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Problems of Social Biology

ONE of the prime needs at the present time is the development of research in the social and biological sciences on a scale commensurate with the prosecution of research in the physical sciences in the past. This would replace our ignorance of social change by the precise knowledge upon which effective control depends, and would also assist in dispelling the misunderstandings or misinterpretations of social and economic history which lie at the root of many prejudices and other influences opposed to rational change.

The plea for a wider orientation of research and especially for investigations on the biological side has been reiterated by industry itself, notably by Sir Harry McGowan in the Messel Memorial Lecture to the Society of Chemical Industry, and was eloquently expounded by Prof. J. S. Huxley in his recent book "Science and Social Needs" (London : Watts and Co., 1934). The prosecution of research in these fields is undoubtedly likely to throw light on the true causes of many perplexing social phenomena observed both in industry and society. More, however, is required if we are to check and overcome the tendency for man's capacity for collaboration in work, his belief in his social functions and sense of group solidarity, to be destroyed by rapid scientific and technical advance.

The demands made on management by the magnitude and complexity of industrial operations at the present time have been one of the many factors forcing attention on training for management and the supply of industrial leaders of the requisite capacity. The demands made on leadership are, however, equally great whether administration is concerned primarily with problems of industry or with those of government or society.

It is here indeed that we touch on one of the most acute dangers of all. So long ago as 1913, Brook Adams ("The Theory of Social Revolutions". London: Macmillan and Co., Ltd.), pointing out the tendency for civilisations to break down through administrative difficulties or defects, suggested that even then the possibility of maintaining administrative quality and consequently stability of social equilibrium was gravely in doubt. Many indeed of the problems with which we are surrounded and the ills from which society is suffering to-day bear unmistakeable witness that governments and administrations have been unable intellectually as well as morally to meet the

demands made upon them, and have failed to effect the adjustments to rapidly recurring changes in environment produced by scientific and technical advance. On this point Bavink has commented pertinently, observing that until now, no civilisation has had the knowledge we possess, which alone enables a complete insight into the deeper causes of cultural processes, and in particular into the decline of peoples. The first people to resolve to eliminate those causes, he asserts, will, unless every sign is misleading, rule the world.

The peril of the backward or belated mind in administration is one of the greatest dangers to the continuance of civilisation. No political form of government, from dictatorship to democracy, will avert the disaster if its leaders are incapable of assessing the various factors and acting with sufficient vision, vigour and courage to effect the necessary adjustments to changed social conditions. No feature of the lopsidedness of our development is more serious than the discrepancy between the way in which we have developed scientific research and the training of scientific workers, and the comparative neglect or failure of our attempts directed to the discovery and training of administrators of exceptional capacity. The country that first solves the problem of discovering the administrative élite and of maintaining working *moral* will infallibly outstrip the rest in the quest for stability, security and development. The universities of the world have scarcely begun, however, to think about the training of the new administrator.

These who, confronted by the problems presented by the rationalisation of industry, have lightly asserted that the human mind is incompetent ever to handle efficiently the problems of administration presented thereby, have overlooked the fact that no attempt has been made to discover and train the right type of administrator or even to eliminate factors or conditions which definitely hinder his discovery and training. They overlooked, too, the fact that national administration presents problems equally complex, demanding equally a knowledge of technical, biological and social facts for their solution, and that civilisation must produce administrators of the requisite capacity and knowledge, or perish.

There could, therefore, be no more opportune time than the present for the discussion of the relation between science and social problems. If the discussions at the Aberdeen meeting of the British Association have done no more than encourage co-operation between the scientific worker and the community, and foster a sense of social solidarity, if they have given a definite impulse to the education of society and its leaders as to the contribution which science can make to the general welfare and the importance of the scientific and technical factors involved in many of our national and social problems, if they can initiate a determined effort to face the problem of discovering and training leaders for industry and society of the calibre and capacity required, they will have done much to justify the vision of the Prince Consort displayed in his presidential address when the Association first visited Aberdeen in 1859. "We may be justified in hoping that, by the gradual diffusion of science and its increasing recognition as a principal part of our national education, the public in general, no less than the Legislature and the State, will more and more recognise the claims of science to their attention; so that . . . the State will recognise in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

History and Medicine

(1) *The Rise of Preventive Medicine.* By Sir George Newman. (University of London: Heath Clark Lectures, 1931, delivered at the London School of Hygiene and Tropical Medicine.) Pp. ix+270+8 plates. (London: Oxford University Press, 1932.) 10*s.* 6*d.* net.

(2) *Great Doctors: a Biographical History of Medicine.* By Dr. Henry E. Sigerist. Translated by Eden and Cedar Paul. Pp. 436+60 plates. (London: George Allen and Unwin, Ltd., 1933.) 15*s.* net.

(3) *The Physician: as Man of Letters, Science and Action.* By Prof. Thomas Kirkpatrick Monro. Pp. viii+212. (Glasgow: Jackson, Wylie and Co., 1933.) 10*s.* 6*d.* net.

(4) *The Life of Edward Jenner, M.D., F.R.S., Naturalist and Discoverer of Vaccination.* By Dr. F. Dawtrey Drewitt. Second edition (enlarged). Pp. xi+151+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 6*s.* net.

(1) SIR GEORGE NEWMAN'S book represents the first series of lectures founded in the University of London by Mr. Charles Heath Clark, who died in 1926. The general scope of these lectures as decided by the Senate of the University was to include the educational, cultural

and humanistic aspects of preventive medicine as distinct from technical and manipulative training.

Of the twelve lectures of which the book is composed, the first deals with folk-lore, magic, custom and religion, which form the beginning of a science and art of medicine. The second lecture is devoted to the consideration of Egypt and the Mosaic law. The preventive medicine of the Egyptians as revealed in the Edwin Smith and Ebers papyri and the history of Herodotus included regulation of diet, meat inspection, purification of water, bathing and the sanitation of dwellings, while the Mosaic law involved eight great principles, namely, the institution of one day of rest in seven, cleanliness of the human body, the use of clean food, the protection of the water and food supply, cleanliness, conservancy and sanitation of camp life, the practice of circumcision, laws of sexual relationship and sexual health, and the prophylaxis and suppression of contagious disease.

The next two lectures are concerned with Greek medicine, both in its land of origin and as regards its dissemination over Europe. A sketch is given of the work of Hippocrates and his contemporaries, followed by an account of Greek medicine in Alexandria, Rome and the Byzantine Empire, and its transmutation by the Arabians. In the fifth lecture, which is entitled "The Middle Ages and the Black Death", the prevalence of famine, pestilence, ergotism, pellagra, deficiency diseases, leprosy and bubonic plague in Europe and Great Britain are described. In this period, measures for the prevention of epidemic disease were first introduced, consisting particularly in public control by law, notification, isolation and disinfection, as well as by quarantine and international co-operation.

The Renaissance and the rise of physiology form the subject of the sixth lecture, in which it is shown that the Renaissance was an efflorescence from many roots, namely, the Greek spirit and its curiosity and freedom, the Arabic infiltration, the influence of the twelfth century and its manors, monasteries and guilds, the rise of the universities, the unifying influence of the Papal Church, the rich thirteenth century, the Black Death, the arts of painting and printing, the fall of Constantinople, the voyages and discoveries of the world, the Medici at Florence and the Oxford Reformers. The advance in anatomy is illustrated by a comparison of the work of Vesalius with that of his predecessors, such as Galen and Mundinus, while the stimulus given to the study of anatomy and physiology by the great painters is exemplified by reference to the pictures of Giotto, Leonardo da Vinci, Dürer, Michelangelo and Calcar.

Consideration is next given to Harvey's work on the circulation of the blood and the new physiology which resulted therefrom, with special reference to Claude Bernard's theory of constant internal environment.

In the seventh lecture, which deals with clinical studies of communal disease, the remarkable contribution of the English medical practitioners in the seventeenth and eighteenth centuries to the underlying principles of preventive medicine is emphasised. Examples of this contribution are offered by the writings of Mead, Fothergill, Huxham, Haygarth and Heberden in infectious diseases; Fothergill, Lettsom, Cadogan and Willan in domestic hygiene and child welfare, Pringle in diseases of the army, Lind and Blane in the prevention of scurvy and other diseases of seamen, Baker in the prevention of lead colic, and, last but by no means least, Jenner and vaccination.

In the eighth lecture, which is concerned with pathology and bacteriology, the necessity of pathology to preventive medicine is illustrated by the work of Morgagni, Matthew Baillie, John Hunter, Bichat, Charcot and Ehrlich. The evolution of modern bacteriology and parasitology is then considered, starting with the earliest observers, such as Fracastor, Leeuwenhoeck, Bassi and Cohn, and continuing with the researches of Pasteur, Koch, Metchnikoff, Behring, Ehrlich, Laveran, Manson and others.

In the ninth lecture, which is entitled "The Application of Discoveries", Sir George Newman discusses successively the improvement of medical practice as illustrated by the prevention of such diseases as smallpox, anthrax, cholera, plague, typhoid fever, rabies and diphtheria, the medical control of the character of infection, such as personal contact, water supply, food and occupation, the application of physiology to industrial well-being, and the effect of anæsthesia and antisepsis on surgery.

The concluding lecture deals with the organisation of the medical profession in England as exemplified by the foundation of the College of Physicians, the organisation of medical teaching, the creation of medical societies, the passing of the Medical Act, and the establishment of the General Medical Council.

(2) In his biographical work on great doctors, which has been admirably translated from the second German edition by those expert interpreters Eden and Cedar Paul, Dr. Henry Sigerist, formerly professor of the history of medicine at Leipzig, and now holding the corresponding chair at Johns Hopkins University, has given a concise account of the life and times of fifty-six medical men from Imhotep to Sir William Osler. Representatives of Greek, Roman and Arabian medicine, the school of Salerno, the Renaissance and modern times have been skilfully selected, and a good

description has been presented of their work and historical background.

A bibliography of the most important recent works on the history of medicine and of the doctors described in the book is appended. The text is liberally interspersed with excellent contemporary portraits and other illustrations.

(3) In his fascinating little work on "The Physician: as Man of Letters, Science and Action" Prof. T. K. Monro has given biographical sketches of men with medical qualifications who have distinguished themselves in other ways than in the practice of medicine, such as literature, philosophy, the Church, administration, art, science, invention, law and politics, sport, piracy and crime. As regards the various departments of natural science, chemistry is represented by T. Andrews, W. Babington, T. Beddoes, J. Black, T. Clark, W. Cullen, H. Kidd, Marcet and Mayow; botany by R. Brown, Gerarde, Nehemiah Grew, I. Hill, Hooker, Sir Thomas Millington, Withering and Woodward; zoology by Buckland, Flower, Huxley and Sir Thomas Molyneux; geology by Atherstone, Bevis, Hutton, Mantell, John Millington and J. Parkinson; and astronomy by Bainbridge, Sir Thomas Maclear and R. J. Mann. Mention should also be made of Peter Mark Roget, at one time physician to the Manchester Infirmary, who in 1827 succeeded Sir John Herschel as secretary of the Royal Society, and Sir Hans Sloane, who was physician in charge of Christ's Hospital in 1694–1730 and president of the Royal Society in 1727–41.

The bulk of the work is devoted to British physicians, but about twenty-five pages are given to Continental and other foreign medical men, such as Pierre Belon, Clemenceau, Copernicus, Dioscorides, Emir Pasha, Haller, Helmholtz, Rabelais, Redi, Schiller, Sun Yat Sen and Swammerdam. The work concludes with a section on students of medicine who never qualified, such as Charles Darwin, Humphry Davy, Francis Galton, Goethe, Littré and Samuel Warren.

(4) Dr. F. Dawtrey Drewitt's "Life of Edward Jenner" contains a sympathetic account of Jenner's early life as a country practitioner, his observations on natural history, particularly in connexion with the hibernation of hedgehogs, the importance of earthworms, in which he anticipated Darwin, the habits of the young cuckoo, a description of which he gave to the Royal Society in 1788, and his introduction of vaccination, which naturally forms the bulk of the work. His early investigations in this connexion, the publication of his epoch-making pamphlet, the opposition which he encountered, and his final triumph are vividly narrated. The text is accompanied by portraits of Jenner and a facsimile of one of his letters.

Secret Societies in Melanesia

Malekula: a Vanishing People in the New Hebrides. By A. Bernard Deacon. Edited by Camilla H. Wedgwood. Pp. xl+789+24 plates. (London: George Routledge and Sons, Ltd., 1934.) 42*s.* net.

BERNARD DEACON was a brilliant young ethnologist who in 1925 went out from Cambridge to study the natives of the northern New Hebrides, and particularly of the large island of Malekula. After more than a year's intensive work he fell victim to blackwater fever and died. A paper published posthumously in the *Journal of the Royal Anthropological Institute* (vol. 57, 1927) on "The Regulation of Marriage in Ambrym" has already marked him out as a first-class investigator from whose loss ethnology has suffered much.

The main body of his work, now edited by Miss Camilla Wedgwood, is concerned chiefly with the south-western and north-western districts of Malekula, and is pregnant with significant and detailed material for the study of cultural history, sociology and ritual. There is much exact information regarding the workings of clan organisation, together with such matters as the 'wiping out' of distant relationships so as to legitimatise marriages between persons to whom this would otherwise be forbidden. Though there is no sensational discovery to compare with that of the six-class system of relationship on Ambrym, the many lists of kinship terms show signs of having previously had a class basis, though this does not always seem to have been the same. In one district, for example, the father's father's father is classed with the elder brother, while in another it is the father's father's father's father. Whatever class basis there ever was, has been destroyed owing to the existing system of patrilineal descent with local exogamy now present throughout the island, although towards the north there are increasing signs of matrilineal influence or, more probably, survival.

What chiefly claimed Deacon's attention, however, were the ritual performances and mythology of what he refers to as the "Secret Society culture", which, in common with the natives all over Malekula, who have no doubt whatever on the matter, he regards as the most recent addition to the many influences which go to build up the complex culture of this island. Among the many institutions connected with this culture is the public graded society, common, with variations in detail, to all districts of the island, and corresponding to the Banks Islands *Sukwe* described by Codrington and Rivers. In its south-western form,

it comprises more than thirty grades, and centres round the planting of wild canes, erythrina, cycad, croton and other bushes and trees, and the erection of images of wood and tree fern in the lower degrees, and in the higher of plain monoliths and finally stones carved to represent the human form, said to be the dwelling-place of the founder of the grade as well as of all previous initiates and, after death, of the spirit of the new candidate himself. Sacrifice of tusked boars is made to the central object erected, after which the candidate, assuming in the higher grades the rôle of a hawk, is invested with his new regalia and title and in some cases acquires a new fire.

A more secret graded society corresponds, through its closer association with the dead, together with the use of masks and secret noises, to the Banks Islands *Tamate*, while a third society presents a resurrection drama. The greatest mystery of all, and possibly the most important of Deacon's discoveries in Malekula, is the rite called the "Making of Man", based on a belief in culture-heroes corresponding to, but more highly developed than, the mythology centring round the Banks Islands legendary hero Quat. A unique feature of the legend in this part of Malekula is the fact that the chief hero, in one district spoken of as the creator, is in another said to have been buried sitting upon a flat stone seat within a "dolmen-like structure" covered with a mound of earth and small stones, and that "his body never decayed", while his two sons procreated a number of stones which gave birth to the founders of the ten "houses", into which the village is divided. These culture-heroes, said to have been white-skinned and narrow-nosed, are accredited with the manufacture of vessels of coarse pottery no longer made by the natives and now used in fertility and mortuary rites, the introduction of the dog, since lost until re-introduced by Europeans, and the making of the mortuary effigies for which this area is well known, the heads of which are formed of the deceased's own skull modelled with paste to represent his features while alive. It is further said that, unlike the natives of to-day, they were not cannibals. The "Making of Man" is a close mystery, the secrets of which are guarded from all but the clan magicians. Its chief object is the perpetuation of the human race, and, in the only district where Deacon was able, owing to the imminent extinction of the population (due, say the natives, to its discontinuance), to gain reliable information regarding it, its central features are the washing of the supposed body of the chief hero and his wife, and a council of magicians, each seated on the stone from which he is descended, followed by their incestuous intercourse with women of their own and neighbouring villages "which necessarily violates all rules of clan exogamy".

This "Secret Society culture" Deacon considers to have been brought to these shores in the "great sea-going canoes" which were in use until recently. It is to be regretted that he did not live to discuss the bearing of his own discoveries and their relation to similar beliefs and practices elsewhere.

Deacon was not only a skilled investigator and fine linguist, but also a shrewd observer of native character and an artist capable of appreciating the beauty of the dramatic ritual, dancing and music for which this island is unrivalled in Melanesia. It is impossible here to do justice to the great variety of subjects dealt with. There are sections on the village and village life, marriage and the relation of the sexes, warfare, birth and initiation (including the operation of incision with, in the north-west, its accompanying hoaxes), the ritual life of women, the ceremonial exchange of pigs, gongs and gong-rhythms, totemism, magic (including such matters as the psychological preparation of the sorcerer), and a final discussion on culture sequence in the Northern New Hebrides as a whole. While there is little new information regarding the artificial deformation of heads in the south-west, there are, on the other hand, considerable additions to our knowledge of the Big Nambas inhabiting the northern plateau of the island, who are alone among the peoples of Malekula in that they possess chiefs, drink kava and practise true circumcision. The book is well produced, with good maps and illustrations, and ends with a few native texts with literal translation, a glossary and index.

It is no easy task to give order to another's field notes. The editor has succeeded to the extent that the book is well arranged and makes good reading for the general reader, though much of what Deacon had himself already written up has been unnecessarily and not always accurately paraphrased. It is unfortunate that expert advice was not sought in handling the many native terms, which lose much philological significance through lack of division into their component parts. References to other published work are curiously inaccurate. These are, however, details compared with the almost complete absence throughout the text, despite the insertion of many of the editor's own observations, of any indication as to which parts of the work are Deacon's and which Miss Wedgwood's, thus robbing the book of much value for the student of detail. The only exceptions to this unfortunate omission are initialled footnotes and a few passages quoted direct from Deacon, mostly printed in small type.

Fluid Motion

(1) *Fundamentals of Hydro- and Aeromechanics: based on Lectures of Prof. L. Prandtl.* By Dr. O. G. Tietjens. Translated by Dr. L. Rosenhead. (2) *Applied Hydro- and Aeromechanics: based on Lectures of Prof. L. Prandtl.* By Dr. O. G. Tietjens. Translated by Prof. J. P. Den Hartog. Pp. xi+311+27 plates. (Engineering Societies Monographs.) (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net each.

THESE two translations of books published a few years ago will be welcomed by all students of aerodynamics who are not familiar with the German language. The material is based largely on lectures given by Prof. L. Prandtl in Göttingen, though considerable additions have been made by Dr. Tietjens himself. The treatment is wide without being exhaustive, particularly as regards the more recent practical applications of the theory, and its underlying principle is a reconciliation of the apparently conflicting aspects of theoretical hydrodynamics and practical hydraulics.

This synthesis has been made possible by a realisation of the limitations of the classical hydrodynamic theory of perfect fluids, by Prandtl's development of the conception of the boundary layer, and by the consequential conception that vortices may spring from the surface of a body, even when the action of viscosity is neglected in the general motion of the fluid. The distinctive character of these books arises from the fact that the effects of the viscosity and compressibility of a real fluid are not relegated to later chapters following on the theory of a perfect fluid, but on the contrary are continuously borne in mind in the development and interpretation of the theory.

The first volume is devoted to the theory of fluid motion, and presents a lucid development and discussion of the fundamental conceptions rather than a detailed account of the manifold possible applications of the theory. The analysis is developed largely in vector notation, which gives a concise form to many of the fundamental equations. The material covers a wide range, including brief excursions into meteorology and the operation of free balloons, but its greatest value lies in the discussion of those phenomena which distinguish the motion of a real fluid from the classical theory of a perfect fluid. The chapter on vortex motion is therefore of prime importance, and in this chapter clear explanations are given of the origin of vortices at a sharp edge, of the development of circulation round an aerofoil, and of the system of vortices arising from the instability of a surface of discontinuity. Another brief but important chapter deals with the application of the theorems of energy and momentum.

The second volume is devoted to the practical applications of the theory and conceptions which have been developed in the previous volume, and it is in this volume that Dr. Tietjens has extended the scope of Prof. Prandtl's lectures. Successive chapters deal with the flow in pipes, boundary layers, drag of bodies and aerofoil theory, and each subject is fully and ably treated, although at a few points it is noticeable that the latest developments are not included. Items of special interest in these chapters are the entry conditions for flow in a pipe, the discussion of turbulent flow in pipes and in the boundary layer, and the method of determining the drag of a body from measurements of pressure and velocity in the wake.

A final chapter is devoted to experimental methods and apparatus, of which the most interesting is the section dealing with the visualisation of flow phenomena. The book contains a large number of excellent plates illustrating the use of these methods to record the details of several interesting types of flow, including the development of the boundary layer and wake behind a bluff body and of the circulation round an aerofoil.

The translations of the two volumes are due to Dr. L. Rosenhead and Dr. J. P. Den Hartog respectively, and this arduous work has been done ably. Very few lapses have been noticed, but in the first volume it is unfortunate that the term *stream function* has been used for entirely different functions on consecutive pages, and in the second volume the discussion of methods of defining the thickness of the boundary layer has lost some of its clarity in the translation. Both volumes follow the German originals closely, the only important difference being that the derivation of the general equations of motion of a viscous fluid has been transferred from the second to the first volume.

Ocean Waves

Ocean Waves and kindred Geophysical Phenomena. By Dr. Vaughan Cornish, and Additional Notes by Dr. Harold Jeffreys. Pp. xv+164+26 plates. (Cambridge: At the University Press, 1934.) 10*s*. net.

DR. VAUGHAN CORNISH is well-known for his researches in the matter of water wave formation, and this new volume from his pen forms a serviceable and welcome addition to his previous work on "Waves of the Sea and other Water Waves". In the present instance, he has extended his purview to include waves in sand and snow, as well as tidal bores and other progressive waves in rivers. The book is a record of

observations carried out systematically and painstakingly over a period dating back to the beginning of the century, during which the author has made a number of voyages and visited various countries for the purpose of collecting data and gaining information. In part, his object has been to provide mathematicians with numerical data for the further development of the theory of water waves, and to enlist their interest in the progressive undulations of granular material. In this respect, he has had the assistance of Dr. Jeffreys to generalise and extend the results of his observations and measurements.

That the study of ocean waves is one of no little difficulty and complexity can be readily seen from an inspection of the photographs of the sea in turbulence reproduced in the book. Under conditions of so unfavourable a nature for taking observations as are provided by a ship in heavy weather, it is surprising that Dr. Cornish was able to obtain results in which visual estimates accorded so well with theoretical expectation. As regards maximum values, he records the occurrence in October 1921 of waves 70 ft. in height in the Pacific from the observations of Capt. Wilson, and he deduces from information supplied to him in connexion with a voyage of the *Majestic* across the Atlantic in February 1923, that the observations on that occasion were best satisfied by a range from 60 ft. to 90 ft., which gives a mean value of 75 ft.

The study of ocean waves occupies only a third of the volume under review and almost a quarter is taken up with a consideration of waves in sand and snow, formed and propelled by wind and current. For the investigation of sand waves, Dr. Cornish not only examined microscopically the shore drift at Bournemouth and Poole in Dorset, but he also went to Egypt to inspect the formation of desert sand dunes over large areas. Several interesting photographs are reproduced of sand waves at Helwan and Ismailia. As regards snow waves, Dr. Cornish sought his information in Canada as far west as Winnipeg.

