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The British School of Archæology at Athens

FOR a month—from October 14 until November 14—the British School of Archæology at Athens is marking the completion of its fiftieth year of existence by holding an exhibition illustrating its activities and achievement at the Royal Academy of Arts, Burlington House, London, W.1, which is also made the occasion of an appeal for funds to maintain the efficiency of the School. For the archæologist who lightly passes from one millennium to another in his exploration of the ages before our era, fifty years is but a brief span. Nevertheless, the fifty years of "the British School", as it is affectionately known to its intimates, relatively few though they may be, are not far from covering the whole period which has seen the development of archæological excavation on ancient sites as a scientific method of reconstructing the cultural history of the great civilizations of the past, of which, for the most part, all other record, if such there were, has vanished.

"Gone are the walls that were so good,
And corn now grows where once Troy stood."

Though this no longer will be true, thanks to the co-operation of the Turkish authorities in the work of archæologists from the United States at Hissarlik, it was only an inspired faith in the works of Homer that led Schliemann first to excavate there in 1866, and eleven years later to dig at Mycenæ on the mainland of Greece, thus initiating those explorations on the sites of long-forgotten and deserted cities, palaces and temples, which not merely have transformed previous conceptions of the pre-historic past in classical lands, but also have built them up anew.

Schliemann, however great his merits as a pioneer, was too intent on the more spectacular aspects of the results of his excavations to elaborate a technique that could be termed truly scientific. By his excavations at Troy, Tiryns, and more especially at Mycenæ, he established the existence of a great civilization of the bronze age. Yet notwithstanding the development in the methods of excavation which followed, especially under the influence of Dorpfeld, it was not until the work of the British School at Melos, and more especially on the site of Phylakopi, in the years 1895–99, that a stratified site in Greece proper was excavated on scientific lines.

The enthusiasm aroused in the world of scholarship by the discoveries of Schliemann and others led to the foundation of the British School at Athens in the autumn of 1886, following on an article written by Richard C. Jebb. His proposal that such a school should be instituted aroused the active interest of the Prince of Wales, afterwards King Edward VII, and among its most active supporters were Prof. Percy Gardner, J. E. Sandys, Sir Frederick Leighton, D. B. Monro (later Provost of Oriel) and James Gow, as well as Francis C. Penrose, who became the first director, George A. Macmillan, honorary secretary from 1886 until 1897 and chairman of the Committee of Management from 1903 until 1934, and Walter H. Leaf, treasurer from 1886 until 1906. To the generous devotion and benefactions of the two last named the School is indebted more than to any for its survival in days of stress.

The objects with which the British School was founded were sufficiently wide. It was intended to afford British students of the literature, art, architecture, archæology and history of Greece of all periods from the earliest times to Byzantine and modern days, adequate facilities for travel and research in Greece itself. How varied have been

the interests for which it has provided may be gauged by the names of only a very few of its students, such as Ernest A. Gardner, archæologist, David G. Hogarth, archæologist and geographer, Marcus N. Todd, epigraphist, Montague R. James, whose recent death is deplored, R. Schultz Weir, Byzantine archæologist, John L. Myres, archæologist, geographer and historian, now chairman of the Committee of Management, Sir James Frazer, author of the monumental edition of Pausanias, and Sir Arthur Evans, the School's most distinguished and senior honorary student.

Of the academic side of the student's life at the School little is known to the outside world, nor indeed of the intense application, incidental to archæological study. Yet those who care to turn over the pages of the thirty-four volumes of the "Annual" of the School will be astounded at the range of exploratory work—topographical, linguistic and cultural—there recorded, and representing only part of the mass of information collected by the students in the extensive journeys they have been encouraged to make in Greece, the islands and Asia Minor in the course of their term of residence. Indeed it is no exaggeration to say that our campaign in the Eastern Mediterranean and the Balkans in the Great War ultimately came to a fortunate issue largely through the knowledge of local conditions and of the language, customs and mentality of the peoples, which was possessed by members of the School serving in the Forces.

It is an interesting and fascinating occupation for the visitor to the School's exhibition to follow catalogue in hand the excavations there illustrated, which have been conducted by its members, in their chronological succession and to mark how, with the development of scientific method—a development in which the School has taken no small part—the work gains in intensity, the results in breadth of application. Unfortunately, this development cannot be followed here in detail, though a word must be spared for one piece of early research shown, which stands outside the better known activities of the School. This is the Byzantine work of T. S. Weir in the early 'nineties, which was before its time.

Although the work of the School in prehistoric archæology may be not unknown to the public in general outline, it becomes impressive in detail with even a mere recapitulation of the names of some of the sites which have been excavated. Beginning with Phylakopi, and ignoring familiar names which went before, we have Minoan Palækastro in Crete, Sparta with its temple of Artemis Orthia, the epoch-making Mycenæ, sites in Thessaly, Macedonia, Lesbos—this last excavation which under Miss Winifred Lamb has recreated the background of Troy—and the important early Hellenic sanctuary of Perachora, near Corinth, upon which the School is still engaged.

Although comment upon the results which have been achieved by these excavations is not possible, a moment must be spared for a more general reflection on the influence of the School on archæological method. As already mentioned, Schliemann in his excavations achieved his object of establishing the existence of a great bronze age civilization, although as regards substantiating the works of Homer he raised more difficulties than he solved. Later work of other excavators aimed primarily at elucidating, with such scientific precision as was envisaged from time to time, the more or less complete history of the site upon which they were engaged. But even in early days, in the work of the School there may be discerned the first steps towards the ideal of the modern archæologist, the reconstruction of a complete culture complex and its contacts, such as that by which is now being built up gradually, for example, the cultural reconstruction as an integrated whole of pre- and protohistoric times from the Eastern Mediterranean to India and eastern Asia. The pioneers in this movement—speaking now only of members of the School—were Arthur Evans and J. L. Myres, the latter of whom as a young student in 1893 was the first British explorer of Crete, and whose identification of the Kamares ware, previously found by Flinders Petrie in Egypt, first demonstrated connexion between Egypt and the Greek world at a date earlier than the Eighteenth Dynasty. The full flower of this pioneer work is to be seen in the truly remarkable collection now at Burlington House illustrating Minoan culture from its earliest to its latest phase, and demonstrating its external relations with Egypt and the East, which has been staged by Sir Arthur Evans. It forms the *clou* of the exhibition. It illustrates an advanced but early culture in a manner such as has never been seen before, and probably will never be seen again.

Since the School at Athens was founded, similar British Schools have been established elsewhere. To them we could wish no better fortune than that when they complete their fiftieth year, the tale of their success may be as great as that of their prototype.

Plant Pathology in the Tropics

Diseases and Pests of the Rubber Tree
By Arnold Sharples. Pp. xvii+480+4 plates. (London: Macmillan and Co., Ltd., 1936.) 25*s.* net.

THIS is a most notable addition to books on the diseases of tropical crop plants. Since Petch's "The Diseases and Pests of the Rubber Tree" (1921) and Steinmann's "Diseases and Pests of *Hevea brasiliensis*" (1925) were published, there has been great activity in investigating, in a more detailed manner than was formerly possible, the major diseases to which the rubber tree in the Eastern plantations is prone. Nowhere has this activity been more pronounced or more productive of striking results than at the Rubber Research Institute of Malaya, to which the author of the present book was seconded as head of the Pathological Division in 1931, after being Government mycologist in the Department of Agriculture for many years.

The establishment of the rubber plantation industry, through the foresight of a former Director of the Royal Botanic Gardens, Kew, is one of the romances of commerce. At the present time, some millions of acres of land, formerly mostly under high forest, are devoted to the cultivation of *Hevea brasiliensis* in Malaya, Ceylon, the Dutch East Indies and other countries of south-eastern Asia. For example, in travelling by train from Penang to Singapore, one passes through an almost continuous rubber forest which stretches away for miles on either side of the railway track. Such large areas devoted to the cultivation of a single crop, under humidity and temperature conditions particularly favourable to the development of parasitic fungi, may seem to offer a terrifying prospect for the establishment of epidemic disease. Happily, the rubber plantation industry has never been seriously threatened in this way, and this has been largely due to the skill and foresight of the plant pathologists who have served the industry so well.

It is sometimes stated that disease in a crop plant is merely a symptom that cultivation is being carried on under unsuitable conditions. However true this may be with regard to certain crops, no one who has had experience of rubber cultivation can doubt that the incidence of disease is a serious factor even in trees which are growing with the maximum vigour. Again, it is sometimes claimed, and rightly so in some instances, that the menace of disease can be overcome by the utilization of disease-resistant varieties; unfortunately, there seems to be no prospect of amelioration along these lines as regards *Hevea brasiliensis*. So far, no strains of the rubber tree have been discovered which have the desirable properties of resistance to disease; furthermore, most of the fungi which attack this tree are not highly specialized parasites such as those against which the plant breeders have achieved certain notable successes. The price of security is unceasing vigilance, and as regards the rubber plantation industry, plant pathologists will have to continue to exercise this watchfulness without remission.

General considerations of this kind are emphasized in Mr. Sharples' book, which in fact can be looked upon as a general treatise on the principles of plant pathology with particular reference to rubber cultivation. For this reason the book will have a wide appeal to plant pathologists in general as well as to rubber planters, for whom in some respects the book has been primarily written. No better book could be placed in the hands of a young plant pathologist proceeding overseas for his first period of service in a tropical country.

The immense importance of environmental factors in determining the incidence of certain parasitic diseases is rightly stressed. For example, the author points out that pink disease, caused by *Corticium salmonicolor*, occurs seriously in Malaya only in the regions of highest rainfall and in the vicinity of large forest reserves. *Oidium Heveæ*, the powdery mildew of the rubber tree and a comparatively recent arrival in the plantations, only attacks under certain weather conditions the new foliage which develops after the 'wintering' or annual defoliation of the trees. *Ceratostomella fimbriata*, causing Mouldy rot of the tapped bark, becomes a menace only under extremely high atmospheric humidity. In connexion with this disease, the author sounds a note of warning in regard to the danger of encouraging dense semi-arborescent growths of other species among the rubber trees (following so-called forestry methods of rubber cultivation) because of the excessive humidity which they occasion.

One of the most interesting sections of the book is that dealing with the root diseases of the rubber tree, which in some ways are the most difficult to combat. Most of the rubber plantations have been established on land previously under high forest. After felling the trees, root parasites such as *Fomes*

lignosus and *Ganoderma pseudoferreum*, which were kept under control in the natural forest, develop actively and become a menace to the newly established plantation. Thanks to investigations carried out recently, chiefly at the Rubber Research Institute of Malaya, much new light has been thrown on the biology of these root parasites, with the result that more rational methods of control can now be carried out than hitherto. With the replacement of worn-out stands of rubber by superior high-yielding strains of trees, the control of these root parasites has become all the more imperative.

Among other topics dealt with in this book are the damage to trees caused by lightning—a subject to which little attention has hitherto been paid in the tropics—the insect pests of rubber trees—fortunately not a formidable list—and the methods of cultivation now in vogue in rubber plantations. An appendix contains a list of fungi recorded on rubber trees in Malaya, most of which are saprophytes. The book is profusely illustrated and admirably printed.

All who take an interest in the cultivation of tropical crop plants will appreciate the value of this book, and the rubber plantation industry in particular should be under a deep debt of gratitude to the author for his enlightening and comprehensive survey of many of the major problems which concern their estates. The publication of Mr. Sharples' book is high testimony to the services of the scientific experts without whose aid this romantic industry could never have been established. F. T. BROOKS.

Blood Pigments

Essai sur la biochimie générale et comparée des pigments respiratoires

Par Prof. Jean Roche. Pp. 170. (Paris : Masson et Cie., n.d.) 40 francs.

PROF. ROCHE'S monograph is the first book the reviewer has met which deals at length with the comparative properties of the four principal groups of blood pigments, the hæmoglobins, the hæmocyanins, the chlorocruorins and the hæmerythrins; it fills a much-felt gap. The author has limited himself to those aspects of the subject on which he has been personally engaged, thereby excluding any extended treatment of that common property to which they owe their name, their oxygen-binding ability, so that the outstanding physiological function of these fundamentally important pigments receives only occasional incidental reference. This is a deliberate omission, which may have been wisely made, but which many of Prof. Roche's readers will regret.

The work contains a great mass of very useful material; it is essentially a review of the author's own researches, supplemented by a fairly complete summary of the literature on these topics, which includes the elemental and amino acid compositions of the blood pigments, their ultra-violet absorption spectra, their isoelectric points, acid-base titration curves, and their molecular weights. As a reference work, however, the book would have been much improved if an index had been provided (an almost inexcusable omission in a book of this character), if each topic had been treated coherently instead of being broken up into subdivisions entitled "previous work" and "personal research", if the bibliography (itself excellent) had been provided with some key to the references in the text, and if the proof-reading had been a little less casual (to cite a single example, the table on p. 35 contains fourteen references of which three are incorrectly ascribed; there are also at least two significant omissions).

The main theme of the book is the specificity of the blood pigments, the differences not only between the four main groups, but also between different species in the same group, and sometimes even between different individuals of the same species, and Prof. Roche provides enough evidence to convince even the most sceptical that blood pigments possess scarcely any properties which fail to display such differences, given sufficient accuracy of measurement. The correlation of these varying properties with the needs of the organism has scarcely been attempted up to the present; the problem is one which will rightly challenge comparative biochemists and physiologists in the future.

The outstanding virtue of this very useful book is the author's first-hand experience with the substances about which he writes, for he has personally undertaken extensive and valuable experimental work on each branch covered. He is enabled thereby to speak with an authority and assurance which goes far to compensate for the exclusion from his survey of fields which still cry for adequate comparative treatment.

Medical Biography

(1) Great Doctors of the Nineteenth Century
By Sir William Hale-White. Pp. vii+325. (London: Edward Arnold and Co., 1935.) 15*s*. net.

(2) Benjamin Rush, Physician and Citizen, 1746–1813
By Nathan G. Goodman. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1934.) 17*s*. net.

(3) Franklin Paine Mall: the Story of a Mind
By Florence Rena Sabin. Pp. xiii+342+8 plates. (Baltimore: The Johns Hopkins Press; London: Oxford University Press, 1934.) 12*s*. 6*d*. net.

(4) Those Were Good Days!
Reminiscences. By Carl Ludwig Schleich. Translated by Bernard Miall. Pp. 280+9 plates. (London: George Allen and Unwin, Ltd., 1935.) 12*s*. 6*d*. net.

(5) The Proceedings of the Charaka Club
Vol. 8. (Published for the Charaka Club.) Pp. xvi+202+31 plates. (New York: Columbia University Press; London: Oxford University Press, 1935.) 25*s*. net.

(1) SIR WILLIAM HALE-WHITE is to be congratulated on having employed his leisure on retirement from practice by the compilation in an intimate and attractive style of the life and work of seventeen eminent British physicians and surgeons of the nineteenth century, with some of whom he was personally acquainted.

General medicine is represented by Richard Bright, William Stokes, Thomas Addison, Sir William Gull and Sir Samuel Wilks; surgery by Sir Astley Cooper, Sir James Paget and Lord Lister; neurology by Sir Charles Bell, Marshall Hale and Hughlings Jackson; tropical medicine by Sir Patrick Manson and Sir Ronald Ross; public health by Edward Jenner and Sir John Simon; ophthalmology by Sir William Bowman; and anæsthetics by Sir James Young Simpson.

An added interest is given to the work by the remarkable versatility of several of these doctors. Richard Bright, for example, who is described as better known than any physician since William Harvey, was also a geologist and traveller, linguist and writer. Sir Charles Bell, in addition to being an eminent anatomist and surgeon and a pioneer in neurology, was also a skilful artist. Sir John Simon was alike eminent as a surgeon, pathologist and sanitarian, having been at different times president of the Royal College of Surgeons and principal medical officer of the Local Government Board, as well as author of a classical work on English sanitary institutions and a text-book on general pathology. Sir Ronald Ross, whose discovery of the mosquito as the transmitter of malaria is known to all, was also a poet, mathematician, novelist, water colour painter and musician. Sir John Young Simpson, who introduced chloroform anæsthesia, was president of the Society of Antiquaries of Scotland and member of several other archæological societies. With the exception of Addison, one of the ablest clinicians of his time, whose name is attached to pernicious anæmia and disease of the suprarenals, and Sir James Young Simpson, all were fellows of the Royal Society.

Short sketches of the lives of distinguished contemporaries of the principal characters are included, such as Robert Graves, author of the famous "Clinical Lectures", William Farr and Southwood Smith, the sanitarians, Henry Hill Hickman, a pioneer on nitrous oxide anæsthesia, and Thomas Hodgkin and Hilton Fagge, well-known physicians and contemporaries of Addison and Sir William Gull respectively.

(2) In his work on Benjamin Rush, Dr. Nathan G. Goodman gives a richly documented account of a man who was equally illustrious as a physician, humanitarian and patriot. His activities as an American patriot consisted in being the only doctor of medicine who signed the Declaration of Independence and in serving as Physician-General to the Middle Department of the Army. He has left classical descriptions of the relation of disease of the teeth to joint infection, cholera infantum, dengue and the hygiene of troops as well as a remarkable account of the yellow fever epidemic at Philadelphia in 1793.

By the introduction at the Pennsylvania Hospital of humane and judicious treatment of the insane, for whom he provided bathing facilities and occupational therapy, and by a careful study of the causes, symptoms and treatment of insanity in his essay on diseases of the mind, Benjamin Rush deserves the title given him by Dr. Goodman of "the first American psychiatrist". His humanitarianism was also shown by his denunciation of slavery and its attendant evils, his protest against capital punishment, his interest in prison welfare and his campaign against alcoholism. Lastly, as educator, Rush was the foremost teacher of medicine in America in his time and took an active part in the foundation of Dickinson College at Carlisle, Pennsylvania.

In addition to brief notes on the text, a bibliography of twenty-seven pages including manuscript sources, a list of Rush's published works, contemporary newspapers and secondary works is appended. The text is interspersed, among other illustrations, with portraits of Rush and his wife, pictures of his birthplace and last residence and of the Pennsylvania hospital to which he was attached.

