

for which there will be a demand. This will enable costs to be reduced, and at the same time the population will benefit by the improvement. He suggests, therefore, that economics be given a more prominent place in engineering education. Psychology is another subject of study that will assist the engineer in carrying on his work effectively under modern conditions. The question arises, in what way should the syllabuses of the colleges be best altered so as to accomplish this.

Mr. Hellmund has noticed that young engineers in industrial organizations frequently become so absorbed in the solution of an interesting problem that they neglect to study its economic and commercial aspects. During the depression, it was more than ever necessary to focus attention on this side of the question. In many college curricula, courses in economics are included, but they are given by the department of economics, and much of the work covered at present is far removed from the practical applications encountered by the engineer in his everyday work. He concludes that the engineering schools should offer special abbreviated courses which show how the basic laws can be applied in practice.

Psychology is another subject that in several ways can assist the engineer in carrying on his work effectively. In industrial organizations, work cannot be done efficiently without a thorough knowledge of human nature. The depression has emphasized the importance of this. Although the study of psychology will not correct all personal shortcomings, yet it seems the only practical way by which the colleges can bring about improvement. A few specific lectures on this subject would be helpful in a school of engineering, but, at least at first, they should not be made compulsory.

Graduate courses at college prior to entering industry are, in Mr. Hellmund's opinion, only of limited value. It is dangerous for an engineering student to stay too long in a college atmosphere. The profession is one which requires courage and initiative, qualities which are rarely developed in college life by the type of students who take post-graduate courses. It is true that there are a few kinds of highly technical research work which might advantageously be done at a postgraduate course at the university. If the postgraduate work is undertaken because the graduate is unable to find immediate employment in industry, it is advisable not to take courses in the specific subjects of the branch of engineering contemplated but in affiliated subjects. For example, an engineer wishing to enter research work on electrical subjects would do well to take additional mathematics, physics and physical chemistry. One intending to take up practical design would find additional work relating to the materials used in his type of engineering, such as

chemistry and metallurgy, very useful. The opinion is expressed that it is generally better for the young engineer to enter industry as soon as possible after completing his undergraduate course.

During the depression, the business of many industries decreased by 20-60 per cent of previous levels. The heavy industries were as a rule the most severely affected. During the lowest level, it was difficult for engineering graduates to find employment. Now industry is increasing and the prospects are good. As a rule, employers can engage their old employees with specific experience and ability, but some of these have taken up activities outside the engineering industry and so there is a demand for young engineers. In some cases the latter have a great advantage over the older men, as they know the latest theories and methods and have not forgotten how to handle the technical details in calculations, laboratory and similar work.

Mr. Hellmund has noticed that about seventy per cent of all engineering graduates express a desire to go into power transmission work, the design of large machinery, railway electrification and similar work. As they all cannot get employment in this direction, it is necessary to persuade some of them to take up other activities. The author can recall no instance where the men who took his advice afterwards regretted their action, as they soon found that there are very interesting and important problems in almost every branch of engineering. The young engineer need not fear to enter work not entirely in accord with his wishes. He should prepare himself to handle effectively the work assigned to him.

Chemistry of Fibres

THREE papers read at the annual conference of the Textile Institute held in London on June 3-6 dealt with various aspects of the chemistry of fibres.

One of these was a comprehensive summary by G. F. Davidson of current theories of the molecular structure of cellulose. After an outline of the chemical and physical evidence in support of the molecular chain theory, the membrane theory of Hess was dealt with critically; the author, in common with most other investigators, appears to prefer the former. Six methods for the determination of the molecular weight of cellulose and its derivatives were then described, and the difficulty of correlating and interpreting the resulting values was emphasized. Thus, chemical determinations of end-groups give the 'molecular weight' of the largest unit within which the atoms are bound by primary valencies; osmotic pressure and ultra-centrifuge methods measure only particle size and, therefore, depend on the degree of aggregation of the molecules; whilst viscosity measurements must be standardized against an absolute method.

The second part of the paper described how the methods devised by the British Cotton Industry Research Association for the preparation of modified cotton cellulose by the action of acids and oxidizing

agents have enabled evidence in support of the chain theory to be obtained.

A second paper, entitled "Wood Pulp for the Rayon Industries", by L. Hebbs, contained some interesting side-lights on the influence of the early work of the late C. F. Cross. Thus, it was pointed out that so long ago as 1904 a pulp with an α -cellulose content of 88.8 per cent had been produced by mercerization with alkali. Moreover, in 1906 an analytical method for the determination of α -cellulose was outlined, which is essentially the same as that used to-day. The correlation of the copper number and the cuprammonium- and viscose-viscosities with the strength and cellulose purity of pulp was then discussed, the relationships being illustrated graphically. The elimination of resinous matter in the manufacture of wood pulp is greatly assisted by removal by washing and screening of the small sacs, medullary rays and short fibres in which it is concentrated, and by bleaching the pulp in several stages. Rapid replacement of cotton linters by wood pulp is expected.

In the third paper, Dr. R. Cuthill discussed the sorptive properties of the silk fibre, which are of considerable importance both from a theoretical and a practical point of view. Gases and vapours, non-electrolytes in solution and pure liquids, suspended solids, electrolytes and dyes were dealt with in turn.

Canadian Work on Dermatophyte Fungi

A NUMBER of papers by members of the University of Manitoba form an admirable review of modern knowledge of the dermatophytes, or fungi which produce ringworm and favus diseases of human skin. The general mycologist will find many features of interest in this field of specialist endeavour, and Dr. P. H. Gregory has provided adequate summaries¹.