From the foregoing brief statement it will be seen that there is a considerable wealth of observation in the book, and natural science is indebted to Dr. Cornish for the prolonged and patient research which he has made in a field presenting many difficulties, and which has not hitherto attracted any considerable body of workers.

B. C.

Short Reviews

Gmelins Handbuch der anorganischen Chemie. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 59: *Eisen.* Teil A, Lief. 5. Pp. 847–1166. (Berlin: Verlag Chemie G.m.b.H., 1933.) 50 gold marks.

THE manufacture of commercial iron is a matter of such far-reaching importance and interest that no fewer than three issues of Part A of this work have had to be devoted to this aspect alone of the chemistry of iron. Now that the section on metallurgy is complete, we have available for the first time a comprehensive survey of the whole of the literature on this subject, and the compilers have good reason to be satisfied with the result. This part of the work has been entrusted to Prof. R. Durrer, president of the Institute of Ferrous Metallurgy in the Technische Hochschule in Berlin.

About one third of the volume deals with the theoretical developments which have resulted from a systematic study of the various technical processes by modern physico-chemical methods, and tribute is paid to the work of pioneers in this direction in England. The middle portion of the volume deals with cast-iron and cast-steel. Historical notes are given of the development of the various processes used and a detailed description will be found of the manufacture of different varieties of steel. The graphite-lined crucible, the cupola furnace, the reverberatory furnace, the Siemens-Martin furnace and the small converter are described in turn with copious references to original publications. Then follows a description of various alloys of iron used in the manufacture of steel; for example, ferro-silicon, ferro-manganese, ferro-molybdenum, ferro-tungsten, etc. Finally, there is a lengthy supplement containing material which has appeared since the publication of the earlier sections. Thus the literature on the metallurgy of iron has been completely revised to August 1933.

The presentation in attractive form of the available results of these researches must have been a very formidable task, and we should like to congratulate the compilers on the skill with which they have been able to relieve the monotony of figures and tables by the judicious choice of phase-rule diagrams and illustrations of modern plant. These diagrams are very clearly printed and greatly enhance the value of the work.

The A B C of Biology. By Prof. C. M. Yonge. Pp. ix+252. (London: Kegan Paul and Co., Ltd., 1934.) 4*s.* 6*d.* net.

THIS book is a worthy addition to the A B C series, and Prof. Yonge is to be congratulated on being so successful in what was undoubtedly a difficult task. Within recent years, biology has come much to the fore, not only in relation to teaching in the schools, but also as a subject of great interest to the adult public. As might be expected, many books on biology have appeared, and the subject treated from different points of view according to whether the author had in mind school instruction at various

stages, or the intelligent and inquiring adult. Of these two varieties, the latter probably presents the more difficult problem, the successful solution of which really requires a master hand.

Prof. Yonge's method of treatment is good within the limitation he has imposed on himself. The author points out that, within the compass of a book of this size, it is not possible to treat of plants and animals equally in relation to all the main branches of the subject. The plants, therefore, are dealt with only in the general account of living matter, and in a description of the interactions between plants and animals. The principal theme of the book is confined to animals, but the treatment is sufficiently broad and up to date, and is arranged in three sections, the mechanisms of life, the organism as a whole, and the organism of Nature. As might be expected from one whose work has largely consisted of studies on the activities of animals, and on animals living in their natural surroundings, Prof. Yonge treats of animals as living, doing creatures. The result is a very interesting and readable volume, with 50 illustrations, a reasonable index, and a useful short list of books for further reading.

The New Modern Gasworks Practice. Being the third edition, entirely rewritten and greatly enlarged, of "Modern Gasworks Practice". By Alwyne Meade. Vol. 1: *Design and Construction of Gasworks, Carbonisation Plant, Mechanical Handling of Materials.* Pp. xiii+534. (London: Eyre and Spottiswoode, Ltd., 1934.) 50*s.* net.

LIKE most progressive industries, the town's gas industry, as a result of the developments of chemistry and engineering, exhibits rapid changes in its processes which can only be followed in the periodical literature. Moreover, the industry is already well advanced into its second century, and possesses an accumulated fund of almost traditional experience. There is clearly a place for a book which will at intervals bring into focus the old and the new technology. During the last twenty years, this had been done by "Alwyne Meade", and the appearance of the first volume of the third edition is a reminder that it has met the need. This volume deals only with the construction and operation of carbonising plant. Those interested in gas manufacture will remember that "Alwyne Meade" deals essentially with matters of fact, and is not an analysis of scientific principles. It is a work for the practical man and possibly the student of technology. So well is it known, that it is scarcely necessary to do more than indicate its reappearance, bigger and more comprehensive than before. H. J. H.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Supplement 1928–1933. Edited by C. A. McCallum and D. W. I. Cannam. Pp. xx+453. (Melbourne: Council for Scientific and Industrial Research, 1934.) 5*s.*

THE original work, which was reviewed in NATURE of September 13, 1930, p. 392, and to which this is a supplement, was issued in 1930 by the Australian Council for Scientific and Industrial Research in the confident expectation that the work would be of material assistance to scientific investigators in Australia in locating sets of periodicals to which they have references. This expectation has been fully justified. The publication, which comprised about ten thousand items, has also proved useful as a check-list to enable librarians in Australia and other countries to complete their holdings of scientific journals.

Recognising that the usefulness of such a work depends on its being kept up to date, the Council has issued the present supplement, which has been prepared under the able editorship of Mr. E. R. Pitt, who supervised the compilation of the main work. This supplement, containing about seven thousand new entries, will prove of the greatest value to Australian scientific workers and librarians in their investigations. It will also be invaluable to their colleagues overseas as a first-hand record of Australian scientific and technical periodical literature.

S. C. BRADFORD.

Traité d'algologie: introduction à la biologie et à la systématique des algues. Par Prof. Pierre Dangeard. (Encyclopédie biologique, Tome 11.) Pp. 441. (Paris: Paul Lechevalier et fils, 1933.) 175 francs.

THIS volume is primarily a comprehensive treatise on the structure and morphology of the Algæ. It contains also useful summaries of recent work on their cytology, physiology, biology and fossil occurrence. In the absence of recent works of this character, it is a distinctly useful volume and may well become a standard work of reference. The morphological chapters are, on the whole, judiciously treated and the illustrations, often original, are good and well chosen. Where so much ground is adequately covered, it is perhaps ungracious to remark that the treatment is in parts rather uneven, notably in the chapters on algal physiology and on pure culture methods. Moreover, the Rhynic fossil algæ should certainly be mentioned in any chapter dealing with that subject, as they are the earliest the structure of which is known.

Forestry for Woodmen. By C. O. Hanson. Third edition. Pp. 238+12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 6*s.* 6*d.* net.

THIS new edition of a very useful book maintains the general form of the second edition published in 1922, but the author has made numerous alterations in detail in order to fit it for present requirements. It was originally written for teaching purposes for use in forest schools, and it has well fulfilled its object all through, for the information given is in every way correct, concise, to the point and presented in a way that can be readily understood by a student. In addition to its value for teaching purposes, the book contains much information of use to everyone interested in forestry, and it should find a place on the bookshelves of all workers amongst trees.

Exploration of the Mineral World by X-Rays*

By PROF. W. L. BRAGG, O.B.E., F.R.S.

THE mineral world has supplied us with many of the most beautiful examples of crystal structure. Crystals grow best when the growth takes place in very constant conditions and very slowly, and these conditions are fulfilled in Nature in a way that cannot be rivalled in the laboratory. The beauty of natural crystalline forms has always attracted attention, and some of the rare and durable varieties have been prized, as jewel stones, as the most valuable of all natural objects.

The present is a suitable time to review our knowledge of the structure of the mineral world, because all the main types of minerals have been analysed. The existence of any well crystallised mineral has always been a challenge to those whose research is the analysis of crystals by X-rays. Nature provides us with such excellent material on which to exercise our technique. The first crystals to be analysed were minerals, rock salt, diamond, fluor, blende, pyrites and calcite. For twenty years, the inquiry has been pursued, and with the recent analysis of the felspars it may be claimed that the main survey has been completed. There are, of course, many fascinating points of detail still to be investigated, but we can summarise the general laws which govern the different structures composing the solid crust of the earth.

We may first inquire how it is that we are able to speak of minerals as a limited class of chemical compounds. The number of compounds that can be formed from the chemical elements is endless. Yet the number of mineral species is restricted, and if we except the rare kinds which are found in odd corners where very special conditions have existed, the number is quite small. It must be admitted that part of the interest in mineralogy has been the interest of the collector. The fun of making a collection would be spoilt if Nature kept on producing endless new varieties of minerals.

The minerals are limited in number because they are the last survivors of the wear and tear of ages. They represent matter in the ultimate state of equilibrium. They have sunk into so deep a pit of low potential energy that no chemical change can tempt them to desert it.

This state of lowest potential energy is one of order and not of disorder. A crystal is more stable than a jumble of atoms. The perfect geometrical arrangement of a crystal represents matter in its most dead and inert form, from which nothing further in the way of change can be expected, just as the various Utopian schemes of society which have been put forward from time to time represent the most dull state in which it is possible to conceive living.

The world we are to study, then, is to be ruled by the laws of geometry. We will speak of tetrahedra, octahedra, angles, faces and edges. To appreciate this world, we must be like the Greek geometers, who were ravished by the beauty of the symmetrical solid figures. In no other science do these geometrical figures play so important a part; they are peculiar to crystallography. Though all crystals are based on geometrical patterns, the simplest regular geometrical forms are of outstanding importance in mineralogy just because minerals are so extremely inert. The condition for low potential energy imposes upon their configurations certain geometrical requirements, which are broken by the ephemeral compounds we prepare in the laboratory.

UNITS OF MINERAL PATTERN

Eight elements compose 98 per cent of the earth's solid crust. In our broad survey, we will neglect all the other elements, most of which only occur in odd cracks here or there where we laboriously search for them. The common elements are oxygen, silicon, aluminium, iron, calcium, potassium, sodium and magnesium.

The bulk of the crust is oxygen. Not only is it the commonest element, but also it takes up the most room. The rocks are made of oxygen atoms cemented together by silicon, aluminium and a few other elements. According to the way in which they build up structures with oxygen, these elements are divided into three classes, to which we will have frequent occasion to refer.

(*a*) Elements forming the centre of a *tetrahedral* group. Four oxygen atoms are grouped together at the corners of a tetrahedron, and the element is situated at the centre. All the silicon is in this situation, and by far the greater part of the aluminium.

(*b*) Elements forming the centre of an *octahedral* group. Six oxygen atoms are grouped at the corners of an octahedron, with the element at the centre. This is the characteristic situation for magnesium and iron, and also for the remainder of the aluminium. Aluminium is peculiar in that it can play a double rôle, generally grouping itself with silicon, but sometimes behaving like the metals iron and magnesium.

(*c*) The bulky elements sodium, calcium and

* From an evening discourse to the British Association delivered at Aberdeen on Sept. 10.

potassium. These elements are too large to be placed in tetrahedral or octahedral groups. They are accommodated in large, often unsymmetrical, holes in the structure.

The types of group are illustrated in Fig. 1. The tetrahedral and octahedral groups are the fundamental units of pattern—the stitches of which the mineral fabric is composed. All the common minerals, however complex their patterns, are a framework of these tetrahedral and octahedral groups. It must be realised that the groups are not distinct units, for there are not enough oxygens for each central atom to have its complete group belonging to it alone. The oxygen atoms of one group also form part of the next. It is very convenient to use the tetrahedra and octahedra in describing the structures, but it must be remembered that these units have common corners, edges, or even faces, because an oxygen atom of one also belongs to another. In this way the whole structure is knitted together.

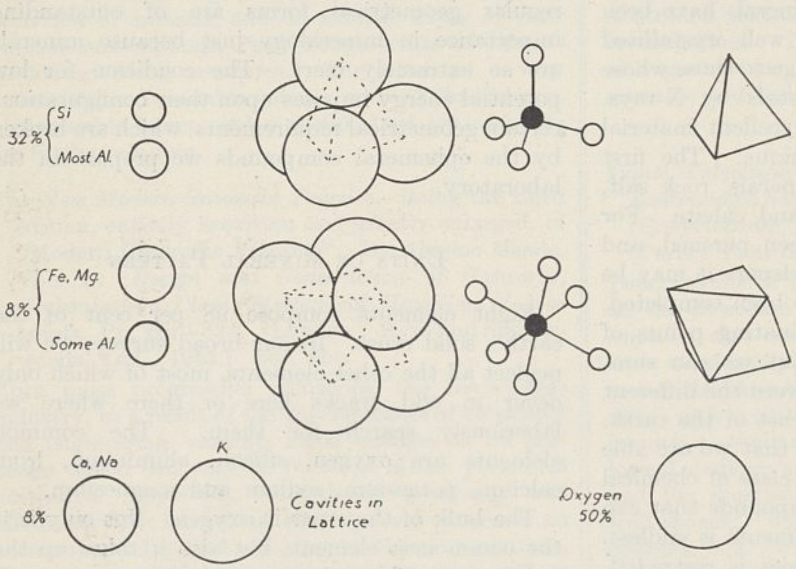

FIG. 1. Association of common elements with oxygen in mineral structures.

CLASSIFICATION OF MINERALS

The common minerals are divided into certain large groups, and in making his classification the mineralogist has in the past been guided by physical properties and form, rather than by chemical constitution. A study of the structure of minerals has amply justified this allegiance. It is now seen that the basis of the classification is a kind of skeleton of the mineral structure, composed of the linked tetrahedral groups. These links are stronger than the octahedral links, and very much stronger than the links of the bulky elements calcium, sodium and potassium. The tetrahedral framework is the hardest part of the mineral, its skeleton, and it has the chief influence in deciding the form of the structure.

The most common minerals are quartz, felspar, mica, pyroxenes and amphiboles. The basic ferromagnesian silicates such as olivine may also be included. These great natural divisions of minerals have strikingly different physical characteristics, and are built up as follows:

(*a*) *Olivine* (Mg, Fe)SiO_4. The SiO_4 tetrahedra are not linked directly to each other, only by intermediate octahedral groups round Mg or Fe. (Fig. 2*a*.)

(*b*) *Pyroxenes and Amphiboles.* $MgCa(SiO_3)_2$, $Mg_5Ca_2(Si_4O_{11})_2(OH)_2$. The tetrahedral groups are linked into endless chains by stringing them together corner to corner. These chains are held together sideways by magnesium and iron octahedra. (Fig. 2*b*.)

(*c*) *Micas.* $K(Al_2, Mg_3)(AlSi_3O_{10})(OH)_2$. The tetrahedral groups, containing both Si and Al, are linked into endless sheets. These sheets lie on each other like the leaves of a book, and are bound together in various ways. (Fig. 2*c*.)

(*d*) *Felspars.* $KAlSi_3O_8$, $NaAlSi_3O_8$, $CaAl_2Si_2O_8$. The tetrahedra form a framework in three dimensions, each tetrahedron being linked by every corner to another. The framework has the composition (Al, Si)O_2. The bulky ions K, Na, Ca are in open spaces within it. (Fig. 2*d*.)

(*e*) *Quartz.* SiO_2. This is a structure composed entirely of tetrahedra containing Si, linked everywhere corner to corner.

The type of structure corresponds to the composition of the mineral, in particular to the ratio of the first group of elements (those inside tetrahedra) to the available oxygen. For example, if there are four oxygens or more to every silicon, we have separate SiO_4 groups. If there are only two oxygens to every silicon, the tetrahedra must share *every* corner in order that each Si may have four oxygens around it, and the structure of quartz is the result. The intermediate types of linking represent intermediate ratios:

(*a*)	SiO_4	Separate SiO_4 groups	Olivine
(*b*)	SiO_3	Single chains	Pyroxenes
	Si_4O_{11}	Double chains	Amphiboles
(*c*)	$(Si,Al)_2O_5$	Sheets	Mica
(*d*)	(Si, Al)O_2	Networks	Felspar
(*e*)	SiO_2	Networks	Quartz

PROPERTIES AND STRUCTURE

We may now consider some properties conferred upon the minerals by these characteristic forms of grouping.

(*a*) *Olivine.*—In olivine the separate SiO_4 tetrahedra are linked together by Fe and Mg octahedra. It is geometrically possible to do this in an extremely compact way, without wasting any space. The mineral is also very uniform in texture, since there are no exceptionally strong bonds in one direction rather than another. Hence we have a heavy compact mineral of a glassy texture.

(*b*) *Pyroxenes and Amphiboles.*—These are composed of strings of tetrahedra, linked side by side by the Fe and Mg octahedra. As is to be expected, they are all fibrous in nature, splitting very easily along the chains but not across them. *Asbestos* is a well-known example of such a mineral. Asbestos fibres are most remarkable. One can tie an overhand knot in a fibre and pull it tight without breaking it, just as one can with a cotton thread. Familiarity lessens our surprise, but it is really extraordinary that a knot can be tied in a stone with such ease. This property arises from the very strong bonds along the chains of tetrahedral groups, and the relatively weak links which bind the chains together laterally.

These minerals are divided into two great classes, the pyroxenes and amphiboles. They are distinguished by their cleavage. The cleavages cross each other at about 90° in the pyroxenes, and 56° in the amphiboles. The reason for this difference was discovered by Warren. All pyroxenes are based on single chains of tetrahedra, all amphiboles on double chains, two chains being linked side by side to form a kind of tape. When we look at the chains end on, it will be seen that the amphibole chains have a much more oblong cross-section. The consequence is that the cleavage cracks, in avoiding cutting the chains, cross each other more obliquely in the amphiboles.

(*c*) *Mica.*—Sheets of mica cleave with extreme ease. A sheet can be split again and again into thinner lamellæ in an apparently endless way.

The structure of mica was first analysed by Pauling. The main feature is a series of sheets of tetrahedra, each tetrahedron being linked by three corners to neighbours to form a hexagonal network. Two such sheets are then linked together by Al, Mg, or Fe octahedra to form a composite sheet. It is these double sheets which are so immensely strong, and enable mica to be cleaved so easily, because each is only fastened to its neighbours on either side by the weak attractions of potassium atoms lying between them.

The perfection of the mica cleavage is a truly remarkable phenomenon. It runs along the plane where the potassium atoms are situated, and may run for a centimetre or more without deviating from this plane by a single atom. We can show this, as Friedel first pointed out, by growing crystals of ammonium iodide, $(NH_4)I$, on the mica. The ammonium atoms in this salt happen to have precisely the same arrangement as the potassium

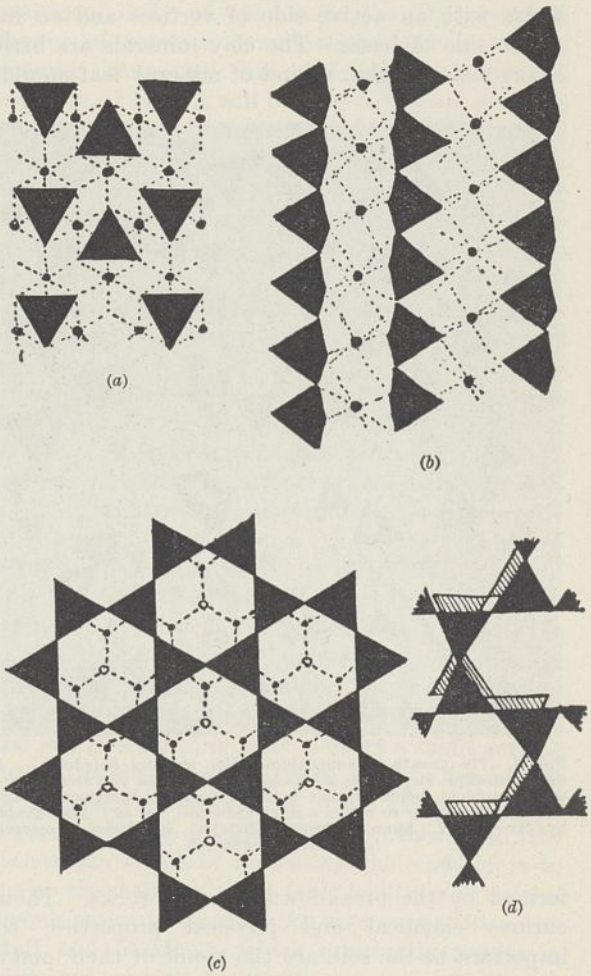

FIG. 2. The arrangement of the (Si, Al)–O tetrahedra in the common minerals. Tetrahedra are silhouetted in black. (*a*) Olivine, separate groups; (*b*) Pyroxene, chains; (*c*) Mica, sheets; (*d*) Felspar, three dimensional network.

atoms in mica, both in shape and scale. In consequence, the crystals all grow in parallel orientation on the mica. The grain of the pattern in successive molecular sheets of mica points alternately to right and left of its symmetry plane, hence the little crystals of ammonium iodide also point to right or to left depending on which type of sheet forms the top surface of the mica. If

they all point the same way, the top sheet must be the same all over the surface. Fig. 3 shows a mica surface in two steps, all the crystals pointing one way on one side and in the reverse direction on the other.

The 'grain' is less marked in micas (biotite, phlogopite) with the formula $K(Mg, Fe)_3(AlSi_3O_{10})(OH)_2$, than in micas (muscovite) with the formula $KAl_2(AlSi_3O_{10})(OH)_2$; hence in the former case the ammonium iodide crystals point indifferently in either direction.

The mica-like sheets form the basis also of the *clay* minerals. These are single sheets of tetrahedra with an active side of vertices and an inactive side of bases. The clay minerals are little hexagonal spangles, a kind of mineral 'leaf-mould'

FIG. 3. The growth of ammonium iodide on mica (lepidolite). A sub-microscopic step on the mica sheet separates the two areas where the ammonium iodide crystals point in opposite directions. Each area is a true plane to within a single molecule. (× 80.) Photograph by Mr. C. W. Bunn, Imperial Chemical Industries, Research Laboratory, Northwich.

formed by the breakdown of other rocks. Their curious chemical and physical properties, so important to the soil, are the result of their platy character.

(*d*) *Felspar*.—This is the most important mineral of the earth's crust. We are familiar with it as a main constituent of granite. It is composed of Si and Al tetrahedra linked by every corner in every direction, a three-dimensioned lattice-work of tetrahedra. The bulky atoms Na, K, Ca are immeshed in its interstices.

We may only refer here to two of its interesting properties. In the first place, if we make a structure of tetrahedra linked by all their corners in this way, it is geometrically impossible to fit octahedra on to it. In consequence, magnesium and iron, which are characteristically in octahedral groups of oxygen atoms, are excluded from the felspar structures. We never find these metals in felspar.

In the second place, the felspars are divided into two great families. The more symmetrical orthoclase, $KAlSi_3O_8$, is typical of one family, and the less symmetrical albite and anorthite, $NaAlSi_3O_8$ and $CaAl_2Si_2O_8$, of the other. The difference is simply a question of the size of the large cation. Potassium is so large that when inserted into the framework it holds it distended into the symmetrical form, whereas the smaller sodium or calcium allow it to sag over into a lop-sided unsymmetrical shape. This explanation is due to Taylor, who first analysed the felspars.

DENSITIES OF MINERALS

Finally, I wish to refer to another broad feature of minerals, their *densities*. The densities again depend to a large extent upon considerations of geometry. If we pack isolated tetrahedra together with octahedra, as in olivine, space can be utilised in a most economic way. It is geometrically possible to arrange the structure so that a maximum number of oxygen atoms, with their concomitant cations, are included in a given volume. On the other hand, building up a structure by attaching tetrahedra corner to corner is most wasteful as regards volume. It produces an expanded structure containing large open spaces.