(3) In her sympathetic study of Franklin Paine Mall, professor of anatomy at Johns Hopkins University, his former student, Miss Florence Rena Sabin, relates the life and work of a man who, like Osler, Welch, Flexner and Halstead, transplanted to the United States modern scientific medicine from Europe, where Mall was the pupil of His in anatomy and embryology and of Karl Ludwig in physiology. Before the return of this small but influential band of men from Germany in the 'eighties, the United States possessed no laboratories, no equipment and no money for education, but within a decade these deficiencies were made good. In addition to the active part which he played in the organization of scientific societies such as the Association of Morphologists and the American Anatomical Association, Mall was responsible for the appearance in 1901–2 of the *American Journal of Anatomy*, of which he edited the first seven volumes, as well as the first volume of the *Anatomical Record*.

Though primarily an anatomist who founded a school of anatomy in the United States and trained men who carried his teaching to other laboratories, Mall had also a profound influence on medical education in general. Miss Sabin quotes in full the appreciation of his work which appeared in NATURE, **96**, 205 (1916); **106**, 179 (1920). A bibliography of his most important publications is appended, as well as the German text of letters received from His and Ludwig, with whom Mall corresponded for many years after leaving Germany.

(4) In the autobiography entitled "Those Were Good Days", Carl Ludwig Schleich, the versatile and eccentric surgeon who died in 1922, gives a vivid account of his childhood, student life and tempestuous maturity, together with a living picture of pre-War Germany. After acting as assistant to a number of distinguished chiefs, including Langenbeck and Bergmann, the surgeons, and Virchow, the pathologist, to each of whom a chapter is devoted, as well as to Senator, the physician, and Olshausen, the gynæcologist, he founded a private clinic for surgery and gynæcology, where he initiated the method of regional anæsthesia for which he is best known. The method at first met with a hostile reception, but ten years later Miculicz, a leading German surgeon, announced that he had performed thousands of completely painless operations by this means. A special chapter is devoted to Ehrlich, as man and scientific worker, whom Schleich used to visit frequently in his Biological Institute at Frankfort.

Schleich's activities were not confined to his profession. He was an intimate friend of August Strindberg, the novelist and playwright, and of Richard Dehmel, the poet, and was himself the author of numerous poems and plays, a musician and painter. An epilogue by his friend Wolfgang Goetz is appended to the autobiography.

(5) The eighth volume of the *Proceedings of the Charaka Club* (a select band of New York practitioners interested in the history of medicine) contains several papers on medical biography. The first of these is a sketch by Dr. Archibald Mallock of the life of James de Berty Trudeau, artist, soldier and physician, and father of the better known Edward Livingston Trudeau, pioneer in the sanatorium treatment of tuberculosis. In addition to being general commanding the Louisiana Legion at New Orleans in 1861 at the outbreak of civil war, and author of a treatise on the organization of the militia for the defence of the State of Louisiana, Trudeau wrote a book on "Woman and her Diseases", and was the designer of several caricatural statuettes of well-known medical men which are here reproduced.

Dr. Casey A. Wood contributes an instructive paper on "Johannes Baptista Porta (1540–1615), Neapolitan Oculist and Natural Philosopher". Porta was also the founder of the "Accademia degli oziosi" and "Accademia secretorum" at Naples, which recorded a number of scientific discoveries, a writer of plays, many of which were staged with remarkable success, and a collector of natural history specimens, with which he converted his house into a museum. Porta's chief claim to be remembered, however, is that he discovered and described several optical instruments, including the camera obscura. He was also the author of "Magia Naturalis" (1558), by which he intended to destroy some of the prevalent superstitious beliefs, "Phytognomonica" (1583), which is described as a herbal, an advanced text-book on botany, a treatise on comparative biology, and a compendium of surgery, anatomy, medicine and pharmacology, and "De humana physiognomia". in which he proved himself a predecessor of Lavater.

Dr. Karl M. Vogel's paper entitled "Sea Surgeons in the Days of Oak and Hemp" contains a brief account of John Esquemeling, surgeon, buccaneer and writer; Lionel Wafer, another medical man of prominence in buccaneering circles; Thomas Dover, the pirate, who gave his name to the well-known powder; Tobias Smollett, the novelist; John

Atkins, author of "The Navy Surgeon", which contains the first detailed description of African sleeping sickness as occurring in the natives of the Gold Coast in 1737; and Savigny, one of the survivors of the shipwreck of the *Medusa*, which he related with its appalling consequences. In his essay on "Doctors and Gardens", Dr. Frederick Peterson refers to Linnæus, the father of botany, who was professor of medicine at Uppsala before he became professor of botany there; Dahl, his pupil; Gaulthier, of Quebec; Pierre Magnol, professor of medicine at Montpellier; Lobel, of Lille, physician to James I; Leonard Fuchs, professor of medicine at Ingoldstadt, and many other doctors who have given their names to well-known plants.

Yeast

Die Bierhefe als Heil-, Nähr- und Futtermittel Von Dr. Julius Schülein. (Technische Fortschrittsberichte: Fortschritte der chem. Technologie in Einzeldarstellungen, herausgegeben von Prof. Dr. B. Rassow, Band 35.) Pp. viii + 194. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 9 gold marks.

WHEREAS bakers' yeast remains in the bread after it has done its useful work, brewers' yeast remains as a by-product of brewing and is sometimes a waste product. This is certainly improper, and a great deal of work is going on in all countries to find uses for it either in medicine, or as a food for man and animals. It is claimed that the craze for synthetic organic pharmaceuticals is abating and that the medical man should restudy the old-fashioned natural materials in the light of modern knowledge—above all, yeast.

In England, a material—marmite—made from brewers' yeast has found extensive use for some considerable time, and is freely referred to in books on nutrition. It is one of the two foodstuffs which are rich in vitamin B_1, the other being wheat germ: it was supplied to the Army in the East for the prevention of beriberi during the Great War. In Germany, up to 1914, brewers' yeast was disposed of locally; the value of a pot of yeast, so-called young beer, as a blood purifier was known to the peasants, but most of it was thrown away. During war needs, the under-nourished population took to it, but the demand did not persist.

A very thorough investigation of the vitamin content of brewers' yeast has been made by a number of workers, as well as that of certain amino acids and glutathion. It has been established that the dried material is very rich in vitamin B_1 and B_2 in comparison with the usual foods, and that brewers' yeast extracts properly prepared are far superior to the flesh extracts which are so largely used; indeed these are regarded by some as an unnecessary waste of the animal material.

The author has collected a great deal of information in regard to these points and in particular to the beneficial effects of yeast in cases of malnutrition; his book contains more than four hundred citations to the original literature.

Whereas brewers' yeast is grown in the mash tun along with the nutritive elements derived from the germinated and malted barley, bakers' yeast is produced in quite a different manner under conditions of high aeration from molasses and inorganic nitrogen, the object being to manufacture a product from a single pure culture which is absolutely regular in its character and activity, so that a dough made from a standard flour mixture is properly fermented in a standard number of minutes. It is the aim of the yeast-maker in competition to reduce this time.

Modern bakers' yeast may be described primarily as a gas-making machine. Such yeast dried is eminently palatable, which is scarcely the case with dried brewers' yeast, and successful attempts are now being made to manufacture a special yeast for nutritional purposes in which the vitamin and other therapeutic content of the yeast is enhanced. Apparently the cost of the protein in such yeast is higher than the equivalent quantity as beef or mutton, but the vitamin content is far superior.

It is probable that the public will in future be offered genuine valuable yeast preparations, though some safeguards will have to be discovered to guard them from spurious preparations of inferior or no vitamin content, which they themselves will be unable to recognize.

The sale of vitamin-rich foods containing the requisite accessory factors to our normal unsatisfactory diets is bound in time to present the problem of their supervision. Quick and satisfactory tests of a chemical nature for the vitamins will have to be found in substitution for the present laborious tests on animals, so that the proper public authority may take the control in hand.

Poisons Law

a Guide to the Provisions of the Pharmacy and Poisons Acts 1852 to 1933 and the Dangerous Drugs Acts 1920 to 1932 for the use of Pharmacists and others concerned with Transactions in Drugs and Poisons. By Hugh N. Linstead. With a Chapter upon the International Background of Dangerous Drugs Legislation, by Sir Malcolm Delevingne. Pp. vi+448. (London : The Pharmaceutical Press, 1936.) 5*s*. net.

THE Act of 1933 made drastic changes in poisons law, and the Poisons List and Poisons Rules, issued by the Secretary of State on the advice of the Poisons Board, have brought complications and liabilities to all concerned, in whatever way, with transactions in poisons. The List, excluding esters and salts, approaches 200 entries, some covering ranges or groups of substances; the rules number 33, and 12 schedules are appended. Fortunately, this review is not concerned with the List or Rules as such, but only with the way in which the author explains and amplifies them. They appear involved and interdependent and it is obviously desirable to have them co-ordinated and explained for the assistance of those who are primarily concerned with their practical application. No one is more fitted to do this than he who is the Secretary of the Society which has been concerned with the administration of each Act dealing with poisons in Great Britain, and who is a member of the Poisons Board set up under the latest Act. He has dealt with the subject from the practical point of view and after discussing the question of labelling, he shows the application of the rules to, respectively, retail pharmacy, listed sellers, laboratories, manufacturers and wholesalers, medical practitioners (including dentists and veterinary surgeons), hospitals and manufacturers of animal medicines. In spite of the complexity of the subject and of certain essential repetitions, he has been able to compress these aspects to, respectively, 14, 7, 2, 11, 5, 6 and 2 pages of conveniently large print.

Nothing but praise can be given for completeness, conciseness and clarity. A few *ex cathedra* interpretations are given, and since it may be assumed that these express the attitude of the Pharmaceutical Society, they will probably be acted upon and become standard practice. The paraphrase on p. 98 of the proviso to Rule 23 (2) must be criticized, since it appears to deny completely to a shelf a storage function which the proviso only conditionally restricts. The book concludes with a useful list of poisons and substances containing poisons, with an indication of the special restrictions applying to each. J. R. N.

Alternating-Current Machines

By A. F. Puchstein and Prof. T. C. Lloyd. Pp. viii+582. (New York : John Wiley and Sons, Inc.; London : Chapman and Hall, Ltd., 1936.) 25*s*. net.

IN the preface the authors state that the time devoted in technical colleges to the study of alternating current machines varies between wide limits. It is stated that a definite text-book is chosen and the syllabus is constructed from it. Granting this, it is of great importance that the text-book be comprehensive and thorough. The present volume is a treatise which covers a very wide ground. The authors admit that only a fraction of the material in the book can be studied in the classroom.

We think that, from the training point of view, the treatise would have been much more useful if it had been cut down considerably. Considering the many subjects which electrical students have to study nowadays, and that only a small number of them will take up seriously machine design and operation in their profession, it would have been better for the greater number of students if the authors had discussed only a few typical machines. The treatment is on orthodox lines and will be easily understood by the technical student. Many examples are given, but it would have helped those who try them to have had the answers given and to have more of them worked out.

Die menschlichen Rassen:

eine populärwissenschaftliche Einführung in die Grundprobleme der Rassentheorie. Von Dr. Rudolf Lämmel. Pp. xv+283+48 plates. (Zürich : Jean Christophe Verlag, 1936.) 7 francs.

THIS clearly written treatise on human races belongs to the polemical class of literature, being more concerned in rectifying the errors of German professors than in laying before its readers a scientific presentation of modern ethnology. Readers can best judge of its scientific worth by noting the classification applied to men of the European type. It is proposed to divide them into thirteen races : these are Nordic, Baltic, Alpine, Dinaric, Armenian, the "Faelischen", Turanians, Mediterraneans, Orientals, Indides, Veddahs, Ainos, Polynesians.

The first essential of a classification of objects of any kind is that its groups must be capable of identification and that there is some degree of unity in the total assemblage. The classification in this book breaks these elementary requirements. A. K.

Motivation of Behavior:

the Fundamental Determinants of Human and Animal Activity. By Prof. P. T. Young. Pp. xviii+562. (New York : John Wiley and Sons, Inc.; London : Chapman and Hall, Ltd., 1936.) 20*s*. net.

THIS is a very interesting and sound psychological account of the mainsprings of conduct under the caption of the motivation of behaviour. The work is well developed and well balanced, the evidence clearly put and the argument logically advanced. The author gives his own position by stating that the mind and the brain are one and the same reality, and that motivation is a process of arousing movement by physical energy transformations which are concurrent with behaviour.

At the end of the book is a collection of questions on each chapter—to anyone who has the energy and time to answer these questions seriously they cannot fail to be a great boon. We wish it was a usual practice.

The Harvard Tercentenary Celebrations

HARVARD celebrated its tercentenary on September 18 by a ceremony which was as impressive in its setting as it was comprehensive in its conception.

The scene was set in the "Yard"; for those to whom Harvard is a name, albeit a great name, a word must be said about the actual terrain. The Yard at Harvard, which forms the nucleus of the University, is situated in the town of Cambridge much as Trinity College is situated in Dublin; the buildings are less regularly disposed than those of the colleges at Cambridge or Oxford, and being detached from one another the arrangement into definite 'Courts' or quadrangles is less defined. The quadrangles, in so far as they exist, however, differ from those in the English universities in that they are planted with trees as well as with grass and therefore shaded completely with foliage. Of these leafy areas in the 'Yard', that which most definitely resembles a quadrangle is one bounded by the Memorial Church on the north and by the Widener Library on the south, both noble buildings, each at the head of an imposing flight of steps, and facing one another one hundred and thirty yards apart.

In this court the ceremony took place. The steps of the Memorial Church formed a terraced stage, from the centre of which the addresses were given. In the centre sat also the President of the United States, an old Harvard graduate, and the diplomatic and civic representatives, including Mr. Curley, Governor of Massachusetts. To the right and left sat the recipients of honorary degrees, and in the tiers behind them the delegates from other universities and corporations, and also the representatives of the faculties at Harvard. As the number of delegates was in the region of five hundred, there cannot have been less than one thousand persons who faced the assembly. For it fourteen thousand chairs had been placed in the court. "In the court" is perhaps not a good phrase, for at the back on each side of the Widener Library there is a gap in the buildings, and the rows of chairs stretched out into these two gaps until they were lost to sight beneath the trees.

The actual proceedings lasted about three hours. Over the whole of this colourful assembly hung the menace of storm. The weather for the preceding days had been perfect; but a hurricane was known to be on its way, travelling up the Atlantic coast. Rain-drops fell at the commencement of the proceedings and from time to time during its continuance, but the President, with resolution amply justified by the event, refused to transfer the programme to an alternative one which had been arranged in the event of wet weather. All knew that it was a race with time. Ten minutes before the termination of the sitting the skies broke, but the torrent of rain which poured from the clouds was no more than a reminder of what might have been. To some indeed the conditions may have seemed in a sense an allegory. What better symbol could there be of the determined growth of a University through three centuries of difficulty and strife to its present magnificence than the resolution of its President in carrying the tercentenary celebration to its climax through three hours of menacing storm.

The proceedings opened with a prayer and closed with a benediction—a detailed account of them would perhaps be out of place. Items of particular interest to English readers would perhaps be: (1) The fact that shortly after the opening prayer the chimes of Southwark Cathedral, that in which John Harvard was baptized, were broadcast across the Atlantic and listened to by the audience. (2) The Poet Laureate of England, John Masefield, who travelled 3,000 miles to deliver his tribute in verse . . . which, referring to John Harvard, concluded:

"Would that his human eyes untimely dead,
Freed from that quiet where the generous are,
Might see this scene of living corn made bread,
This lamp of human hope become a star."

(3) The conferment of honorary degrees. The degree of doctor of science was conferred as follows:

Prof. E. B. Bailey—a British geologist whose skilful questioning of the Scottish highlands drew forth revealing answers, telling of the origin of mountain ranges and their evolution in the past.

Dr. Kiyoshi Shiga—the discoverer of the cause of epidemic dysentery, a valiant and effective fighter in the international struggle for the prevention of disease.

Prof. T. Levi-Civita—a mathematician great in accomplishment, an intellectual leader of the land we all revere, the birthplace of the art and science of the present day.

Sir Arthur Eddington—a student of the cosmos who peers within the atom and surveys the expanding universe, an expounder to the multitude of the poetry of modern science.

Prof. A. H. Compton—a physicist who forces light itself to illumine the dark secrets of its still mysterious nature.

Prof. L. Ruzicka—a chemist, daring in his attack, brilliant in his methods, successful in his interpretations of the architecture of Nature's baffling compounds.

Prof. B. A. Houssay—a physiologist noted for his studies of the ductless glands, a leader of science in the new world to the south.

Sir Joseph Barcroft—an investigator of many phases of the respiration of higher animals, a beloved guide to younger men on both sides of the Atlantic.

Prof. C. Gini—a versatile sociologist and statistician who early turned his attention to that most vital problem, the growth of populations.

Prof. B. Malinowski—an anthropological explorer who initiated a new movement for the study of the gregarious habits of the human race.

Prof. J. Hjort—the naturalist of the northern sea, whose studies and explorations have benefited alike the science of biology and the fisheries of his native land.

Dr. F. Bergius—a modern magician, his knowing touch transforms coal to oil.

Dr. N. L. Bowen—a scientific Vulcan, in his laboratory furnaces he measures those forces which once formed our igneous rocks.

Prof. E. D. Adrian—a physiologist whose brilliant experimentation established new principles concerning nerve impulses and the action of sense organs.

Prof. P. M. F. Janet—a pioneer in studying the multifarious phenomena of mental pathology, his systematic analysis founded a branch of psychology.

Prof. J. B. Collip—a skilful biochemist, a bold explorer among the tangled complexities of the internal secretions.

Prof. A. Pannekoek—an astronomer who has gauged the distances of the dark nebulae, an astrophysicist who has assayed the stellar atmospheres.

Prof. E. J. Cartan—a versatile investigator in the realm of pure thought, a mathematician who has advanced his science on many fronts.

Prof. P. Debye—a large-hearted physicist who gladly lends the chemist a helping hand by elucidating the electrical properties of matter.

Prof. The Svedberg—a man who sees beyond the microscope, at his bidding centrifugal forces make giant molecules reveal their size.

Prof. H. Spemann—a biologist who experimented with embryonic tissue and discovered a new approach to those agents which determine organic form.

Prof. C. G. Jung—a philosopher who has examined the unconscious mind, a mental physician whose wisdom and understanding have brought relief to many in distress.