The outstanding characteristic of a dermatophyte is that it can utilize the highly insoluble sclero-protein *keratin* as a source of energy. This is apparently accomplished by means of a keratolytic enzyme secreted by the organism. Such fungi may be introduced to unkeratinized parts of the body; several have, indeed, been re-isolated from the blood-stream; but they do not seem to be able to parasitize any organ but the skin.

A very high degree of specificity is found. Some species of the genus *Microsporon* produce ringworm of the scalp in children, but not in adults; the lesions disappear naturally at puberty. Certain species parasitize the hands and feet, whilst others attack only the hairy parts of the body. *M. audouini* infects man, but not other animals. This limited pathogenicity cannot be due to chemical differences between the various sources of keratin, for a number of species will attack that substance from all sources—scalp hair from children and adults, pubic hair, human nails, porcupine quills and snake scales—when it is dissociated from living tissues.

The localized fungal infection, known as a 'mycosis', may not be the sole effect of the organism upon the host. 'Mycids' may occur. These are secondary lesions of a non-parasitic nature, but definitely associated with the presence of the fungus in another part of the body. The very great emphasis on the need for keratin as food for the parasitic dermatophytes is rather striking, as they are also saprophytes of a taste sufficiently catholic to include such diverse food substances as tinned oysters, straw, cereal grains and a wide variety of synthetic media. Their characters are also changed in the saprophytic phase, and very numerous forms of organs appear in artificial culture which are unknown in the state of natural parasitism. The spontaneous degeneration known as pleomorphism often occurs in the saprophytic phase; but infection of animals has been accomplished from fungi which have been grown saprophytically upon keratinized tissues *in vitro* for some time. The need for investigation of natural sources of infection raises some very interesting problems for the field mycologist. From what saprophytic substrata can a dermatophyte proceed to attack a human subject? How is the transference to the host accomplished, and by what kind of spore?

Classification of the 880 species of dermatophytes at present described is very difficult. Four different systems of grouping have been suggested, but the general mycologist would only be at home with that of Langeron and Milochevitch, which includes all the ringworm and favus fungi in the Gymnoascaceæ, though perhaps, as yet, with insufficient justification. The system originally proposed by Sabouraud, and revised in 1929, is still the most useful to medical men. It also possesses sufficient parallels with the classification of the Fungi Imperfecti to enable it to be adapted mycologically as future researches should dictate. The local dermatophyte floras of various parts of the world are being studied, and

Drs. A. M. Davidson and P. H. Gregory have published their quota². The same two authors have also helped to simplify the problem of classification by their proof³ that the so-called 'mosaic fungus', often associated with ringworm attacks, is in reality an intercellular deposit of cholesterol crystals. Dr. Gregory discusses reports of the discovery of asci in dermatophytes, and considers their possible relationships with other fungi.

Certain species of dermatophytes cause a green fluorescence to appear on infected hairs when viewed in ultra-violet light. This is due to the presence of a water-soluble substance, and the fact is used to facilitate the diagnosis of ringworm. Dr. A. M. Davidson, S. A. Boyd and C. P. Haltalin have described a very simple and convenient apparatus for this purpose⁴. The work, which is the result of co-operation between a research worker, a physician and an electrical engineer, is typical of the determined team spirit which is very obvious in the publications of the Manitoba workers on dermatophytes, and should not fail to yield results of practical value to humanity.

¹ "The Dermatophytes", *Biol. Rev.*, **10**, 208 (1935); and "The Parasitic Activity of the Ringworm Fungi", *Trans. St. John's Hospital Dermatological Society*, 56-65 (1935).

² "The Dermatophytes of Manitoba, Canada", communicated to the Ninth International Congress of Dermatology, and appearing in the first volume of deliberations of the Congress. (Budapest: "Patria"-nyomda. R.-T.)

³ *J. Amer. Med. Assoc.*, **105**, 1262-1264 (October 19, 1935).

⁴ *Canad. Med. Assoc. J.*, **33**, 534-536 (1935).

Educational Topics and Events

EDINBURGH.—Prof. James Ritchie, regius professor of natural history in the University of Aberdeen, has been appointed to the chair of natural history, in succession to the late Prof. J. H. Ashworth.

The degree of Doctor of Science has been conferred upon the following: A. B. Brown, for a thesis entitled: "Studies in Cambial Activity"; Sasindra Chandra Dhar, for a thesis entitled: "On certain Investigations of the Properties of the Functions of Mathieu, Whittaker, Weber and other Confluent Hypergeometric Functions: On the Uniformization of Algebraic Curves, and on certain Electromagnetic Waves in Gravitational Fields in Relativity"; Nancy M. Galpin, for a thesis entitled: "Biological and Statistical Studies on the New Zealand Romney Lamb, with reference to Relative Growth Gradients"; J. M. Stagg, for papers on "Terrestrial Magnetism, with special reference to the Magnetic and Non-photographic Auroral Data brought back from Fort Rae, North-West Canada"; J. Carmichael, for a thesis entitled: "Investigations into Tuberculosis in Uganda"; Philippus L. le Roux, for a thesis entitled: "Observations on Schistosomiasis and Paramphistomiasis in Sheep, and Notes on the Morphology of Helminths from Mammals and Birds in South Africa".

LONDON.—Dr. W. J. Hamilton, since 1935 lecturer and deputy director of anatomy at St. Thomas's Hospital Medical School, has been appointed University professor of anatomy (St. Bartholomew's Hospital Medical College).