In consequence we find that olivine is the heaviest, and felspar and quartz are the lightest, of the common minerals, others being intermediate. The greater the extent of the tetrahedral linking, the lighter the structure, as the following list shows:

	Density.
Olivine	3·4
Pyroxene, amphibole	3·3–3·1
Mica	2·85
Quartz	2·65
Felspar	2·75–2·55

The fact is, of course, that the earth's crust is mostly composed of these minerals, with felspar and quartz predominant, just because they are the lightest and so float to the top. According to the scale of densities, the light felspars float on the heavier ferro-magnesian silicates, and these in turn probably on metallic sulphides and metals which are much denser. Geometry is again triumphant. The fortunate existence of a raft of rock on which life is possible is seen to be a result of the geometrical properties of tetrahedra and octahedra.

Science at the Universities*

By H. T. TIZARD, C.B., F.R.S.

THE general growth in the teaching of science at secondary schools has naturally been accompanied by a great increase in the number of students of science at universities. There are now about 50,000 students in the universities of Great Britain, half of whom are studying some form of natural science. This growth has been made possible only by the provision of public money; all universities in Great Britain are now dependent on the taxpayer and ratepayer. The State alone provides annually for university education a sum nearly ten times as great as was provided before the War; and local government bodies, in addition to their direct contributions, find large sums for maintenance allowances to students. The student of science has to be provided with laboratories, where he consumes power, heat, light and expensive material. He is in consequence the most costly of university students: I estimate that the public expend, in one way or another, nearly £200 a year on each student of science, with the possible exception of students at Oxford and Cambridge, which are more richly endowed from private sources.

This public expenditure has laid additional responsibilities on the teaching and administrative staffs of universities. Most of us are now in the position of public trustees; we have to examine our expenditure more scrupulously than we should if we were not (indirectly) responsible to the public, and we have continually to ask ourselves whether additional expenditure can be justified.

There was a time when some universities were in the same happy position as the public schools. As self-supporting institutions they could go their own autocratic way, impervious to outside criticism. They took special measures to encourage the influx of students of outstanding ability; and as for the rest, the chief conditions of entry to a college were that they should be capable of paying highly for the privilege, and of passing a very elementary examination—often waived for men of noble birth or athletic renown.

The chief advantage of this complete independence was that it encouraged individuality in teachers and students; the chief disadvantage of the many reforms that have taken place since then, resulting finally in financial dependence, is that they tend to discourage individuality. Is any university school of physics or chemistry, for example, noticeably different from any other? In London we do our best to encourage individuality by having different final examinations for certain degrees in different colleges; at the Imperial College the B.Sc. degree of London is awarded on the results of college examinations in which outside examiners take part. The advantage of this is that it is not necessary to bring our syllabuses and methods of teaching exactly into line with those of other London colleges. There is, however, a strong, but fortunately not a majority, body of opinion in the University in favour of common examinations, chiefly on the grounds that they are easier and cheaper to organise. I hope it will be long before our measure of independence disappears. I would go so far as to say that individuality, which should be a natural growth in universities, needs to be deliberately encouraged in these days of committee rule. Any step taken to discourage it is a step downwards.

Oxford and Cambridge still have considerable freedom of action, partly because of their old traditions, but mainly, I think, because of the financial independence of the colleges. I do not know how far the ancient universities of Scotland preserve their own complete independence, but, in spite of apparent autonomy, the newer universities of England have not quite the same measure of freedom as Oxford and Cambridge. Their income can normally only just cover their expenditure, for if the margin were great, it would mean that they were receiving too much from the public. The close budgeting that is necessary inevitably restricts freedom of action. For example, if the number of students be reduced, the loss in fee income may convert a slight surplus into a deficit for some years, as it is impossible to reduce expenditure on staff and equipment correspondingly quickly. On the other hand, the immediate effect of increasing the number is to make the balance sheet look healthier: until a strong case can be made for more expenditure on staff and buildings, which eventually results in increased cost to the public.

It is unfortunate that there is quite a strong financial incentive to increase the number of students at universities; it looks so well on paper. Yet I feel that the time has come when we ought seriously to consider whether a further increase can really be justified. The public, I take it, is not interested in the individual; if the taxpayer thinks at all about his contribution to university education—and I do not suppose he does, as it is so trifling compared with other public calls upon his income—he must come to the conclusion that

* From the presidential address to Section L (Educational Science) of the British Association delivered at Aberdeen on Sept. 6.

the object of his contribution is to help students who will afterwards be of more value to the nation if they spend three or more years of a sheltered existence at a university, than if they were obliged to earn their living on leaving school. Where shall we draw the line ?

There are many students who occasion no misgiving. They are those who are capable of teaching themselves, given the opportunity. To them, and ideally to all, the attitude of the university should be this : We give you here the opportunity of learning, if you wish to, from masters of their subjects ; we give you access to well-equipped libraries and laboratories ; and opportunities for learning from each other. We help you to help yourselves. What use you make of these opportunities depends upon yourselves. If we find you do not, or cannot, make good use of them, you shall go, and make room for others. Broadly speaking, I believe that is the right attitude. In such an atmosphere, learning, individuality, and self-reliance flourish ; and public expenditure is worth while. Judged from this point of view, I have little hesitation in saying that universities are too full. As a result, the tendency is towards over-organisation, too little latitude, and too much spoon-feeding. The more distinguished the teacher, the more he is tempted away from teaching and research : his presence is required on committees. In London we elderly gentlemen even organise students' athletics ; and official debates take place on such important questions as the site and finance of a university boat club for women. The wider we fling open the doors to a university, the more will such organisation be necessary, and the worse will be the conditions for the best teachers and students.

There is another, more practical, way of looking at this question of numbers. Do graduates find any difficulty in getting suitable employment at the end of their university career ? Perhaps it is scarcely fair to attempt to draw a definite conclusion from experience during the last few years ; but it does form some guide to policy. The majority of students of the Imperial College enter some branch of industry ; and most of them, even in these difficult times, have succeeded in finding posts within six months of leaving the college. Whether they are all suitable posts for university graduates, I doubt ; many of them could equally well, and perhaps better, be filled by students from technical schools.

Different branches of industry seem to hold different views about the value of a university education in science. Compare, for example, the present position of the university chemist with that of the engineer. The chemical industry calls out for university graduates ; every year you will find leading representatives of the prominent firms in the universities, looking for recruits. It is not demanded of the recruit that he should possess a large stock of practical knowledge ; it is expected of him that he should have high scientific qualifications, and that he should have shown aptitude for independent work. The attitude of the engineering industry seems different. In some branches of the engineering industry the university graduate is as welcome as he is in most branches of the chemical industry ; but in many he seems to be regarded as a misfit. One prominent manufacturer, the creator of a great industry, who has lived most of his life near a university, has been known to boast that he employs no university graduates. Many employers seem to expect of an engineering graduate a degree of acquaintance with practice that they have no right to expect ; for we do not pretend to teach at universities what can be better learned at the works. Finally, my experience is that too many engineering graduates find themselves in blind alleys from which they have little opportunity to escape.

Where does the fault lie ? With the employers or with the universities ? I think there are faults on both sides : let me leave the faults of the employers for others to discuss, and for time to correct, and deal with some of the problems of university schools of engineering.

Engineering is a branch of technology. The object of a university school of technology is to seek to advance and apply scientific knowledge for practical purposes. Many people at universities still think there is something derogatory about this ; they would prefer that instruction and research had no relation to the practical needs of mankind, forgetting perhaps that most, if not all, university education started with a practical aim in view, or we should have had no schools of law or medicine.

Let me quote from the report of the University Grants Committee for 1921 :

"There is nothing in the nature of technology which makes it necessarily unsuited to the methods and spirit of university work. . . . The very fact that this alliance [between science and industry] is intimate, and the border line between pure and applied science difficult to define, involves serious difficulties for the universities. We cannot ignore a certain tendency to lay an exaggerated emphasis on utilitarian applications in some technological departments. . . . It would be in the worst interests of industry itself if the study of scientific problems were to be approached by the universities from the point of view of immediate material advantage. . . . We believe it to be urgently necessary, therefore, to define more closely the aim of university courses in engineering and technology, and to differentiate such courses from work properly assignable to technical colleges."

With these views and criticisms, I heartily agree : what is more to the point, perhaps, is that they have, I feel sure, the approval of many university professors of engineering, who would say that their aim is to teach principles, not practice ; to train the mind without neglecting the training of the hand ; and to send out ultimately from the university resourceful men whose education and outlook enable them to attack with confidence the new problems that are perpetually arising in the engineering world. A university school of engineering should be primarily a school of what is now called classical physics, the principles of which are illustrated in lecture room and laboratory by examples and problems which have a special bearing on engineering. To a less extent it should be a school of mathematics and chemistry. I think we are inclined, at universities, to value mathematical ability in an engineer too highly. Many students have obtained first-class engineering degrees mainly through their mathematical ability ; but such students do not necessarily become first-class engineers, and some of the most original and distinguished engineers are poor mathematicians : one of whom I believe had to be content with a pass degree at his university.

I am inclined to think that there are too many students of engineering at universities. There are many young men who have a practical flair, but who cannot respond to the kind of teaching that I believe to be appropriate to the university. Their presence at the university, where everyone wishes to do their best for them, inevitably encourages the introduction of practical instruction of a kind more suited to technical schools. The university school is then trying to fulfil two functions, and runs the risk of failing to fulfil either well.

The same is true, I suggest, of other branches of technology. The chief aim of a university department of technology should be to produce the leaders of the profession. The best education for potential leaders is not the same as the best education for the rank and file. It cannot be expected that all university graduates will become leaders ; but at least we ought to look for, and develop, the qualities of leadership. This we cannot do if we fall into the temptation of mass production.

Highly specialised schools of science at universities present somewhat different problems. How many students, for example, should one encourage to study subjects such as mining geology, biochemistry, plant biology, entomology, when the demand for such specialists may be small and fluctuating ? Take the biological subjects as typical. Two years ago there was published the report of a strong committee appointed by the Government to advise on the education and supply of biologists. Their first two conclusions were :

(1) There is a substantial and growing demand from Government departments for biologists for service in Great Britain and in the colonies, and there is a small but probably growing demand for biologists from concerns engaged in agricultural production overseas and in industry in Great Britain.

(2) It is not possible to state this demand in precise arithmetical terms, but the supply of candidates for biological posts is not equal to the present demand, and even in those branches where the supply is sufficient in quantity it is deficient in quality.

Whatever evidence in support of these conclusions existed when the Committee started its inquiry in 1930, I think it safe to say that even before the report was published these conclusions were falsified by events. The fact is that some ten to fifteen years ago there was a sudden demand for biologists to meet the needs of new and of rapidly expanding research organisations at home and in other parts of the Empire. Highly trained biologists of all kinds were sought for, and naturally could not be found in sufficient numbers, for universities cannot suddenly increase the rate of production of first-class specialists. Some of the new organisations made the mistake, therefore, of accepting less able and less highly trained men, which is bad for the individuals concerned and for the organisations ; for, if a first-class man is really needed, it is better to wait until one is available than to make shift with a second-class man, who runs the serious risk of having his livelihood taken away from him later on.

Then came the world depression, and far from there being an increased demand for 'industrial' biologists in recent years, there has been a contraction. This is a serious state of affairs for universities. It would be a fatal policy to encourage young men of good ability to spend long years in specialised study, only to find at the end that there was no demand for their services, or that what little demand there was offered inadequate prospects for the future. It is a far better policy deliberately to keep the supply somewhat short of the demand ; the world will not appreciably suffer if any particular application of science to industry and agriculture develops rather more slowly than the enthusiast could wish, and there are few spectacles more distressing than that of the highly educated specialist who is unemployed through no fault of his own, and whose training and interests do not fit him for other work. The lessons of the last few years teach us that public statements about the shortage

of specialists in any branch of science and technology are apt to have an unfortunate effect in schools and universities; for they may be out of date before a normal period of advanced training is finished.

It is of interest to examine a little further the Committee's belief that the supply of biologists at universities is lacking in quality as well as in quantity, which they attribute to the neglect of biology as a subject of study in schools. While sympathising with their views, which are shared by many people, I think it cannot be denied that whereas a biologist must have an adequate knowledge of physics and chemistry, it is not necessary for a physicist or chemist to have a knowledge of biology; and if one considers the position from a cultural rather than from a practical point of view, it would be fair to say that the boys who need least to study biology as a cultural subject at schools are those who are going to study it at a university. The only point that remains, then, is that if biology were taught more widely in schools, it is possible that here and there a boy "may experience from biology a pull which he had hitherto failed to secure from his special subject".

For my part, I feel confident that directly there is an assurance of reasonable careers in biology, suitable candidates will be forthcoming, and education at schools and in the universities will develop on sound lines. Lack of teaching of biology at schools has not led to a shortage of doctors. How, then, can it be mainly responsible for a shortage of other biologists? It needs no inspired prophet to foresee a great development some day of the biological sciences: the work of pioneers to-day makes that sufficiently obvious. The next generation may live to see a development comparable with that of the physical sciences, and their applications, in the last thirty years; but the time is not yet ripe. Until it is, our duty at universities is to keep our biological departments moderate in size, but high in quality.

These practical considerations are not exhaustive and do not lead to any definite conclusion on the problem of the size of university departments of science and technology. In the end, the optimum size is a matter of judgment; my judgment, for what it is worth, is that on the whole there is no strong case for increasing the numbers of students of science and technology at universities. In thirty years' time, this statement may look ridiculous, but one cannot foresee events so far ahead. Rather than any marked expansion in numbers should take place during the next five years, I should prefer to concentrate on giving the better man a better chance than he has now; to improve the quality rather than to increase the quantity.

Obituary

Prof. W. M. Hicks, F.R.S.

BY the death of William Mitchinson Hicks on August 17, the world of science has lost an outstanding figure, whose achievements were perhaps more appreciated by the last than by the present generation. Born at Launceston on September 23, 1850, he went up to Cambridge in 1870 as a scholar of St. John's College, and reached the position of seventh wrangler in the Mathematical Tripos of 1873. This was the year in which the Cavendish Laboratory was founded with Clerk Maxwell as first professor, and Hicks formed one of the small band of distinguished students of experimental physics who gathered round him, and came directly under his inspiration. In 1876 he was elected a fellow of St. John's, and lived there until 1883, engaged in the earlier stages of his mathematical researches on the theory of vortex rings. In that year he was appointed principal and professor of physics and mathematics in the Firth College at Sheffield, and from this time onward his energy was devoted to the furtherance of university education in that town.

This tiny College—the staff numbered only half a dozen all told—had developed, as in other towns, out of the zeal for higher education marking the earlier days of the century, which was shown in this instance by a bequest of Mr. Mark Firth. It carried on a struggling and precarious existence, but its subsequent history forms a monument to the vision and untiring work of Dr. Hicks.

The first stage of Dr. Hicks's ideal was the union of the Firth College, the Technical School, and the Sheffield School of Medicine into one university college, which he succeeded in accomplishing in 1897. The opportunity for further development, apart from the foundation of new departments, came in 1903, when the Victoria University formed by the Liverpool, Manchester, and Leeds Colleges was dissolved. It was clear that the system of constituting a university by the federation of several distant university colleges was too cumbersome to work, and each town set about providing its own. The opportunity was seized in Sheffield also—it was now or never, and a large sum would have to be raised. Dr. Hicks's quiet but persistent pressing forward of his ideals, his scientific eminence and his obvious single-mindedness and sincerity, convinced the important persons of the city, and ultimately gave rise to a wave of popular enthusiasm which brought the necessary endowment in its train. He was a man content with doing his good work for the founding of the University, and courted no popular recognition,

but those who knew the circumstances know well that his was the vision, and to him the accomplishment of it was largely due. On its constitution in 1905, the University appointed him as its first Vice-Chancellor, but he only held the office for a few months. His bent had always been for research, and he was anxious to get back to it, so that as soon as possible he withdrew from the vice-chancellorship to become simply the professor of physics, with comparative leisure for his research work. However, in 1913 he acted as Vice-Chancellor again for a year, stepping into the breach in an emergency.

Hicks's scientific work falls naturally into two parts separated in time by the year 1909. Up to this date, much of it can be summed up by the words 'vortex rings'. After the discovery by Sir William Thomson of the permanence of a vortex ring in a frictionless fluid, this subject made a double appeal to the younger school of mathematical physicists in Cambridge. In the first place, the mathematical difficulties of further treatment presented a continual challenge to their ability, and in addition there was the definite hope, in those classical days, of developing from it a theory of the real atom. Hicks made the subject peculiarly his own, inventing the necessary 'toroidal' functions for the treatment, and in a series of four brilliant memoirs in the *Philosophical Transactions* worked out the properties of vortex rings exhaustively. Among his discoveries was that of the existence of vortex aggregates, which showed a remarkable analogy with the periodic constitution of the elements. His eminence in these researches was marked by the award in 1885 of the Hopkins Prize in Cambridge, and by his election to the Royal Society in the same year. Later he was awarded the Royal Medal of the Society, and he served on the Council for many years.

From 1909, not only to his retirement in 1917 from his chair of physics, but also to the very end of his life, Dr. Hicks devoted himself to the task of elucidating the structure of spectra. Greatly attracted by Rydberg's memoir on the relationships between series lines, and imbued with a profound admiration for Rydberg's work, he set about extending it. The basic idea was to try to find out as much as possible about the relations between the frequencies of lines apart from all questions of theory. In its spectrum, each element wrote its signature, but in cypher form, and the methods he proposed to adopt were purely those appropriate to finding the key of the cypher. The difficult mathematics of his earlier works was replaced almost wholly by numerical calculations, simple individually, but laborious in the immense number of them. The results are presented in numerous papers in the *Philosophical Transactions* and the *Philosophical Magazine*. His essay on the "Analysis of Spectra" was awarded the Adams Prize in 1921, and a full account of his work up to then, based on the essay, was published in 1922. The results of his later work are to be published this autumn in a book on the "Structure of Spectral Series", on the proofs of which he was working when he collapsed with the illness which in a few weeks ended his life.

It is difficult at the present time to estimate justly the value of Hicks's results in this field. They tend to be neglected by modern spectroscopists, because admittedly in a certain proportion chance agreements occur in the applications of the rules he has discovered, and it is difficult without great labour to determine to what extent the validity of the rules may be affected thereby. But another reason is that no one can find any way of fitting them into the present day theories of the emission of light. Hicks recognised both these difficulties, but believed that his results must be held available, perhaps for a later generation of spectroscopists to succeed in fitting them into a framework of theory.

Dr. Hicks had two sons, one of whom was killed in 1915 in the War; his memory is perpetuated by the Basil Hicks lectureship, which provides for a series of public lectures at the University of Sheffield by eminent men on subjects connected with the War and international peace. Not very long after his retirement from the chair of physics at Sheffield, Dr. Hicks's wife died, and in 1919 he went to reside in the little country village of Crowhurst in Sussex, and remained there until his death. He was a man of vigorous constitution, extremely fond of walking, and a great lover of Nature. He explored the countryside for miles round his home, and many villagers must now miss his genial presence. Hampered somewhat by increasing deafness in his later years, he lived an extremely regularly ordered life, working with amazing industry at his calculations every morning, and walking in the afternoon. Nothing gave him greater pleasure than to be visited by his friends and old students, for whom he had a warm affection. The simplicity and courtesy of his mind and manners, his thoughtfulness for others, and the selflessness of his devotion to truth, mark him as a noble, not merely an eminent, man. The memory of him as such will be cherished by his friends as long as they live, while his scientific work on one hand, and the University of Sheffield on the other, form enduring monuments to his fame. S. R. M.

THE death is announced of Dr. Maurice Fishberg, the anthropologist, which took place suddenly at the age of sixty-two years in New York on August 31. Dr. Fishberg was born in Russia, but educated in New York, where he studied medicine. He also devoted special attention to the study of anthropology and questions of race, and came to be recognised as the foremost authority on the physical anthropology of the Jews. He was the author of "Physical Anthropology of the Jews", "Comparative Pathology of the Jews" and a volume "The Jews" which appeared in the Contemporary Science Series. His views on the origin of the differences in physical character displayed by the Jewish people in varying environments have been more widely accepted among non-Jewish anthropologists than they have among those of his own people, who have stressed the unity and continuity in history of the Jewish people as a race of distinctive character and culture.

News and Views

Sir Richard Glazebrook, K.C.B., F.R.S.,

SIR RICHARD GLAZEBROOK reaches his eightieth birthday on September 18, and there must be few men in this or any other generation whose names are associated with such a long career devoted unremittingly to the services of science and the State. "Ease, from this noble miser of his time, no moment seeks" and first as fellow, tutor and bursar of Trinity College, Cambridge, then as principal of University College, Liverpool, and afterwards as first director of the National Physical Laboratory, Sir Richard has never wearied in well doing, and has ever brought a single-minded resolution to bear in turn on each of the many problems which came to hand. Of the breadth and diversity of his activities there is no room to speak here—the Universities Commission, the Museums Commission, the 1851 Commission, the Aeronautical Research Committee, the "Dictionary of Applied Physics", the Gas Referees, the presidencies of many institutions and societies—he has always revelled in work and thrived on it. As chairman of countless committees, he is not likely to be surpassed for his ability to crystallise discussion into decision and decision into action. But the biggest debt of all which the Nation owes him, and for which he will always be remembered, is for the skill, resource, pertinacity and judgment he brought to bear in creating and moulding the laboratories at Teddington into a great national institution with a standing unquestioned, both at home and abroad. It is a privilege to be able to extend our congratulations to Sir Richard on a great occasion, and to wish him many more years of untiring service.

Prof. W. W. Watts, F.R.S.: President-Elect of the British Association

No man of his generation has exercised greater or more knowledgeable influence on geologists and the progress of British geology than Prof. William Whitehead Watts, president-elect of the British Association for 1935. Born at Broseley in Shropshire in 1860, he was educated first at local schools and then at Denstone College, Staffordshire, and Sidney Sussex College, Cambridge. His teaching career was started when he undertook university extension lecturing and for a time took charge of the Department of Geology at Leeds. It was continued when, after some years of service as petrologist on H.M. Geological Survey, he became deputy professor of geology at Oxford. It was as professor of geography and assistant professor with Charles Lapworth at Birmingham that he made his mark, and by that time he had produced his "Geology for Beginners", a small book which for forty years has provided the first introduction of the science to young geologists in all the English-speaking world. In 1906, Watts succeeded Judd as professor of geology at the Royal College of Science and the Royal School of Mines, London, where he has built up a school, the students from which have filled academic professorships, directorships of geological surveys and many and diverse posts of influence in industry in many lands. Since the Imperial College was instituted in 1908, the Department of Geology has been extended by Watts's organisation of the Sub-Departments of Oil Technology and Mining.

PROF. WATTS'S talent for administration has led him to respond to insistent demands for his services outside the Imperial College, and he has held office as dean of the Faculty of Science and member of the Senate of the University of London, secretary and president of the Geological Society of London, president of the London Geologists' Association, president of the Mineralogical Society and secretary of the Conjoint Board of Scientific Societies and Technological Institutions. Notwithstanding the time taken up by teaching and administration, Prof. Watts's own researches—more especially those concerned with Charnwood Forest and in Shropshire—have proved an inspiration to all British workers concerned with Lower Palæozoic rocks. His interest in the applications of science led him to choose for his presidential address to the Geological Society in 1911 the problem of the hidden coal resources of Great Britain, a conspectus remarkable for its breadth of view. Prof. Watts's connexion with the British Association dates back to 1883, and since that time he has been associated as secretary and chairman with the still active Committee on Geological Photographs, the oldest of the Association's research committees extant and the only one which has been self-supporting since its inception. He has been in turn secretary, recorder and, at Southport and again at Toronto, president of Section C (Geology). Among the honours which have been conferred upon him are the Wollaston and Murchison Medals of the Geological Society, honorary doctorates of the Universities of St. Andrews and Edinburgh and the honorary fellowship of Sidney Sussex College, Cambridge.