Prof. L. E. Dickson—a fruitful speculator on the significance of numbers, an algebraist noted for his stimulating work.

Prof. R. G. Harrison—an embryologist whose method of transplantation yields new insight into the process of development.

Prof. R. A. Fisher—a student of heredity, who has improved statistical methods and assisted agriculture by the application of his science.

Prof. S. A. S. Krogh—a physiologist for ever probing with new instruments the unknown mechanism of life processes.

Dr. K. Landsteiner—the master of the science of immunology, the discoverer of those fundamental principles which made blood transfusion possible, saving countless lives.

Prof. G. H. Hardy—a British mathematician who has led the advance to heights deemed inaccessible by previous generations.

Prof. A. C. Lawson—a geologist who has ranged widely both in time and space.

Dr. J. H. Northrop—a chemist turned biologist, a skilled manipulator of those catalysts on which life depends.

Dr. F. Silvestri—a brilliant entomologist who has searched many continents to find those parasites which guard our crops.

Prof. H. Fischer—a master builder of molecular structure whose labours tell us why grass is green and blood is red.

Prof. R. Carnap—a philosopher of penetrating insight who lights the way for those who seek through logic the unity of the world.

Sir Frederick Gowland Hopkins—the discoverer of the vitamins, a pioneer in many fields, whose work stands as a symbol of the ceaseless adventure of the human mind.

Among the other awards, the honorary degree of doctor of letters was conferred on the following, among others :

Prof. J. Piaget—a deft inquirer into the growth of those mental processes which mark the gradual development of the normal child.

Prof. V. Gordon Childe—a far-seeing archæologist whose writings allow us to behold the dawn of civilization in Central Europe.

Prof. R. Maunier—a contributor to our understanding of the functioning of social institutions, the director of research into the laws of simpler peoples in the colonies of France.

Prof. P. Pelliot—an intrepid explorer whose examination of the manuscripts and art of central Asia enhances our appreciation of a group of ancient cultures.

Dr. R. M. MacIver—an inquirer into the structure of society, a learned systematizer of our social theories.

Prof. M. I. Rostovtzeff—the social and economic historian of the Roman empire, whose fruitful study of antiquity accumulates for all who read centuries of rich experience.

(4) The most interesting feature of all was the oration of President Conant, a man, be it remembered, of less than forty-five years of age and until two years ago professor of chemistry, the courage and eloquence of which cannot be conveyed in a few words. Starting with the President's conception of the proper ordering of a university, the oration developed into a plea for citizenship based upon the search for truth in all departments of intellectual activity. To the man of science it was interesting to observe that to President Conant the health of a university depends upon the maintenance of a correct balance between four components : student life, the teaching of abstract subjects, professional training, and the search for new knowledge. Typical of the later part of the speech was the demand for "absolute freedom of discussion, absolutely unmolested

enquiry". This note of freedom was struck also by the President of the United States in his speech to the alumni of Harvard the same afternoon. "In this day of modern witch-burning, when freedom of thought has been exiled from many lands which were once its home, it is the part of Harvard and America to stand for the freedom of the human mind and to carry the torch of truth."

So much for the eighteenth of September, but it was only the climax. The proceedings of the two days previous may be passed over, though either of them would furnish matter for an interesting article. Rather would we go back to events still earlier and to a phase of the celebrations which possibly is without precedent.

Harvard determined if possible to make its celebration primarily an intellectual one. Before inviting universities and other corporations to send delegates, it drew out a list "of leading scholars in different parts of the world to a number which we trust will bring to the proposed conference some sixty or seventy men of high distinction from the whole field of learning". These received invitation to take part in a conference the intention of which was expressed in the following words: "It is hoped that we shall succeed in finding a meeting ground on which it will be possible not only for the results of research in detail to be communicated by scholars, to one another, but also for problems which concern a variety of disciplines to be the object of common attack."

The event proved overwhelmingly successful, so far, at least, as the present writer was able to judge from the proceedings kindred to his own subject, and from what he was told concerning others.

These 'proceedings', as indicated in the above quotation from the letter of invitation, fell into several forms. There were addresses on the general aspect of one broad subject such as that by Sir Frederick Hopkins on "The Influence of Chemical Thought on Biology"; "Diabetes as a Disturbance of Endocrine Equilibrium", by Prof. Bernardo Alberto Houssay; "Insect Polyembryony and its General Biological Aspects", by Prof. Filippo Silvestri; "Plants and Civilisations", by Prof. Elmer Drew Merrill. There were sittings devoted to a group of kindred subjects such as that on the "Applications of Chemistry to Biology" in which the individual papers were: (1) "The Use of Isotopes as Indicators in Biological Research", by Prof. August Krogh; (2) "The Formation of Enzymes", by Dr. John Howard Northrop; (3) "Protein Molecules", by Prof. The Svedberg.

There was no possibility of discussion on the great scale, but the effective 'meeting ground' was found in another way—after the communications, groups of those interested in the subject met and thrashed the matter out, or tried to do so. To take an example, after a communication on "The Fundamental Nature of the Respiratory Rhythm", a group consisting of two experimental psychologists, two pharmacologists, one physiologist and three anatomists had a most fruitful discussion on the initiation of neuro-muscular function in the fœtus, and one which will probably clear up many existing divergences of opinion. Such in its small measure admirably fulfilled the desire of Harvard "for problems which concern a variety of disciplines to be the object of common attack".

On this great scale, the same object was attained by the institution of symposia. These were classified as follows (Nos. 4 and 5 really were not symposia in the same ordered sense as 1, 2 and 3; they were groups of communications of the type of and including those already discussed):

(1) Factors determining Human Behaviour.

(2) Authority and the Individual.

The State and Economic Enterprise; Stability and Social Change; The Place and Functions of Authority; Classicism and Romanticism.

(3) Independence, Convergence and Borrowing in Institutions, Thought and Art.

Europe and the Near East; The Middle Ages; East and West.

(4) Biological Sciences.

Various Aspects of Biology; Experimental Morphology; Parasitism; The Applications of Physical Chemistry to Biology.

(5) Physical Sciences.

Mathematics, Astrophysics, Cosmogony (Sessions of the American Mathematical Society and the American Astronomical Society); Theoretical Physics; Cosmic Radiation; Nuclear Physics; Geology and Geophysics; Chemistry; Industrial Chemistry; Communication Engineering.

The first of the above symposia was attended by the complete conference in joint session and was indeed the inaugural meeting. The remaining four represented the four divisions into which learning was divided for purposes of convenience—human relations, arts and letters, biological sciences, and physical sciences.

As an example of how the plan worked in detail, the first symposium may be taken. The intention was to sample various aspects of the activity of the human nervous system, from the most simple to the most complex. The opening paper was by Prof. E. D. Adrian on the objective physiology of "The Nervous System". This was followed by papers on "Hormones in Relation to Human Behaviour", by Prof. J. B. Collip, "Les principaux facteurs determinant l'évolution intellectuelle de l'enfance à l'âge adulte et de la genese des

principes de conservation", by Prof. Jean Piaget, "Psychological Factors determining Human Behaviour", by Prof. Charles Gustav Jung, "La force et la faiblesse psychologique", by Prof. Pierre Marie Félix Janet, "Logic", by Prof. Rudolf Carnap, "An Example from the Evidence of History", by President Emeritus Abbott Lawrence Lowell, and finally "Culture as a Determinant of Behaviour", by Prof. Bronislaw Malinowski.

The last of these took the form of an evening lecture. Other public lectures treating of subjects of general interest were by Frank Baldwin Jewett, of the Bell Telephone Laboratories in New York, on "The Social Implications of Scientific Research in Electrical Communication"; by Prof. Wm. Berryman Scott, on "The Laws of Mammalian Evolution"; by Sir Arthur Stanley Eddington, on the "Constitution of the Stars"; by Prof. G. H. Hardy, on "The Indian Mathematician, Ramanujan"; by Prof. E. J. Dent, on "The Historical Approach to Music"; by Prof. Corrado Gini, on "Authority and the Individual during the Different Stages of Evolution of the Nations"; by Prof. John Dewey, on "Authority and Resistance to Social Change"; by Prof. W. E. Rappard, on "Economic Nationalism"; and by Prof. Johan Hjort, on the "Biology of Whales".

Reviewing the activities of the congress, or such of them as fall within the scope of a biologist, it can only be said that the event far exceeded what might have been expected of it. It may be doubted whether any congress covering so wide a field has ever succeeded in at once reaching a level so sustained in matter, and in manner so intelligible to those not acquainted with the particular and specialized techniques of those who rose to so high a level.

Lastly, a word as to the hospitality poured with both hands upon the members of the congress. It is difficult to know where to begin or end in treating of it. American hospitality is the high water mark; to say that it reached the highest level of American hospitality is no less than the truth. One item, however, must be mentioned specifically, namely, the orchestral concerts, three in number, given by the Boston Symphony Orchestra. Two were instrumental, in the third the orchestra combined with the chorus of Harvard University and Radcliffe College. All were a sheer delight. At the close of the last concert, just before "Fair Harvard" was sung, President Conant walked up the hall, ascended the platform, shook hands with Dr. S. Koussevitzky, whose skill and enthusiasm as a conductor had been so largely responsible for this feast of pleasure. Dr. Conant said a few words, ending as follows: "I wish to say just two words 'Thank you'." A fitting ending, for there is no delegate who can have left Harvard with any other thought in his mind. Harvard—Thank you!

The Patterns of Experience*

By A. W. Wolters

SUMMING up his important contributions to the psychology of perception, Prof. E. Rubin demonstrated, in a paper devoted to the 'ways of seeing' read before Section J of the British Association at Norwich last year, that perceptual cognition is shot through with suggestions of movement and direction which are not reducible to the geometry of the object. The mind contributes structural principles to its own experience.

Like many scientific theories, this was not new. Many besides Rubin, and many earlier than he, have suggested that the mind, at least in part, makes its own experience. The value of his contribution lies in the beauty of his experimental development of the theme, and in the detailed application of it. But at least one of his demonstrations at Norwich was so new as to be thrilling. Those who were present will remember vividly how we were brought to recognize that pictures in European art have a definite left-to-right character, upon which their meaning and æsthetic appeal largely depend. I reported this to Mr. Betts, the head of the School of Art in the University of Reading. We went through his stock of lantern slides, and found that in nearly every case Rubin was clearly right. But our most exciting moment was that in which we discovered a drawing in which Rembrandt had gone astray. My colleague suggests that Rembrandt made his sketch from a mirror, a quite usual method, so that having posed his model correctly—that is, as Rubin would have had him do—and being absorbed by the technical problems of his sketch, he overlooked the extraordinary and unpredictable effect of the lateral inversion.

* From the presidential address to Section J (Psychology) of the British Association, delivered at Blackpool on September 11.

It seems clear that there are pre-established manners of seeing, and we must expect the same to hold in the other modalities of sense. It appears that perception can be shaped by factors extrinsic to the material experienced. Under their influence the mind is creating, is actively patterning its experience, so that in some sense and to some degree (the limits being determinable by experiment) the mind makes the world it knows. To speak a little dogmatically, I hold that the mind informs its sensory material, making the percept consistent with certain subjective principles. This implies that the patterns of experience are in some sense already latent in the subject's mind as he confronts the world. Can we say how ?

Alas, not very well. We must be content for the present with a small but useful advance to be made along the following path. If one says that perceiving is a response of the organism, meaning what one says, it follows that the distinction between cognition and conation is not an ultimate one. The general utility of the traditional division is not in question, but in the end we have to recognize that the process of coming to know is an activity, a piece of behaviour linked up with and subordinated to other behaviour. Conation *must* be the fundamental concept, because the first duty of every organism is to remain alive, and it needs to manage and control its environment to that end. Let us look for a moment at other forms of behaviour.

It is agreed that behaviour exhibits certain regularities of sequence which entitle us to formulate laws. In describing the phenomena, the phrase which comes most readily to the tongue is that they exhibit patterns. The word has of recent years been very freely used. It requires no technical knowledge to understand the statement that a man's business activities show a constant pattern, no matter how varied the details with which he has to deal at different times. Our insight into the character of acquaintances mainly rests upon the observation of their behaviour patterns. It is very difficult to describe them, and still more difficult to analyse them, but they are easily recognizable. They are, in fact, the constancies without which social life would be impossible.

The outstanding example of patterns of behaviour is presented by the instincts. In them we have themes which can be recognized as essentially the same while the details of the activity vary thoroughly, just as the theme of a symphony can be recognized through its development. But to say this is to apply the term 'pattern' as an objective description, and not as an explanation. Whether in this field you prefer to speak of urges and drives, or of fields of force and closure, is indifferent to the present argument, which requires only two points conceded to it : first, that these patterns of behaviour are observable, it being in virtue of them that the adjective 'instinctive' is applied, and, secondly, that the character of the organism is among the causes which produce them. We note that the behaviour of the human individual displays patterns which are similar in their outline to those of animals, and which, arguing from them, we must assert to depend upon the connate character of the organism.

To argue the obvious a little more fully, if a pattern is observable in behaviour, it must be dependent either upon the detailed events themselves, or upon the organism. In many cases, such as the behaviour of insects or nest-building in birds, there seems to be no sense in the first alternative, and consequently we take the patterns to be determined by the nature of the organism. This is to assert that the pattern is latent in the organism ; but not after the manner of a 'blue-print'. The latent pattern is not open to inspection. It exists, to use an old and respectable term, formally. There is a character of the organism which gives a distinctive pattern to its reactions. But there are also patterns observable in acquired activities, and in this case we have an everyday term to designate the quality of the agent which produces it. We call it a skill, and regard it as inherent in the subject whether he is or is not engaged in the activity at the moment. But once more it is not inspectable as the pattern of the activity is. All we can observe is that *A* by economical and coherent actions consistently achieves success in a given field, while *B* as consistently fails in it. Believing that all phenomena have a cause, we ascribe to *A* a skill which *B* lacks. So far as language goes, we can say either that *A* is skilled, or that he possesses a skill. Both expressions are admissible, but I would suggest that the former is better in psychology, since we can neither observe, nor by deduction describe, a skill in itself. When we attempt to do so we usually find ourselves describing again the pattern of the activity. Let us take a skill to be a character of the individual, a manner in which he has been psychologically shaped by racial or individual experience. To say that a person is skilled means that he is prepared to deal adequately with situations of a particular kind, but prepared in an outline, flexible manner which is sensitive to the varying details of the moment. Skill is in this respect on a higher plane than tropism, reflex or habit. The organism's skill is displayed in controlling and organizing material on the way to achieving a goal.

Now we can return to our original problem of perception. No present-day psychologist can be content to regard perceiving as no more than

reflecting the material world, or as a process to be studied in isolation. It is a preparatory reaction, prior to more far-reaching activities, its immediate goal being the organization of sensory data into manageable forms. So we come to the conclusion that the predetermined 'ways of seeing' of which Rubin spoke belong to the vast family of skills, and can be treated with the others. The range of processes in which the pattern of behaviour, and the pattern resulting from the behaviour, depend upon the mental characteristics of the agent would appear to cover the whole extent of human life.

At the London meeting of the British Association in 1931 I read a paper advancing the hypothesis that what is termed conceptual thinking can be dealt with in terms of skill, saying that what are termed concepts are best considered as outline preparations for response, and not as mental entities. I endeavoured to show that the behaviour of animals displays patterns parallel with those of a higher grade in human beings. I introduced the term schematic preparation, or more shortly 'schema', as a name for this subjective character. Five years later, fortified by the parallel advance of Prof. F. C. Bartlett in another part of the field, I am bold enough to claim that our conception will cover all parts of animal and human psychology, pulling together into a system many heterogeneous results.

Can we apply the outcome of this discussion in the field of social psychology? The term 'social pattern' is in common use, and perhaps is employed with dangerous facility. In the first place, it appears to mean an observable system of relationships between individuals and their activities, constituting a unity of a higher order of complexity than that of any one of its members. Secondly, the social group is a part of the environment of each of its members and of persons who make contact with it from outside. It is a system of facts to which individuals have to adapt their behaviour. In this it is parallel to the inanimate environment, and since the principles of behaviour will resemble those already encountered, the matter may be left for a moment at that level. Thirdly, social groupings present a puzzling combination of determinacy and flux. To live in society is rather like rowing in rough water. Within a quite characteristic pattern of the whole there is an inconvenient mobility of the elements, which requires continual variability of response. The patterns of society are determinate but dynamic, and to react successfully to them demands skill.

To deal with this problem in a little more detail I turn to another paper read before Section J at Norwich, one by Prof. T. North Whitehead, since published in *The Human Factor*, 9, 381. A group of five girls working at the same tasks came in time to form a real social group with a complex but readily discernible pattern. An objective record of it was obtained by studying the relations between the output of individuals, and the investigator was able to reduce these to a clear diagrammatic form. Since conversation is the chief instrument of social relationship, the seating arrangements proved largely decisive for the pattern. When an experimental change was made in the seating order, the social and psychological pattern was broken and a new one had to be formed, output being adversely affected during the process.

Prof. Whitehead's interesting report is concerned mainly with the objective study of the group. There are, however, important implications on the subjective side. In the first place, like everything else, society is only apprehended by individuals, whose perception will be shaped in ways analogous to those revealed by Rubin in simpler material. This is the common handicap of all science, and no more need be said of it than to remind ourselves that each person must react to society as *he* sees it. A more important matter is that society, whose dominating influence we realize more and more, has proper significance for psychology only in its impact upon individual lives. It is, indeed, only actualized in those moments. Its components are individuals acting, and their behaviour is informed by the principles studied earlier. Yet their activities form a system, and we have to reconcile that with individual psychology.

A group only exists in virtue of conative tendencies developed by individuals in the course of accommodating their behaviour to each other's. It requires skill to live socially, and I see no reason why we should not treat this as we did others. Social skills are predetermined schematic preparations for adaptive responses to situations presented by the presence of other persons, whose behaviour forms a reciprocally interacting system, and so it is the psychological character of individuals which chiefly determines the social pattern. I should like to adapt a famous conclusion of Rousseau, and say that society becomes a topic for psychology just because it exists immanently in the minds of its members. Whitehead's subjects did not build up a real unified group merely through the seating arrangements. The effects of the removal of the one who had become the leader show this. The unity of the group broke up, and though her successor became even more popular it was never fully reconstituted. So, at least, the writer maintains. But I venture to think that there was formed a new and firmly integrated pattern of a

kind too subtle and intimate to be revealed by the test of correlative fluctuations of output. How otherwise can we account for the odd fact that when the former leader came back to replace her temporary successor the group was entirely broken up through the newly developed hostility to her, formerly the outstanding member of the group ?