It has been resolved to institute a B.Sc. degree in chemical engineering for internal students in the Faculty of Engineering.

The following D.Sc. degrees have been conferred: In agriculture, on P. H. H. Gray, of the Rothamsted Experimental Station; in botany, on W. A. Roach,

a recognized teacher at the East Malling Research Station; in botany, on F. C. Steward, of Birkbeck College; in fuel technology, on R. J. Sarjant, of the Imperial College (Royal College of Science); in history, methods and principles of science, on Dr. Douglas McKie, a recognized teacher at University College; in physical chemistry, on C. F. Goodeve, a recognized teacher at University College; in zoology, on R. J. Ortlepp, of the London School of Hygiene and Tropical Medicine.

Alexander Haddow has been re-appointed to the Laura de Saliceto studentship for the year 1936-37. The Sir George Jessel studentship in mathematics for 1936 has been awarded to W. J. E. Butler, of University College.

BEIT fellowships for scientific research, tenable at the Imperial College of Science and Technology during the academic year 1936-37 have been awarded as follows: extensions of fellowships to R. Walls, for the continuation of his research on the metamorphic rocks of north-east Scotland, under the direction of Prof. P. G. H. Boswell; E. W. Hewson, for the continuation of his research in meteorology, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada, under the direction of Prof. D. Brunt. New fellowships have been awarded to: E. K. Woodford, of Olds School of Agriculture, Alberta, 1929-30, and the University of Alberta, 1930-36, for research in the physiology of plants, with special reference to problems of plant growth and metabolism, under Prof. V. H. Blackman; Dr. N. Kemmer, of the Universities of Göttingen and Zurich, for mathematics research, using the ideas and formalisms of quantum theory (especially quantum electrodynamics), under Prof. S. Chapman.

A NEW handbook of information about facilities available for students from other countries at university institutions in Great Britain and Ireland has been published by the Universities Bureau of the British Empire (88a, Gower Street, London, W.C.1). In the sixty-four pages of this pamphlet are set out, succinctly but lucidly, indications of conditions of admission, costs of living, fees and other charges, courses and subjects of study, special courses for overseas students, vacation courses, social amenities, some features of university administration and notes on research facilities and open scholarships. Under the heading "Cost of Living", overseas students are strongly recommended to obtain entrance to hostels, as they provide contacts which are not readily obtainable in the seclusion of lodgings and boarding-houses or even in families where students are received as paying guests. The list of courses of study comprises those which experience has shown may be of special interest to overseas students and research workers. Among special courses for overseas students mention is made of an offer by Ashburne Hall of Residence for university women, Manchester, of places at reduced fees (£13 for the term or £1 5s. per week) to foreign women students prepared to give some conversational French, German, Italian or Spanish to students resident in the Hall. Other institutions which offer special courses for overseas students are: University College, London; London School of Economics and Political Science; University College, Exeter; University College, Nottingham; and University College, Southampton.

Science News a Century Ago

Progress on the Liverpool and Manchester Railway

At a meeting of the proprietors of the Liverpool and Manchester Railway held in Liverpool on July 27, 1836, it was reported that the receipts for the half-year ending June 30, 1836, had been £109,355, and the expenses £69,953. It was also reported that the tunnel at the new station, in Lime Street, Liverpool, would be opened for public business on August 15, and that this new means of approach to the railway would prove of great public accommodation. The expense of erecting this station and the one at Edgehill, which was constructed on a most magnificent scale, amounted to about £150,000. The directors also intended, it was said, to erect a commodious station in Manchester similar to the one at Liverpool, and with that view extensive premises had been purchased in the neighbourhood of Water Street, near the River Irwell.

The Euphrates Expedition

In a supplement to the *London Gazette* of July 29, 1836, a dispatch from Colonel Chesney to the India Office was published describing the loss of the steamer *Tigris*, the smaller of the two steam-vessels with which he was descending the Euphrates to the Persian Gulf. His dispatch was dated May 28, 1836, from the steamer *Euphrates* at Anna. All had been going well, he said, up to May 17, the survey having been carried 509 miles down the great river and "all was continued prosperity up to the afternoon of the 21st inst when it pleased God to send the calamitous event of which it is now my duty to give a feeble sketch. A little after 1 p.m. the flat boats being a little ahead, and the *Tigris* leading the *Euphrates*, a storm appeared bringing with it, high in the air, clouds of sand from the west-north-west quarter. At the moment we were passing over the rocks of Is Geria (deeply covered) and immediately after made a signal for the *Euphrates* to choose a berth and make fast. . . . The *Tigris* was immediately directed towards the bank against which she struck without injury but with so much violence as to recoil a distance of about eight yards." The wind then veered, said Col. Chesney, the water came aboard and the vessel soon sank. Col. Chesney escaped, but no fewer than twenty officers and men were drowned. The storm only lasted about 12 minutes. In spite of the disaster, which included the loss of instruments, journals and surveys, the work of the expedition was carried on by the *Euphrates* alone, "the party continuing their survey to Bussora hoping to demonstrate the speed, economy and commercial advantages of the river Euphrates".