British Association at Aberdeen

IMMEDIATELY before the delivery of his presidential address at the inaugural meeting of the British Association, Sir James Jeans announced that the following message had been sent to H.M. the King: "Your Majesty,—We, the Members of the British Association for the Advancement of Science assembled in the City of Aberdeen in annual session, desire humbly to recall to Your Majesty that it was in this City that His Royal Highness The Prince Consort assumed the Presidency of the Association in the year 1859. From the Presidential Chair, he conveyed to the assembled members of the Association a gracious message from Her Majesty Queen Victoria, and delivered an Address which disclosed his own profound interest in the advancement of Science. The many marks of Royal favour which have been extended to our Association on subsequent occasions have provided further signal encouragement to us in

our pursuit of the aims defined by His Royal Highness, and on all these counts we now desire to express to Your Majesty our humble gratitude. J. H. Jeans, President." The following reply was received from Sir Clive Wigram: "I am commanded by the King to thank the members of the British Association for the Advancement of Science for the loyal message which they have addressed to His Majesty, their Patron, from the Inaugural General Meeting in the Ancient City of Aberdeen. His Majesty appreciates their kind remembrance of the occasion when the Prince Consort, as President of the Association, delivered a message from Queen Victoria to the members assembled in this City three quarters of a century ago. The King desires me to assure the members of his unabated interest in their Meetings and his confidence that their investigations into the manifold problems confronting present day Scientists will continue to be productive of results which will benefit mankind. Clive Wigram."

THE report of the Council of the British Association, adopted by the General Committee at Aberdeen on September 5, records that the Local Committee for the Leicester meeting has presented the sum of £1,000 to the Association, being the unexpended balance of the fund raised locally for the purposes of the meeting. This gift has been gratefully accepted, and the sum will be invested to form a Leicester and Leicestershire Fund, the interest of which will be used "to assist by scholarship or otherwise a student or students working for the advancement of science". Five new members of Council were elected by the General Committee, namely, Sir T. Hudson Beare, Prof. A. V. Hill, Dr. W. W. Vaughan, Dr. W. T. Calman and Prof. H. M. Hallsworth. Future meetings of the Association will be at Norwich, 1935 (September 4–11); Blackpool, 1936; Nottingham, 1937; Cambridge, 1938; Dundee, 1939 or 1940. Sir Josiah Stamp announced at the conclusion of the inaugural meeting at Aberdeen that the membership for the meeting had reached a total of 2,784.

Causation of Cancer

IN a paper published in *Medizinische Welt* of August 25, Dr. W. von Brehmer claims to have obtained in pure culture an organism, present in the blood of cancerous patients and of animals bearing tumours. The organism could also be obtained from human and animal tumours. It is a pleomorphic aerobe which in pure culture appears in the form of tubules 0·5 μ–2·8 μ long and 0·2 μ–0·8 μ broad, and can be stained by a Giemsa stain. The tubules are filled with spores, which when liberated, are stated to be able to enter damaged cells and thus cause cancer. An essential condition for obtaining cultures of this organism, to which the name *Syphonospora polymorpha* has been given, is an alkaline condition of the medium, with a *p*H of 7·5–7·6, and von Brehmer maintains that cancer is always associated with a shift of the hydrogen ion concentration of the blood toward the alkaline side. The organism is stated to exist in the blood of apparently normal healthy people in the form of small spores which are non-pathogenic, but become pathogenic with the shift of the hydrogen ion concentration. Dr. von Brehmer also claims to have produced tumours in animals by the injection of pure cultures of his organism, but no detailed evidence is given.

DR. VON BREHMER'S paper is followed by a paper by V. Schilling, who has repeated these experiments, partly with von Brehmer's assistance. He has succeeded in obtaining pure cultures of this organism from malignant tissues and from the blood of cancer patients and of animals bearing tumours. His experiments on the production of cancer in animals by inoculation of these tumours have, however, given negative results. He is, therefore, inclined to regard the presence of this organism as being due to a mixed infection or to its being a non-pathogenic symbiont, and he dissociates himself from the therapeutic and diagnostic conclusions drawn by von Brehmer from his work. The existence of a relatively large, visible and stainable organism as the cause of cancer is difficult to reconcile with many of the well-established facts concerning cancer. Moreover, the existence of an alkalosis in cancer, which von Brehmer considers to be an essential feature of cancer, is questionable and several competent observers using exact methods have failed to demonstrate it. It has been reported (*Times*, September 10) that von Brehmer's claims will be submitted to an official investigation, initiated by the authorities in Germany. Until the results are known, it is necessary to reserve judgement.

Food Storage and Transport

ON September 7, Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, delivered the Hardy Memorial Lecture before the British Association at Aberdeen, in which he paid tribute to the work of the late Sir William Hardy, who during the last seventeen years of his life, devoted much of his time to research on the transport and storage of foodstuffs. Sir Frank described the work being done on the kippered herring at the Torry Research Station, Aberdeen, which was founded by Sir William Hardy. A new kippering kiln has been evolved there, in which all variables such as temperature, humidity, etc., can be controlled. Thus, any desired cure can be produced with certainty. At the same station, a new kind of mild salted herring has been produced by the combined processes of salting and chilling. About 1,600 steam trawlers fish from the ports of Great Britain, landing nearly 700,000 tons of white fish valued at about 12½ million sterling each year. Storage in crushed ice, under conditions prevailing when Hardy took up the problem in 1929, could only hold such fish fresh for 6–7 days. To-day, work at the Torry Station has extended that period to 12 days, by reducing bacterial contamination. Further work has shown that freezing in brine at − 20° C. and storing at the same temperature will keep the fish for three months. The 10,000-ton vessel *Arctic Queen*, fitted as a floating factory for halibut, was also described. The importance of refrigeration cannot be over-

emphasised in connexion with food storage and transport. Sir William Hardy's fruitful work along these lines was fittingly described by Sir Frank. Thanks largely to the work of Sir William, it is realised to-day that the biologist must formulate the condition required in food storage and transport, and the engineer provide those conditions. The problems of the biologist concern not only methods of refrigeration itself, but also cleanliness, damage to foods by cold, etc. The most recent developments in gas storage using carbon dioxide, and in the storage of living material such as fruit, were also discussed by Sir Frank.

Cleansing of Oysters

THE cleansing of oysters on a commercial scale has now been accomplished after a period of some fifteen years' continuous research work at the Conway Experimental Station of the Ministry of Agriculture and Fisheries. A purification station has been established at Brightlingsea, and since May has produced 'certified' American and Portuguese oysters. The principles of the process are almost the same as those involved in the cleansing of mussels, namely, a thorough preliminary cleansing of the outside of the shell is followed by a first and then a second bath in sterilised water. During immersion in the baths the oysters cleanse themselves internally and externally (that is, the external soft parts inside the shell) of bacteria in a simple way; the internal bacteria are expelled from the gut in the fæces, the external in mucoid films which are gleaned from all parts by cilia to be collected and extruded in masses as pseudo-fæces. After each bath, the shells are thoroughly washed to remove the excreta and are finally treated with water containing three parts in a million of free chlorine to destroy any remaining adherent germs. An essential feature of the oyster-cleansing process consists in the use of water at a temperature not less than 56° F., as it was found after a long series of experiments that ciliary activity below this temperature could not be relied upon to effect perfect cleansing. Mussels can be reliably purified in water which does not fall below 39° F. The English native (or European) oyster (*Ostrea edulis*) has been purified in a process involving three baths, and differs otherwise in its reactions from the American and Portuguese. It is reported that purified *O. edulis* may be produced in the coming winter. The summer capacity of the tanks is 360,000 oysters per week, but in winter when the sea-water requires to be warmed, the capacity is halved. Full details of the process and the plant are not yet available, but may be published in the near future.

The Droitwich Broadcasting Station

IN the presence of representatives of the Press, the new B.B.C. transmitting station at Droitwich was formally opened on September 6, to take over a part of the National broadcasting programme. This station will ultimately provide a full national programme from the long-wave transmitter which is now working, and also a regional service for the Midlands from a medium wave transmitter which will be completed in about six months' time. The programme transmitted from the new station on the opening day was heard in London very clearly, and its volume was considerably greater than that of the London National transmitter at Brookman's Park. It is expected that the new long-wave station will give a service of such quality over so large an area of Great Britain that three other national stations—those for London, the West and the North—will not need to go on broadcasting. The wave-lengths thus released may be used for other British stations to be erected in the future. The wave-length of the new Droitwich transmitter is identical with the long-wave Daventry station so that no change is required in listener's receiving sets.

THE issue of *World Radio* of September 7 contains an illustrated technical description of the new transmitting station at Droitwich, by Mr. Noel Ashbridge, chief engineer of the B.B.C. This transmitter has an aerial input power of 150 kw., five times as great as that of Daventry. The whole of the power for the station is generated by heavy oil engines, and these prime movers together with the electrical machines and their control equipment occupy a considerable proportion of the space in the station buildings. The long-wave wireless transmitter consists of five units, by means of which, weak oscillations of a carefully controlled radio frequency are amplified up to a final output power of 150 kw. Modulation is carried out at the penultimate stage by varying the high-tension supply to the anodes of the high-frequency valves, with which the modulating valves are in series. This method of modulation, together with a special output circuit arrangement, makes it possible for this transmitter to emit broadcasting programmes of a much superior quality to that hitherto possible from a long-wave station. The quality of the transmissions from Droitwich is expected to be at least equal to, and probably better than, those at present obtainable from the medium-wave stations. The new station is now radiating the morning National programme from 10.15 A.M. until 11.55 A.M. and the late dance music every week-day; it will continue to do this until it takes over the full service of the National programme from Daventry in October.

Edinburgh Geological Society Centenary

THE centenary of the Edinburgh Geological Society was celebrated on Monday and Tuesday, September 3 and 4. A considerable number of invitations had been sent out to kindred societies and institutions both at home and abroad, and a most gratifying response was received. On Monday morning the delegates were received by the president of the Society, Sir John Flett. Naturally the majority came from Scotland and England, but out of a total of sixty visitors, thirteen came from the Continent, nine represented the Colonial Empire, and four the United States of America. Following this reception, the whole party, including many fellows of the Society, had lunch in the city and proceeded to visit the Royal Scottish Museum, where the various exhibits were demon-

strated by the Museum staff. Afterwards a visit was paid to the offices of the Scottish branch of H.M. Geological Survey. Here all branches of the work were illustrated by carefully prepared exhibits including photographs, maps, rock collections and models. On Monday evening the fellows of the Society and the delegates were received by the Lord Provost and Town Council of the city. Tuesday's programme opened in the Geology Department of the University with a welcome by the principal, Sir Thomas Holland, who gave an address on the position of geology at the time the Society was founded. This was followed by addresses by Prof. F. D. Adams of Montreal, who dealt with the beginnings of Canadian geological survey. Prof. C. F. Kolderup, of Bergen, compared the geology of Norway with that of Scotland, and Prof. Baron de Geer gave an interesting summary of the work on varve-clays and their possible use in correlating glacial deposits throughout the world. Prof. W. N. Benson, of New Zealand, described the work of Sir James Hector, who was a graduate of the University of Edinburgh and a member of the Society and initiated the geological survey of New Zealand. The afternoon was devoted to a tour of places of geological interest within the city. The celebrations were brought to a close on Tuesday evening when the Society entertained its delegates to a dinner.

International Scientific Radio Union

A PLENARY congress of the International Scientific Radio Union (Union Radio Scientifique Internationale) is being held in London on September 11–19. The "U.R.S.I." is one of the constituent bodies of the International Council of Scientific Unions, and its secretariat is conducted by Dr. R. B. Goldschmidt in Brussels. This is the first occasion on which the Union has met in London, and representatives of some twelve or more nations are in attendance. The Congress is being held in the rooms of the Royal Society, Burlington House, with Dr. W. H. Eccles acting for the president of the Union, Prof. A. E. Kennelly, who is unfortunately prevented by ill-health from making the journey from the United States. The British National Committee of the U.R.S.I. is led by its president, Prof. E. V. Appleton, with Prof. S. Chapman as secretary and Dr. E. H. Rayner as president of the reception committee. The work of the assembly is divided among five commissions dealing respectively with radio measurements and standards, the propagation of waves, atmospherics, liaison, and radio physics. Subcommissions have been appointed to deal with the detail work on the agenda falling under these subjects. The London meeting includes certain technical visits and other appropriate engagements of interest to the delegates from other countries.

Prehistoric Shetland

A REMARKABLE view of the life and culture of settlements of prehistoric and Viking times is given in the results of excavations, which have now been carried on for four seasons, at a promontory in the inlet of Sumburgh Voe at the southern extremity of the Shetlands, by Mr. A. O. Curle under the Office of Works. The site was first brought to light about thirty years ago, when, as the result of a storm, a brock and subsidiary buildings, of which the occupation probably extended into the Christian era, were found on the foreshore. According to an account of the present season's excavations in the *Times* of September 10, several dwelling-places have been explored, some belonging to the prehistoric settlement, others to the Viking settlement, which is dated at the tenth to twelfth centuries. The prehistoric inhabitants were a simple pastoral people, of stone age culture, whose pottery suggests the Iron, rather than the Bronze, Age. In the oldest of the dwellings as yet examined, there are three phases of occupation and, in the third of these, moulds for bronze weapons and implements appear. In the later occupation of the site, bronze gives way to iron, while the earlier simple unornamented pottery with a plain rounded rim is replaced by pots with the deep hollowed rim characteristic of the Continental Hallstat culture. Towards the close of the Bronze Age, souterrains were in use, of which three have been found. Cattle were housed in the dwelling-place, and the people lived in small lateral chambers. In front of one of these was a quern, while four steatite vessels stood on a bench in front of another. One Viking house, which has been excavated, gives a remarkably complete view of the internal arrangements and method of roofing of the structure. Among numerous Viking relics the most noteworthy is a series of engraved slates, on one of which is a sketch of a Viking galley, singularly detailed within the limitations of the technique.

Anthropology and the African

THE presidential address to the Royal Anthropological Institute delivered by the Rev. E. W. Smith (*J. R. Anthrop. Inst.*, **64**, Pt. 1) is noteworthy as a carefully balanced survey of the arguments which have been advanced for and against anthropological studies as a factor in the future development of the African, by one who has had a prolonged experience of the practical problems which arise in close intercourse with the less-advanced peoples of the continent. While pointing to the advances which have been made in the practical application of anthropological principles and knowledge of anthropological data in the problems of administration, he also stressed the fact that the 'open door' is by no means entirely won. In dealing with criticism of missionaries and the criticism of anthropologists by missionaries, his views as a member of both bodies should do much to remove a general misapprehension as to the relation of the two systems, which, as he showed, are by no means incompatible in practice. For while he admitted that in earlier days missionaries had tended to introduce into missionary teaching much which belonged to Western civilisation rather than to Christianity, a new body of missionaries is growing up whose work is carried on in a spirit analogous to that of the administration under 'indirect rule' by the effort to build on African institutions and sentiment, preserving what is good

in it, rather than destroying it entirely, as too often was the endeavour of earlier generations. It has been noted recently that a feeling of disillusion and pessimism is appearing among Africans; but Mr. Smith looks to win the co-operation of the African in his own development, and in this connexion regards hopefully the interest he is beginning to take in the systematic study of his culture and institutions.

Training for Management

DURING recent years, considerable interest has developed in the possibilities of specialised training for business management. Such training, it is recognised, is not a substitute for experience but a supplement, or rather a preparatory basis, which provides a broader foundation on which experience can build. The applications of science to industry, intensified world competition, the increasing complexity of industrial organisation and other factors have combined to make the task of successful management far more complicated and difficult than it was in the past. To provide for the systematic training of men for responsible posts in business, a Department of Business Administration was established at the London School of Economics in 1930 through the joint efforts of leading business firms and the authorities of the School. Selected students are given full-time training in the broad principles of business administration, and throughout the course efforts are made to keep the teaching in close touch with reality through discussions opened by business men and by visits to factories, shops and offices. Special attention is paid to marketing, retail management and sales management, and instruction in these subjects is based on fresh investigations into current practice. The recently issued prospectus of the Department for the coming session shows that during the past three years nearly fifty students have passed through it, most of them university graduates. Last summer, the Department began an experiment in training which was designed to be of practical help in bridging the gap between university study and entry into business. Under this scheme, which is being extended during the coming session, a number of firms offer appointments to university graduates of high standing who are selected by them and approved by the Department on condition that they attend the specialised business course during the academic year from October until June.

A MANAGEMENT course for industry and commerce, which covers departmental functions, methods, problems, underlying sciences and managerial mental activity is being given by Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1. Mr. Dunlop offers a complete outline of knowledge relevant to the management and direction of an organisation departmentally and as a whole. There is also a personal side devoted to individual difficulties and requirements. The course is useful, not only to those who manage or who expect to, but also to professional and technical experts from the point of view of co-operative efficiency, and has been taken, either orally or by correspondence, by experienced accountants, managers, industrial chemists and engineers in some of the largest industrial concerns. Critically selected references for reading are included. The course, which is personal and private, has its advisory professional practitioners from whom expert information and advice can be obtained when required, thereby combining the chief advantage of institutional instruction with private tuition.

Medieval Spices

COMMENTING on a suggestion in a recent review of a leechbook in NATURE (**134**, 270, Aug. 25, 1934) that certain spices "must have been hard to come by in fifteenth century England", Mr. G. M. Meyer, of 38 Manor Park Gardens, Edgware, points out that ginger and pepper must have been usual articles of commerce in the years 1300–1, and presumably in later years, since they were then the subject of specified King's dues and of authorised brokerage charges at the port of Sandwich. The mere fact that a commodity is imported into a country does not necessarily imply that it is not difficult to obtain, at any rate by those not blessed with wealth and influence. The interesting historical account of pepper given by Fluckiger and Hanbury ("Pharmacographia"; London, Macmillan and Co., 1879) shows that it was only after the Portuguese, incited in part thereto by the high price of pepper, had discovered a sea-passage to India in 1498, that the cost of this condiment began to fall, and the following quotations from these authors seem to indicate that pepper was usually too uncertain in supply and too expensive to be regularly obtainable, except by the wealthy. "The price of pepper during the middle ages was always exorbitantly high, for the rulers of Egypt extorted a large revenue from all those who were engaged in the trade in it and other spices. The general prevalence during the middle ages of pepper-rents, which consisted in an obligation imposed upon a tenant to supply his lord with a certain quantity of pepper, generally a pound, at stated times, shows how acceptable was this favourite condiment and how great the desire of the wealthier classes to secure a supply of it when the market was not always certain." Ginger was apparently not so commonly a subject of comment and controversy in medieval times as pepper, but it is on record that during the thirteenth and fourteenth centuries a pound of ginger cost about the price of a sheep.

British Association Mathematical Tables

THE issue of NATURE of March 17 gave a historical account of the British Association's work since 1888 in the calculation of Bessel functions and of the financial difficulties which have impeded publication. It was pointed out that unless funds were provided, there was a danger that all this labour would result merely in a manuscript locked up in a fireproof safe. We are glad to hear that the appeal for funds has been successful; the British Association has contributed £100 and the Royal Society £50, and the publication of the tables is now assured. They will form vols. 6 and 7 of the Association's collection. The first three volumes have already been noticed

in this journal. Vol. 4, "Cycles of Reduced Ideals in Quadratic Fields", prepared by Dr. E. L. Ince, was published in August, and vol. 5, containing the prime factors of all numbers from 1 to 100,000, is now in the press, and it should be available before the end of the year. This valuable set of tables is not as well known as it should be, possibly because it has not been handled by a publishing firm. New arrangements have now been made, and in future the tables will be sold by the Cambridge University Press.

Seismological Committee of the British Association

THE thirty-ninth report of this Committee is chiefly concerned with the maintenance of the International Seismological Summary. The University of Oxford has agreed to provide room and part of the working expenses until the time comes when these can be met entirely from sources outside the University, such as the International Union for Geodesy and Geophysics, the Crombie and Gray-Milne funds, and the British Association grants. The summary for the third quarter of 1930 is now in course of preparation, and in this the Committee is able to avail itself of the new Jeffreys-Bullen tables, the accuracy of which will greatly help in the determination of epicentres. The precision of the work now being carried on is evident from the suggestion that the time is approaching when the spheroidal form of the earth will have to be taken into account in the estimation of distances.

International Physiological Congress

THE Fifteenth International Physiological Congress will be held in Leningrad and Moscow on August 9–17, 1935, under the presidency of Prof. I. P. Pavlov. Arrangements will be made for visits, after the Congress, to various parts of Russia. The International Committee consists of Profs. Bottazzi, Frank, A. V. Hill, Howell, Johansson, Lapicque, Pavlov and the Congress Committee of Profs. Pavlov (president), Orbeli, Palladin, Beritoff (vice-presidents), Fedorov (general secretary), Volborth, Koshtojanz (secretaries). It will greatly assist the work of the Committee if physiologists intending to be present enrol as early as possible. Correspondence concerning the Congress should be addressed to Leningrad, Main P.O., Box 13.

Iron and Steel Institute

AT the general meeting of the Iron and Steel Institute in Brussels which opened on September 10, it was announced that H.M. the King of the Belgians, Leopold III, has honoured the Institute by accepting nomination as honorary member. This continues the tradition by which H.M. King Leopold II (1874–1909) and H.M. King Albert I (1913–1934) had been honorary members of the Institute. The Council is proposing Sir Harold Carpenter for election as president at the annual meeting of the Institute in May 1935, and Mr. James Henderson, deputy chairman and general manager of the Appleby Iron Company, Ltd., and of the Frodingham Iron and Steel Company, Ltd., and president of the British Iron and Steel Federation, has been elected honorary treasurer in succession to Sir Harold Carpenter, who is resigning at the end of September. The date of the annual meeting for 1935 will be May 1–3.

Announcements

THE following gold medals of the North East Coast Institution of Engineers and Shipbuilders have recently been awarded : Engineering Gold Medal to W. T. Bottomley, E. W. Corlett and Frank Piercy for their paper entitled "The Possibilities of Applying Improvements Effected in Modern Land Power Plant to Ship Propelling Machinery" ; Shipbuilding Gold Medal to N. M. Hunter for his paper entitled "The Electric-Welded Ship *Peter G. Campbell*".

THE second meeting of the Microchemical Club will be held at Reading on September 29. At 11 p.m. the Club will meet at the University for the discussion of papers, and after luncheon a visit will be paid to the National Institute for Research in Dairying, Shinfield, where demonstrations will be given.