What the experiment depicts is the gradual orientation of individuals to each other—in other words, their learning ways of living with each other. When the social environment is changed, a new set of behaviour tendencies has to be established, until in the final setting an environment was found to which the girls could not react successfully. But they had done so at an earlier stage, and we must conclude that in the intervening period some change had occurred in the other girls. The earlier objective conditions were repeated, but there was no unity. Can we avoid the conclusion that the unity had existed in the minds of the members, and those minds had changed to such an extent that the old reactions had become impossible ? An objectively observable group pattern is a product of the skill-characters, or behaviour schemata, of the constituent members. So a problem of group psychology reduces itself to one of individual psychology.

Social patterns are largely manifested in institutions and current ideas, and often in combinations of the two. The English Common Law provides an excellent example of the last. This remarkable invention of our race has been maliciously described as consisting of a vast body of decisions and pronouncements, all readily deducible from a very few simple and universally accepted principles, though no one knows what they are. I cannot say whether this description is true, but there is no psychological difficulty in it. Common Law principles are the ways of living together developed by English people, and like all skills (for skills they are) they were developed in pursuit of ends which did not include the purpose of inspection.

Pursuing a purpose and thinking about the pursuit are quite different processes. So for a long time, possibly always, they would not be amenable to analysis or description. To describe them necessitates the development of a new skill directed to the material provided by the prior one. This is in essence Bartlett's illuminating distinction between schemata as the instruments of reaction and schemata as objects to which reaction is directed. The Common Law is the expression of the directive tendencies of citizens bent on living together along determinate lines, though they may have never reflected upon them. Probably the majority of Englishmen have never heard of the Common Law, though it governs their lives in so fundamental a manner. It is quite usual to find that people who evince a great determinateness of behaviour are unaware of the principles which govern them. Why should they pause in the process of achieving their ends, if all is going well, to 'turn round upon the schemata' which are serving them ?

There is a danger in any form of expression which suggests an opposition between social psychology and individual psychology. The field marked out by the former term is one proper for the specialist, but it remains the study of individuals acting socially. It would avoid the risk of over-abstraction, with possibly something of mysticism arising from it, if we were satisfied to speak of the psychology of social behaviour. At bottom it is the study of the development and nature of schemata employed in orientation to other behaving organisms. They, too, act from schemata, and if they are to live together they must effect a considerable degree of uniformity. So the social pressure upon individuals is intensified by the establishment of institutions which are the outward patterns resulting from the psychological characteristics of the members of the group, and in return a potent means of shaping the next generation. Here the vital problem of society resembles that of the individuals (as must be the case) ; it is that of keeping the outline preparations for adaptive behaviour sufficiently fluid to be sensitive to variations in the problems presented. The Hegelian limit of efficiency is inflexible specific habit, which is a skill so perfectly developed as to become a hindrance.

Now to summarize briefly the thread of this discussion. The subject-matter of psychology is taken to be the activities of the individual organism striving to maintain its full integrity in the universe in which it lives. To obtain control it must organize the presented material of experience into patterns manageable by it, and to this end it develops skills in its activities. Naming these skills by a word not inconvenienced by overmuch usage, we have called them schemata, and the system of a person's schemata embodies all his experience up to the present moment, and determines the direction of his future experiencing. The patterns of experience are formed by them, though not independently of objective conditions. Thus in outline the 'ways of seeing' and the 'ways of living'—whether socially or otherwise—are reducible to a common psychological genus.

The value of this view to me lies in its providing a unitary point of view from which, it is hopefully claimed, one can survey the whole extent of psychological study. At least it may prevent a born eclectic like myself from degenerating into

a kind of scientific jackdaw. So I invite you to regard experience, in the fullest sense of that word, as formed in a complex of patterns largely made by the experiencer, patterns in some cases interlacing, in others forming a hierarchy of increasing generality. Or, to start from the other end, let us take our science to be the study of all the detailed embroideries upon that most common and most comprehensive of patterns, the formula of which runs: He was born, and strove to master his world for his own safety; he mated, fought for his offspring, and died.

Campbell Swinton and Television

By Dr. J. D. McGee

THE successful inauguration by the British Broadcasting Corporation of the high-definition television transmitting station at Alexandra Palace has focused the attention of the technical world on the successful development of the all-electric, instantaneous system of transmission. The degree of success achieved shows that the cathode ray transmitting tube has at last emerged from the research laboratory to take its place as the complement of the receiving cathode ray tube. The latter is well known, and has been recognized for some years as the most effective means for picture reception, and is now a highly developed commercial product. Modern television technique, which will withstand the criterion of the flickerless talking picture, both from the producing and reception points of view, has only been made possible by the development of the receiving and transmitting cathode ray tubes. This development is the result of improvement in technique brought about by the work of many scientific investigators in research laboratories throughout the world.

The manufacture of the modern cathode ray tube for picture reception has evolved slowly as improvements in vacuum technique, glass manufacture, fluorescent materials have been made, while the transmitting tube inherits also the wealth of developments in photo-electric technique. Besides these key units, the whole television equipment—amplifiers, scanning oscillators, pulse generators, cables, radio transmitters, etc.—have each been improved to a stage where they are capable of dealing with the enormous frequency bands, exacting phase conditions, etc., which are necessary for the production of high-definition flickerless picture. This has been achieved by improvement in valve and circuit technique spread over the last twenty years.

The object of this article is to pay a tribute to the memory of a man who probably thought more deeply, clearly and disinterestedly about television than any other of his time and who, had he but lived six years longer, would, I believe, have agreed that his life-long dream had at last come true.

The late Mr. A. A. Campbell Swinton was the first to propose[1] an all-electric system of television in 1908, and continued to urge its claims[2] up until the time of his death in 1930. Sir Richard Gregory has recently reminded us of Campbell Swinton's early suggestions in connexion with television[3], but it might not be redundant to show how Campbell Swinton continued to develop his ideas as technical methods advanced during the remaining twenty years of his life. He first suggested the idea in a short letter to NATURE in 1908[1], later explaining and amplifying it in his presidential address to the Röntgen Society on November 7, 1911[4]. This plan of twenty-eight years ago only required the application of modern technique to become the non-mechanical system now installed at Alexandra Palace, and still in course of development in Germany and America.

It is worth while quoting at some length from the published papers of Campbell Swinton in order to emphasize not only the remarkable accuracy with which he visualized his scheme, but also the kindly unassuming manner in which he presented it to the world.

Campbell Swinton's definition of television is worth noting when considering modern developments, in order to appreciate the difference between television proper and telekinematography. He defines television thus[5]: "If you point a photographic camera at any view or object, whatever is in front of the lens is depicted on the ground glass screen, and what I mean by television is some method whereby what is depicted on such a screen, with any motions or other changes that may be taking place, is electrically transmitted to a distance and made reappear instantaneously on a similar screen at the distant station." This conception of television is implicit in all his early publications.

Referring to a letter from Mr. Shelford Bidwell in NATURE of June 4, 1908[6], in which the difficulty

of obtaining synchronism with mechanical television systems was discussed, Campbell Swinton observed[1]:

". . . this part of the problem of obtaining distant electric vision can probably be solved by the employment of two beams of kathode rays (one at the transmitting and one at the receiving station) synchronously deflected by the varying fields of two electromagnets placed at right angles to one another and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams are caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence.

"Indeed, so far as the receiving apparatus is concerned, the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.

"The real difficulties lie in devising an efficient transmitter which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the kathode beam of the receiver, and further in making this transmitter sufficiently rapid in its action to respond to the 160,000 variations per second that are necessary as a minimum.

"Possibly, no photoelectric phenomenon at present known will provide what is required in this respect, but should something suitable be discovered, distant electric vision will, I think, come within the region of possibility."

This 1908 statement is, undoubtedly, the first published suggestion of a television system which has now been developed on a commercial basis to produce pictures of even higher order of definition than the inventor then proposed as a satisfactory minimum. In the elaborated account of this suggestion in his lecture to the Röntgen Society in 1911, Campbell Swinton gives more details of his proposed transmitting tube, and while it is crude in comparison with a modern transmitting tube, anyone who is familiar with the development of the subject will agree that it was an enormous step in the right direction. It is characteristic of the man that, in proposing his suggestion, he emphasized that[4]:

"it is an idea only, and the apparatus has never been constructed. Furthermore, I would explain that I do not for a moment suppose it could be got to work without a great deal of experiment and probably much modification. It is, indeed, only an effort of my imagination, and can be useful merely as a suggestion of a direction in which experiment might possibly secure what is wanted. What, however, is claimed is that, so far as I am aware, it is the first suggested solution of the problem of distant electric vision in which the difficulty of securing the required extreme rapidity and accuracy of motion of the parts is got over by employing for these parts things of the extreme tenuity and weightlessness of cathode rays".

What must astonish the modern television engineer is the accuracy of Campbell Swinton's idea, when he reflects that, at the time it was suggested, radio communication was in its infancy, radio valves practically unknown, vacuum technique very primitive, photo-electric cells very inefficient.

In the period following the Great War, much time and money was spent in developing mechanical systems of television to the present high limits of mechanical efficiency, but the all-electric system has proved, after a comparatively short period of development work, to be much more powerful.

Campbell Swinton repeatedly pointed out the limitations of the mechanical methods, and repeatedly urged that the development of the all-electric system should be taken up seriously by some large industrial research laboratory. "There are, at any rate," he wrote[7], "no theoretical objections to the scheme, and it is now for some ingenious experimenter to work out the details of the apparatus and to give the world some form of television by this means."

It may justly be asked—"Why did not Campbell Swinton develop his own scheme?" The answer is twofold—first, that he did carry out experiments along lines which have recently proved successful, and second, that physical technique was at that time quite inadequate to deal with the problem. In a letter to NATURE of October 23, 1926[8], Campbell Swinton wrote:

"I actually tried some not very successful experiments in the matter of getting an electrical effect from the combined action of light and cathode rays incident upon a selenium-coated surface. . . . The transmitting apparatus consisted of a home-made Braun oscillograph in which a metal plate coated with selenium was substituted for the usual fluorescent screen, the image to be transmitted being thrown by a lens upon the selenium surface, and the end of the cathode ray beam being caused electromagnetically to traverse the projected image. Experiments were also tried in receiving with a Braun tube which I purchased in Germany, but in its then 'hard' form it proved very intractable."

It is interesting to note that this actual experiment has been repeated recently in the Research Laboratories of Electric and Musical Industries Ltd., under the direction of the present writer, and has proved successful. Two important features of the modern transmitting tube are described in this short note, namely, the use of a 'signal plate' and the projection of the optical image on to the same surface as is scanned by the electron beam—another step in the right direction.

This solution of the problem of high-definition television was not a 'one-man-job', as Campbell

Swinton saw clearly[9], but one which could only be solved by the close co-operation of a large band of research workers having at their disposal the facilities of a well-equipped research laboratory. The problem has been attacked during the last decade in many of the large industrial research laboratories in America, Germany and Great Britain, and the progress in many of these organizations has been roughly parallel, but it is fitting that Great Britain should be the first to inaugurate a public television service employing the system which was first outlined twenty-eight years ago by a distinguished British scientist.

[1] NATURE, **78**, 151 (June 18, 1908).
[2] "Autobiographical and other Writings". A. A. Campbell Swinton, pp. 131–137. (Longmans, Green and Co., Ltd.)
[3] NATURE, **137**, 984 (June 13, 1936).
[4] *J. Röntgen Soc.*, Jan. 1912, p. 7.
[5] *Wireless World*, **14**, 51 (1924).
[6] NATURE, **78**, 105 (June 4, 1908).
[7] "Autobiographical and other Writings". A. A. Campbell Swinton, p. 137.
[8] NATURE, **118**, 590 (Oct. 23, 1926).
[9] *Wireless World*, **14**, 118 (1924).

Stratosphere Flight

THE recent world's height record, for aeroplanes, of 49,967 ft., set up by Squadron-Leader F. R. D. Swain, R.A.F., piloting a Bristol monoplane fitted with a special type Bristol Pegasus engine, has served to focus a certain attention upon the question of flights at great altitudes, and the possible advantages to be derived therefrom.

The most obvious gain comes from the reduction of the resistance to the aircraft's motion as the density of the air to be displaced decreases, which, if other conditions remained the same, would result in increases of speed of a valuable order. For example, in round figures, an aeroplane of maximum speed 180 miles per hour at sea-level would travel at 550 miles per hour at a height of a little more than ten miles. This is equivalent to London to New York (3,000 miles) in 5½ hours, neglecting the time taken to climb to and descend from that altitude.

Other probable advantages are a relative wind in a direction opposite to the rotation of the earth, if a shear effect in the belt of atmosphere rotating with the earth may be assumed ; the absence of meteorological and electrical disturbances with their effect upon accurate navigation, that would also allow routes to follow the shortest line from point to point irrespective of the conditions upon the earth's surface, as for example across the polar regions ; and the psychological effect of constant sunshine, lack of clouds and equable temperature conditions are possibly not to be ignored.

The principles upon which the flight of the present-day heavier-than-air machine are based, however, make use of the density of the atmosphere in several ways in which its rarefaction at great heights would be a definite disadvantage, and may possibly set a limit upon entering the stratosphere which will make it not worth while, at least as a commercial transport proposition. The importance of doing so for the purpose of research into the physical conditions comes within a different category.

The power plant gives the machine a forward motion through the medium of an airscrew, this being required in order that the circulation of air around the lifting surfaces may be set up, resulting in the necessary lift and control. A reduction in air density will lessen this thrust and thus reduce the lift indirectly by reducing the speed, in addition to the direct loss of lift. Further, use of full power would result in excessive rotational speed of the airscrew due to the thinness of the air. Variable pitch propellers, already a practicable proposition to a limited extent, will help in this respect.

The internal combustion engine, the present-day power plant, requires a definite weight of oxygen for the proper combustion of its fuel. The rarefied and poor quality air can be forced into the engine, up to a certain limit, by super-chargers, and after this it does not appear to be impossible to carry a supply of oxygen under pressure to make up this deficiency, more especially as a supply will probably have to be carried for the occupants of the aeroplane. The physiological requirements of the passengers and crew will call for extra size and weight of the cabin, which will have to be of sufficient capacity for the required change of air, to carry apparatus for storing the oxygen and for absorption of the carbon dioxide and moisture exhaled, and will almost certainly have to be heat insulated. This may be against the low temperature of the surrounding atmosphere, or against heat generated by the friction set up by the rubbing of the air at these high speeds. Which will predominate, and how far one will balance the other, will depend upon the heights and speeds attained.

This state of affairs is already partly achieved, and its consummation does not appear to be beyond the bounds of possibility, at least, as a scientific experiment. As an everyday transport

proposition, experiment alone can settle whether the balance between total loads carried, and the part left for useful carrying capacity, after the elaborate equipment is installed, and the effect of the artificial conditions, accelerations and such discomforts upon the passengers, will make it worth while. It has been suggested that under these conditions, and with existing materials and aerodynamic design as now accepted, there are theoretical reasons for thinking that a limit will occur upon speeds at about 650 miles per hour.

To travel without this limit in the higher regions of the stratosphere will necessitate the use of some new method of propulsion, not dependent upon the presence of air for its functioning or the application of its tractive effort. The obvious solution that comes to the mind in this case is rocket propulsion. A certain amount of experiment has already been carried out in this respect; one quite serious proposal was made not long ago to fire mails from France to England across the Straits of Dover. The principal problem to be solved is that of control of the orientation of the machine while in flight. If this calls for the presence of the human element, the effect of the terrific accelerations at the start and finish cannot be ignored. Should this prove insuperable, automatic control of some kind does not appear impossible, but it will necessarily exclude passenger traffic.

A possible midway step between the two that has often been suggested is reported to be under construction and nearing completion in Soviet Russia. An aeroplane fitted with the usual internal combustion engine and propeller also carries rocket tubes. These will continue to give the necessary forward movement by reaction propulsion after the normal tractive effort has become negligible by reason of the reduction of the density of the air. This is not the complete rocket propulsion, and its efficiency would still appear to be largely dependent upon the air density for its reactive effort.

With regard to flight in the stratosphere by lighter-than-air craft, this is a much simpler problem. It becomes a matter of calculation as to the displacements of the balloon at the anticipated air density at the maximum height proposed, and the design of the envelope and the passengers' car to withstand the pressure differences. Such flights are of importance for the investigation of conditions in the upper air, and the perfection of such meteorological information will be of importance in the development of heavier-than-air craft under similar conditions. There does not appear to be any direct value in them from the point of view of controlled air travel. The height record for free balloon travel in the stratosphere is 72,395 ft., reached by Captains Stevens and Anderson, United States Air Corps, in the balloon *Explorer II* on November 11, 1935.

Obituary

Mr. J. W. Gordon, K.C.

MR. JOHN WILLIAM GORDON, K.C., who died in his eighty-third year on September 21 last, was the son of Mr. John Lewis Gordon, and was called to the Bar in 1884. He was a well-known Patent Law expert and was always strongly attracted to scientific and technical investigations. He was a member of the Commission appointed to inquire into the pitch industry of Trinidad; assisted in drafting the Patent Act of 1907; was formerly honorary secretary of the Royal Microscopical Society; received the gold medal of the Society of Engineers for his work on railway surveying by photography; and throughout his long life he never lost his interest in optical and allied subjects. It is, perhaps, by his work in connexion with microscopic resolution that he will be best remembered in the future.

Mr. Gordon also did some interesting and valuable work with regard to the plotting of surveys from air-photographs, and in his book "Generalised Linear Perspective", which was published in 1922, he describes how he rediscovered a method originally devised by Brook Taylor (of Taylor's theorem) two hundred years ago. Briefly, the method is this; if there are three points in a line in the cartographic field and the real lengths of the two segments are known, then it is easy to calculate the position of the point where the given line cuts the horizon; and if there is available a second similarly divided line, the horizon can be drawn.