Medicine in Denmark

ON July 30, 1836, the *London Medical Gazette* published the following note: "Every physician and surgeon in Denmark gets an education which qualifies him to maintain the dignity of his profession, as a worthy member of a class that is generally considered to be one of the most respectable and most liberal. The Danish medical men are usually held in high esteem. . . . Danish physicians and surgeons are so honoured abroad that very often Swedes come to Copenhagen in order to be treated by them. Mountebanks and quacks among the Danish medical men

are rare. . . . The learning and scientific intercourse among the medical men in the Danish capital are supported by two medical societies. In their general methods of cure the Danish medical men do not commonly use but rather shun heroic remedies: as true sons of Hippocrates they follow his maxims in studying Nature and in endeavouring in all their treatment to obey it and to sustain the *vires medicatrices* not disturbing them by too active medicine".

The Siamese Twins

The *British and Foreign Medical Review* for July 1836 gives the following account of this interesting pair, who were then in Paris: "The connecting band united them at first face to face, but constant traction has so changed its direction that they are now side by side. Its length above is two inches, below nearly four; from above downwards it measures three inches, and its greatest thickness is one and a half inch. . . . The band is formed superiorly by the xiphoid appendix and by some of the cartilages of the ribs, and presents inferiorly the cicatrix of the umbilicus: the cavities of the two chests do not communicate, but the abdominal cavities do. . . .

It has been proposed to divide the band, but, if this description be correct, any incision would open the peritoneum; such a proposal is very disagreeable to the twins, who have often said they have never seen any single individual so happy as they are united. Their names are Eng and Chang, and they were born in May 1811 in a small village on the coast of Siam, twenty leagues from Bangkok, of Chinese parents. They have the Chinese features; the internal angles of the eyes slightly drawn down, skin yellow and hair very black; they are extraordinarily alike, only Eng is a little larger and stronger, and Chang appears to rest more willingly on his brother. They are five feet in height, well proportioned and of great muscular strength; they are very agile, they walk and run rapidly, and can swim as well as a single person. Their intellectual faculties are well developed. They understand English and speak it perfectly, but they have forgotten their native tongue, which is not to be wondered at, as they never speak to each other except sometimes asking a question. They have both an equal knowledge of English. Two persons have endeavoured to converse separately with each at the same time, but both turn invariably to one speaker, and converse alone with him. They suffered from ague in America; the attack commenced at the same time in both, and the stages of the disease exactly corresponded, so that they experienced rigors, heat and sweating at the same moment. Chang also had pain in his side, during which his brother was uncomfortable, and when Chang was being bled, Eng felt indisposed.

Their taste for food, for persons and things is similar, what pleases one, pleases the other; they both experience hunger and thirst, go to sleep and wake at the same instant; one is never awake while the other sleeps, and to wake them it is only necessary to touch one. During sleep they often change their position by one rolling over the other without waking. There is the utmost uniformity in their motions, as if both were influenced by one will. They have never been known to be angry with each other; the one who wishes to perform any act, makes no sign to the other, who, notwithstanding, concurs without the slightest hesitation".

Societies and Academies

Edinburgh

Royal Society, July 6.

B. G. SHAPIRO and H. ZWARENSTEIN: Relation of the pituitary gland to muscle creatine. The creatine content of the thigh muscles of *Xenopus laevis* is about 400 mgm. per 100 gm., the extreme limits for normal animals, male or female, being 40 mgm. above or below this figure. Six months after total removal of the pituitary gland, the muscle creatine content is found to be about 320 mgm. per 100 gm. The same result follows the removal of the anterior lobe alone. The drop does not follow immediately after operation, and is still comparatively slight after three months have elapsed. Injection of anterior lobe extract into normal toads of the same species raises the muscle creatine level by thirty per cent. This effect is tissue specific.

EDITH A. T. NICOL: The fauna of the brackish water lochs of North Uist. These lochs lie at different levels and show all conditions between lochs entered by every tide with a salinity of more than thirty per mille and those entered by only the highest tides with a salinity of about two per mille. The pH varies between 7.8 and 9.9 in spite of the low pH of the fresh-water and the alkali reserve is often below 0.0010 N. The fauna is unusually rich owing to the varied conditions of salinity and substratum, and consists of 59 marine, 24 fresh- and 25 brackish-water species, as well as 5 euryhaline forms. *Sphaeroma hookeri* is recorded for the first time in Scotland.

P. C. KOLLER: The chromosomes of the male grey squirrel. The diploid chromosome number of the grey squirrel (*Sciurus carolinensis leucotus* Gapper) is 28. The sex chromosomes exhibit very little difference in size. The sex bivalent during meiotic metaphase is invariably asymmetrical, which indicates an obligatory pre-reduction. A deviation of metaphase chiasma frequencies, found in different individuals, is brought about by a different degree of terminalization of diplotene chiasmata. The ultimate cause of the deviation is either genetical or environmental.

F. WALKER and C. F. DAVIDSON: A contribution to the geology of the Faeroes. The eighteen islands of the Faeroes archipelago, 540 square miles in area, are formed of a great sequence of Tertiary basalts and tuffs, 14,000 feet thick. Small volcanic vents, sills and dykes are present, and thin seams of sediments, including lignite, are intercalated with the basalts. Traverses show that the lowest exposed horizons of the plateau, the base of which is not seen, are formed of tholeiitic basalts. These are succeeded by olivine-basalts, and in turn by a vast thickness of porphyritic feldspathic and tholeiitic basalts, capped by ankaramites and olivine-rich lavas at the highest levels. Composite flows, dyke-feeders to lavas, and other phenomena are described, and an extensive bibliography is given. Seven 'superior' chemical analyses of Faeroes rocks are now available.