DURING the forthcoming winter it will be possible for Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, Harpenden, and other members of the staff, to give lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

A CONFERENCE of malting barley growers and malting barley buyers and maltsters will be held at the Rothamsted Experimental Station on October 10, at 11.30 a.m., when the chair will be taken by Mr. Stanley O. Ratcliff, president of the National Farmers' Union. The purpose of the conference is to enable buyers and maltsters to meet growers and discuss with them the grading of samples. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A demonstrator in applied mechanics at the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1 (Sept. 17). Veterinary officers for the Administrative Counties of East and West Suffolk—The Clerk of the Local Authority, County Hall, Ipswich (Sept. 20). Civilian garrison engineers for the Establishment for Engineer Services at Army stations in Great Britain and Northern Ireland—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (Sept. 22). A lecturer in power plant at the Polytechnic, Regent Street, London, W.1—The Director of Education (Sept. 24). A botanical specialist and an animal breeding specialist in the Fouad I Agricultural Museum, Egypt—The Under Secretary of State, Ministry of Agriculture, Cairo (Sept. 30). A lecturer in physiology at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London (Oct. 17).

Letters to the Editor

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

Wasting Disease of *Zostera* in American Waters*

THE unprecedented widespread occurrence and devastating nature of the prevalent disease of the eel-grass, *Zostera marina*, have been viewed with considerable concern by those directly affected by its disappearance. To plant pathologists and marine biologists, the ecological changes following the total disappearance of the plant from our Atlantic coast[1] and from the western coast of Europe[2] have been a matter of special interest.

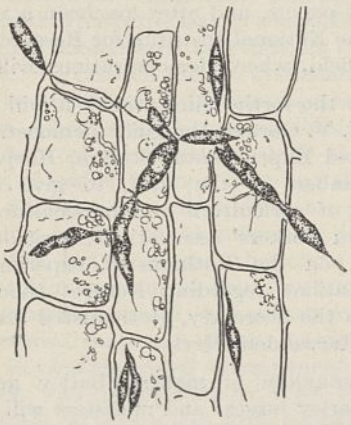

FIG 1. Diagram showing association of the *Labyrinthula*-like organism within leaf tissue of *Zostera marina*.

In the summer of 1933, with the return of sporadic growths near Woods Hole and at various points on the eastern coast[2,3], there was begun in these laboratories a search for an agent responsible for the spotting and darkening of the leaves that are symptomatic of the disease. A number of bacteria were isolated from diseased specimens but none of these demonstrated pathogenicity satisfactorily, although it has been claimed that bacteria are the causative agents[4,5,6]. Further, we have been unable to observe the *Ophiobolus*-like fungi reported by other investigators as commonly occurring on the rhizomes and leaves of diseased plants[7,8]. Rather, all of the specimens that we have examined, taken from various points along the coast and secured locally, show the presence, within the air spaces and in cells of the diseased leaves, of thin-walled, tenuous, spindle-shaped organisms. Their detection in preserved tissue depends upon careful fixation and staining as they are but slightly refractile. They are very difficult to observe in the living tissue, though, it might be mentioned, this has been done.

From our superficial examination the organism appears to be a mycetozoan very similar to the *Labyrinthula* described long ago by Cienkowski (1876), as parasitic upon filamentous marine algæ[9]. The individual organism is spindle-shaped with terminal, often branching, tenuous pseudopods. The air spaces of infected leaves are filled with net-like aggregates of these bodies, the members of which are attached to each other by their filamentous pseudopods.

In zones about the discoloured areas they may occur in more loosely organised chains. Within the cell they bring about disorganisation of the chloroplasts and disintegration of the nucleus—the cell wall is not attacked except at the point of entrance of the delicate pseudopod (see Fig. 1).

The life-history of the organism has not yet been studied in great detail. Further, although it is almost universally present in freshly collected diseased leaves observed by us, we are not satisfied that it is the causative agent of the disease, though it is placed under suspicion as a possible factor. The necessary isolation and inoculation experiments are under way in our laboratories. Despite the unfinished nature of our work, we believe the association of the organism with the diseased condition as found by us to be of sufficient importance to merit the earliest possible attention of those interested in the disease.

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N.J. Agricultural Experiment Station,
New Brunswick, New Jersey.
July 20.

* Contribution No. 53, Woods Hole Oceanographic Institution and Journal Series Paper of the N.J. Agr. Exp. Station.

[1] Cottam, C., *Plant Disease Reporter*, **17**, (6), 46–53; 1933. (10), 1933.
[2] Cotton, A. D., NATURE, **132**, 277, Aug. 19, 1933.
[3] Adams, J., NATURE, **132**, 483, Sept. 23, 1933.
[4] Fischer-Piette, F., Heim, R., and Lami, R., *Bull. Labor. Marit. St.-Servan*, **10**, 17; 1932.
[5] Fischer-Piette, F., Heim, R., and Lami, R., *C.R.*, **185**, 1420; 1932.
[6] Heim, R., and Lami, R., *Ac. d'Agr. France*, Ext. Pr. verbal de la Seance, Juin 14, 1933.
[7] Mounce, I., Report of Biological Board of Canada, 1933, Ottawa, 1934.
[8] Petersen, H. E., NATURE, **132**, 1004, Dec. 30, 1933.
[9] Cienkowski, L., *Arch. Microscop. Anat.*, **3**, 274; 1867.

Vision in the Ultra-Violet

ALTHOUGH normal visible light is generally considered to extend from 7500 A. to 4000 A., most spectroscopists are familiar with the fact that the 3650 line of the mercury spectrum is quite visible. Saidman and Dufestel reported[1] that this latter line is visible after a period of accommodation, and that its colour sensation is identical with that of the 4047 A. line. They report that no lines farther in the ultra-violet are visible. I have recently found with the new Müller-Hilger universal double monochromator normal vision down to 3125 A. This instrument gives monochromatic light of a high intensity and of a very high degree of purity. The purity was confirmed by means of calibrated filters. The 'object' for these tests was the slit of the monochromator, across which were placed two wires $\frac{1}{8}$ in. apart. Most of the observations listed below have been confirmed by eight observers. There were no failures to confirm.

Light of 3125 A. also produced a violet colour sensation similar to that of 4047 A. Considerable difficulty was experienced in focusing the object, unless it was within 4 in. of the eye. When in focus, it appeared to be 9–12 in. away, and the wires appeared to be $\frac{1}{4}$–$\frac{3}{8}$ in. apart. This illusion was very definite and is to be expected, owing to the presumably higher refractive index of the proteins of the eye lens for this wave-length. On removing the eye to a

distance beyond 4 in., the object appeared to recede to a great distance and suddenly to become out of focus. At a distance of 6 ft., the object appeared only as a large ring of about 6 in. diameter. These tests were carried out with a light-adapted eye, and indeed the object could be seen in the normal lighting of the room.

The 3390 A., 3650 A., and 3906 A. mercury lines could also be seen, and gave similar colour sensations. The focusing problem was similar to that above, but to a progressively lesser degree.

With the 3023 A. line, no impression on the retina was observed, but only a pronounced fluorescence of the front part of the eye. This fluorescence was also obtained to a slight degree with the 3125 A. line, but the two effects were quite separable, the fluorescence being merely an illumination with no sense of direction, similar to that produced by a bright light with a closed eyelid. Even with the dark-adapted eye, it was impossible to be conscious of the position of the object when illuminated with light of 3023 A.

No vision nor fluorescence was obtained with either 2536 A. or 2625 A. mercury lines.

The sharp cut-off of vision between 3125 A. and 3023 A. is probably due to a threshold of absorption of light by the proteins of the eye lens, and such a threshold is indicated by the work of Tetsuo Abe[2]. The similarity in the colour sensation of the ultra-violet needs quantitative confirmation, and it may lead to an elucidation of the theories of colour vision.

C. F. GOODEVE.

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July 11.

[1] *C.R.*, **182**, 1173; 1926.
[2] *Arch. Phys.-Biologique*, **6**, 1; 1927.

Analysis of Profiles of Helium Lines in Spectra of *B* Stars

NEAR the normal positions of the diffuse series lines of both par- and ortho-helium, one finds very broad absorption lines in the spectrum of many

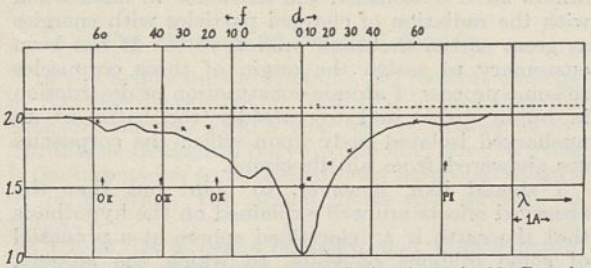

FIG. 1. Profile of the helium group including λ4471 in 88γ Pegasi.

B-type stars. The symmetry of each structure is imperfect in that the violet side represents the stronger absorption, and the profile indicates a complex nature. The purpose of this note is to point out in more detail the characteristics of the profiles, and to suggest possible origins of the main features.

So far as the Stark effect is concerned, we know that the diffuse lines are displaced towards the red only, so that the exceptionally strong violet absorption cannot be attributed to Stark effect on these

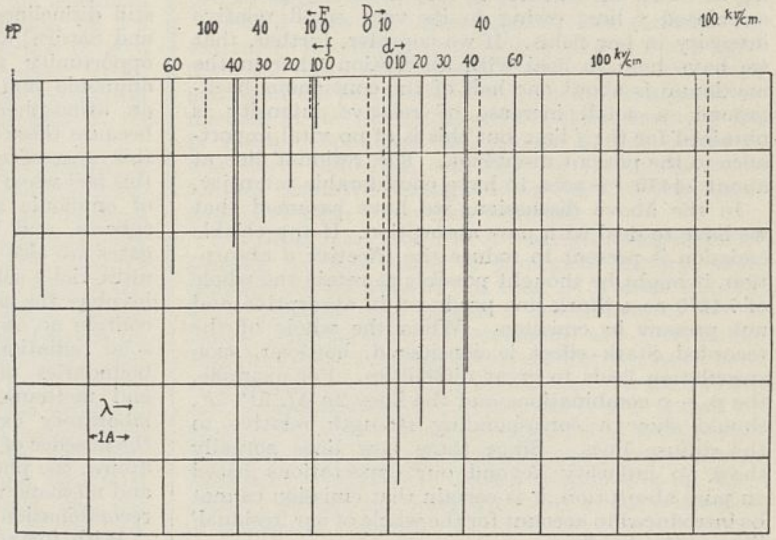

FIG. 2. Theoretical displacements and intensities of helium lines $2p$–$4d$ and $2p$–$4f$ in electric fields.

lines. Nevertheless, clear evidence for the presence of electric fields is found in certain combination lines ($2p$–$5f$, $2P$–$5F$) which remain in nearly the same position at all fields, and hence project sharply into the general profile. Assurance on this point forces us to attribute a generous portion of the red side of each diffuse line to Stark effect. Since electric fields produce no counterpart on the violet section of the d line itself, a very large portion of the violet profile remains to be explained upon some basis other than that of a broad diffuse line.

From our earliest plates of four class *B* stars, it seemed possible to find a qualitative explanation of the contours on the assumption of multiple electric fields in the stellar atmospheres, and, in fact, much remains to be said about the distribution of fields. From quantitative considerations, however, it immediately becomes clear, that it is quite impossible to account for all of the violet structure by Stark effect alone. The new lines have not the right wave-length to explain a large fraction of the stellar absorption; neither have they sufficient intensities. As a result, we find on the violet side of each diffuse line in the stellar spectra, a large section which, both as regards position and intensity, cannot possibly be explained on the basis of Stark effects. By subtracting the maximum possible Stark structure (as determined from the observed red *d* profile) a residual helium line or band is found near λλ4922, 4471, 4388, 4026. The position of the maximum in this band is 1·2 A.–1·7 A. from the diffuse line.

A good example is afforded by λ4471 ($2p$–$4d$) as it appears in 88γ Pegasi of spectral class *B*2. Fig. 1 is a profile averaged from nine three-prism spectrograms of this star taken at the Dominion Astrophysical Observatory. A wedge calibration served to reduce the microphotometer tracings to intensity profiles

for each plate. Fig. 2 illustrates the known displacements and intensities of $2p$–$4d$ and of $2p$–$4f$ in electric fields 0–100 kv./cm. Assuming (roughly) that the portion of the d line due to electric fields is as indicated by the crosses, the ratios in Fig. 2 make possible the calculation of the f line at corresponding fields as indicated. Even if one takes the entire d broadening as Stark effect, there is very little change in the calculated f line, owing to its very small relative intensity in low fields. If we consider, further, that we have here to deal with absorption wherein the maximum is about one half of the continuous background, a small increase of relative intensity is obtained for the f line, but this is of no vital importance to the present discussion. The 'residual' line at about λ4470·1 is seen to have considerable intensity.

In the above discussion, we have assumed that we have to deal with pure absorption. If appreciable emission is present to reduce the effective d absorption, it might be thought possible to retain the whole of λ4470 as a Stark line produced in absorption and not present in emission. When the whole of the recorded Stark effect is considered, however, such speculation leads to great difficulties. For example, the $p - p$ combinations and the lines $2p$–$5f$, $2P$–$5F$, should show a corresponding strength relative to the diffuse lines. Since these new lines actually show no intensity beyond our expectations based on pure absorption, it is certain that emission cannot be introduced to account for the whole of our 'residual' line as Stark effect.

We express our thanks to Dr. J. S. Plaskett for the opportunity to work at Victoria, and to Drs. Beals and Hogg for additional plates taken during the present year. The investigation has been aided by grants from the National Research Councils at Washington and Ottawa.

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A. VIBERT DOUGLAS.

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McGill University, Montreal.
June 5.

The Atmospheres of the Giant Planets

IN their article on the atmospheres of the giant planets[1] Drs. A. Adel and V. M. Slipher suggest that a predominantly hydrocarbon structure might not be at all unlikely for these planets; this conclusion is also indicated, in their opinion, by the fact that the mean densities of these celestial bodies are in a class with densities of most organic liquids.

In a recent paper[2] I tried to explain the low densities of the four outer planets by a modification of certain conceptions of H. Jeffreys, which now may be considered as well established and in accord with the leading ideas of geochemistry. The giant planets are supposed to consist of a core (density 5·5, similar in structure to the earth), a thick layer of ice (density 1·0 under very high pressure) and uppermost, a layer of condensed gases (highly compressed, density 0·35), mainly hydrogen. The mass ratio of the different layers (each supposed as homogeneous) is then fixed by the observed values of mean density and moment of inertia. The numerical evaluation proves a mass ratio of hydrogen to heavy elements which is of the same order of magnitude as in the sun. This result is consistent therefore with the current conceptions about the origin and evolution of the giant planets (formation from ejected solar matter, with no considerable loss of volatile constituents).

This scheme of the internal constitution of these bodies seems to be preferable to the hydrocarbon hypothesis, because it avoids special assumptions. Nevertheless, the remarkable abundance of the saturated hydrogen compounds ammonia and methane requires explanation with respect to their origin and stability. A recent letter from Dr. H. Jeffreys to me stated that "some astronomers here are still disinclined to believe that they [that is, Jupiter and Saturn] are not red-hot". I therefore take this opportunity to point out that the existence of ammonia and methane is quite incompatible with an atmospheric temperature of about 1000° abs., because these compounds are strongly dissociated in this range of temperature. I had omitted to emphasise this fact when I made the first tentative identification of ammonia and methane in the planetary atmospheres, and I may now add that probably these gases are also fairly stable under the influence of the ultra-violet solar radiation. The above quoted model involves the assumption that the atmospheres should contain no oxygen and, therefore, be transparent to solar radiation down to 2200 or 1800 A., the upper boundaries of continuous absorption of ammonia and methane, respectively. From the results of laboratory experiments one would expect that in the absence of appropriate acceptors for free hydrogen atoms, the photochemical decomposition of ammonia and methane would be followed by a nearly complete recombination.

With further knowledge about the photochemical processes in the Schumann ultra-violet and their secondary reactions, it will perhaps be possible to obtain indirect evidence or to exclude the existence in the planetary atmospheres of such compounds as give no absorption bands in the accessible region of the spectrum, but which would play an important rôle as partners in secondary reactions.

R. WILDT.

Universitäts-Sternwarte,
Göttingen.
Aug. 5.

[1] NATURE, **134**, 148, July 28, 1934.
[2] *Göttinger Nachrichten*, 67, No. 5; 1934.

Origin of the Cosmic Corpuscles

THE investigations of A. H. Compton and his associates on the dependence of the intensity of cosmic radiation on latitude support the theory of Lemaître, in which cosmic rays are treated as corpuscular, while the experiments of Kunze and others have established the existence in association with the radiation of charged particles with energies as great as ten thousand million volts. It has been customary to assign the origin of these corpuscles to some process of atomic construction or destruction in outer space, and to consider the earth as an uncharged isolated body upon which the corpuscles are showered from all directions.

I should like, however, to point out that the observed effects are well explained on the hypothesis that the earth is an electrified sphere at a potential of some millions of volts, to which the charged corpuscles, originally of small energies and of interplanetary location, are drawn by electrostatic attraction.

A conductor of the dimensions of the earth, although charged to a potential of many millions of

volts, would be surrounded by an electrostatic field of relatively feeble intensity. For example, the electric intensity at the surface of a charged conducting sphere of radius $6{\cdot}4 \times 10^8$ cm. (radius of earth) at a potential of 10^6 E.S.U. (300 million volts) is 1/640 E.S.U. per centimetre (0·47 volt per centimetre), and the surface density of charge $1{\cdot}24 \times 10^{-4}$ E.S.U. per square centimetre, so that a spherical shell of atmosphere only 1 kilometre in thickness charged with electrons at a concentration of 2·6 electrons per cubic centimetre would suffice to give the earth a negative potential of this value. It is, therefore, possible for the earth to possess a potential of this order, with no striking consequences at its surface.

In seeking a possible origin for such a charge, it is natural to examine Størmer's theory of the polar lights, according to which streams of charged corpuscles enter the atmosphere at comparatively small velocities. If these are assumed to be electrons of solar origin, it is evident that in such a stream the earth, simulating the grid of a triode, would assume a negative potential, the value of which depends on the numbers and energies of the solar electrons, and on the rate of loss of negative charge by it due to the capture of positive corpuscles and the escape of electrons from the atmosphere. In the condition of equilibrium, electrons expelled from the sun with energies of some millions of volts would approach the earth with greatly reduced velocities, and the electrostatic field due to the earth's charge, by spreading the incident beam, would probably assist the magnetic field in directing the electrons into the polar regions.

The large energies of cosmic corpuscles may accordingly be supposed to be derived indirectly from the sun acting in combination with the earth to form a cosmic electrostatic generator of the Van de Graaff type, which maintains the earth at a large, but not of necessity constant, negative potential.

Thus, the hypothesis, which I have suggested above, of a charged earth, affords a simple explanation of the two principal features of cosmic corpuscular radiation, namely, the enormous energies of the corpuscles and the absence of any favoured direction of approach. It suggests that the incident corpuscles are similarly charged and of comparatively local origin, and it is at the same time consistent with the observed fact of the small velocities of approach of the corpuscles responsible for the polar lights.

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Aug. 16.

The Museum of Practical Geology

IN the article on the Museum of Practical Geology in NATURE of July 28, p. 129, it is stated that the Treasury allotted £300 a year for the upkeep of the "Ordnance Geological Survey". While, however, this is the impression to be gained from published sources of information, the actual facts are, briefly, as follows :—

In 1832, De la Beche offered to colour geologically "eight sheets of the Ordnance Map of England, comprising Devon, with parts of Cornwall, Somerset, and Dorset" for the sum of £300. In 1835 he informed the Board of Ordnance that the maps had been completed, and suggested that the work should be extended to other areas. Following upon a favourable report by a small committee representing the Geological Society (comprising Lyell, Sedgwick and Buckland), the Government decided "to direct the continuance of a Geological Survey on the scale of the Ordnance Maps". Col. Colby reported that the probable cost would be £1,000 per annum, "independent of any salary which it might be deemed proper to give to Mr. De la Beche".

Behind these bare statements of fact there lies an extremely interesting story which throws much light upon the state of geological knowledge at the time, and upon the perseverance of De la Beche himself. A mistake in the identification of certain strata by De la Beche jeopardised the scheme almost before it was fairly launched, and but for the sympathetic interest displayed throughout by Col. Colby it might well have been completely wrecked.

For some years past I have been gathering material relating to this phase of geological history, and, through the kindness of Col. J. I. D. Nicholl and Mr. H. S. Gordon (the former a descendant of De la Beche, and the latter of Buckland), also Prof. Sollas and the Director of the Ordnance Survey, have been able to peruse much relevant correspondence. There are, however, still gaps in the story, and I shall be grateful to receive news of unpublished letters that passed between the pioneers (especially De la Beche, Buckland, Conybeare, Lyell, Sedgwick and Murchison), should any such letters be in the possession of readers of NATURE.

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Aug. 14.

Origin of the Wever and Bray Phenomenon

IT has been shown by Witmaack and more recently confirmed by Kaida[1], that following division of the VIII nerve in the cat central to the peripheral cochlear and vestibular ganglia, the ramus cochlearis fails to conform with the well-known Wallerian law in that the nerve elements including the spiral ganglion distal to the point of section undergo degeneration. In the following experiment, use has been made of this fact to adduce evidence bearing upon the problem of origin of the potential changes generated within the intact mammalian cochlea, in response and of a frequency corresponding to physiologically applied sound waves (Wever and Bray phenomenon).

Unilateral section of the VIII nerve was carried out in a full-grown cat. Six months later the electrical reactions of the two cochleæ were investigated. On the unaffected side, the Wever and Bray potentials, as also the potentials in the corresponding auditory tracts, were found to be of high amplitude and were recorded after suitable amplification upon moving ciné-bromide employing a cathode ray oscillograph. Upon switching over to electrodes already placed in position upon the affected cochlea and corresponding auditory tracts, no response could be elicited to any frequency (100~ – 6000~) using higher intensities of sound (some 40 decibels) with maximum amplification.

Intra-vital fixation of the two ears was at once carried out. This procedure followed by celloidin embedding made possible a highly critical examina-

tion of the histological features of the two ears concerned. On the affected side, all neural elements in the cochlea had disappeared apart from a few scattered and atrophic members of the spiral ganglion and some neurilemmal remnants. All other features of the affected cochlea, the rods, and hair cells of Corti's organ, Reissner's and the tectorial membrane, the stria vascularis, and the capillaries with contained fresh blood cells, were perfectly preserved and indistinguishable morphologically from these structures as found in the opposite unaffected ear, in which, however, the ganglion cells and other neural elements were present in normal numbers and preservation. No abnormalities were present in the middle or external ear on either side.

Since thus the only demonstrable histological difference between the two ears was the absence of neural elements upon the side exhibiting a conspicuous and carefully attested absence of electrical response, it is considered that the experiment described furnishes striking evidence, though of a purely morphological character, in support of the view that the cochlear potential changes constituting the Wever and Bray phenomenon are of neural origin.

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[1] Kaida, Y., *Jap. J. Med. Sci.*, 12, 1, No. 2, 237; 1931.

Wing Pattern in Butterflies

THE genus *Lethe* (Lepidoptera, Satyridæ) belongs to the largest in its family and is therefore of considerable interest as to the dependence of its wing-pattern upon the general Nymphaloid prototype established by one of us[1]. In spite of the fragmentary character of materials at our disposal, we have been able to ascertain that the above prototype represents a basis of the wing-pattern of *Lethe*, just as is the case in a number of other genera of Nymphaloid families[2].

Besides this main fact, several directions of wing pattern evolution have been studied in *Lethe* by the method of comparative morphological series, and some remarkable processes discovered. Perhaps the most striking of them is the group of processes culminating in the wing pattern of *Lethe argentata*. A number of dislocations, ruptures, coalescences and other modifications affecting the prototype components result in the fact that the general appearance of *argentata* pattern reminds one in a way of that of the swallow-tail *Papilio podalirius*, though the homologies of the two are, of course, very different. A very demonstrative example of the 'destruction' of prototype stripes and spots by the light interspaces lying between them has been discovered, and some other interesting phenomena recorded.