The system is essentially a point-by-point method of plotting, and there are cases in which it may be of value, especially when the photographic plate is considerably tilted. But Mr. Gordon was inclined to claim somewhat too much for this method, which, after all, is only one of many. Nowadays we are in the more intricate region of stereoscopic air-photography and of mechanical plotters, and, except in very simple cases, we have left point-by-point methods behind us. But Mr. Gordon's book has its own place in the history of the subject, and perhaps that is as much as it will be possible to say of the writings of most of us.

Mr. A. E. Clarence Smith

IT would be difficult to over-estimate the contribution made by the late Capt. Alton Clarence Smith, who died on September 16 at the age of forty-nine years, to the development of the Department of Chemistry at University College, Southampton, during the seventeen years in which he was responsible for the teaching of physical chemistry.

Mr. Clarence Smith was a man of wide culture, interested in biology as well as in physical science. He had also an unusual degree of mechanical skill and a marked taste for architectural design, gifts strikingly shown in the planning and equipment of the laboratories which he designed for the use of his students. His research work lay chiefly in the domain of photomicrography, on which he was an acknowledged authority, and his papers on this subject in the *Journal of the Quekett Club* and similar publications led to his being frequently consulted by biologists and others interested in the use and construction of microscopes.

But Clarence Smith was in the first instance a teacher, and it is as a great teacher of physical chemistry that he will be remembered by the students who in successive years listened to the extraordinarily clear discourses with which he illuminated the difficult field of study embraced in physical chemistry. He took infinite pains in the presentation of his subject; the notes which he prepared for his lectures were models of clear thinking and accurate expression. He was genial and sympathetic with his students, appreciating fully their difficulties, and he had in full measure their affection and respect. His knowledge, experience and that critical judgment which was one of his outstanding characteristics, were always at the service of his colleagues; the research work of the Chemistry Department at Southampton owes a great debt to him for the interest, the counsel and the generous help which he gave so freely.

The loss which the death of Clarence Smith brings to the teaching strength at University College, Southampton, is very great; but, above all, he will be missed for the charm of his personality, from which there radiated always the virtues of sincerity, courage and goodwill. D. R. B.

We regret to announce the following deaths:

Mr. Alan Blakeway, director of the British School of Archæology at Athens, on October 9, aged thirty-eight years.

Sir George Buchanan, formerly senior medical officer in the Ministry of Health, on October 11, aged sixty-seven years.

Prof. W. E. Praeger, emeritus professor of biology in Kalamazoo College, Michigan, known for his work in ecology, on August 13, aged seventy-two years.

Prof. Camille Sauvageau, formerly professor of botany in the University of Bordeaux, aged seventy-five years.

News and Views

International Relations promoted by Broadcasting

AN international convention on the use of broadcasting in the cause of peace was adopted at a Conference at Geneva on September 23 and signed by representatives of eighteen countries. Soviet Russia signed with some reservations, but Hungary did not sign the convention although the Hungarian delegation had taken part in the proceedings throughout. The Italian delegation, which had also followed the proceedings with close interest, had previously been instructed to withdraw from the conference, and left expressing good wishes for its success. The text of the convention does not differ essentially from that prepared by the International Institute of Intellectual Co-operation at the request of the Assembly of the League of Nations. There are fifteen articles, of which six deal with matters of substance. The purpose of the convention is to ensure that broadcasting is never used in a manner prejudicial to good international understanding. A distinction is made between messages in the nature of a direct appeal to the inhabitants of another country and those designed primarily for national listeners. The former are prohibited in so far as they incite to acts incompatible with the internal peace or security of the territory of another party. States are bound under the convention to prohibit any broadcast likely to prejudice good international understanding by statements the incorrectness of which is, or ought to be, known to those responsible for the broadcast and to ensure that such statements are rectified immediately. Under a special provision, Governments agree, especially in time of crisis, to ensure the accuracy of the information concerning international relations broadcast within their territories. Provision is also made for the exchange of information calculated to promote a better knowledge of civilization and the conditions of life in the countries concerned and also for arbitration and conciliation procedure in the event of a dispute.

Co-operation between Oxford and Cambridge

IN Convocation at Oxford on October 7, the Vice-Chancellor announced a scheme for co-operation in academic work which has been discussed by the governing bodies of the Universities of Oxford and Cambridge. It is proposed to promote legislation to allow students, whether undergraduate or post-graduate, from either university to go to the other for special courses of study and to keep residence

while doing so. Facilities available at one of the universities only may thus be made available for common use, and studies of insufficient general interest to make it worth while for each university to have its own department need not be duplicated; it is possible that some existing duplication can be eliminated and the funds thus set free used for urgent needs. At first sight, this proposed innovation seems a great break with the traditions of the older universities; but there is no doubt of its excellence in principle. The college authorities, it is expected, will be less in favour of it than the university, but this is probably all to the good. They will see to it that the proposed freedom to migrate for a term or more will not be abused; that, in fact, only those who will greatly benefit by the change will be encouraged to enjoy it. With respect to facilities for instruction and research in science, it is likely that Oxford students will benefit more than Cambridge from the new proposal, at least at the undergraduate stage. The honours man at Oxford in science has generally but one subject to specialize in and consequently has time to take extra courses elsewhere; at Cambridge he is partly occupied with other subjects: and, of course, at Cambridge facilities for work in science are on a much more generous scale than at Oxford.

Research in Social Studies

THE Vice-Chancellor also spoke encouragingly of the scheme for research in social studies at Oxford made possible by the five-year grant from the Rockefeller Foundation which has now been in operation for a year. An institute of statistics has been started, several research lecturers have been appointed, and promising schemes of combined research in Colonial Government, in politics, in social services, and in economics have been begun. The first year of the experiment has been a great success. Research activity in other humane studies is also increasing remarkably. Since 1931 the number of those working for research degrees in the humane faculties has risen from 145 to 256.

Rhodes Memorial Lectures: Dr. E. Hubble

THE Rhodes Memorial Lectures at Oxford will be delivered during the Michaelmas Term by Dr. Edwin Hubble, of the Mount Wilson Observatory. They will be given at 5 p.m. on October 29, November 12 and November 26 in the Milner Hall of Rhodes House, Oxford. The lectures will bear the general title of "The Observational Approach to Cosmology", and will deal in turn with the observational characteristics of that region of the universe accessible to telescopes now in operation, secondly with empirical tests of the physical nature of the spectroscopic 'red-shift', and finally in the third lecture with the possible models of the universe which follow from the previously established interpretation of 'red-shift'. Dr. Hubble, who is himself a former Rhodes scholar, is well known in England. As a result of his discovery of Cepheid variables in the extra galactic nebulæ, and his determination of their periods, nebulæ such as those in Andromeda were first definitely revealed as systems of stars comparable in dimensions with the huge galactic system of which our sun is a part. Working out from the nearer of these objects, and using his own determinations of their apparent luminosities, Hubble was enabled by statistical methods to find the distances of these objects in a volume of space of 300 million light years radius; from these distances and the velocity determinations of Slipher and Humason, he first established in 1929 the existence of a linear relation between distance and velocity (assuming the observed spectroscopic 'red-shift' to be due to Doppler effect).

HUBBLE'S law, it need scarcely be added, is basic to all discussions of the expanding universe, whether in the relativistic form of Lemaître, Eddington and de Sitter, or in the kinematic form of Milne. As clearly set out in his Halley Lecture at Oxford in 1934, Hubble himself, however, has been led to seek whether there do not exist observational methods of determining whether this 'red-shift' is due to a velocity of recession, or to some other, as yet unspecified, physical cause. There will, therefore, be a widespread interest in his Rhodes Memorial Lectures, not only because they will reveal the conclusions which he has reached in this matter, but also because they may be expected to show the results of the furthermost exploration of the universe which can be carried out with the existing instrumental equipment.

Radcliffe Travelling Fellowship in Astronomy

THE Board of Visitors of the University Observatory, Oxford, is inviting applications for the Radcliffe travelling fellowship in astronomy. This new fellowship in observational astrophysics, open to all suitably qualified astronomers irrespective of nationality, carries an annual salary not in excess of £700, the exact amount of which is fixed by the Board. The fellow will divide his time approximately equally between the new Radcliffe Observatory in Pretoria with its 74-inch reflecting telescope, and the University Observatory, Oxford, with its new solar equipment, and will work on problems of his own choosing in observational astrophysics. The tenure of the fellowship is normally three years, but this period may be extended (or shortened) if this seems desirable in the case of a successful candidate. The fellowship therefore represents a stage in restoring the balance between observational and theoretical astronomy in England, now overweighted in favour of the latter, and at the same time marks the beginning of a new period of friendly and close collaboration between the two observatories concerned. The fellowship is being financed by the Radcliffe trustees, as an earnest of their interest in the study of astronomy in Oxford, while the nomination to and the emoluments of the fellowship are in the hands of the University.

The Harvard Tercentenary Celebrations

ELSEWHERE in this issue (p. 667) we print an account of the impressive functions by which the tercentenary of the foundation of Harvard University

at Cambridge, Massachusetts, was celebrated as an outstanding event in the history of knowledge by a great gathering representative of all branches of learning and drawn from all parts of the world. A tribute of a different character came from six of the industrial leaders of the United States, in the form of a letter to President Conant directing attention to the indebtedness of American industry to the universities. They pointed to the large and increasing number of university trained men in industry and business as evidence of the influence of university education on industrial progress, and stated that, having caught the spirit of research from the universities, industry has applied its methods successfully and with noteworthy results. During the past twenty-five years, the number of industrial research laboratories in the United States has grown from a handful to more than 1500, and is rapidly increasing. "From the universities also flows much of the basic knowledge of science on which modern technical industry has built and will build in the future." The letter is signed by Walter S. Gifford, president of the American Telephone and Telegraph Company ; Alfred P. Sloan, jun., president of the General Motors Corporation ; Thomas G. Watson, president of the International Business Machines Corporation ; Pierre S. du Pont, chairman of the board of E. I. du Pont de Nemours and Company ; Owen D. Young, chairman of the board of the General Electric Company; and Walter C. Teagle, president of the Standard Oil Company of New Jersey. It is a striking tribute to the significance of university institutions in industrial progress.

African Problems

A WIDE and varied field was covered in the discussions which engaged the attention of the twenty-third biennial session of the International Colonial Institute held in London on October 6–8. As Mr. Ormsby-Gore pointed out in a speech at the banquet at which the delegates were entertained by the British Government, the Colonial Powers are all confronted with a number of problems, human, political and social, which have to be studied objectively in common. To this end the mere interchange of views and experience is useful, even though no very decisive conclusion may appear to emerge. In this respect, the pooling of experience and discussion of methods of meeting the new problems raised by the introduction of newspapers, broadcasting and the cinema are highly instructive. This, too, is perhaps the most beneficial outcome it is legitimate to expect from the discussion of the detribalized native, which was opened by Lord Lugard and occupied a considerable part of the session. It was evident, as might have been anticipated, that measures applicable to one area may not be possible in another. Thus the conclusion put forward by Father Charles, that tribalism can be revived successfully only under rule on tribal lines and by the use of native courts, may be accepted as a general proposition. Clearly, however, it cannot meet transitional cases, such as those to which Mr. Ormsby-Gore referred, when he spoke of the product emerging under missionary influence, for example, in the towns of the west coast, which it is difficult to fit into the evolution and progress of tribal life and the social organism. On the other hand, Prof. Basil Williams, while expressing approval of the system in the Belgian Congo, under which the mine-workers are encouraged to bring their wives, admitted that it has been impressed upon him that such a system would not be practical on the Rand, where mine-workers number a quarter of a million.

Natural Resources Conservation

ONE of the important questions discussed at the recent World Power Conference was the conservation of natural resources. Science Service, of Washington, D.C., has issued reports of papers, dealing with this subject, which formed the basis of a discussion at the Conference. It is stated that whether the business systems are capitalist or socialist or a combination of the two, we must organize our activities to meet the demands of natural law, and all civilized nations are struggling towards this end each in its own way. The principles laid down for 'resource planning' by the writer of the reports are to keep soil, water, forest and grass as at present, but to economize by every possible means in the use of irreplaceable minerals. Nature lays down the terms, and we must either obey or suffer. We can come to terms with Nature in regard to the self-renewing resources by using them only as fast as they are replaced. With regard to the non-replaceable minerals, we can come to terms only by finding new and abundant substitutes faster than we use up the older materials. It is a race between technology and waste. Face to face with the inexorable demands of Nature, we suffer from human weakness. The consent of the people has to be obtained in spite of the propaganda issued by those whose interests are opposed to the public welfare. The laws of a federal union of sovereign States are a tangle of inconsistent rights and powers that hampers the action of the nation. The United States are now struggling to acquire legal and political powers commensurate with their necessities. If it fails, we are threatened by a crisis when essential materials are exhausted and it becomes necessary to reduce the population.

British Chemical Manufacturers

REPORTING on its activities during the year ended May 31, 1936, the Association of British Chemical Manufacturers justly claims to have rendered substantial assistance to an industry which is one of our most important national assets. It is concerned with the organization of displays of British goods, such as that provided by the British Industries Fair, with legislation and the incidence of taxation, with commercial treaties with foreign countries, with the Ottawa agreements and means for stimulating trade within the Empire, with transport, safety precautions, and in fact with any problem relating to the industry other than questions involving wages, hours and conditions of work. There is, however, much still to be done, and the Association is anxious to realize

that expansion of services which would be rendered possible by an increase in its membership to include every chemical manufacturer in Great Britain. In his speech at the annual general meeting held on October 8, the chairman referred to the successful outcome of many of the enterprises which the Association has undertaken in the interests of its members, including in his survey a reference to the measures which are being undertaken to protect our factories against air attacks in the unfortunate event of war. The Association has also participated in investigations concerning the detection of toxic gases in industry. It is announced that the first pamphlet of the series, that dealing with hydrogen sulphide, will shortly be published by the Department of Scientific and Industrial Research. Dr. E. F. Armstrong was re-elected president for the coming year.

The Velocity of Light

FROM time to time, Mr. M. E. J. Gheury de Bray has published in the columns of NATURE communications on this subject. He has now brought together the results of his investigations in an article published in *Isis* (**25**, 2; September 1936), entitled "The Velocity of Light: History of its Determination from 1849 to 1933". Reprints of the article have been prepared and can be obtained from Mr. Gheury de Bray, Imperial Patent Service, First Avenue House, High Holborn, W.C.1 (price 1*s*.).

Pavlov Institute of Aviation Medicine

As successful flying over long distances or to high altitudes depends not only on the efficiency of the aeroplane and the skill of the pilot but also to some extent on such minor details as the clothing and diet of the pilot, the structure of the cabin, etc., an Institute of Aviation Medicine dedicated to Prof. I. P. Pavlov was organized about a year ago in Soviet Russia. The laboratories of the Institute make tests of clothing, oxygen apparatus and anti-noise helmets, and study the problem of producing light, warm and comfortable clothing for airmen. Oxygen apparatus used in flights is produced under the direct supervision of the Institute, and the fitness of airmen wishing to ascend to high altitudes is tested in the Institute's barometric chamber.

Early Photographic Instruments

SOME of the earliest instruments in the history of photography have just been acquired by the Science Museum, South Kensington, on loan from the Royal Photographic Society of Great Britain. They include three instruments used by Fox Talbot, the inventor of the first paper photographic process: (1) A camera lucida, the use of which on the shores of Lake Como in 1833 first suggested to him that the invention of a sensitive paper would record such scenes more perfectly than sketches made by hand. This is the instrument mentioned in his "Pencil of Nature", published in 1844. (2) Fox Talbot's solar microscope, with which the earliest photomicrographs on paper were produced. (3) A Culpepper type microscope, *c*. 1820. With other instruments and specimens which have recently been acquired and are in course of classification prior to exhibition, the representation of Fox Talbot's work in photography bids fair to be complete.

"Annual Tables of Constants and Numerical Data"

THE publication of the "Annual Tables" having lagged behind schedule since vol. 10 (1930), the new managing committee (Institut de Chemie, 11 Rue Pierre Curie, Paris, 5^{e}) proposes to make up for it by publishing the data for 1931–36 in a more condensed form and more critically edited, in separate fascicules by subjects, partly separately for 1931–34 and 1935–36 and partly for the whole period 1931–36. The set of these fascicules will form vols. 11 and 12 of the "Annual Tables". This programme is to be completed in 1937: the numerical material published in the "Annual Tables" will then be brought up to date. In addition, an index volume by substances for vols. 6–10 (1923–30), like that published for vols. 1–5 (1910–22), is to appear towards the end of this year. A new index volume by substances will be prepared for vols. 11 and 12, to be published in 1937. The Committee would welcome inquiries about the "Tables", and state that the back numbers have now been greatly reduced in price. The new fascicules are being issued at a very modest price, which will place them at the disposal of all scientific workers likely to need them in their investigations. The preparation of the "Annual Tables", which is a purely scientific and non-profit-making undertaking, is a worthy task deserving the active support of men of science in securing their prompt publication.

Dr. A. H. Mackenzie

IN announcing the death of Dr. A. H. Mackenzie, in NATURE of October 10, he was described, following "Who's Who", as "Pro-Vice-Chancellor of the Osmania University, Hyderabad". Prof. M. S. Ahmed writes to say that the correct official title is "Pro-Vice-Chancellor of and Special Propagandist for the Osmania University of Hyderabad". He adds: "Dr. Mackenzie was appointed to the position of Pro-Vice-Chancellor of the Osmania University in which capacity he had to work six months in the year at Hyderabad, and the remaining six months he had to spend in Great Britain in doing special propaganda in the British Universities on behalf of the Osmania University".

A Nova in Sagittarius

THE discovery of a nova on October 6 (the third to be discovered since last June) has been announced by telegram from the International Astronomical Union's Bureau at Copenhagen. The position is given as R.A. $18^{h}\ 4{\cdot}5^{m}$: Dec. 34° 21′ south: magnitude 6 on Oct. $6^{d}\ 0^{h}$ U.T. This position places the nova in the constellation of Sagittarius and roughly midway between the 3rd magnitude stars, γ Sagittarii and η Sagittarii. The discoverer is Mr. C. Jackson,

of the Union Observatory, Johannesburg, who less than a month ago discovered a faint comet (1936 *c*). Owing to its southern declination of −34°, it will not be possible to observe the nova from the latitude of Greenwich, and further news of its behaviour must be awaited from southern observatories.