F. A. E. CREW and P. C. KOLLER: Genetical and cytological studies of the intergeneric hybrid of *Cairina moschata* and *Anas platyrhynchos platyrhynchos*. The two genera are fertile *inter se*, but the hybrid is infecund. The characterization of the hybrid differs according to which way the cross is made. The male hybrid ex *Anas* (male) × *Cairina* (female) is normally equipped sexually but infecund; the female has a

rudimentary ovary, infantile oviduct, exhibits no sex behaviour and in size equals the male. The male hybrid out of the reciprocal cross is infertile and much larger than the female, which has a functional ovary, an oviduct and normal sex behaviour. She lays small eggs which are infertile. The chromosome number of the two genera is probably the same and the larger chromosomes are morphologically alike. In the male hybrid no viable gametes are to be found. Spermatozoetes undergo dedifferentiation and nuclear condensation. Multinucleate giant cells in which vacuoles develop and nuclei degenerate are plentiful. The spindle is normal. The sterility of the hybrid would seem to be due to the action of complementary genetic factors which do not affect chromosome pairing but which disturb the relationship of this with spindle development.

HAROLD JEFFREYS: Note on fracture: a note on Dr. E. M. Anderson's paper "The Dynamics of the Formation of Cone-Sheets, Ring-Dykes, and Calderon-Subsidences".

Paris

Academy of Sciences, June 15 (*C.R.*, 202, 1953-2020).

VITO VOLTERRA: The equations of biological fluctuations and the calculus of variations.

HENRI DEVAUX: The determination of the thickness of the albumen membrane formed between water and benzene, and the properties of this membrane. The interfacial membranes of albumen between water and benzene are monomolecular.

HUGO STEINHAUS: The curve of Peano and independent functions.

M. KAC: Some remarks on independent functions.

R. DE MISÈS: The energy of acceleration of a solid.

PIERRE E. MERCIER: Oscillatory phenomena in suspensions.

LOUIS COUFFIGNAL: The use of binary numeration in calculating machines and nomomechanical instruments.

JEAN LAGRULA: The method of simultaneous pupillary regions. Application of Charles Fabry's method of stellate photometry. Taking four exposures on each plate, by successive rotations of a right angle, relative magnitudes have been determined with an accuracy of 0.005-0.01 magnitude.

L. CHADENSON: A functional space of quantum mechanics.

GABRIEL DUCH: Some relations between the functions of the cohesion forces of liquids and their chemical function at the boiling point under constant pressure.

J. SERPE: The *K*-radiation of boron. Boron prepared by Moissan's method gives a *K*-radiation which has at high temperatures three conductivity electrons per atom. The maximum kinetic energy of these electrons is 20 ± 2.5 v.

JEAN ROIG and JEAN THOUVENIN: The variation of the optical density of photographic plates with the dryness conditions. A photographic plate, uniformly exposed, never gives uniform darkening. One of the causes of this variation is moisture variation, and results of a quantitative study of this effect is given.

Mlle. ARLETTE TOURNAIRE and ETIENNE VASSY: The influence of the wave-length of the light on the evolution of the latent image. The evolution of the latent image, in plates in which it occurs, is shown to be a function of the wave-length of the incident light.

RENÉ DELAPLACE: Atomic hydrogen and the disappearance of hydrogen in discharge tubes. If the discharge tube is freed from traces of water vapour by cooling with liquid nitrogen for twenty-four hours, the hydrogen does not undergo irreversible contraction, and traces of methane and carbon monoxide are no longer produced by prolonged discharge.

PIERRE SPACU: An argento-mercuric compound. From an X-ray study it is shown that Wöhler's substance $\text{Hg}(\text{CN})_2 \cdot \text{AgNO}_3 \cdot 2\text{H}_2\text{O}$ is a definite compound and not a mixture.

ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT: The Raman spectra of some substituted epoxy-cyclopentanes.

PIERRE BRAUMAN: A new type of vanadyl-salicylate.

PAUL COUTURIER: The action of mixed organo-magnesium compounds on the aromatic *N*-diethyl-amides with phenolic function.

RENÉ TRUCHET: Heavy chloroform, CDCl_3 . This was prepared by the action of heavy water on a suspension of quicklime in chloral, and contained only a small proportion of ordinary chloroform, shown by the Raman spectrum.

GEORGES DENIGÈS: The constant formation of carbonyl derivatives (aldehydes and ketones) of the same condensation in the explosive decomposition of nitric esters.

V. AGAFONOFF: The soil types of Tunis.

JEAN MARÇAIS: The geological constitution of the region to the north of Taza and of Guercif (Eastern Morocco).

MAURICE ROQUES: The cristallophyllian series of the Lespinouse massif, in the neighbourhood of Lacaune.

WACLAW MOYCHO: The independence of the production of proteases and the development of the cell in *Bacterium prodigiosum*. By varying either the pH or the amount of phosphate, the development of the bacterium and the production of proteases can be influenced differently. The two processes, at least in this organism, appear to be independent.

RENÉ SOUÈGES: The embryogeny of the Campanulaceæ. The development of the embryo in *Campanula patula*.

Mlle. MARIE LOUISE VERRIER: The purple and visual cells of the fovea of the nocturnal birds and of other vertebrates.

PAUL CHABANAUD: The interbranchial opening of the unsymmetrical teleosts.

GEORGES BROOKS: Researches on the fluorescence of the skin of the frog, *Rana esculenta*. Study of the mineral substances. The mineral fluorescent substance of the skin of the frog is composed of a complex mixture of mineral salts containing manganese and zinc.

CONSTANTIN LEVADITI and PEREZ HABER: The affinity of the virus of bird plague for the neoplastic (epithelioma) cells of mice.