A paper dealing with the above data is now in press in the *Acta Zoologica*.

B. N. SCHWANWITSCH.
G. N. SOKOLOV.

Entomological Laboratory,
University of Leningrad.
July 5.

[1] B. N. Schwanwitsch, *Proc. Zool. Soc. London*; 1924.
[2] B. N. Schwanwitsch, *Zeit. Morph. Oekol. Tiere*, 13; 1929. 21; 1931. B. N. Schwanwitsch, *Trans. Zool. Soc., London*, 21; 1930.

Sparrows and Bees

THE weather of the first fortnight of July 1934 was abnormally hot and dry, which condition may account for the following interesting observations made on two hives of bees, in the garden of the Convent of Notre Dame, Ladywood, Milngavie, near Glasgow.

One hive had not swarmed, and was very strong. Drones were leaving it during the middle of the day in fairly good numbers. They did not seem to have power of flight, due perhaps to the fact that worker bees had given them an injection or starved them. (This onset of what looked like preparation for winter conditions may have been induced by lack of moisture to form a sufficient quantity of nectar. The hive became normal when damper weather returned.)

Sparrows were evidently suffering from the drought, and consequently took advantage of the helpless condition of the drones to pounce upon them, kill them, much as a bird does a large worm, eat them, and especially one pair of birds, feed their young, still in the nest, under the roof of the house. They then began to attack and carry off the worker bees, catching them on the wing, or as they fell heavily laden to the ground, before they had time to rise. Both cock and hen did this, but the hen was especially daring. She perched on a vertical rod in front of the hive, and dived on to the alighting board time after time and never failed to carry off a bee. The hive was a very busy one, so it was fairly easy to secure a victim, on account of the crowded condition of the alighting board.

An improvised netting protection failed to deter the depredations of the sparrows, who crept under and went on. Some bread and milk and other dainties placed nearby at last tempted them away, and with the onset of moist weather they eventually abandoned the attack.

The sparrows made no attempt to go to the second hive, which was weaker, having thrown off two big swarms. Since there were fewer bees going in and out, they were less easy to secure, and a miss might have aroused the ire of the rest and brought out an angry attacking force.

The bees are French black or grey like the British. Though the stocks originally consisted of one Dutch, and the other French, the Dutch seem to have disappeared and only French remain.

SISTER VERONICA.

Notre Dame,
Dowanhill,
Glasgow.
July 30.

Design of Theodolite Axes

THE 'Wild precision theodolite'—a light-weight type of primary triangulation instrument—is well known for the ingenuity and compactness of its design as well as for the superb workmanship exhibited in its construction. The couplings of the instrument mechanism, however, are designed on machine tool principles, and although the tolerances on the cylindrical fits of the axes are very small, a recent investigation by J. L. Rannie and W. H. Dennis[1] of the Geodetic Survey of Canada, Department of the Interior, Ottawa, has shown that the performance of a number of these instruments was not satisfactory.

Many consider that the highly accurate perform-

ance of such an instrument as the theodolite when carefully made is sufficient proof that axes designed as straight or slightly tapering cylindrical members fitting their mating elements with extensive surface contact are good enough for any instrument and nothing further need be said. But it is not possible without extraordinary precautions to make geometrically perfect cylindrical elements, and though the deviation from geometrically circular form in manufactured elements may not be sufficiently great to affect the readings of a theodolite by axis shift during rotation of telescope or circles, it may easily give rise to a serious source of error by slight but variable resistance to motion which is communicated to the instrument indications as a strain shift in an irregular manner. With decrease of the tolerances a more pronounced effect of this kind during relative motion of the two elements would be expected, and when the clearance between the functional surfaces reaches very small dimensions, the shearing of the lubricant may also cause the pointings and circle readings to change with time.

These defects will appear in the indications as systematic errors confused with the accidental errors, since the probable error is merely a measure of the agreement of average repeated readings and is not a measure of the accuracy of a reading. The two kinds of error can be separated, however, by devising special tests to establish a standard probable error of the accidental errors peculiar to the instruments and methods used. The systematic errors will then be revealed as an increment of the standard probable error.

It is by such specially arranged tests on the Wild instruments that Rannie and Dennis have been able to separate the systematic errors known to exist. "All of the evidence, . . . , indicated that angular errors of appreciable magnitude—of the order of 2″ to 4″—may have resulted from strain or other axis trouble in at least nine of the 10 Wild theodolites examined."

The authors then proceeded to modify the alidade and telescope axes so that the unavoidable imperfections of geometric form would have no effect upon the instrument indications. That is to say, when the telescope was rotated in azimuth or transited, no irregular resistance to the movement would take place and consequently no elastic deformations would upset the circle readings.

The original paper should be consulted for the details of the modifications the authors were able to make, but it is sufficient to state here that the alterations to the axes conformed to kinematical principles as closely as the existing design would permit. After each instrument had been remodelled in this way, it was again taken through the previous tests, which showed that not only had the systematic errors been eliminated but also that in addition the accidental errors had been slightly reduced.

This paper, embodying the results of exhaustive tests upon the performance of certain theodolites by the Chief of the Triangulation Division and the District Engineer of the Geodetic Survey of Canada, surely must be regarded as one of the most important, if not the most important, contribution to the design of theodolites in particular and of measuring instruments in general which has hitherto been published.

It has conclusively shown that the usual machine-tool design applied to an instrument of high precision, no matter how perfect the workmanship may be, is fundamentally wrong. It has shown that even an approach to correct or kinematic design of the couplings at once improves the reliability of the instrument indications, and incidentally it has shown that equally strict attention must be given to the design of subsidiary parts, such as levelling screws, if the best results are to be obtained.

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South Kensington, S.W.7.
Aug. 3.

[1] "Improving the Performance of Primary Triangulation Theodolites as a result of Laboratory Tests", *Canadian J. Research*, **10**, 347; 1934.

Accuracy of Least Squares Solutions

I HAVE recently obtained the solution of this problem: Given n linear equations of condition in m unknowns, and that (1) the set of errors of the equations of condition are a sample drawn at random from a normal population of unknown standard deviation σ, and that (2) nothing more is known about the values of the unknowns or of σ than that which can be inferred from the equations of condition, then (A) what are the values of the unknowns? By rigorous, direct methods, and with no further assumptions, I have obtained the distribution functions in answer to question (A). They are the same as those which Jeffreys[1] obtained in semi-intuitive fashion, by making the somewhat arbitrary assumption that the "prior probability" that σ lies in a certain range $d\sigma$ is proportional simply to $d\sigma/\sigma$.

I have also obtained by direct arguments, with no assumptions other than (1) and (2), the answer to question (B): What is the value of σ? This distribution function is considerably more complicated, involving m and $\Sigma\delta^2$ as it should, than $d\sigma/\sigma$; and if one uses the function as a "prior probability", one can obtain in this second, indirect fashion the same answer as before to question (A). I think that Jeffreys's conclusions were highly creditable to his insight, although I am compelled to agree with Fisher[2] and Bartlett[3] that his arguments were fallacious. I shall publish the new treatments in due course. T. E. STERNE.

Harvard College Observatory,
Cambridge, Mass.
June 25.

[1] Jeffreys, *Proc. Roy. Soc.*, A, **138**, 48; 1932.
[2] Fisher, *Proc. Roy. Soc.*, A, **139**, 343; 1933.
[3] Bartlett, *Proc. Roy. Soc.*, A, **141**, 518; 1933.

Velocity of Reactions in Solution

IN a recent publication, Williams and Hinshelwood[1] reach the important conclusion that the influence of substituents on the velocity of benzoylation of aromatic amines in benzene solution depends principally on changes in the activation energy, that is, E in the expression $k = PZe^{-E/RT}$. Changes in P, a factor independent of the activation rate, are of much smaller importance as long as the medium is unchanged.

This publication is welcomed as affording lateral support to the conclusion already reached by my collaborators and myself on the basis of (1) the temperature effects, and (2) the additive effects observed, that the relative rates of chlorination of substituted phenyl and tolyl ethers in 99 per cent acetic acid are dependent solely on the activation energies. A summary and discussion of these results, which appear to have been overlooked by Williams

and Hinshelwood, are given in *Chemistry and Industry*[2], where full references are to be found. An extension of the measurements to the bromination of ethers in 50 and 75 per cent acetic acid indicates that, within the range so far examined, change in medium and/or reagent is accompanied by a change in the activation energy such that $E_1 = mE_2$, where m is a constant independent of the constitution of the ether. Details of these measurements will be published later.

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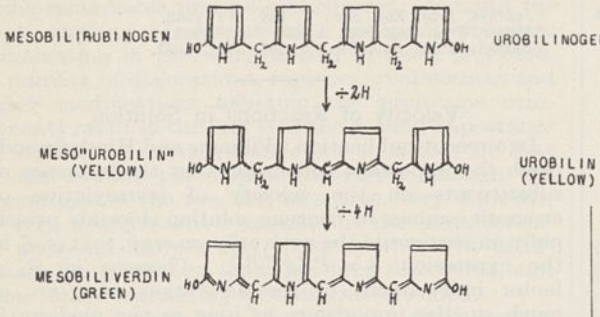
[1] *J. Chem. Soc.*, 1079; 1934.
[2] *Chem. and Ind.*, 254; 1932.

Urobilinogen

SINCE Fischer and Meyer-Betz isolated crystals of mesobilirubinogen from a pathological urine[1], it has been generally assumed that urobilinogen and mesobilirubinogen are identical. However, Watson[2] was unable to reduce crystalline urobilin from fæces or urine to crystals of mesobilirubinogen.

My experiments give further evidence of the non-identity of the two chromogens. Natural urobilin and 'urobilin' from mesobilirubinogen show a very slight, but definite, difference in the position of their absorption maxima in acid alcohol (490·9 and 493·2 mμ respectively in the Hartridge reversion spectroscope). With ferric chloride, mesobilirubinogen and also its 'urobilin' are dehydrogenated to mesobiliverdin and mesobiliviolin, whereas urobilinogen from normal urine and fæces and from pathological urine (splenic anæmia) is only changed into urobilin[3]; the latter is completely stable against ferric chloride. It makes no difference whether urobilinogen is obtained directly from urine or fæces or by reduction of urobilin with sodium amalgam; nor is mesobilirubinogen changed into urobilin, if subjected to the procedures involved in the preparation of the latter from fæces or urine.

These observations prove that the two chromogens differ in their skeletal system, not (or besides) in the side chains. For the deep colour of the green and violet pigments is caused by a chain of conjugated



double bonds going through the system of the four pyrrole rings. The assumption of two carbonyl groups standing between the pyrrole rings I and II and between III and IV in urobilinogen instead of two CH_2-groups in mesobilirubinogen would appear to be in agreement with the analytical findings of Watson for urobilin and would explain the impossibility of further dehydrogenation beyond the urobilin state. In the above formulæ the side chains have been left out. Experiments to prove the carbonyl groups and to reduce them to CH_2-groups are being made.

Thus urobilinogen is not a simple product of reduction of bilirubin by the intestinal bacteria, but a product of dismutation or oxidation of bilirubin. That the bile pigment is subjected to such processes in the intestine is shown by the presence of mesobiliviolin in the fæces (Watson). This contains four hydrogen atoms more than bilirubin in the side chains (two ethyl groups instead of two vinyls), but as I found recently, four atoms of hydrogen less than bilirubin in the skeletal system.

It seems extremely improbable, however, that Fischer was mistaken in the isolation and identification of his mesobilirubinogen. The only remaining explanation is that in some pathological cases (that of Fischer was one of liver cirrhosis[4]) mesobilirubinogen may occur instead of urobilinogen[5]. It seems not impossible that in cases of extensive liver damage, bilirubin is reduced by the liver, perhaps an infected liver, to mesobilirubinogen and that this reaches the kidney without passing the intestine[6]. The differentiation of the two urobilinogens is therefore of importance in clinical diagnosis. It should be mentioned that there is no reason for the clinician, who bases his determinations of urobilin directly or indirectly on the mesobilirubinogen standard, to get alarmed. There is apparently no difference between the two chromogens as regards their standard value for the Terwen—Ehrlich estimation.

RUDOLF LEMBERG.

Sir William Dunn Institute
of Biochemistry,
Cambridge. July 24.

[1] Fischer and Meyer-Betz, *Z. physiol. Chem.*, **75**, 232; 1911.
[2] Watson, *Z. physiol. Chem.*, **204**, 57; 1932. **208**, 101; 1932. **221**, 145; 1933. *Proc. Exp. Biol. and Med.*, **30**, 1207, 1210; 1933.
[3] Lemberg, *Chem. and Ind.*, **53**, 179; 1934.
[4] Fischer, *Z. f. Biol.*, **65**, 163; 1915.
[5] Hoesch (*Biochem. Z.*, **167**, 107; 1926) observed that some urines gave violin bands with ferric chloride, whereas others did not.
[6] Lichtenstein, *Münchener mediz. Wochenschr.*, **72**, 1962; 1925. Weiss, *Biochem. Z.*, **207**, 151; 1929.

Fish Liver Oils Rich in Vitamin A

THE outstandingly high vitamin A content of the liver of the halibut (*Hippoglossus hippoglossus*) has led to considerable commercial interest in any species giving a liver oil of a potency comparable with halibut liver oil. In the same family as the halibut, several of the larger species give rich oils, but they are not of the same order of potency as good halibut oils. Samples of sturgeon (*Acipenser* species) liver oils examined varied widely in potency, as with halibut liver oil, and seemed quite comparable, the best sample showing 4,000 blue units in the antimony trichloride test for 0·2 c.c. of a 20 per cent solution. Recently, the liver oil of the tunny fish (*Thunnus thynnus*) has been examined. The oil was rich in vitamin A, the blue values for three samples being 1,927, 1,993 and 2,724. The livers contained about 20–25 per cent of oil. The particular fish used were caught off Scarborough.

Torry Research Station, J. A. LOVERN.
(Department of Scientific and
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Aberdeen. Sept. 3.

Research Items

Lea Valley Mesoliths. A mesolithic site at Broxbourne has been described by Messrs. Hazzledine Warren, J. G. D. Clarke, W. A. MacFadyen and H. and M. E. Godwin (*J. Roy. Anthrop. Inst.*, 64, pt. 1). The industry lies above the deposits of the Tundra stage, which is to be correlated with the Magdalenian, and below the peat of the Boreal Forest epoch. The site is situated in Rikof's Pit in the Lea marches, east of Broxbourne railway station. The flints described come from one only of a number of sites identified. This site was small, not exceeding 15 ft. in diameter, and could have been occupied by few people only. The surface below the peat was sand. Owing to the conditions of examination, the flints may be regarded as a completely representative series, with the debris of manufacture, sealed by a peat deposit soon after manufacture. A number are calcined by fire. Five types of point, including micro-burins, are identified. There are also cores, burins, scrapers, axes and hammerstones. As regard its cultural affinities, Broxbourne belongs to the Forest Culture A, which correlates with the Boreal climatic period. Typologically, Broxbourne falls into the group of axe, burin and non-geometric microlith industries of south-east England, which represents an extension of the mesolithic forest cultures of Baltic lands; while by the pollen analysis, here described, it can be dated independently of typological considerations as belonging to Boreal times. Owing to the fortunate circumstances of its discovery and examination, and the incomplete character of the evidence from other similar sites in Britain, Broxbourne must be considered the type site of Forest Culture A in Britain. The Continental sites with which it may be compared are Svaerdborg, Mullerup, and Holmgaard in Sjaelland and Duvensee near Lubeck, all dated on botanical evidence to the Boreal period.

The Ovimbundu of Angola. Mr. Wilfrid D. Hambly, as leader of the Frederick H. Rawson-Field Museum Ethnological Expedition to West Africa, undertook research in Nigeria and Angola from February 1929 until February 1930, and made a study of the Ovimbundu of Portuguese West Africa and their culture contacts (Field Museum of Natural History, Chicago, *Anthrop. Ser.*, 21, No. 2). The Ovimbundu live on the central plateau of Angola, the Benguela Highlands, which rise in places to an altitude of 6,000 ft. Their villages are built on the hillside, and the nature of the ground affords them a natural protection from their enemies. There are two main physical types, one having a brown skin colour and slender build, while the other is a shorter, darker and more sturdy type. The Ovimbundu are Bantu negroes, who possibly result from a crossing of Hamites and true Negroes. This would account for both types. Topography and climate fix certain conditions, which favour agriculture and cattle-keeping on an extensive scale; while a sufficient rainfall favours the growth of timber serviceable for the craftsman. One of the fundamental factors in their economic life is the division of labour on a sex basis. In recent times, the loom and the conical furnace for smelting iron have disappeared, owing to the increasing importation of foreign cloth and the facilities for obtaining scrap iron. Bark cloth is no longer made. Drum signalling has declined with the decrease of warfare, and for the same reason the double gong is now rare. Originally the Ovimbundu were cannibals. This practice was intimately associated with slavery, as only slaves were eaten in the ceremonial feasts; but with the discouragement of inter-tribal warfare under the Portuguese, the capture of slaves became obsolete. There are numerous resemblances between the cultural pattern of the Congo region and that of the Ovimbundu of the present day. A number of cultural identities support the thesis that the Ovimbundu are of the central African matrix of culture.

American Opossums. A thorough revision of the genus *Marmosa* has been made by G. H. H. Tate (*Bull. Amer. Mus. Nat. Hist.*, 66, 1933), so that, with the new forms described, the genus now includes 49 species and 100 recognisable sub-species, all belonging to five well-marked groups. The bulk of the work, of 250 pages, is taxonomic, but the introduction contains much of general interest. Colour bears a relationship to environment parallel to that shown by some other groups of mammals and birds: the species of the humid Andean region are nearly all dark brown, the forest forms grey tinged with brown, the natives of the dry areas of Ecuador and Peru are grey. Certain definite trends suggest to the author that orthogenesis has been at work: there is a tendency for the pouch to disappear and the mammæ to spread to the pectoral region, for the primitive arboreal habit to be replaced by terrestrial or aquatic habits and for the development of a food-storage mechanism, as in the thickened tails of some southern genera.

Reduction of Carapace in Chelonians. It is a remarkable fact that although reptiles usually possess more ribs than other vertebrates, those reptiles—the Testudinates—in which the bony skeleton is most exaggerated have fewer ribs than the majority of mammals. Reduction of the carapace may be due to atrophy of some parts owing to hypertrophy of others, or it may be due to an inhibition of growth (P. E. P. Deraniyagala, *Spolia Zeylanica*, 18, May 1934, p. 211). Where the species is a land-living form, the inhibition affects only the bony corselet of the carapace but not the scales or scutes, but in aquatic forms both components of the carapace are reduced. Indeed, in pleurodirous forms, loss of scales and scutes precedes osseous inhibition. The loss, necessarily associated with aquatic habit, seems to proceed as follows. The marginals act as guards to the free ends of the ribs, and form a rim to support the dermal carapace which they raise off the plastron. These requirements are essentially terrestrial. In aquatic forms, inhibition of the costal plates isolated the costal marginals and, no longer necessary as a rim support in the new medium, they were the first to disappear. In water, the carapace no longer presses down upon the plastron, and since also the ribs, shortening in proportion to the length of the inhibited costal plates, could no longer be protected at their tips by marginals, all the remaining marginals became functionless and disappeared.

Cytogenetics of *Digitalis*. The genus *Digitalis* shows several interesting genetic and cytological features. Six European species, including *D. ambigua*,

D. purpurea and *D. dubia*, have $2n = 56$ chromosomes, while three species, *D. eriostachya*, *D. lutea* and *D. obscura*, belonging to southern Europe, are tetraploid, having $2n = 112$. A new constant tetraploid species, *D. mertonensis*, was produced a few years ago from a fertile F_2 plant derived from a cross between *D. purpurea* and *D. ambigua*. Messrs. B. H. Buxton and S. O. S. Dark (*J. Genetics*, **29**, No. 1) record the results of various crosses between these species. The hybrids are generally matroclinous, and differences occur in the reciprocal crosses. In crosses between the diploid species the F_1 is completely sterile, as are also the hybrids between *D. mertonensis* and *D. lutea* or *D. eriostachya*. Although the last two tetraploid species are indistinguishable in their flowers, which are very small, yet their hybrids with *D. mertonensis* are markedly different. This appears to be due to genes expressing themselves in the hybrid but not in the parent species. In these hybrids there is much more pairing of the chromosomes than in crosses between *purpurea* and *ambigua*, from which it is concluded that the wild tetraploid species have originated in the same way as *D. mertonensis*. By crossing the latter with diploid species, various triploid tri-hybrids were produced, all of them sterile. It is concluded that in the evolution of the genus there was differentiation into at least two groups of diploid species with quite unlike chromosomes.

Researches on *Euchæto norvegica*. This is one of the largest known copepods, and has a wide range of distribution in northern waters. It is a very important fish food in America, but in Loch Fyne in the Clyde sea-area where it occurs in abundance it is never found in the stomach of the herring, which is surprising, for it is rich in oily matter. It probably, however, serves indirectly as herring food as *Meganyctiphanes* eats *Euchæta* and is eaten by the herring. Mr. A. P. Orr, in his paper "The Weight and Chemical Composition of *Euchæta norvegica*, Boeck" (*Proc. Roy. Soc. Edin.*, **54**, Part 1, No. 5), describes the analyses of material taken from catches made in Loch Fyne in October and November 1931. The values of fat and protein differ considerably from those hitherto recorded for marine plankton which last were, however, based on mixed plankton catches and with smaller organisms. The present results show *Euchæta* to be a very rich food for fish, the fat content of adult males being about 23 per cent of the dry weight and that of non-ovigerous adult females 21 per cent, and the ovigerous females much fatter (36 per cent). The average value of the protein was 36 per cent. Dr. A. G. Nicholls in No. 4. of the same part of the *Proceedings* describes the developmental stages of *Euchæta norvegica*, reared by him in the Millport Laboratory. This is a very beautiful piece of work and those who understand the difficulties involved in rearing the young stages of any copepod will appreciate the care that must have been taken to attain the desired results. The six nauplii and first copepodite stages were successfully reared; good descriptions and figures are given and the growth and development compared with that of *Calanus*. It appears that *Euchæta* passes through its nauplius stages without feeding, being dependent on its large supply of yolk.

Insects and Spike-Disease of Sandal. Part 1 of vol. 20 (May 1934) of the *Indian Forest Records* consists of a paper by Messrs. Cedric Dover and M. Appanna on insect transmission of the above disease. These authors state that field investigations and biological analyses strongly support the conclusion that spike-disease is transmitted by insects. Experiments with 31 species of Hemiptera appear to confirm the theory previously advanced that *Moonia albimaculata* is a very possible vector. Suggestive symptoms have occurred in five well-defined cases, as the result of infection with viruliferous individuals of this species. Cytological study of the plants involved have, furthermore, revealed the presence of characteristic intracellular inclusions. In a single case an apparent infection by an aphid (*Macrosiphum*) is recorded as the result of transmission experiments. Their observations lead to the conclusion that mandibulate insects are not vectors of the disease. In a postscript to the above paper, Dr. C. F. C. Beeson, forest entomologist at Dehra Dun, mentions that the special grant subsidising spike-disease expired in 1933, and the investigation has had to be closed down. Further experiments dealing with the transmission of the disease by *M. albimaculata*, which were then in progress, had to be abandoned. While the various papers on the subject, so far published, will form a useful basis for any future research, the Board concerned with the investigation is not wholly agreed that the available evidence, so far obtained, affords conclusive demonstration that spike-disease has been experimentally transmitted by any species of insect.