Announcements

THE Royal Society of New Zealand has awarded the T. K. Sidey Summer-Time Memorial Medal and Prize for 1936 to Sir Leonard Hill. This award, which consists of a gold medal and £100 in New Zealand currency, is made to the person who in the opinion of the Council of the Society has made a valuable contribution to human knowledge by original research into the effect of light and solar radiations on human comfort.

THE Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered in the rooms of the Royal Society on October 27 by Prof. E. Westermarck, who will take as his subject "Methods in Social Anthropology".

THE following appointments and promotions in the Colonial Service have been made: H. M. James, to be agricultural superintendent, Cyprus; C. H. F. Walker, to be agricultural officer, Nigeria; J. M. Waterson, to be plant pathologist, Agricultural Department, Bermuda; C. J. Taylor, to be assistant conservator of forests, Gold Coast; J. A. Allan, to be lecturer in botany, chemistry and physics, Department of Science and Agriculture, Barbados; L. P. Henderson (late agricultural officer), to be agricultural officer, Nigeria; Capt. J. R. Mackie (assistant director of agriculture), to be director of agriculture, Nigeria; F. B. Notley (entomologist, Kenya), to be entomologist, Agricultural Department, Tanganyika; D. F. Chesters (senior assistant conservator of forests), to be conservator of forests, Nigeria; Dr. J. C. Tull (Government pathologist and professor of pathology, Straits Settlements), to be pathologist, Cyprus; S. G. Willimott (Government analyst, Cyprus), to be assistant Government analyst, Straits Settlements.

THE Institute of Hygiene of Czechoslovakia is carrying out important studies in connexion with vitamins in the diet of the poor, especially in winter, when most of their food contains only a very small quantity of antiscorbutic principles.

THE central administration of the perfumery and cosmetics industry of the U.S.S.R. is to open an Institute of Cosmetics and Hygiene at Moscow in November. The Institute will consist of three departments devoted respectively to cosmetics, physiotherapy and plastic-therapeutic gymnastics, with a staff of specialists in dermatology and physical therapy.

WE are asked to state that the address of the publisher of "The Way to Happiness for Humanity" noticed in NATURE of October 10 (p. 636) is 93 Braybrook Street, London, W.12.

MESSRS. WILLIBALD KELLER, Hindenburgstr. 94, Leipzig, are issuing shortly a new edition of the classical work "Die Alpen im Eiszeitalter" by Albrecht Penck and Ed. Brückner. The new edition will contain an additional chapter in which Albrecht Penck has given a survey of the present development of knowledge of the glacial period and the progress since the publication of the first edition. The subscription price of the work, consisting of three volumes, is 66 gold marks until November 30.

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

One resident engineer, two senior engineers and one junior engineer for airport construction—Secretary, Office of Public Works, Dublin (October 21).

An assistant engineer in the Ministry of Transport—Establishment Officer (October 21).

A records officer in the office of the Industrial Research Council of the Department of Industry and Commerce, I.F.S.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (October 22).

A junior assistant in the Department of Civil Engineering, Queen's University, Belfast—Prof. Hummel (October 23).

A teacher in engineering and an engineering workshop instructor at the Kenrick Technical College, West Bromwich—Director of Education (October 23).

A technical assistant (electrical, mechanical and civil engineering industries) for a War Department inspection establishment at Woolwich—Under-Secretary of State (C. 5), War Office, London, S.W.1 (October 24), quoting "Appts./1".

An assistant director of horticultural education and an agricultural advisory officer to the Norfolk County Council—The Clerk, The Shirehouse, Norwich (October 24).

Two assistant drainage engineers in the Ministry of Agriculture and Fisheries—Secretary (October 26).

A public analyst to the Metropolitan Borough of Chelsea—Town Clerk (October 29).

A professor of philosophy and a lecturer in the Department of Education and Philosophy, Canterbury University College, Christchurch, New Zealand—Secretary, Universities' Bureau, 88A Gower Street, London, W.C.1 (October 31).

A lecturer in the Department of Pathology, University, Birmingham—Secretary (October 31).

A head of the Science Department, West Ham Municipal College—Town Clerk and Education Officer, West Ham (November 6).

An assistant curator (male) at Somerset County Museum, Taunton Castle—The Curator.

A civil engineer for the Public Works Department, Government of North Borneo—Secretary, British North Borneo (Chartered) Company, Staple Hall, Stone House Court, Bishopsgate, London, E.C.3.

Civil engineering and architectural assistants in the Drawing Office, H.M. Dockyard, Portsmouth—Civil Engineer-in-Chief, marked "D.O. Assts., Portsmouth".

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 688.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Calculation of Structure Factors and Summation of Fourier Series in Crystal Analysis: Non-centrosymmetrical Projections

Two useful methods for carrying out these operations have recently been described in NATURE. The Fourier synthesis reduces to summing series of the type

$$\Sigma\Sigma A \cos h\theta_1 \cos k\theta_2 \text{ and } \Sigma\Sigma A \sin k\theta_1 \sin k\theta_2,$$

θ_1 and θ_2 being co-ordinates in a projection of the structure, expressed as fractions of the cell sides. In the method described by C. A. Beevers and H. Lipson[1], strips of numbers are printed giving all the values of $A \cos h\theta_1$ from $A = +99$ to $A = -99$, $h = 0$ to $h = 20$, and θ_1 at 6° intervals from 0° to 90°, the latter 15 numbers being printed in a row along the strip. The synthesis then reduces to selecting the correct strips, placing them over each other, and adding up the columns of numbers.

In the calculation of structure factors a similar summation is involved, but in this case θ_1 and θ_2 are the co-ordinates of the atoms in the unit cell, and the coefficients A depend upon their scattering power. In the method described by W. L. Bragg[2], contoured graphs of the function are prepared for different combinations of the indices h and k, from which component terms in the structure factor can be read off.

The object of this note is to point out that a numerical method which I described some time ago[3] for the summation of Fourier series can be applied equally well to the calculation of structure factors. The method is similar to that of Beevers and Lipson, but the strips of cosine factors are prepared for different values of A only, the different values of h being obtained by moving the strip along an appropriate scale, graduated in terms of θ_1, when the required result appears under a fixed column. The method may not be quite so fast as that of Beevers and Lipson, as the strips have to be moved along the scales for each successive value of θ_1, but this loss is partly balanced by the greater ease of selection of the strip, only 100 being required instead of about 4,000 in the method of Beevers and Lipson.

In order to use the method for the addition of structure factors, we note that the co-ordinate θ_1 now refers to the position of an atom in the unit cell, and may therefore have any value. If the given values are restricted to multiples of 6°, then there is a maximum possible error of 3° in assigning the position of the atom. This is not important if the value of the index h is 1, but for high values of the index the error is serious. This difficulty is overcome by extending the set of *scales* to cover all values of θ_1, from 0° to 180°, at one degree intervals (or half-degree intervals, if still greater accuracy is required). The same strips of cosine factors are used as before, with the same sorting board and fixed columns, but the

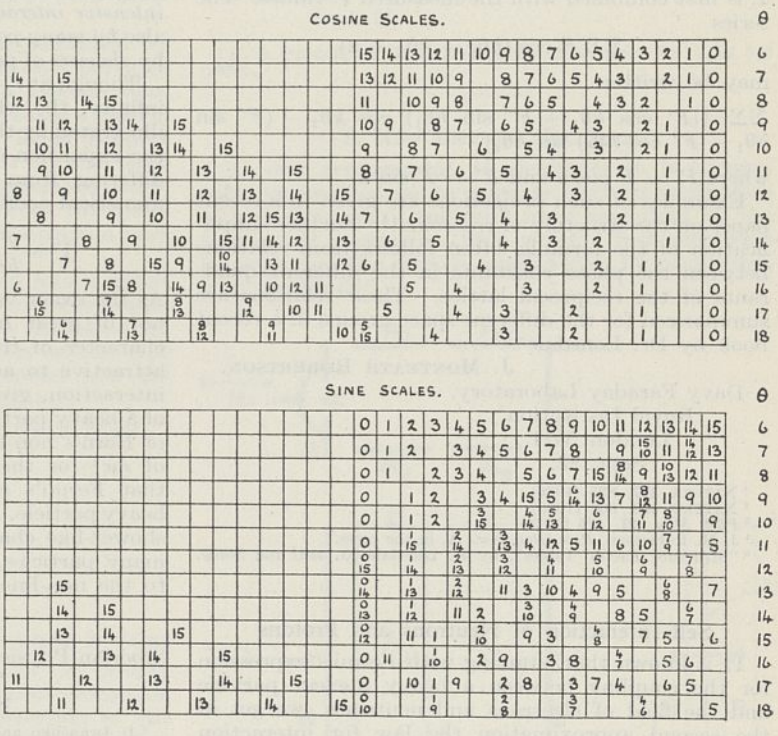

FIG. 1.

new scales prevent the error of position of any atom ever exceeding the maximum of 3° no matter how high the index of the plane may be. Some examples of the new scales are shown in Fig. 1, from which their construction and use will be clear, on reference to the previous description[3]. The numbers are written on strips of cardboard with V ends, for easy attachment to the sorting board. The scales for $\theta = 6°$, 12°, 18°, etc., are identical with the scales for $h = 1, 2, 3$, etc., used for Fourier synthesis. For Fourier summations, the numbers on the scales represent successive values of the co-ordinate θ_1, in steps of

6°, and a separate scale is used for every different value of the index h. For structure factor summations, the numbers on the scales represent successive values of the index h, and a separate scale is used for every different value of the co-ordinate θ_1, the number of scales required being equal to the number of atoms in the asymmetric unit.

In practice, the calculation of a number of structure factors can be made with the same facility as the calculation of the electron density at the same number of points on a projection of the structure. The first factor, $A \cos h\theta_1$, is evaluated for a number of values of h, and these results are used as coefficients for the final summations. The method is particularly useful for structures containing large numbers of atoms of rather similar scattering power, such as occur in organic compounds, where sufficient accuracy can be obtained by using the same atomic f-curve for all the atoms, but weighting the coefficients in proportion to the atomic numbers.

As a further supplement to my previous paper[3], I should like to point out that the Fourier synthesis of non-centrosymmetrical projections can be carried out very easily either by my method or that of Beevers and Lipson if the arbitrary phase constant, α, is first combined with the measured F values. The series

$$\Sigma\Sigma\, F \cos (h\theta_1 + k\theta_2 - \alpha)$$

may be written

$$\Sigma\Sigma\ [(F' \cos h\theta_1 + F'' \sin h\theta_1) \cos k\theta_2 - (F' \sin h\theta_1 - F'' \cos h\theta_1) \sin k\theta_2]$$

where $F' = F \cos \alpha$ and $F'' = F \sin \alpha$.

Examples of such projections are given in a recent paper on the structure of resorcinol[4]. Further simplification of the formulæ often follows from relations between the phase constants in the different quadrants of the reciprocal lattice. These relations are summarized for the different space groups in a recent book by Dr. Lonsdale[5].

J. MONTEATH ROBERTSON.
Davy Faraday Laboratory,
Royal Institution,
London, W.1.
Sept. 22.

[1] NATURE, **137**, 825 (1936).
[2] NATURE, **138**, 362 (1936).
[3] *Phil. Mag.*, **21**, 176 (1936).
[4] J. M. Robertson, *Proc. Roy. Soc.*, A, in the press.
[5] "Structure Factor Tables", by K. Lonsdale (G. Bell and Sons).

Self-Interaction of Neutrons and Protons

IT is known that, starting with Fermi's expression for the coupling between a heavy nuclear particle and the field of electrons and neutrinos, we get in the second approximation the law for interaction between proton and neutron[1]. This law :

$$\sim \frac{g^2}{hc} \frac{(h/mc)^{2s}}{r^{5+2s}}$$

(g is Fermi's constant, the best choice for s is 3) gives a divergent result at $r \to 0$, which shows the impossibility of constructing a point model of a heavy particle, just as the classical and quantum electrodynamics both lead to infinite self-interaction of a point charged particle on Coulomb's formula. The only reasonable method so far proposed to remove this difficulty of classical electrodynamics is the non-linear generalization of Maxwell's equations developed by Mie and Born[2], who introduced a new characteristic length (the analogue of the radius of the electron).

Fermi's theory also introduces a universal length $r_0 = \sqrt{g/hc} \sim 10^{-16}$ cm., or better $r_0 = \sqrt[s+2]{(h/mc)^s\, g/hc} \sim 10^{-13}$ cm. with $s = 3$, say, which fact changes the whole situation of the interaction problem, as well as that of the theory of scattering[3]. Let us compute the interaction between heavy particles transferred not only by a single pair, but by 2, 3 . . . n pairs of light particles, electrons and neutrinos. In electrodynamics this would correspond to the transfer of energy by 2, 3 . . . n photons, afterwards emitted and absorbed by two charged particles. Putting $\psi = \psi_0 + \psi_1 + \ldots \psi_n$ for the wave function of two heavy particles, we get for the interaction, as far as the $2n$th approximation :

$$V = -\frac{g^2}{hc}\left(\frac{h}{mc}\right)^{2s} \frac{1}{r^{2s+5}} \sum_{n=0}^{\infty} (-1)^s \alpha_n \left(\frac{r_0}{r}\right)^{2n\,(2+s)}$$

where α_n are numerical coefficients of the order unity.

At great distances ($r \gg r_0$) we obtain, of course, the previous law, but at small distances $r < r_0$ the successive members of the series are of the same order of magnitude, which corresponds physically to the *intensive interaction transfer* not only by one pair but also *by many pairs of light particles*, or as we may say, by *showers* of particles.

Though at $r \to 0$ each member of the series tends to infinity, the whole sum can be finite, which is best illustrated by the example of the following expression, the expansion of which is quite similar to our series, differing from it possibly only in the values of numerical coefficients :

$$V = \frac{g^2}{hc}\left(\frac{h}{mc}\right)^{2s} \frac{1}{(r^{2s+4} + r_0^{2s+4})^{1+1/(2s+4)}}$$

As the exact values of the coefficients are at present not of great importance owing to the preliminary character of the whole of Fermi's theory, it is very attractive to admit this law as the general form of interaction, giving the required finite proper energy of a heavy particle Mc^2 at $r \to 0$, just as the potential of Born's non-linear theory leads to the finite value of mc^2 for the electron. We find in this manner that Fermi's r_0 plays the role of the radius of a heavy particle. We see that by taking into account the shower-like character of energy transfer, realized by many particles, or photons, we are led immediately to the non-linear law of interaction.

D. IWANENKO.
A. SOKOLOW.
Siberian Physical Technical Institute,
Tomsk.
Sept. 13.

[1] D. Iwanenko and A. Sokolow, *Verhandl. d. Sibirisch, Phys.-Techn. Instituts*, (Russ.), **4**, 67 (1936). NATURE, **138**, 246 (1936). *Z. Phys.*, **102**, 119 (1936).
[2] M. Born, *Proc. Roy. Soc.*, A, **143**, 410 (1934).
[3] W. Heisenberg, *Z. Phys.*, **101**, 119 (1936).

A New Kind of Ring Phenomenon in Sputtered Metallic Films

AN interesting ring phenomenon which is expected to throw light on the mechanism of condensation of sputtered particles was noticed while working on cathodic sputtering. Details will be published elsewhere.

It was noticed that if a small bead of plasticine or a small drop of oleic acid is placed on a specially

cleaned (not degased) glass plate, and the plate given a deposit of cathodically sputtered silver or copper in air, a set of coloured rings is formed surrounding the bead or the drop. The distance between the successive sets of coloured rings increases with the distance of the ring from the centre. In monochromatic light the rings appear alternately dark and bright.

The drop of oleic acid does not spread on the glass until the discharge is started. Within a few minutes of the starting of the discharge the drop flattens into a white patch, which shows a grey deposit when observed under a magnifying eyepiece. The ring formation occurs around this patch.

A small bead of paraffin was also tried instead of plasticine. The paraffin melted and spread on starting the discharge, but no marked rings were obtained though colours could be seen, being usually blue in the centre with a wide yellow circular band round it.

The same experiment using a small piece of pure aluminium instead of the oil did not show any rings.

Some separate experiments showed that oleic acid does not spread to any appreciable extent when placed on either a freshly prepared or an old mirror made by a cathodically sputtered deposit even when heated up to 100° C.

The formation of the rings may be explained by assuming the condensed metallic sputtered particles to form a liquid expanded film or a gaseous film. The experiments of Ditchburn[1] on the surface motion of cathodically sputtered cadmium lends support to this view. The oleic acid spreads on this fluid film, and thus gives rise to the interference rings. It is quite likely that adsorption between the metal particles and the organic molecules also plays a part in the formation of the rings.

The spreading of the oleic acid drop into a patch may be explained by assuming the cohesive forces on the surface of the acid drop to be decreased by the adsorption of the metallic particles on the acid surface. Moreover, the surfaces in contact now are not glass-acid-air but metallic fluid-acid-air.

UTSAB KUMAR BOSE.

Physical Laboratory,
University of Lucknow.
Aug. 31.

[1] *Proc. Camb. Phil. Soc.*, **29** (1933).

Surface of Copper formed by Solidification *in vacuo*

MECHANICAL or chemical treatment is usually required to prepare a surface for electron diffraction examination. This may lead to distortion of the structure which is undesirable, particularly when comparison with X-ray data is required. A surface formed by solidification of a molten metal *in vacuo* may be regarded as probably the most satisfactory obtainable. In the present investigation the purest available copper was melted in an alundum boat in a fused silica tube which was connected to a Hyvac pump. The surface of the specimens was bright and smooth. Both electron diffraction and X-ray photographs were taken. Both gave sharp spots indicating the presence of large crystals, but whereas X-rays showed that the orientation of the crystals differed from specimen to specimen, electron diffraction showed spots from copper crystals orientated with either {111} or {100} planes parallel with the surface, the {111} orientation being most frequent. Twenty photographs gave similar results.

We also examined specimens which had been maintained for a long time at 950° C. The results were identical. Even a single crystal acquired, after heating, a layer of crystals orientated with their {111} and {100} planes parallel with the surface, independent of the structure underneath. A silver specimen behaved similarly.