Cape Town

Royal Society of South Africa, April 15.

F. G. CAWSTON: Some observations on *Opuntia* used as a larvicide. The mucilage of *Opuntia maxima* was tested in various concentrations, and the effect studied on four different anophelines and *Culex*. The majority of the larvæ rapidly succumbed, but the

mucilage had little effect on those which had reached the pupal stage. There was also an arrest of development of those which were afterwards removed to clean water. The effect of the juice is largely mechanical, and a preservative is needed to prevent decomposition.

VIVIEN ELLENBERGER: History of the Ba-ga-Malete of Ramoutsa. The traditional and historical movements of the Malete tribe, Bechuanaland Protectorate, collected from native tribal sources and from official records. Notes on the social structure, regimental system, national praises and the tribal territory are included.

I. SCHAPERA: Acculturation among the BaKxatla.

FLORENCE RICH: Some diatoms from the Victoria Falls. An account of diatoms contained in the washings of a collection of *Dicraea* (*Podostemaceae*) made just above the Falls, on the rocks at the east side, where these plants are covered by rapid-flowing water in the rainy season. About sixty different species have been identified, most of which proved to have been previously recorded from South or Central Africa. One new species and several new varieties are described and figured.

W. S. S. LADELL: Use of serum as an accessory medium in tissue culture.

H. ZWARSTEIN: A revised simple technique for the frog test.

V. SCHRIRE and H. ZWARSTEIN: The pancreas and blood inorganic phosphorus. The normal plasma inorganic phosphorus content of *Xenopus* is 7.1 mgm. per 100 ml. (average of 58 estimations). Temperature has no effect. Pancreatotomy caused a 30 per cent increase six hours after operation. Injection of insulin into normal animals caused a 50 per cent drop four hours after injection.

Cracow

Polish Academy of Science and Letters, April 6.

W. ORLICZ: The LM spaces.

K. ŠTEINS: The technique of astronomical calculations according to an international inquiry. Some conclusions based on a questionnaire sent out to twenty-two countries relating to various points in astronomical calculations.

S. PIOTROWSKI: A star, probably new, in Gemini.

K. GUMINSKI: The luminescence of barrier anodes of aluminium. A study of the influence of the nature of the electrolyte, of the anode and the electrical conditions on the light emission of the anodes. The results are discussed from the point of view of the current theories of this luminescence.

I. ZLOTOWSKI: The structure and properties of the insulating layers formed on aluminium electrodes during anodic polarization.

K. DZIEWONSKI and J. MOSZEW: The reactions of methyl-*m*-xylyl ketone with compounds of the thiocarbanilide type.

A. KOCWA: The reactions of the alkyl-aryl-pyrazolones and their derivatives of the anil type with carbanil and thiocarbanil.

MLEE. J. BURTAN: The stratigraphy of the Silesian Beskide.

J. CUNGE: The cyto-architectonic of the cerebral cortex in Japanese waltzing mice.

T. VETULANI: The forest tarpan recently introduced into the forest of Bialowieza.

Official Publications Received

Great Britain and Ireland

- Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1602 (T. 3503): Influence of a Uniform Jet on the Lift of an Aerofoil. By H. Glauert. Pp. 14+3 plates. 1s. net. No. 1679 (1835): Stability of a Monocoque in Compression. By Dr. J. L. Taylor. Pp. 9. 6d. net. No. 1681 (1810): Experiments on a Small-Chord Flap on a Clark YH Aerofoil in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 14+8 plates. 1s. net. No. 1683 (1926): Cooling of Aircraft Engines, with Special Reference to Ethylene Glycol Radiators enclosed in Ducts. By F. W. Meredith. Pp. 13. 9d. net. No. 1684 (2094): Two-Dimensional Flow of Compressible Fluids at Sub-Sonic Speeds past Elliptic Cylinders. By Dr. S. G. Hooker. Pp. 16+4 plates. 1s. net. No. 1686 (2038B): Flutter Experiments on a Model Wing fitted with a Dead-Centre Aileron Control. By V. M. Falkner, W. P. Jones and C. Scruton. Pp. 10+7 plates. 1s. net. No. 1694 (2018): A Routine Method of Stressing for Three-Ply Covered Fuselages, with Special Reference to some Mechanical Tests on a Particular Fuselage. By H. Davis. Pp. 4+3 plates. 6d. net. (London: H.M. Stationery Office.) [306]
- Report on the Phenological Observations in the British Isles from December 1934 to November 1935. By Ivan D. Margary. (No. 45.) Pp. 299-358. (London: Royal Meteorological Society.) 3s. [77]
- London Shellac Research Bureau. Technical Paper No. 9: Plasticising Lac Films, Part I. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 29. (London: London Shellac Research Bureau.) [87]