Root Systems of Apple Trees. Messrs. W. S. Rogers and M. C. Vyvyan have recently reported the results of their continued studies on the extent and character of root systems of apple trees (*J. Pomol. and Hortic. Sci.*, 12, No. 2, 110–150, July 1934). The present investigation relates to twenty-six trees on various clonal root-stocks growing on three types of soil—loam, sand and clay. In all cases, the roots spread further than the branches, and fine roots grew in all directions. The ratio of the weight of stem to weight of root was 2–2·5 in loam soil, about 2·1 on clay, and 0·7–1 in sand. The ratio was comparatively constant for a given soil, and did not vary appreciably for trees of markedly different vigour. The deepest roots (9 ft. 6 in. below the surface) were found on Stock No. IX (very dwarfing), and generally speaking, the more vigorous stocks had shallower root systems. Earlier statements about the extent of root systems of apple trees are substantiated with further data, but the possible modifying influence of a water table is discussed. A useful appendix, describing the methods of excavation and grading, is added.

Plant Disease in Great Britain. The Ministry of Agriculture and Fisheries has recently issued Bulletin No. 79, "Fungus and other Diseases of Crops, 1928–1932" (London: H.M. Stationery Office, 2*s*. June 1934). The publication is a useful survey of fungus and virus diseases which have occurred in England and Wales during the last five years. Thirty-three plant pathogenic bacteria and fungi which are either new to science or have not been previously recorded for Britain, and twenty-eight uncommon species, are enumerated. Brief introductory chapters on weather conditions, progress in control measures, and scheduled plant parasites form a useful prelude to the descriptions of diseases. Host plants are subdivided under the following headings: cereals, potatoes, roots and fodder plants, pulse, pasture and forage crops, vegetables, fruit, hops, mushrooms and flax, ornamental plants, and bulbs, corms, etc. Extensive

indexes of parasites and of non-pathogenic and virus diseases enable the reader to review the latest findings on any particular problem in plant pathology. As knowledge expands, it becomes increasingly difficult for one worker to review the whole field even of his particular study, and the volume under notice is an excellent collection of up-to-date knowledge. Dr. G. H. Pethybridge, Mr. W. C. Moore and Dr. A. Smith are the joint authors, though much of the subject matter has been contributed by collaborators in all parts of the country.

Correlation by Radioactive Minerals. The age of the metamorphic rocks of eastern Connecticut has long been an unsolved problem. An important contribution towards its solution has been made by W. G. Foye and A. C. Lane (*Amer. J. Sci.*, August). Three analyses of uraninite by F. Hecht show that the Strickland pegmatites date back some 280–290 million years, indicating that they were injected during the Acadian orogenesis of late Devonian time. The Bolton schist, which is intruded by the Strickland dykes, can be correlated with the Brimfield schist of Massachusetts, and since both must be older than the Carboniferous, they cannot be correlated with the Worcester phyllite, which is known already to be of Upper Carboniferous age. The pegmatites are associated with the Monson granodiorite, and the Dedham granodiorite of Massachusetts is of the same age. Both igneous masses may therefore be reasonably referred to the Devonian. An important by-product of the investigation shows that the factor k in the lead-ratio $Pb/(U+k.Th)$ is about 0·36, as adopted in "The Age of the Earth" (Bull. 80, National Research Council, 1931), and not 0·25 as advocated by Kirsch. Fenner's analysis of a monazite (free from uranium) from the same Strickland quarry gives an age of 278 million years when the factor 0·36 is used. This result corresponds very closely with those for the uraninites, which are poor in thorium. Had the smaller estimate for k been used in calculating the age of the monazite, the latter would have been only 221 million years.

Specification of Optical Glass. It has been customary in the past to specify the properties of an optical glass by its refractive index n_D for the middle of the D lines of sodium and by its reciprocal dispersion, $v = (n_D-1)/(n_F-n_C)$ now called its constringence, where n_F is for the blue and n_C for the red line of hydrogen. This specification entailed three determinations of refractive indices. In a review of an extensive series of glasses available in Great Britain by Mr. T. Smith of the National Physical Laboratory (see NATURE, April 16, 1932, p. 584), it was pointed out that if the constringence were defined as $(n_F-1)/(n_F-n_C)$, only two determinations would be necessary. Mr. Smith also urged glass makers to publish charts in which each glass was represented by a point on n, log v scales. He showed also that for many glasses the change of n was proportional to the change of a power, not differing much from unity of the wave number of the transmitted light. In a new list of nearly 80 optical glasses, Messrs. Chance Brothers adopt the n, log v chart, but the logs are from 0·40 to 0·88 instead of from 1·40 to 1·88. They adopt n_D-1 where n_D is the refractive index for the yellow line of helium, for the numerator of the constringence and give the values of the partial dispersions throughout the spectrum in preference to using the suggested wave number power relation. An improvement which will be much appreciated by designers is the substitution of the specification of each type of glass by a number, the first three digits of which are the excess of the refractive index of the glass over unity and the remaining three the constringence, for the former method of using random letters or numbers.

Electric Waves in Insulators. The variations of the dielectric constants of insulating media with the wave-length of the oscillations they are propagating, and in particular the great decrease in value which takes place as the wave-length decreases from 1000 to about 1 metre, have been explained as due to conduction, which gives a 'normal' dispersion, to free periods of the molecules giving resonance, and to the existence of dipolar molecules the orientation of which is influenced by the electric field. Dr. Werner Ziegler has examined the experimental results available to determine to what extent the last two theories will explain 'anomalous' dispersion (*Phys. Z.*, June 15). For pure liquids—water, alcohols and ethers—the dipolar theory affords an adequate explanation, but for glycerine and insulating oils it is not satisfactory, nor is the resonance theory any better. For the oils, conductivity appears to play the most important part. For solid insulators, both conductivity and polar theories must be appealed to, while for gases the data available are not yet sufficient to show whether the resonance theory is adequate. References to more than a hundred recent papers are given.

Flow of Water under Structures on Sand Foundation. There has been issued from the Punjab Irrigation Research Institute in two parts (*Research Pub.*, 2, Nos. 3 and 4. Government Printing Office, Lahore. 5*d*. each) a dissertation by Dr. E. McKenzie Taylor, the director of the Institute, and Mr. Harbans Lal Uppal, assistant research officer, on the nature and lines of flow of water through sand under models which have been designed to give the effect of standard methods of construction. A full description of the apparatus is given in Part 1; it consisted of an experimental tank, 3 ft. 10 in. long, 2 ft. 6 in. deep and 2 ft. wide, with pipe connexions for draining away the water and providing an outlet for the sand. The model, made in teak, having been inserted in the tank, with watertight jointing at the sides, the stream flow was studied by means of the reaction between solutions of potassium chromate and silver nitrate, each of 1 per cent strength. The sand was first saturated with the potassium chromate. Silver nitrate was then introduced at intervals into the sand on the upstream side by means of a series of tap funnels the points of which were drawn out so as to give a fine stream. The silver nitrate reacted with the potassium chromate and gave a red precipitate along the line of flow, which was then photographed through the glass plate with the aid of suitable illumination. A number of photographs are reproduced in the pamphlets showing the stream lines under an impervious floor and under various types of foundations of sheet piling and impervious aprons. It is stated that probably the most important result obtained from the experiments is the observation that 'creep' (that is, a major line of flow in contact with the work) is non-existent. This may have an important bearing on future design. It is added that a floor protected by upstream and downstream sheet piles and aprons appears to be the most stable form of work possible.

International Federation of Eugenic Organisations

THE eleventh Assembly of the International Federation of Eugenic Organisations was held in Zurich with various conferences on July 18–21 under the presidency of Prof. E. Rudin. Eighteen members of the Federation attended the Assembly, and visitors to the conferences brought the total number to more than fifty. As in previous years, the conferences were limited to a few topics, namely, feeblemindedness; the analysis and genetics of mental traits; twin studies and reports on eugenic progress in certain countries.

Mental deficiency or oligophrenia was restricted to two major questions, diagnosis and grading. Prof. Rudin, president, described the distinction made in Germany between oligophrenia as a psychiatric condition and what his school describes as normal stupidity. Prof. R. J. A. Berry gave an account of his long researches, and submitted the theory that mental defect can best be described as failure of development of the central nervous system; a condition which as such passes by indistinguishable grades from a pre-embryonic type in brain and cortex development to something which can best be characterised as less than the highest development known. He finds somatic and functional characters corresponding biologically to the various grades of lack of neural development. Dr. Rudolf, of Brentley Colony, Bristol, gave a lucid explanation of the way in which legislation has governed both the terminology and method of certification of mental deficiency in Great Britain.

A number of research workers in this field were present; amongst others, Dr. Wildenskow and Dr. Jens Smith, Denmark, Prof. Maier and Dr. Brugger, Switzerland, and Dr. Tietze and Dr. Hamburger, Austria. It would appear that legislation in both Germany and Great Britain has to some extent controlled the purely medico-biological treatment of the question. Denmark, with complete legislative control, has avoided this pitfall; the Danish psychiatrists, frankly admitting that an arbitrary line is drawn, below which lack of intelligence is regarded as warranting social control. Several speakers urged the evolutionary importance of this outlook; it might be hoped that, generation by generation, the point of poor development might be slightly raised if and as the average intelligence of the population rises progressively. Time did not allow of a full discussion on grading, but the only comparable base line still appears to be the Binet-Simon tests. A comparative study is urgently required.

The second day began with a study of psychometry. Dr. Mjoen opening with a demonstration of his methods of testing musical ability. The demonstration of five of his twenty different tests created so much interest that discussion ran through the whole morning, concentrating mainly on the degree to which training would affect test of performance. Dr. Mjoen gave evidence from re-tests, proving that certain of the most diagnostic factors remained unchanged.

Prof. C. Spearman gave a lucid exposition of his analysis of intelligence into a general and special factors, and asked for help in the attempt which is being made both by national committees and by a committee of the International Federation of Eugenic Organisations to bring greater order and clarity into methods of psychological measurement.

Dr. Steggerda, who has just been appointed chairman of the International Federation of Eugenic Organisations Committee, gave an account of the difficulties of psychological studies of non-European races, from his own work amongst the Mayas in Yucatan, whites and negroes in Jamaica, Indians in Arizona and some other groups. Both he and Prof. Rodenwaldt stated that there can be no doubt of wide racial differences in mental faculty. For example, in music the tests satisfactory for Europeans would fail altogether to elicit the much finer discrimination common in the yellow races and negroes. It would appear that a careful and sympathetic study of the manner of life of any people should make it possible to eliminate those aspects of European tests, such as speed, which are wholly inapplicable in some other cultures. The afternoon was devoted to papers on twin studies introduced by Prof. Freiher von Verschuer of Berlin, the first problem to be tackled being methods of differentiation of identical and non-identical twins. From a study not yet published, he gave a chart showing the unreliability of judging from the chorion. In 52 cases with double chorea, 12 proved to be identical and 40 non-identical.

Reports on eugenic work occupied three sessions. Several of those charged with administration of the new German eugenic law had accepted the invitation of the Federation to give an account of the practical working of the new measures. Dr. Ruttke, directing popular education in protection of heredity, gave a clear outline of the whole policy, which may be briefly summarised as: (*a*) Unification of State control throughout the nation. (*b*) Removal of unemployment (shown to have disintegrating effects on the sense of parental responsibility and family life). (*c*) De-urbanisation, which removes large families with self-supporting parents and good family history to peasant holdings which will be entailed. (*d*) Revision of marriage laws, making marriages for social or economic ends liable to be annulled. (*e*) Creation of bureaux for advice on heredity and marriage. (*f*) Provision of loans for young persons of sound stock who desire to marry—a measure which goes hand in hand with the exclusion of women from those industries which can be served by unemployed men. (*g*) The sterilisation law. Dr. Ruttke explained that the exclusion of criminals from the operation of this last measure is in order to remove any sense of degradation being connected with the operation; both in the courts and by popular propaganda, the ideal is put forward which has made sterilisation successful in California, that the citizen who accepts the operation with a sense of responsibility for posterity merits the esteem of the community. In regard to compulsion, he stated the fact not so widely known that patients may accept institutional treatment of segregation if they prefer it to sterilisation. (*h*) The Danish plan (also largely used in Switzerland) of castration for habitual sex offenders has been enacted as obligatory, the objective being double, both the cure of the condition in the individual and the protection of society. This last point is not necessarily regarded as a eugenic measure.

Reports of growing work and increasing interest were given from every country represented. These will be published in full in the report which will appear in the autumn, and will be obtainable from the Secretariat, price 2*s*. 6*d*.

The Royal Society of New Zealand

SCIENTIFIC work in New Zealand, so far as research is concerned, has largely depended upon the organisation of the New Zealand Institute, which has now been honoured by the title of the Royal Society of New Zealand.

The New Zealand Institute Act was passed in 1867, and in March 1868 the body began to function. During the sixty-six years of its existence the Institute has encouraged workers in all branches of science and has published a large number of their researches. The first volume of its *Transactions* appeared in 1868, and annually (with one exception during the War) since that date the publication has been produced. It may truly be said that the whole set of sixty-four volumes contains an epitome of the research work in science that has been done in the Dominion.

The recognition of the value and importance of the scientific work of the members of the Institute by the grant of a Royal Charter is a matter that gives the greatest satisfaction to its members. It is perhaps only natural in such a country as New Zealand, where natural objects both animate and inanimate are in large part novel to people from Europe, that observational science would attract the greatest number of research workers. Actually it will be seen that articles on zoology, botany and geology have throughout filled a large proportion of its pages, now perhaps more than ever. Those whose work is in the sciences of chemistry and physics perhaps feel their remoteness from the centres of scientific life more acutely, and wish also to publish in journals which have a wider circulation than the *Transactions of the New Zealand Institute* could claim. Even so, it is a matter of great satisfaction to know that the first scientific research of Lord Rutherford appeared in its pages.

At the meeting of the Council of the Institute on May 16, the actual change took place. The meeting received a letter from the Governor General, Lord Bledisloe, to whose initiative and great assistance the actual grant of the charter is largely due (see NATURE of July 14, p. 59). His Excellency's letter, which aroused great enthusiasm at the meeting, included the following significant words: "To starve knowledge (and especially that clearly ascertained and systematised knowledge which we designate science) or to stint it of its due reward is to court national disaster. If science, in the inevitable evolution of human genius, has contributed to economic adversity, it is because it has been applied in part only to the solution of human problems, and certain it is that only by the further application of science in all its ramifications and by a far more generous and enlightened recognition of its beneficent potentialities by the world's rulers will effective remedies for current human disorders be found."

In the evening, Prof. R. Speight, professor of geology in Canterbury College, Christchurch and president of the Royal Society of New Zealand, delivered an address in which he summarised the work of the Institute in various branches of scientific inquiry. He discussed the standing of the Institute (now the Royal Society) in the scientific life of the country in the past and at the present time. Prof. Speight stated that in his opinion "the activity of the Society and the interest it shows in scientific matters had never been greater".

The Council of the Royal Society were the guests of the president, Dr. J. Henderson, and Council of the Philosophical Society of Wellington on the following day. Addresses were delivered by Dr. Turner, Prof. Burbidge and Dr. L. Cockayne, and excursions were made to institutions and localities of scientific interest in the afternoon. The occasion provided much opportunity for scientific conference and discussion.

Royal Photographic Society's Annual Exhibition

THE Royal Photographic Society's seventy-ninth annual exhibition was opened on September 7 and will remain open until October 6. The hours are from 10 a.m. to 9 p.m. on all weekdays except Tuesdays and Fridays, when the closing hour will be 6 p.m. Admission is free.

As usual, the main part of the exhibition is pictorial, yet there is a considerable amount of work of scientific interest. Trade exhibits of apparatus and materials have been given greater prominence than in most former years. Particularly noticeable are the various substandard cinematograph cameras and projectors, some of which are now obtainable with sound-recording and -reproducing equipment. The small hand camera, too, is to be seen in great variety with all its special accessory apparatus.

H. E. Edgerton and K. J. Germeshausen, of the Massachusetts Institute of Technology, show a series of instantaneous photographs of rapidly moving objects. The time taken for a single exposure in most of these is 1/75,000 of a second; in one set of pictures, however, the exposure time was only 1/1,000,000 of a second. The vortices in the air from an electric fan, a textile spindle turning 10,000 times in a minute, and several other rapidly moving objects are shown apparently stationary.

Aerial photography is fairly well represented, and there is one photograph by H. Frederick Low entitled "Archæology from the Air"; underlying ground conditions produce a variation in the appearance of a growing crop as seen from the air, which enables the outline of the original workings to be clearly mapped.

Mr. G. Aubourne Clarke, of Aberdeen, already well known for his studies of cloud formations, shows a fine series of photographs of clouds. For these he has been awarded the Hood Medal, which is given "in recognition of meritorious performance in any branch of photography".

In radiography, a very interesting development is shown by the Research Laboratories of the Eastman Kodak Company. Radiographs of small animals such as moths, beetles, etc. have been made by using exceptionally soft X-rays. These rays, known as 'Grenz rays', will not penetrate the wall of a normal X-ray tube, so that a special tube with a very thin window had to be constructed. Moreover, they record the texture of paper generally used for wrapping X-ray films, so the films had therefore to be enclosed in a special carrier, the front of which was made from a thin sheet of gelatine dyed to exclude visible and ultra-violet radiation. The tube itself

was excited at relatively low potentials between 2 and 10 kilovolts.

Other work with soft X-rays produced by an ordinary tube is shown by H. Flower and Messrs. Ilford Ltd. The structures of shells and flowers are thus illustrated.

From the very excellent Natural History Section mention may be made of an interesting series of photographs by H. Morrey Salmon illustrating the habits of the Manx shearwater. This bird comes to land only during the breeding season, when the colonies sometimes number thousands of pairs. On shore the birds move only by night. They nest in burrows which they share with rabbits. The nesting bird is said to remain underground during the hours of daylight, and is relieved by its mate at night. Some of the photographs were taken off Pembrokeshire at about 10.45 p.m. about midsummer at a distance of nearly two miles; others, taken by flashlight, were taken close to the birds.

An instructional exhibit by Messrs. Ilford Ltd. shows a 'working model' of the formation of halation circles on plates and films. Excellent examples of the influence of various backings in preventing halation are shown. Further exhibits by Ilford Ltd. in co-operation with Dr. Russell Reynolds show examples of cineradiographs of such subjects as the beating heart, moving joints, etc. The Cossor-Robertson cardiograph is demonstrated by Messrs. A. C. Cossor Ltd. and Ilford Ltd., together with typical cardiograms made on special photographic material manufactured by the latter firm.

Magnetic Materials at Radio Frequencies

FOR some years past it has been the practice of line communication engineers to make use of iron-cored inductance coils and transformers at speech frequencies and even at carrier frequencies up to 50,000 cycles per second. The cores of such coils were usually composed of iron or a magnetic alloy in the form of wire or of powder embedded in a suitable binding material. During the past year or so, the attention of those responsible for the design and production of wireless receivers has been directed to the possibility of using such magnetic cores in coils and transformers, the frequencies of operation of which may exceed one million cycles per second. It has been claimed that broadcasting receivers giving better performance in a smaller space can be designed by the use of such coils, on account of the facility in screening and the more effective coupling between the circuits which these coils afford.

A report*, recently published by the Radio Research Board, summarises existing knowledge, both theoretical and experimental, of the behaviour of magnetic materials at radio frequencies with the object of assisting those engaged in the application of these materials in the manner outlined above. The subject is surveyed in an approximately analytical manner intended to illustrate the individual properties, such as permeability, hysteresis and dielectric loss of the various materials examined; and, where the quantitative data permit, typical numerical values are assigned to these properties for various frequencies up to about 2,000 kilocycles per second. It appears that these electrical properties of ferromagnetic core materials may be expressed in terms of permeability and power-factor in a manner analogous to the use of permittivity and power-factor for dielectrics.

From the information summarised in this report, it is concluded that the effective permeability of magnetic powder compositions is necessarily low compared with that of the magnetic material, and that it depends mainly upon the size of the particles employed and the spacing between them, rather than upon the permeability of the magnetic constituent. It is probable, though not certain, that the greater part of the total radio frequency losses in composite magnetic materials is due to eddy-current formation and a consequent skin-effect in flux distribution. There are at present available a number of iron powder compositions in which, by sufficiently fine division of the magnetic material and provision of adequate particle insulation, the total losses are reduced to a value which gives an economic permeability of from 4 to 10 up to frequencies of about 2,000 kilocycles per second. It is not known to what extent the behaviour of such material is consistent with theory, nor is there any certain knowledge of the constitution of the losses. Further, it is concluded that there is no evidence indicating that the limit of improvement in such materials has yet been reached.

The useful lines of future investigation of the subject are clearly indicated in the report, which undoubtedly forms a clear and concise introduction to this field of research in radio frequency technique.

* Department of Scientific and Industrial Research. Radio Research. Special Report No. 14. "Magnetic Materials at Radio Frequencies, A Critical Survey of Present Knowledge." By F. M. Colebrook. (London: H.M. Stationery Office, 1934.) 6*d*. net.

Determination of the Molecular Weights of Colloids

IN the January issue of the *Berichte der deutschen chemischen Gesellschaft* Prof. H. Staudinger discusses the validity of the method of deducing the molecular weight of a colloid of high molecular complexity from observations of its *specific* viscosity. The author claims that this new method is applicable to the investigation of numerous complex naturally occurring substances such as cellulose and india-rubber, since many physical properties such as elasticity, ductility, solubility, etc., are functions of the length of the molecular chain. Older methods of determining molecular weights of complex molecules are more restricted in their application. Thus the cryoscopic methods give very low results in dilute solutions and in more concentrated solutions the relation between molecular weight and osmotic pressure is no longer simple. The diffusion method is only suitable for particles of spherical shape and can therefore not be applied to the long fibre-molecules of many natural colloids.

An earlier account of Prof. Staudinger's views is to be found in the *Transactions of the Faraday Society* of January 1933, and the main object of this recent paper is to examine certain experimental evidence

which seemed at that time to be in conflict with the viscosity law. No simple relation between molecular weight and viscosity was discovered until measurements were made upon synthetic colloids of high complexity, and there has been reluctance to depart from the older interpretation of viscosity by micelle-formation, since viscosity is not always a simple function of the length of the molecular chain. This is particularly true of heteropolar colloids, for example, albumen, the viscosity of which is largely due to its tendency to polymerise to macro-molecules.

Prof. Staudinger deals in this paper with certain conflicting evidence and he finds a reasonable explanation. He contends that the law is applicable over a very wide range of colloidal substances. It is valid for molecules ranging in length from 10–20 A. to 1450 A. and he claims that it is reasonable therefore to deduce values by extrapolation for the molecular weight of cellulose with a molecular length of 4000–5000 A.

The main criticisms which have been directed against these views appear to have been based upon measurements of solutions of technical samples of cellulose acetate and of certain complex acids. In the former case, the solutions were not sufficiently dilute to allow of complete molecular mobility—in fact gels had been employed in some cases. By applying suitable correction factors the results have been brought into line with the viscosity law. In the case of the complex acids, it is contended that unless the molecular length exceeds about 600 A., there is a decided tendency for the molecules to form complex aggregates. This is sufficient to account for deviations from the viscosity law.