It would be necessary to examine a large number of metals of different structures before venturing to give an explanation of these results. It may be connected with surface tension, by which the planes of highest atomic density arrange themselves parallel with the surface. It is interesting to note[1] that the first layer of cuprous oxide formed on polycrystalline copper is orientated so that a [111] direction is perpendicular to the surface. In our experiments no trace of oxide was found and no distortion.

S. DOBINSKI.

Physical Laboratory,
Jagellonian University,
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C. F. ELAM.

Engineering Laboratory,
Cambridge University.
Sept. 29.

[1] G. D. Preston, and L. L. Bircumshaw, *Phil. Mag.*, Ser. 7, **20**, 706 (1935).

A New Electron Oscillator

A NEW arrangement of electrodes in a vacuum tube has enabled me to generate electron oscillations of higher intensity and with more ease than by the split-anode magnetron, with which I first succeeded in producing the intense micro-waves by connecting it in 'push-pull'.

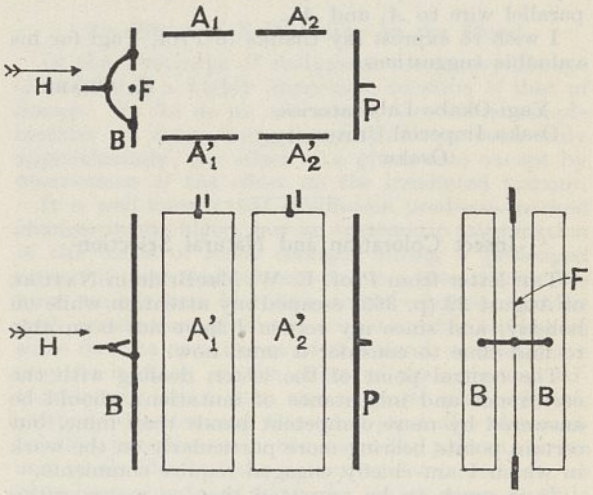

FIG. 1.

In Fig. 1, F is a straight filament cathode which is stretched in about the same plane as the plate-electrodes B. P is an end plate on the other side. Both B and P are kept at a low positive or negative potential.

A_1, A'_1, A_2, A'_2 are rectangular slab electrodes which are all kept at a high positive potential. A magnetic field is applied in the direction H. Now A_1 and A'_1 are connected together, and so are A_2 and A'_2. When a parallel wire circuit is connected

to A_1 and A_2, a strong oscillation current is obtained in the circuit, the wave-length of which is determined simply by the circuit constants.

The adjustment is not at all critical, and the wave-length may be varied within a comparatively wide range about the value estimated as the simple oscillation of electrons between the two opposite plates B and P.

A large number of modifications and different combinations of electrodes are conceivable.

When the magnetic field is gradually increased, oscillation appears at a certain range and then stops, and reappears again at a higher field strength in some cases. If the magnetic field is inclined a certain number of degrees from the symmetrical axis of the arrangement, oscillations of much longer wave-lengths may be generated with the frequency as determined by the oscillation circuit.

The principle of operation of this oscillator may be considered either as the B–K oscillation with positive grids of novel construction and a magnetic field applied in order to straighten the paths of electrons, or as the split-anode magnetron oscillation when the electron stream is differently directed and the split-anodes assume accordingly different shapes. In order to distinguish these tubes of new principle, we are calling them 'Osaka tubes' in our laboratories.

The static characteristic shows no negative resistance effect, but it must naturally be understood that, under oscillation conditions, the negative resistance relation obtains dynamically, so that the electron oscillation may be maintained by the timely retro-action from the circuit.

A useful output of a few watts was easily obtained, when the input was about twenty watts and the wave-length was about eighty centimetres.

With the present tube, the micro-waves were successfully produced by connecting together A_1 and A_2 as well as A'_1 and A'_2, and also by connecting a parallel wire to A_1 and A'_1.

I wish to express my thanks to Prof. Yagi for his valuable suggestions.

K. OKABE.

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Osaka Imperial University,
Osaka.

Insect Coloration and Natural Selection

THE letter from Prof. E. W. MacBride in NATURE of August 29 (p. 365) escaped my attention while on holiday, and since my return I have not been able to find time to consider it until now.

The central point of the letter, dealing with the occurrence and inheritance of mutations, should be answered by more competent hands than mine, but certain points bearing more particularly on the work in which I am chiefly engaged require comments.

It is much to be regretted that so many critics of the theory of mimicry confine themselves to the phenomena as exhibited by butterflies. Let us disregard altogether the Lepidoptera, for the present; then the argument against mimicry so often stressed by my friend on *negative* evidence falls to the ground. For other orders of insects are attacked by birds and insectivorous mammals to a very high degree, and exhibit abundantly the phenomena of mimicry. Therefore the current explanation of mimicry cannot be set aside because in one particular group there is not considered to be sufficient evidence of attacks by enemies which could have a selective influence. Meanwhile, evidence of attacks by birds on butterflies continues to come to hand, and I would ask those who have not witnessed such attacks to consider again the striking evidence presented by Mr. T. H. E. Jackson[1].

Regarding the influence of environment, I directed attention in NATURE some years ago[2] to a well-known case of mimicry which refutes that argument: the Lycoid insects. But since the minutiæ of geographical variations are so often disregarded by critics, the following example of another difficulty is given. The ease with which minor variations can be studied on the large wings of butterflies is responsible for their use in illustrations: I have no doubt that analogous examples will be found among other orders when they have been studied to the same degree.

The female of the butterfly, *Papilio cynorta*, wherever it occurs in tropical Africa closely resembles superficially other butterflies having all the characters of aposematic species. On the west coast, it is like the female of the Acraeine *Bematistes* (= *Planema*) *epaea epaea*, both having a white pattern on a dark background: the male *epaea* has the paler parts of an orange brown. This species, like many others of the West African region, ranges eastwards into Uganda where it undergoes a change. The sexes are alike, the dark background becomes greyish-brown and the paler pattern cream coloured, the pale areas much reduced in size. This is the race *paragea*. The *Papilio* female (race *peculiaris*) undergoes a corresponding change in appearance: the male remains as in West Africa.

Both species extend into south-west Abyssinia and undergo further changes of importance for the argument. We find, as in Uganda, that both sexes of the *Bematistes* are alike but for a different reason: in Abyssinia the female has adopted the orange-brown coloration of the male, which is very little different from the western form: for this reason the Abyssinian race is named *homochroa*.

What happens to the *Papilio* in Abyssinia? According to the argument from environment, it also should respond to Abyssinian influences by becoming orange-brown. Incidentally, it may be remarked that, on this argument, the conditions in Abyssinia must be nearer to those of West Africa than are the conditions in Uganda: a conclusion which I feel sure would not be admitted by geographers. The Abyssinian *Papilio cynorta*, discovered by Sir Arnold Hodson, does not follow the usual model: one may presume that it is because it does not possess the gene for the orange-brown colour. *P. cynorta arnoldi* is black and white, somewhat different in pattern from the western race mimicking *B. epaea epaea*, and resembling the Abyssinian race *aethiops* of the abundant Danaine *Amauris niavius*. The highly interesting fact is that in West Africa the Danaine model is present for the *Papilio* to mimic, but the latter has, so to speak, found it easier to approach the Acraeine *Bematistes*. But when the *Bematistes* adopts in Abyssinia a garb impossible for the *Papilio* to assume, the latter has recourse to an appearance which is within its power, by slight modification of its western form: this latter, however, is supposed to be the result of West African conditions.

Finally, no account is taken, by the advocates of environmental causation, of the highly significant fact that, in complete accordance with the demands of natural selection, mimetic resemblances are

superficial. Mimicry deceives the artist but not the anatomist. Moreover the details of the likeness between model and mimic are not the same. It is a commonplace that apparently the same effect may be produced by different means, a fact also in accord with natural selection.

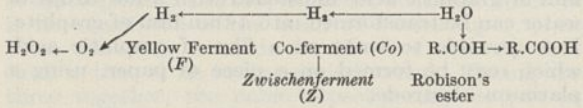
G. D. HALE CARPENTER.

Hope Department of Entomology,
University Museum,
Oxford.
Oct. 1.

[1] See NATURE, **135**, 194 (Feb. 2, 1935).
[2] NATURE, **123**, 661 (April 27, 1929); **124**, 183 (Aug. 3, 1929).

Keilin's Cytochrome *c* and the Respiratory Mechanism of Warburg and Christian

ACCORDING to the investigations of O. Warburg and his co-workers[1] on the reaction



the yellow ferment (F) acts as a more or less specific dehydrogenator of the di-hydro-co-ferment (CoH_2), which cannot be oxidized either by molecular oxygen, or by methylene blue. The *cozymase* reacts in a manner analogous to the co-ferment (H. v. Euler and co-workers[2]).

Until now it has been uncertain whether the direct re-oxidation of the leuco-form of the yellow ferment (FH_2) by molecular oxygen really takes place to any considerable extent in the living tissue cells, where the oxygen pressure is often very low, and whether the FH_2 possibly could be re-oxidized by other substances in the cells, for example the cytochromes.

I have recently investigated the kinetic relations between oxygen, cytochrome *c* and the yellow ferment. The experiments were performed in the following manner: *Co*, *Z*, HCN, *m*/50 $NaHCO_3$ and in certain cases F were mixed in a glass cell of 1 cm. thickness to the volume of 3 ml. Z was used in such small amounts that the oxidation velocity of Robison's ester was proportional to the quantity of Z. After ten minutes the solution was saturated with nitrogen or oxygen or mixtures of both, and then a small quantity of oxidized cytochrome *c* ($Fe\cdots OH$; pure, from beef heart[3]) was added. The *p*H of the solution was 7·35. The light absorption at 550 mμ was determined photo-electrically. Now the substrate, the potassium salt of pure Robison's ester, was added and the light absorption at 550 mμ was followed.

A priori, three different reactions would be expected to be possible:

$$O_2 + FH_2 = H_2O_2 + F \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$
$$2Fe\cdots OH + FH_2 = 2Fe\cdot\cdot + F + 2H_2O \quad . \quad . \quad (2)$$
$$2Fe\cdots OH + CoH_2 = 2Fe\cdot\cdot + Co + 2H_2O \quad . \quad . \quad (3)$$

The experiments proved that reaction 3 does not take place. Thus cytochrome *c*, like oxygen and methylene blue, is unable to oxidize the di-hydro-co-ferment directly.

Reaction 2, on the contrary, takes place most rapidly. If molecular oxygen and oxidized cytochrome *c* were both present in the solution, the relative velocities of reactions 1 and 2 were dependent on the oxygen pressure, but within wide limits independent of the concentration of oxidized cytochrome. The accompanying table shows the relation between the oxygen pressure and the relative reaction velocities at 22° C.

Oxygen pressure (mm.)	Per cent FH_2 oxidized by oxygen	Per cent FH_2 oxidized by cytochrome *c*
760	69	31
150	54	46
38	20	80
0	0	100

About the same values for an oxygen pressure of 150 mm. were found at 31° C.

In the living tissue cells, the average oxygen pressure is much lower than 38 mm. *Thus the re-oxidation of the yellow ferment by cytochrome seems to be the physiological method* occurring in cells containing the Warburg-Keilin iron-porphyrin system—that is, nearly all known cells. It should be pointed out that nothing is said above about another problem, namely, how much of the total cell respiration takes place by means of the yellow ferment.

HUGO THEORELL.

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Stockholm.
Aug. 29.

[1] O. Warburg and W. Christian, *Biochem. Z.*, **254**, 438 (1932); **257**, 492 (1933); **260**, 499 (1933); **266**, 377 (1933); Warburg, Christian and Griese, *Biochem Z.*, **279**, 143 (1935); **282**, 157 (1935), etc.
[2] H. v. Euler, E. Adler and H. Hellström, *Svensk Kem. Tidskr.*, **47**, 290 (1935); *Z. physiol. Chem.*, **241**, 239 (1936), etc.
[3] H. Theorell, *Biochem. Z.*, **279**, 463 (1935); **285**, 207 (1936).

An Effect of X-Radiation on the Blood

IN the treatment of malignant disease by X-rays or radiation, a highly important question is that of dosage. So far as we are aware, there is no simple method of determining quantitatively, even only approximately, the effect of a given dose except by observation of the effect on the irradiated tumour.

It is well known that irradiation produces marked changes in the blood, but no systematic examination of the cause of these changes during a prolonged course of treatment appears to have been made. We have undertaken therefore to investigate whether such irradiation produces a measurable change in some definite constituent of the blood, so that there may be a check on the effect of the radiation administered. By a new and accurate photo-electric method of estimating the total (and also the acid-soluble) phosphorus in the red cells, plasma, serum and whole blood of the patient under treatment, we have been able to ascertain, by taking measurements before and after irradiation by X-rays or radium, that the ratio of the whole phosphorus in the red cells to that in the plasma (a ratio which is usually high in the case of cancer patients but of the order of 5 or less in that of other patients) is reduced, even after only one treatment, by so much as 50 per cent in extreme cases, so that the phosphorus-partition falls within the normal range.

Our results indicate that it may be possible to judge of the effect of X-ray dosages by measuring changes in the phosphorus partition in the red cells

and the plasma. As an example the following two cases may be considered, in which the figures given denote milligrams of phosphorus per 100 c.c.

	Whole blood	Red cells	Plasma	$\frac{\text{P in cells}}{\text{P in plasma}}$
Case I (before irradiation)	25·5	53·0	6·0	8·8
(after „)	38·75	69·0	14·5	4·8
Case II (before „)	22·5	49·0	4·5	11·0
(after „)	20·0	54·0	8·75	6·8

These figures were obtained for blood taken from the patients when fasting. The results of the phosphorus partition in the blood elements of a large number of patients will be published in a later communication. It seems to us that a periodic examination of the blood along these lines during a course of treatment may be a valuable guide to the changes in the condition of the patient.

This work has been done under the auspices of the Cancer Research Committee of the University of Sydney.

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Formation of Carbon Dendrites

THE formation of long carbon dendrites in the electrolytic reduction of aqueous colloidal dispersions of graphitic acid was recently reported by Luke, Madgin and Riley[1].

If instead of the slightly viscous solution, a micellar solution of high viscosity[2] is employed, this phenomenon is also shown clearly, as the movement of the colloidal particles away from the cathode towards the anode is hindered. In the near future a detailed description of other experimental results will be published.

It has been found possible to transform a colloidal solution of graphitic acid into a transparent gel which contains much water and is very similar to the gel of gelatine. The movement of the lamellæ of graphitic acid under an electrical potential is still further hindered in the gel. On touching a small piece of the gel with two platinum electrodes at a potential difference of 220 volts, carbon is formed by reduction at the cathode before the relatively large lamellæ have time to move away. The orientation of the disordered lamellæ under the influence of an electrical field observed under the microscope in polarized light[3] is confirmed by Messrs. Luke, Madgin and Riley[1].

The electrochemical reduction of graphitic acid makes possible the following experiment. A thin film of graphitic acid[4] moistened with a few drops of water can be transformed into a thin film of graphite. It is possible to write on a film of graphitic acid, which may be formed on a piece of paper, using a platinum electrode.

HEINRICH THIELE.

Universität,
Kiel.
Sept. 10.

[1] NATURE, **138**, 161 (1936).
[2] *Z. anorg. Chem.*, **190**, 145 (1930).
[3] *Koll. Z.*, **56**, 129 (1931).
[4] *Forsch. u. Fortschr.*, **10**, 408 (1934).

Points from Foregoing Letters

A RAPID numerical method for the calculation of structure factors and the summation of Fourier series in crystal analysis, which is also applicable to non-centro-symmetrical structures, is described by Dr. J. Monteath Robertson.

The interaction between two heavy nuclear particles is computed by Dr. D. Iwanenko and A. Sokolow on Fermi's theory, assuming the interaction transfer, not by one alone, but by an arbitrary number of pairs of electrons and neutrinos. The generalization of the previous law obtained gives the finite self-energy of a proton or neutron, just as Born's non-linear theory leads to finite self-energy of a point charge, which was impossible on the usual Coulomb formula.

The formation of coloured rings when silver or copper is 'cathodically sputtered' upon a glass plate, on which a drop of oleic acid has been placed, is described by U. K. Bose. The author explains the phenomenon by assuming that the condensed metallic sputtered particles form a surface film of the 'liquid expanded' or 'gaseous' type.

Surfaces of copper crystallized from a molten state by cooling *in vacuo* have been investigated by S. Dobinski and Dr. C. F. Elam both by means of X-rays and by the electron diffraction method. X-rays showed that the orientation of the crystals differed from specimen to specimen, while the electron method showed spots from copper crystals preferentially arranged. The authors suggest that this arrangement may be due to the planes of highest atomic density, (111) and (100), arranging themselves parallel with the surface.

Diagrams illustrating a new arrangement of electrodes in a vacuum tube, by means of which electron oscillations of higher intensity than those obtained with the split-anode magnetron can be produced, are submitted by Prof. K. Okabe. A useful output of a few watts was obtained with an input of about twenty watts. The wave-length was eighty centimetres, but may be varied within a comparatively wide range.

Further evidence in support of the view that natural selection rather than environmental conditions determines mimicry in insects is adduced by Prof. G. D. Hale Carpenter.

Experiments with several constituents involved in the mechanism of respiration of cells, carried out by H. Theorell, show that citochrome *c* (a pigment found in muscle tissue, etc.) is unable to oxidize the di-hydro-co-ferment directly, but does oxidize the leuco-form of the 'yellow pigment'.

The ratio of the phosphorus content of red cells and the plasma of the blood is found by Dr. H. L. Brose and E. B. Jones to be changed after treatment with X-rays or radium. The authors give two examples and suggest that the change may possibly serve as a measure of the effect produced upon the patient by a given dose of X-rays or radium.

Further experiments illustrating the reduction of graphitic acid at a cathode and the formation of carbon dendrites are described by Dr. H. Thiele.