Other Countries

- U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 182 (Home Economic Series No. 19): Consumer-Buying in the Educational Program for Homemaking; Suggestions for Teachers of Homemaking in Secondary School and Adult Classes. Pp. xiii+205. (Washington, D.C.: Government Printing Office.) 20 cents. [246]
- U.S. Department of Agriculture. Circular No. 386: The Wax Moth and its Control. By Warren Whitcome, Jr. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents. [246]
- Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 3: Geology and Vertebrate Paleontology of the Late Quaternary near Clovis, New Mexico. By Chester Stock and Francis D. Bode. Pp. 219-241. (Philadelphia, Pa.: Academy of Natural Sciences of Philadelphia.) [246]
- Suomen Geodeettisen Laitoksen Julkaisuja: Veröfentlichungen des Finnischen Geodätischen Institutes. No. 22: Beobachtungsergebnisse; Winkelmessungen in den Jahren 1932-1935. Pp. iii+148. (Helsinki: Suomen Geodeettisen Laitoksen Julkaisuja.) [296]
- Report on the Zoological Survey of India for the Years 1932-1935. Pp. iii+lx. (Delhi: Manager of Publications.) 1.2 rupees; 2s. [296]
- Memoirs of the Indian Museum. Vol. 11, No. 3: Studies on Indian Jassidæ (Homoptera). Part 3: Descriptions of some New Genera and Species, with first Records of some known Species from India. By Dr. Hem Singh Pruthi. Pp. 101-131+plates 8-9. (Calcutta: Zoological Survey of India.) 1.10 rupees; 2s. 9d. [296]
- Allahabad University Studies. Vol. 12 (Arts and Science). Edited by the Vice-Chancellor and the Heads of Departments. Pp. v+188+5 plates. (Allahabad: Senate House.) 7.8 rupees. [296]
- Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series. Vol. 21, Memoir No. 4: Fossil Algae from the Uppermost Cretaceous Beds (The Niniyur Group) of the Trichinopoly District, S. India. By L. Rama Rao and Dr. Julius Pla. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7s. 9d. [296]
- Indian Forest Records, New Series. Vol. 1, No. 3: The Distribution of Sesquioxides, Silica and Organic Matter in Forest Soil Profiles of the Kulu Hill Area. By R. C. Hoon. Pp. ii+347-365. (Delhi: Manager of Publications.) 12 annas; 1s. 3d. [296]
- Smithsonian Miscellaneous Collections. Vol. 95, No. 12: The Dependence of Terrestrial Temperatures on the Variations of the Sun's Radiation. By C. G. Abbot. (Publication 3392.) Pp. ii+15. (Washington, D.C.: Smithsonian Institution.) [296]
- Studies from the Connaught Laboratories, University of Toronto. Vol. 7, 1935. Pp. v+46 papers. (Toronto: University of Toronto Press.) [296]
- Commonwealth of Australia: Bureau of Meteorology. Results of Rainfall Observations made in Tasmania, including all available Annual Rainfall Totals from 356 Stations for all Years of Record up to 1934, with Maps and Diagrams, and Record of Severe Floods. Published under the direction of W. S. Watt. Pp. 143+4 plates. (Melbourne: Government Printer.) [296]
- Advisory Department of the Imperial College of Tropical Agriculture. Report of the Agricultural Department, Dominica, 1935. Pp. vi+19. (Trinidad: Imperial College of Tropical Agriculture.) 6d. [306]
- Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation: Progress Report (No. 5) for the Year 1935. Pp. 20+5 plates. (Zomba: Government Printer.) 2s. 6d. [306]

Catalogues

The Gardener's Library: a Comprehensive List of Books on all Branches of Modern Horticulture and a Selection of the Early Literature. (New Series, No. 39.) Pp. 44. The Gardener's Library, 1936 Supplement. Pp. 8. Books, Periodicals and Pamphlets on Geology, including Palaeontology, Mineralogy and Mining, with a Supplement of Recently Published Books. (New Series, No. 40.) Pp. 44. Books and Periodicals on Zoology and Botany, including Publications of the British Museum and Works on and by Linnaeus. (New Series, No. 41.) Pp. 58. Cryptogamic Botany. (New Series, No. 42.) Pp. 36. Books on Ornithology. (New Series, No. 43.) Pp. 50. (London: Wheldon and Wesley, Ltd.)