University and Educational Intelligence

OXFORD.—Mrs. Mary Jane Williams, of Whitley, Surrey, who died on July 24, has left £30,000 to the University, to be expended by the Board of the Faculty of Medicine as it deems best for the promotion of Oxford medical education.

A LIST of the public lectures to be delivered at the University of Leeds and the Philosophical Hall, Park Row, Leeds, during the session 1934–35 has recently been published by the University. Among the lecturers will be Lord Rutherford, Prof. C. Burt, Prof. A. Harden, Prof. W. J. Tullock, Prof. B. Melvill Jones, Prof. F. A. E. Crew, Prof. Hans Driesch, Prof. R. W. Whytlaw-Gray, Prof. R. Whiddington and Sir G. Elliot Smith.

CITIZENSHIP as an objective of university education is the theme of an article by Prof. Ashbaugh of Miami University, Ohio, published in *School and Society* of February 3. Like many other articles that have appeared recently in the same journal it testifies to the "amazing and universal increase", to quote from President Roosevelt's review of his first year of office, "in the intelligent interest which the people of the United States are taking in the whole subject of government." The writer gives particulars of two schemes whereby university administrators have attempted to give effect to the ideal of developing socially efficient citizens. One, launched a few years ago at the University of Toledo, comprised a variety of courses spread over the first two undergraduate years under designations such as "Principles of Human Behaviour", "College Life", "Modern Literature", "Problems of Modern State and City Governments", "Chemistry of Everyday Life", "Modern Logic". This attempt failed because "the conservative faculty insisted upon the prerogative of their traditional departmental organization". The other is in course of elaboration in the writer's own department (the School of Education) of Miami University. It stresses the necessity for courses which will not merely impart information but also include genuine training calculated to implant appropriate ideals and attitudes and to strengthen them by actual practice in the workshop of the world. A similar concern for equipping the student for worthily playing his part in present-day community life has marked in some instances the development of the 'junior college' movement in the United States, but too often the pressure of the minority definitely bound for a full and formal university curriculum has obscured the ideal of adquate training for the many whose formal education does not extend more than a year or two beyond the high school.

SCIENCE curricula in the universities are discussed in an article by Prof. L. N. G. Filon in a recent issue of the *Universities Review*. The enormous extension in the last thirty years of the boundaries of knowledge has invalidated some of the assumptions on which was based the existing organisation of undergraduate studies in the science faculties and has thus given rise to problems calling urgently for solution. The article outlines a tentative scheme, involving on one hand the raising of the level of entrance into the university to the Higher Certificate stage and, on the other hand, an abandonment of "the research fetish"—a postgraduate degree (M.Sc. ?) being used to mark the completion of a course of study extending over at least one year to meet the needs of those concerned to consolidate their gains—to fill the gaps, increasingly inevitable, in the knowledge acquired in undergraduate courses. These courses would be, during the first two years of university study, in three subjects, the course in each subject being the same for all students. This work would be tested by an examination corresponding roughly in standard and extent to the present pass or general degree examination, but conducted so as to be a very severe and searching test of minimum knowledge, and including a compulsory paper on the English language, *not* merely an essay. The third year's work would be adjusted to the students' varying capacities and prospective careers: (*a*) those who failed in the minimum knowledge test would be allowed to prepare for a second attempt at the end of their third year; (*b*) those intent on a broadly cultural equipment would have the option of taking a course in some chosen field lying wholly or partially outside those to which the first two years were devoted, for example, education, history of science, border-line sciences of their group, social sciences and so on; (*c*) intending specialists would prepare for a special degree examination on the lines of those now in use, but with no subsidiary subject; and (*d*) those wishing to carry further their selected scientific studies without aspiring to be specialists would take a course for a 'general' honours degree. The successful passing of the third year examination would be marked by the award of a pass degree to candidates of class (*a*) and an honours degree to the others.

Science News a Century Ago

Imperial Academy of Sciences, Russia

The Imperial Academy of Sciences in Russia has published a clause of the will of an artillery officer, Count Araktsehejen, by which the testator established a fund of 50,000 roubles for the author of the best History of the reign of the Emperor Alexander. The work is not to be written until 100 years after that monarch's death, that is, in 1925. The author must be a Russian subject. The money will remain 93 years in the bank where it will accumulate interest. Ten years before the time appointed, that is, in 1915, the Academy of Sciences of St. Petersburgh, will announce that competition is open, and that the prize will be awarded in 1925. Of the sum available one quarter will be devoted to the publication of the work, and the successful author will receive the remainder. (*Gentleman's Magazine*, Sept. 1834.)

Trials of S.S. *Nile*

The *Times* of September 16, 1834, recorded the trials of the S.S. *Nile*, which had been built for the Pasha of Egypt and was referred to as the largest steam vessel that had hitherto been constructed in Great Britain or probably in any country. She was 183 ft. 2 in. in length, 32 ft. 8 in. beam, 21 ft. 9 in. deep in the engine room, and drew about 14 ft. of water. She was more than 900 tons weight and was driven by engines by Boulton and Watt of 220 nominal horse-power. "The trial," said the *Times*, "was successful in every respect; her speed as ascertained at the measured mile below Northfleet, having exceeded from $\frac{1}{10}$ to $\frac{1}{8}$ that of our own Government Steam-ships of equal power. . . . The primary object of this vessel is said to be to tow the ships of the line belonging to the Pasha in and out of the harbour of Alexandria, but she is capable of being converted to purposes of war in case of emergency." The *Nile* appears to have been built at Limehouse and launched under the name of *Pasha* on May 7, 1834.

Ascent of Mont Blanc

"Dr. Martin Barry and six guides left the Priory at Chamouni at half-past eight in the morning of the 16th September, and at noon entered upon the snow, crossed the Boissons Glacier and saw some chamois. The fissures were found to be greatly widened from the lateness of the season [the ascent being by a week the latest that had been made]. The dangers and difficulties were thus much augmented, large masses of ice were met with over some of which it was necessary to climb, and the peril was particularly great in attaining the rock called the Grand Mulet, where the party slept. Next morning, they proceeded attached as they walked, two or three together with cords and cautiously trying every step with their batons. . . . They breakfasted on the Grand Plateau and saw the spot where the avalanche occurred during Dr. Hamel's attempt in 1820. . . . On approaching the summit, so great was the exhaustion from the diminished density of the air, that only a few steps could be taken at a time, and the doctor felt faintness and languor, but at length, his labours were repaid, and he stood on the highest point. He remained on the top an hour and a quarter." (*Annual Register*, 1834.)

Societies and Academies

PARIS

Academy of Sciences, July 23 (*C.R.*, 199, 249–328). CH. PORCHER, HENRI VOLKRINGER and MLLE. JEANNE BRIGANDO: Contribution to the study of casein. Detailed study of the absorption spectra of casein and paracasein. EDOUARD CHATTON and MLLE. BERTHE BIECHELER: The Coccidinidæ, dinoflagellate coccidiomorph parasites of Dinoflagellates and the phylum of the Phytodinozoa. MARC KRASNER: The first case of Fermat's theorem. A. GELFOND: Some new results in the theory of transcendental numbers. JEAN MASCART: The perihelia of the minor planets. HENRI MINEUR and HENRI CAMICHEL: The variations of the ellipsoid of velocities in the galactic plane. HANS EKSTEIN and MICHEL MAGAT: Remarks on the forces of Van der Waals in liquid mercury and in the molecule Hg_2. GEORGES DECHÊNE: The Johnsen-Rabbeck effect. The author gives a new explanation of this phenomenon which also affords an explanation of an experiment described by Toby. DANIEL BODROUX and RENÉ RIVAULT: Some attempts to photograph the television emissions from London and a local station on short waves. Description of the apparatus used for the reception with reproductions of the photographs obtained. ANTOINE GOLDET and ARCADIUS PIEKARA: The thermal variation of the magnetic double refraction of mixtures. The case of a mixture presenting a critical point. L. COLOMBIER: The electrolytic potential of nickel. Values varying between $-0{\cdot}138$ and $-0{\cdot}621$ have been published for this constant. The author discusses the possible causes of this variation and describes experiments in which the errors due to gases fixed on the surface of the nickel and to the increase of activity due to the presence of hydrogen are eliminated as far as possible. The values found fall between $-0{\cdot}225$ and $-0{\cdot}23$. ANTOINE MARSAT: The modes of graphical representation of the distribution of the flux emitted by a light source. JEAN PAUL MATHIEU: The optical activity and solubility of some cobaltammines. PRIVAULT: Weak lines of the K series of the elements from chromium to copper. The fluorescence lines of some compounds of these elements. F. HAMMEL: The X-ray spectra of manganese sulphate and its hydrates. Five specimens of the monohydrate of manganese sulphate prepared in different ways give the same spectrum: nothing in the spectra of the five specimens suggests a difference of structure. These results are not in agreement with those of Krepelka and Rejha. I. ZLOTOWSKI: The heat of the γ-radiation of radium. An application of the adiabatic microcalorimeter of Swietoslawski and Dorabialska. MARIUS BRIAND, PAUL DUMANOIS and PAUL LAFFITTE: The influence of temperature on the limits of inflammability of some combustible vapours either pure or in admixture. Data are given for isopentane, acetone, methyl, ethyl and butyl alcohols and some binary and ternary mixtures. MME. ALMA DOBRY: The osmotic pressure of polymerised substances. Utilising an apparatus capable of measuring with sufficient accuracy osmotic pressures down to $1{\cdot}5$ mm. of water, the limiting value of the ratio pressure to concentration can be determined. These limiting values are independent of the solvent. The molecular weight of nitrocellulose thus obtained is 110,000. MARCEL CHATELET: Some reactions of divalent chromium

chloride. Compounds of chromous chloride with pyridine and with ammonia. HENRI VOLKRINGER, ARAKEL TCHAKIRIAN and MME. MARIE FREYMANN: The Raman spectra of the metallochloroforms in relation with their structure. Comparison of the Raman spectra of chloroform, silicochloroform, germanochloroform and chlorstannic acid. The correspondences show that these four compounds have analogous structures. MLLE. BLANCHE GREDY: The (Raman) spectra of some acetylene compounds of the cyclane series. LÉON PALFRAY and MLLE. SUZANNE TALLARD: The influence of the free acidity on the determination of aldehydes and ketones by hydroxylamine hydrochloride. The amounts of aldehyde or ketone found by the hydroxylamine method are affected by the presence of organic acids, but this error can be minimised by the use of bromophenol blue as indicator. RENÉ EMILE BREUIL: Complex compounds of ferrous salts with ethylenediamine and trimethylenediamine. CAM. LEFÈVRE and CH. DESGREZ: Contribution to the study of the aromatic sulphides. F. LINK: The illumination of the higher atmosphere and the twilight tables of Jean Lugeon. J. LACOSTE and J. P. ROTHÉ: Earthquakes in France in 1930–33. ANDRÉ DAUPHINÉ: The mode of formation of the pecto-cellulosic membrane. P. MARTENS: New observations on the cuticle of floral epiderms. MAURICE PIETTRE: Concerning the protein equilibrium of the blood serum. SÉBASTIEN SABETAY and MME. HERMINE SABETAY: A colour reaction of the azulenogen sesquiterpenes. A. LEPAPE and R. TRANNOY: The influence of radium on the cultural yields of some plants. J. E. ABELOUS and R. ARGAUD: The formation of adrenaline in the suprarenal capsule. Combined or virtual adrenaline and free adrenaline. PAUL MATHIAS and MME. MARGUERITE BOUAT: The development of the egg of *Branchipus stagnalis*, a phyllopod crustacean. MLLE. A. TÉTRY: Description of a French species of the genus *Pelodrilus*. W. KOPACZEWSKI: Seric lactogelification considered as an index of neoformation. LÉON BINET and MLLE. MADELEINE BOCHET: An arrangement for artificial respiration in man.

CRACOW

Polish Academy of Science and Letters, June 4. S. K. ZAREMBA: The trend of the characteristics of the differential equation $Y(x,y)dx - X(x,y)dy = 0$ in the neighbourhood of an isolated singular point (1 and 2). MLLE. B. TWAROWSKA: The extinction of the fluorescence of a solution of biacene in *p*-dichlorbenzene at − 180° C. The loss of fluorescence is explained as being due to the solid solution of mixed crystals changing into a mixture of pure crystals of biacene and of *p*-dichlorbenzene. L. MARCHLEWSKI and WL. GOSLAWSKI: The absorption of the ultraviolet rays by certain organic substances (38). Study of the optical properties of 16 substances of the lignin type. K. SMOLENSKI and A. ZLOTNIK: The reduction of galacturonic acid and of the methyl ether of methyl-galacturonide. K. SMOLENSKI and S. KOWALEWSKI: The pyrogenetic decomposition of ethyl alcohol. Studies on the substances produced by heating ethyl alcohol at high temperatures (400°–500° C.) and under high pressures. K. KONIOR: The geology of the neighbourhood of Przemysl. A. BURSA: *Hydrurus foetidus* in the Polish Tatra. Ecology and morphology (1). W. VORBRODT: The presence of tyrosine in the protein substances of *Aspergillus* (*Aspergillus niger*). Crystalline tyrosine has been prepared from the mycelium of this mould. ST. JASNOWSKI: The inheritance of sterility of the base and summit of the ear of *Triticum vulgare*. F. ROGOZINSKI and ZB. GLOWCZYNSKI: Experimental rickets (6). The influence of magnesium salts. From the experiments described it would appear that an excess of magnesium salts added to the food acts differently according to the proportions of calcium, magnesium and phosphorus in the food. J. FILHOL: The embryology and development of *Lamproglena pulchella*. B. JALOWY: The origin and rôle of the Langerhans cells in tactile hairs.

GENEVA

Society of Physics and Natural History, May 17. P. ROSSIER: Comparison of the atmospheric extinction in the ultra-violet and the visible spectrum. The study of the extremities of stellar spectrograms shows that the importance of the ultra-violet diminishes in relation to the visible spectrum in proportion as the zenithal distance of the star observed increases. For comparisons of magnitudes made only in ultra-violet light, the extinction coefficient appears much larger than in visible light. E. MOLLY: Petrographic studies in Ethiopia. (2) Observations on the basalt rocks of Abyssinia. (3) Observations on the alkaline rocks of Abyssinia. G. TIERCY: The distribution of the temperatures in the interior of the stars. This note defines the connexion that may be established between the solution by polytropic equilibrium valid in the central part of the star and the approximate solution drawn from the theory of the radiation equilibrium, so far as the peripheral part is concerned. G. TIERCY and A. GROSREY: The width of photographic spectra for stars of the *K*0 type. A study of the variation of the width of a spectrum obtained with the Schaer-Boulenger instrument as a function of the magnitude of the star and time of exposure.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 3). N. S. KOSHLIAKOV: On a certain definite integral connected with the cylindrical function $Ju(X)$. V. FESENKOV: Influence of an error in the installation of an equatorial on the deplacement of the images of stars on a photographic plate. I. TAMM: The theory of elementary particles. D. D. IVANENKO: Is the transmutation of hydrogen into neutron possible? A negative conclusion is reached, which is analogous to that drawn by Sommerfeld from his fine structure formula. J. A. KRUTKOV: A note on the rolling of a ship. Mathematical expression of the movements involved is offered. S. LIFSHITZ: Apparent duration unit of sound perception. The apparent duration of a constant 1,000 *v/s* tone sounding during one second with a loudness of 1 db. was taken as the unit. N. SHISHAKOV and L. TATARINOVA: Determination of crystal lattice constants by electron diffraction. The use of a convex specimen is a much simpler method than that introduced by G. P. Thomson in which a flat ground specimen is used (see also NATURE, 133, 686, May 5, 1934). V. ALTBERG: Bottom ice. A brief summary of the work done at the State Hydrological Institute. A. FRUMKIN and A. SHLYGIN: The platinum electrode. Quantitative studies on the electric energy necessary to communicate to the electrode a certain potential. I. I. CHERNIJAEV and A. M. RUBINSTEIN: On Stromholm's triaminosulphite. On oxidising triaminosulphite $(NH_3)_3SO_3Pt$, the residue SO_3 is oxidised first, and simultaneously

the trans-ammonia is split off. Owing to this splitting, the transition from triaminosulphite to triaminochloride is impossible. V. S. SADIKOV and V. A. VADOVA: Alcoholysis of serum albumin. On heating serum albumin in an autoclave at 180° for six hours with 99·5 per cent ethyl alcohol, 99 per cent of the albumin was liquified. Z. S. KATZNELSON: Mesenchymatic development of the striated muscles in Amphibia. Striated muscles of the extremities, gills, ventral wall and head develop by a local differentiation of the mesenchyme. Stages in their development are described. A. KHARIT and A. KOSTIN: The oxidation and reduction processes in working muscle. (4) Oxides and suboxides of iron in muscle during work. A muscle before and during stimulation contains organic oxides of iron which are transformed into suboxides. During work, this process greatly increases. I. J. SYROVATSKII: Biology of some Black Sea fishes. Notes on the seasons of reproduction in *Scomber scombrus*, L., *Sarda sarda*, L., *Caspialosa pontica*, Eichw., and *Spratella sprattus phalerica*, Risso. G. V. NIKOLSKIJ: Materials on the geographical variability of *Capoetobrama kuschakewitschi*, Kessl. (Pisces, Cypronidæ). Description of a new sub-species from eastern Turkestan. A. I. KURENTSOV: Contribution to the problem of the origin of the high-mountain fauna of the South Ussuri region. The ancient faunistic element is composed of the relics of the palæogenic fauna which have survived the Miocene glaciation on the spot. More recent elements belong to the palæarctic fauna which migrated south in the Quaternary period.

MELBOURNE

Royal Society of Victoria, May 10. C. W. WARK: An investigation into the influence of sulphate of ammonia on stubble-sown oat crops in Victoria. Field trials were established at Bannockburn and at Buangor. Sulphate of ammonia was applied at the rates of ¾ cwt. and 1½ cwt. per acre. The application of these dressings caused an increase in the nitrate content of the soil in June–August, an increase in the average number of tillers per plant in spring, and a marked increase in the number of ears and grains produced at harvest. The percentages of nitrogen in the grain and in the straw were not affected. MISS F. J. HALSEY: A disease of cauliflowers in Victoria, Australia (*Gloeosporium concentricum*, (Grev.) Berk. and Br.). The disease is prevalent in Victoria, damaging the leaves, and also the inflorescences. The most characteristic symptom is the presence of minute white fluffy clusters of spores on both surfaces of the leaves. History connected with the fungus is discussed and as a result of this, together with the evidence disclosed by study of the pathogen on the host and in pure culture, it is named *Gloeosporium concentricum*, (Grev.) Berk. and Br. Spores from the host measure on the average $11 \cdot 9 \times 3\,\mu$ and are produced in subcuticular acervuli. The conidiophores are short and unbranched, constricting off at their apices, in succession, the cylindrical, one-celled, hyaline conidia. The pathogen was obtained in pure culture and growth on various media was studied. The conidia are formed at any point throughout the culture; in discrete sporing areas (sporodochia); and in pseudopycnidia. Germinating spores possess a median septum. Inoculation experiments with seedling cauliflowers proved successful. The effect on spore germination of varying *p*H values was studied. Germination percentage fell sharply, especially on the acid side.

Forthcoming Events

WOMEN'S ENGINEERING SOCIETY, September 21–23. Twelfth annual conference to be held at Norwich. Miss E. M. Kennedy: President.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 21–24. Eleventh Annual Conference to be held at Somerville College, Oxford.
Sir Richard Gregory: "Science in the Public Press" (Presidential Address.)

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1933 to 31st March 1934. Pp. 14+11 plates. (London: H.M. Stationery Office.) 3*s*. net.

General Index to the Monthly Notices of the Royal Astronomical Society. Vols. 71–91, 1911–1931. Pp. v+168. (London: Royal Astronomical Society.) 5*s*.

Sea-Fish Commission for the United Kingdom. First Report: The Herring Industry. (Cmd. 4677.) Pp. 51. (London: H.M. Stationery Office.) 9*d*. net.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 8: Further Experiments on the Inheritance of Chlorophyll Deficiency in New World Cottons. By S. C. Harland. Pp. 181–195. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1537 (Strut. 128): Method of Representing Spar Tests. By H. R. Fisher. Pp. 28+11 plates. (London: H.M. Stationery Office.) 1*s*. 9*d*. net.

East London College (University of London). Calendar, Session 1934-1935. Pp. 237. (London.) 1*s*.

Proceedings of the Royal Irish Academy. Vol. 42, Section B, No. 3: The Occurrence and Development of *Euphausia krohnii* off the South-West Coast of Ireland. By Winifred E. Frost. Pp. 17–40. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 10: The Approximate Determination of the Vibration of Beams and the Whirling of Shafts. By Dr. H. H. Jeffcott. Pp. 87–112. 2*s*. 6*d*. Vol. 21 (N.S.), No. 12: The Influence of the Stage of Lactation on Fat Estimations by the Gerber Method. By J. Lyons and M. O'Shea. Pp. 123–131. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

British Association for the Advancement of Science. A Scientific Survey of Aberdeen and District. Prepared for the Aberdeen Meeting, 1934. By various Authors. Pp. 123. (London: British Association.)

OTHER COUNTRIES

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. The Buckler Dory Descriptions of Three New Fishes from off New Jersey and Florida. By Henry W. Fowler. Pp. 353–361. (Philadelphia.)

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 15. 24 plates+text. 4.00 kr. Rapports et procès verbaux des réunions. Vol. 88: Scientific Report of the North-Eastern Area Committee, 1934. Published by Oscar Sund. Pp. iii+102. 4.00 kr. Vol. 89: 2ème partie, Rapport administratif (1933–1934). Pp. 76. 3.50 kr. Vol. 89: 3ème partie, Appendices (1933–1934). Pp. 103. 5.00 kr. Vol. 90: Size-Limits for Fish and Regulations of the Meshes of Fishing Nets; Reports of the Proceedings of the Special Biological Meeting held on June 4th and 8th, 1934, at Copenhagen. Pp. xv+61. 3.00 kr. (Copenhague: Andr. Fred. Høst et fils.)

U.S. Department of Agriculture. Technical Bulletin No. 404: The External Anatomy of the Red Date Scale, *Phœnicococcus marlatti* Cockerell, and its Allies. By F. S. Stickney. Pp. 163. (Washington, D.C.: Government Printing Office.) 15 cents.

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 1: January, February, March, 1934. By Ernest A. Hodgson. Pp. 24. (Ottawa: King's Printer.) 25 cents.

The Indian Central Cotton Committee. Note on the Improvement of Cotton in Sind. Pp. 8. (Bombay: Indian Central Cotton Committee.)

Trinidad and Tobago: Forest Department. Administration Report of the Conservator for the Year 1933. Pp. 22. (Trinidad: Government Printing Office.) 10*d*.

Rubber Research Institute of Malaya. Annual Report, 1933. Pp. ii+163. (Kuala Lumpur.) 1 dollar.

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 20, Memoir No. 4: The Jurassic and Cretaceous Ammonites and Belemnites of the Attock District. By Dr. L. F. Spath. Pp. iv+39+6 plates. (Calcutta: Geological Survey; Delhi: Manager of Publications.) 4 rupees; 6*s*. 9*d*.

CATALOGUES

Bismostab Injection of Bismuth B.P. Pp. iv+42. (Nottingham: Boots Pure Drug Co., Ltd.)

Apparatus for Micro-Chemical Analysis according to Pregl and other Workers. (List No. 103.) Pp. 16. Rubber Testing: Experimental and Research Equipment. (List No. 104.) Pp. 60. (London: A. Gallenkamp and Co., Ltd.)