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

- Andrews, F. Emerson.** New Numbers : How Acceptance of a Duodecimal (12) Base would simplify Arithmetic. Cr. 8vo. Pp. 162. (London : Faber and Faber, Ltd., 1936.) 6s. net.
- Bazzoni, Charles B.** Energy and Matter : Building Blocks of the Universe. (The University Series : Highlights of Modern Knowledge). Med. 8vo. Pp. x+137. (New York : The University Society ; London : Chapman and Hall, Ltd., 1936.) 4s. 6d. net.*
- Bedeau, F.** Théories mécaniques (hydrodynamique—acoustique). 6 : Théorie du diffuseur (haut-parleur sans pavillon). (Actualités scientifiques et industrielles, 281.) Roy. 8vo. Pp. 67. (Paris : Hermann et Cie., 1935.) 15 francs.*
- Boutaric, A.** Les conceptions actuelles de la physique. (Bibliothèque de philosophie scientifique.) Cr. 8vo. Pp. 289. (Paris : Ernest Flammarion, 1936.) 12 francs.
- Boutry, G.-A.** Optique et radiations. 1 : Les phénomènes photoélectriques et leurs applications. 1 : Phénomènes photoémissifs. Roy. 8vo. Pp. ii+100. 20 francs. 2 : Cellules photoémissives. Roy. 8vo. Pp. ii+58. 15 francs. 3 : Photoconductivité. Roy. 8vo. Pp. ii+84. 20 francs. 4 : Différences de potentiel photoélectriques. Roy. 8vo. Pp. ii+50. 15 francs. 5 : Photométrie photoélectrique (mesure des courants). Roy. 8vo. Pp. ii+51. 15 francs. 6 : Photométrie photoélectrique (mesure des flux). Roy. 8vo. Pp. iii+72. 15 francs. (Actualités scientifiques et industrielles, 312, 313, 336, 337, 345, 346.) (Paris : Hermann et Cie., 1936.)*
- Bridgman, P. W.** The Nature of Physical Theory. (Published on the Louis Clark Vanuxem Foundation.) Demy 8vo. Pp. vi+138. (Princeton, N.J. : Princeton University Press ; London : Oxford University Press, 1936.) 9s. net.*
- Catto, William S., and Williams, Frederick J. H.** A Modern Elementary Trigonometry. Cr. 8vo. Pp. 263. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1936.) 3s. 6d.
- Chambers, E. J.** A First Physics Book. Cr. 8vo. Pp. viii+82. (London : G. Bell and Sons, Ltd., 1936.) 1s. 4d.*
- Child, J. M.** Ratio, Proportion and Similar Figures : a Supplementary Geometry. Cr. 8vo. Pp. iii+44. (London : Macmillan and Co., Ltd., 1936.) 1s.
- Durand, W. Fr., Editor-in-Chief.** Aerodynamic Theory : a General Review of Progress. (Published under a grant of the Guggenheim Fund for the Promotion of Aeronautics.) Vol. 6 : The Airplane as a Whole, by W. F. Durand ; Aerodynamics of Airships, by M. M. Munk ; Performance of Airships, by K. Arnstein and W. Klemperer ; Hydrodynamics of Boats and Floats, by E. G. Barrillon ; Aerodynamics of Cooling, by H. L. Dryden. Roy. 8vo. Pp. 286. (Berlin : Julius Springer, 1936.) 28 gold marks.
- Edser, the late Edwin.** Heat for Advanced Students. Revised edition by N. M. Blich. Cr. 8vo. Pp. x+487. (London : Macmillan and Co., Ltd., 1936.) 6s.*
- Eggert, J.** Einführung in die Röntgenphotographie. Sechste Auflage. Roy. 8vo. Pp. 217+22 plates. (Leipzig : S. Hirzel, 1936.) 5 gold marks.
- Evans, W. A., and Harding, J. W.** Revision Test Papers in School Certificate Mathematics (Arithmetic, Algebra, Geometry and Numerical Trigonometry). Cr. 8vo. Pp. vi+56. (London : Macmillan and Co., Ltd., 1936.) 1s. 6d.
- Gonseth, Fernand.** Les mathématiques et la réalité : étude sur la méthode axiomatique. 8vo. Pp. xi+386. (Paris : Félix Alcan, 1936.) 30 francs.
- Herzberg, Gerhard.** Atomspektren und Atomstruktur : eine Einführung für Chemiker, Physiker und Physikochemiker. (Wissenschaftliche Forschungsberichte : Naturwissenschaftliche Reihe, herausgegeben von Raphael Ed. Liesegang, Band 37.) Med. 8vo. Pp. xvi+188. (Dresden und Leipzig : Theodor Steinkopff, 1936.) 13 gold marks.*
- l'Institut Henri Poincaré, Annales de.** Vol. 5, Fascicules 3-4 : Quelques propriétés typiques des corps solides, par R. Peierls ; La structure des noyaux atomiques complexes, par W. M. Elsasser. Imp. 8vo. Pp. 177-262. (Paris : Les Presses universitaires de France, 1935.) 50 francs.*
- Jones, Bradley.** Elements of Practical Aerodynamics. Med. 8vo. Pp. v+398. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936.) 18s. 6d. net.*
- Jordan, Pascual.** Anschauliche Quantentheorie : eine Einführung in die moderne Auffassung der Quantenerscheinungen. Roy. 8vo. Pp. xii+320. (Berlin : Julius Springer, 1936.) 13.80 gold marks.*
- Julia, Gaston.** Introduction mathématique aux théories quantiques. (Cahiers scientifiques, Fasc. 16.) Première partie. Roy. 8vo. Pp. vi+220. (Paris : Gauthier-Villars, 1936.) 60 francs.*
- Kaye, G. W. C., and Laby, T.H.** Tables of Physical and Chemical Constants and some Mathematical Functions. Eighth edition. Roy. 8vo. Pp. vii+162. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1936.) 14s. net.*
- Lainé, P.** Exposés de magnéto-optique. 2 : Biréfringence magnétique de l'oxygène liquide, de l'azote liquide et de leurs mélanges. (Actualités scientifiques et industrielles, 324.) Roy. 8vo. Pp. 55. (Paris : Hermann et Cie., 1936.) 15 francs.*
- Landolt, Max.** Komplexe Zahlen und Zeiger in der Wechselstromlehre. Roy. 8vo. Pp. viii+185. (Berlin : Julius Springer, 1936.) 14.40 gold marks.
- McKenzie, A. E. E.** Sound. Cr. 8vo. Pp. viii+126. (Cambridge : At the University Press, 1936.) 2s. 6d.*
- Malkin, I.** Festigkeitsberechnung rotierender Scheiben. Roy. 8vo. Pp. 100. (Berlin : Julius Springer, 1935.) 10 gold marks.
- Mayne, A. B.** The Essentials of School Geometry. Parts 3, 4 and 5. Cr. 8vo. Pp. xii+173-400+vi. (London : Macmillan and Co., Ltd., 1936.) With or without Answers, 3s.
- Medworth, Frank.** Perspective. Cr. 4to. Pp. viii+133. (London : Chapman and Hall, Ltd., 1936.) 15s. net.
- Milick, El.** Eléments d'algèbre ornementale. 8vo. Pp. 112. (Paris : Dunod et Cie., 1936.) 30 francs.
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