Research Items

Brain Size in Man and the Great Apes

DR. FRANZ WEIDENREICH, who has succeeded the late Dr. Davidson Black as honorary director of the Cenozoic Research Laboratory of the Geological Survey of China, has made the endocranial cast of Peking man the basis of a comparative study of the size of the brain in man and the great apes (*Palaeontologica Sinica*, Ser. D, 7, 4). To the two casts of the original skull and the reconstructed specimen, he has now added a third from a composite reconstruction by himself from material freed from the matrix recently. He points out that previous studies have dealt with the relief of the casts, but the material now available makes it possible to deal more generally with shape and proportions and to show the direction of development. The first feature to strike the observer is the small size of the brain of *Sinanthropus*, even when allowance is made for the fact that the first skull is that of an immature individual. Taking the three together, the cubic capacity may be put at approximately 1,000 c.c., as against 900 c.c. for *Pithecanthropus* and 1,450 c.c. for modern man (male) and 1,300 c.c. (female). Among the anthropoids the gorilla is not quite 600 c.c. and the chimpanzee below 500 c.c. The general average of modern man is below that of Neanderthal man, which works out at 1,425 c.c., so that it would appear that the hominids reached the maximum of skull capacity in that type, and in modern man it is on the decrease. A further point which emerges is that the size of the brain, especially in the hemispheres, increases almost equally in all directions during the development of the hominids, while relative as well as absolute increase is greater in the direction of height, next of length and least of breadth. *Sinanthropus*, *Pithecanthropus*, the Neanderthal group and recent man represent different stages in human evolution which are well marked off one from another.

White Rats and Lamarckism

THE experiments of McDougall, in which he trained rats to discriminate between the light and dark exits from a water tank by giving them a tetanizing electric shock when they chose the lighted exit, are well known. He claimed that the effect was inherited, so that after some generations the descendants of rats which had been trained in every generation learned much more quickly than untrained controls. He neglected, however, to record pedigrees or to keep the individual records of every animal. His work has now been repeated by Prof. F. A. E. Crew (*J. Genetics*, 33, No. 1) using more critical genetical methods. With 18 generations of rats, 1,445 trained and 1,014 controls, the average number of errors in the trained stock did not decrease, and showed no difference whatever from the control stock. Analysis of the pedigrees shows, however, that genetic factors are heavily concerned in determining the scores, quickness to learn being a general dominant to slowness. The parent-offspring correlation for learning was 0·3. A 'quick' strain was developed by selection. Preliminary experiments with each rat, in which the light was constant at both exits and no shock was administered, showed that many rats chose regularly the right or left hand exit and others were photophobic. The genetic basis of these conditions is being further investigated, but the claim for a Lamarckian effect is found to be without foundation.

Imaginal Buds of the Appendages in *Drosophila*

DR. CHARLOTTE AUERBACH has recently traced the development of the imaginal buds of the legs, wings and halteres in *Drosophila* from the first larval instar onwards (*Trans. Roy. Soc. Edinburgh*, 57, 787 ; 1935). The basis of the work is genetical, and the problem as to how the mutant genes influence the development of organs and parts cannot be properly answered unless the normal growth of the parts is known. The account given of the formation of the thoracic appendages and their connexions with associated organs is exceptionally complete. This is followed by a preliminary description of the development of certain mutant wing-types. The time in development when such mutants deviate from typical growth is recorded and the deviation followed in some detail. In wing-development there are four recognizable periods of morphogenetic significance, and various external factors, operating at definite periods, induce the manifestation of certain mutants. The paper is very fully illustrated, and forms a useful contribution to the subject concerned.

The Genus *Keramosphaera* Brady

IN December 1935, Mr. E. Heron-Allen read a paper before the Royal Microscopical Society upon this mysterious genus of Foraminifera, lost sight of for forty years, in which he compared it with other almost legendary organisms, such as the flying squirrel (*Eupataurus*) of Kashmir ; the emu-like bird *Pesophax* ; and the water-rat (*Crossomys*), which was found by Monckton in British Guiana in 1906 and has never been seen or heard of since. Beyond the two original specimens of *Keramosphaera* sent home by Brady in 1874, it was never seen again until 1914 and 1931, when single specimens were recorded from the Antarctic by Pearcey and Wiesner. The original Brady specimens were lost, until Mr. Heron-Allen re-discovered them during the assemblement and systematic rearrangement of the scattered collections of Foraminifera at the Natural History Museum. Thus encouraged, he re-examined the Brady (*Challenger*) material and brought three more specimens of *Keramosphaera* to light. These are illustrated in his paper recently published in the *Journal of the Royal Microscopical Society* (56, 113 ; June 1936). Between the reading and the publication of this paper, two further specimens of *Keramosphaera* were recorded by Mr. A. Earland from some *Scotia* material, which was worked upon, described and illustrated by F. Pearcey many years ago. In his paper, Mr. Heron-Allen directs attention to a partially lost and wholly unpublished paper by his late friend, F. W. Millett, who died in 1915. This paper he found during the sorting, so far as was possible, of the mass of papers and material left behind by Millett on his death in 1915. It deals with the shore sands of Misaki, Japan, and though it was evidently

begun and abandoned in 1904, it contains a fortunately full and complete description, with two drawings, of a further species of the genus *Keramosphaera*, to which Millett gave the name *K. densa*. His two beautiful drawings are reproduced in the paper under notice, together with Miss Barbara Hopkins's drawings of the newly discovered specimens, but the type-specimens of *K. densa* have totally disappeared, though Mr. Heron-Allen discovered an empty and damaged slide, which had contained them, among the debris left behind by Millett.

The Trisomic Mutations of *Œnothera Lamarckiana*

Œnothera Lamarckiana is known to have a ring of twelve chromosomes and one free pair. Dr. D. G. Catcheside (*J. Genetics*, **33**, No. 1) has determined the various possible primary trisomic mutations which can arise through non-disjunction in these conditions. Thirteen dimorphic forms such as *lata* (giving *Lamarckiana* and *lata* when selfed) will arise from simple non-disjunction. It is shown that double non-disjunction on the same side will produce trisomics which breed true and are therefore called monomorphic. These will number 48 and fall into four categories according to the number of chromosomes between the two non-disjunctions in the ring of twelve chromosomes. A further twelve monomorphic trisomics, called by de Vries 'accessories', correspond with each of the twelve dimorphic trisomics, having an extra chromosome from the ring, thus making a total of 73. The dimorphic trisomics will segregate a monomorphic-I trisomic when selfed, provided it is viable. The latter, pollinated by *O. Lamarckiana*, should produce *Lamarckiana*, the monomorphic and the dimorphic trisomic from which it was derived. This analysis of the possible types of trisomics is confirmed in various cases by the genetical and cytological behaviour of known trisomics, such as *lata*, *albida*, *scintillans*, *oblonga* and *cana*. The whole constitutes a valuable analysis of the possibilities in this type of cytological change.

A New Disease of Mushroom Beds

A SHORT note by Mr. P. H. Williams (*Gard. Chron.*, Aug. 22, 1936) announces the discovery in Britain of a new fungal competitor of the mushroom, previously known only in the United States and Denmark. A truffle, *Pseudobalsamia microspora*, has been found in the casing soil of experimental mushroom beds at the Cheshunt Research Station, and though it does not appear to attack the mushroom themselves, it is a rather serious menace by virtue of its energetic competition for food. This discovery strengthens the plea for sterilizing all casing soil before addition to a mushroom bed.

Solar Temperature

A RECENT article by Messrs. W. W. Coblentz and R. Stair (*Bur. Standards J. Research*, July) sums up the results of their measurements of the energy in the ultra-violet of the solar spectrum within and outside the earth's atmosphere, and the conclusions to be drawn from them. Their measurements are made by means of a standard radio tube and a photo-electric cell, coupled in such a way that, when the cell is illuminated, an audio signal is produced the frequency of which is diminished to one or two per second as the illumination is reduced to zero. The wave-length of the light is restricted by suitable filters, and the tube is coupled to a radio transmitter the frequency of which it modulates. The arrangement is attached to a sounding balloon and sent aloft, and from the signals received from the balloon at different altitudes, the distribution of energy between wave-lengths 2900 and 3400 tenth-metres outside the earth's atmosphere is calculated. The graphs show that this distribution is most nearly represented by that of a black body at 4,000° K., and that it is incorrect to assume that solar radiation is identical with that of a black body at 6,000° K.

Invertase and Dyestuffs

J. H. QUASTEL and E. D. Yates have extended their study of the action of dyestuffs on enzymes to invertase acting on sucrose (*Enzymologia*, **1**, 60; 1936). The enzyme is inactivated by both acid and basic dyestuffs, though not all are toxic. It is considered that the basic dyes combine reversibly with an anion of the enzyme, the compound being catalytically inactive, whereas acid dyes combine with the cation. Sucrose competes with both classes of dyestuffs for the enzyme. Glucose competes with basic dyestuffs to a greater extent than with acid dyestuffs for the enzyme, whereas with fructose the reverse is the case. The results cited have led the authors to regard invertase to be acting as a *zwitterion* the oppositely charged groups of which are bridged by sucrose: the glucose section is attached to the anion and the fructose moiety to the cation of the enzyme. Such a theory, however plausible in terms of ionic nomenclature, disregards the effect of stereochemical changes in the sugar molecule in rendering invertase inoperative.

Photographing Meteor Trails

IN *L'Astronomie* of May there is an interesting article entitled "Détermination du Radiant de l'Essaim des Étoiles Filantes du 9 Octobre 1933", by S. Arend and G. Camille Flammarion. It describes the results of photographing 25 meteors between $20^h\ 03^m$ and $20^h\ 55^m$ at the Observatory of Juvisy. An objective 12·5 cm. in diameter and with focal length 60 cm. was used, and α Lyræ was utilized as the star for guiding purposes. Of 25 recorded trails only 8 were retained, the remainder being either very short or extremely faint. The equations of the great circles for these eight trails were used, and the method of least squares applied to determine the radiant with the greatest accuracy. An interesting comparison is made between the results and those obtained on the same night at the Observatory of Uccle with an exposure of 38 minutes. The computed positions of the radiants were almost exactly the same, at $\alpha = 262{\cdot}29°$, $\delta = 53{\cdot}74°$ (referred to the equinox of 1933.0), after making corrections for zenithal attraction and diurnal aberration. These photographic results gave a very accurate determination of the radiant of the Giacobinids on the night of October 9, and show that the radiant was well defined, not a diffuse area, whereas visual observations led to the conclusion that the radiant was diffuse, due to the observational errors which are almost impossible to eliminate in the usual visual work. This conclusion is very important in view of the fact that wherever meteor work is conducted now by competent observers, there is an increasing tendency to treat the results as provisional and approximate, pending more accurate methods of observation.

Some Properties of Aluminium and its Alloys

PARIS MEETING OF THE INSTITUTE OF METALS

AT the invitation of the Bureau International des Applications de l'Aluminium, the autumn meeting of the Institute of Metals was this year held in Paris, on September 14–19. As a natural consequence of this invitation, the majority of the papers presented for discussion at this meeting dealt with various aspects of the metallurgy of aluminium and its alloys.

CONDUCTIVITY OF ALUMINIUM

The first paper presented, by M. Gaston Gauthier, dealt with the conductivity of super-purity aluminium and the influence of small metallic additions. The aluminium employed in the investigation exceeded 99·99 per cent purity, and the added elements were those which may occur as impurities in commercial aluminium. The high purity of the basis metal made it possible to determine accurately the effect of each one of the added elements in the almost complete absence of other impurities. The accompanying diagram (Fig. 1) summarizes the results; it shows the average decrease of conductivity brought about by the various elements within the limits investigated. It is possible to divide the elements into three groups:

(1) Gold, gallium, nickel, silicon, iron and zinc, all of which have little effect.

(2) Copper, silver and magnesium, which have rather more effect.

(3) Titanium, vanadium, manganese and chromium, all of which exert a considerable effect.

In spite of the precautions taken in preparing his samples, the author's figures do not support Norbury's law, to the effect that the increase in resistivity brought about by the addition of the same number of atoms is larger, the greater the separation between the added element and the basis metal in the periodic system. M. Gauthier is considering whether another generalization cannot be established.

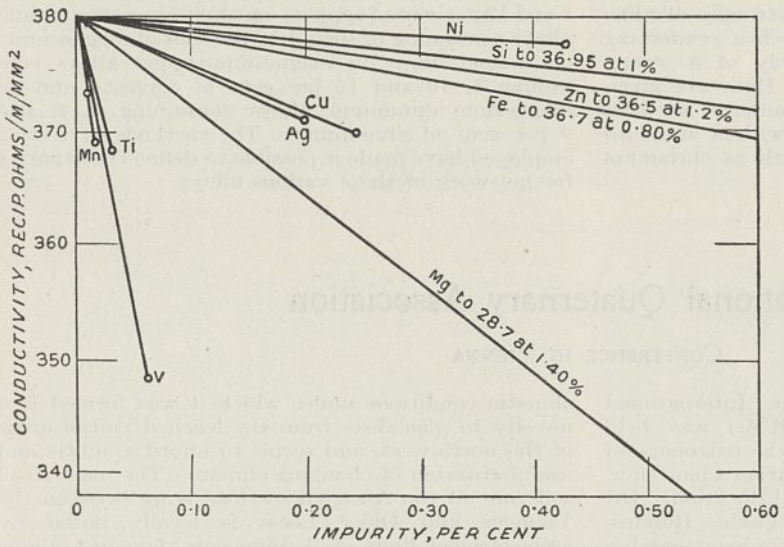

FIG. 1. Mean decrease of conductivity in alloys of aluminium as a function of the content of alloying element added.

INDIRECT FACTORS

Between the initial development of a light alloy and its general utilization in industry there is usually encountered a number of unsuspected and troublesome factors. The Marquis de Fleury, assisted by Dr. H. Portier, presented an analytical study of these factors and the laws governing them in the course of a paper entitled "The Complex Interdependence of the Properties of Alloys and the Industrial Conditions of their Manufacture, Testing and Use". Factors which are apparently unrelated are shown to be actually so interdependent that a simple modification of one can upset the equilibrium of the whole cycle of the life of a casting. This interdependence has been studied in the particular case of aluminium alloys, although the problem is, of course, the same for all metals. Metallurgists are warned against the unconsidered application of new alloys, and engineers against hasty condemnation of the materials with which they are supplied. In spite of careful forethought, unsuitable applications will be encountered which will throw a prematurely advertised material into disfavour; this is the explanation, according to the authors, of the amazing setbacks to be remembered in the history of the most logical developments.

PROPERTIES AFTER PROLONGED HEATING

An investigation of the strength of pure aluminium and various aluminium alloys after heating for long periods at 75°–300° C. was described by Prof. A. von Zeerleder and Dr. R. Irmann. The strength properties of these materials were also determined in the state of complete stabilization. The heating periods employed extended over approximately two years. After treatments of different duration at elevated temperatures, some specimens were cooled and tested at room temperature, others being tested at the treatment temperature. For complete softening at 250° C., for example (that is, to obtain the properties observed in completely stabilized samples), heating periods of at least six months are required in the case of pure aluminium and Anticorodal, and of more than two years for Avional and 'Y' alloy. A still longer heating time is necessary in the case of the alloy 'R.R. 59'. To determine the decrease in strength of any material after heating for long periods at elevated temperatures it is necessary, therefore, to carry out tests of long duration.

The values of the yield-point observed in the normal short time test after heating periods of one year form a basis for calculations for engineers. The permissible loads can be ascertained only by observation of the creep limit, and this property is being studied by the authors.

Aluminium Reflectors

It is well known that the power to reflect incident light is possessed by various metal surfaces to a very varying degree even when such surfaces have been reduced to the same condition so far as possible by grinding, polishing, etc. Not only does the reflectivity vary over the visible range taken as a whole, but it also varies for different wave-lengths and not always in the same manner. The reflectivity of a silver mirror, for example, is very high when measured on the longer waves, but decreases to almost vanishing point over a narrow band in the ultra-violet. In a paper presented by Mr. N. D. Pullen, a description is given of a dual anodic process designed for the treatment of aluminium surfaces in order to produce a high degree of reflectivity. The first bath, in which the electrolytic brightening is produced, is a mixture of sodium carbonate and sodium phosphate in the approximate proportions of 3 : 1 having a strongly alkaline reaction. The second bath, in which a reinforcing film is produced, consists preferably of a strong solution of acid sodium sulphate. Data are given showing the reflectivity of aluminium surfaces treated by this method compared with a standard silver mirror and other surfaces such as chromium plate, nickel plate, etc.

The Fundamentals of Forging

All metallurgists are familiar with Prof. Portevin's methods of treating the practical problems of industry in a fundamental manner. The complex properties of castability and weldability have been greatly elucidated by his publications in the past, and now, together with his colleague Dr. Paul Bastien, he has applied the same method of treatment to the study of forgeability. In their paper, "Study of the Forgeability of Various Light and Ultra-Light Alloys", the authors have endeavoured to determine, by means of laboratory tests, the optimum conditions for hot-working. With this in view they have compared the results obtained from static bending and compression tests and dynamic bending and tensile tests. They have indicated the important part played by the rate of deformation, and have shown that the bending test appears to be the most convenient, speedy and sensitive. The tests were carried out on aluminium ; on copper-aluminium alloys containing 6 and 12 per cent of copper ; on aluminium-magnesium alloys containing 5, 10 and 15 per cent of magnesium ; on magnesium ; on magnesium-copper alloys containing 5, 10 and 15 per cent of copper ; and on magnesium-aluminium alloys containing 3, 6 and 9 per cent of aluminium. The methods of testing employed have made it possible to define the capacity for hot-work of these various alloys.

International Quaternary Association

Conference in Vienna

THE Third Conference of the International Quaternary Association (INQUA.) was held in Vienna on September 1–8 under the patronage of Dr. Kurt von Schuschnigg, the Austrian Chancellor, and Dr. Hans Pernter, Minister of Education. Dr. Otto Ampferer, director of the Geologisches Bundesanstalt in Vienna, who is well known for his researches on the interglacial gravels of the Alps, presided over the Organization Committee, and Dr. Gustav Götzinger was president of the meeting. To these latter and to the genial and multi-lingual secretary, Dr. Helmut Gams of the University of Innsbrück, the meeting owed its undoubted success. That the attendance far exceeded expectations may partly be ascribed to the opportunity of hearing the veteran Prof. Albrecht Penck, who acted as honorary president and spoke on most of the subjects discussed during the Congress.

The geographical situation of Vienna is ideal for such a conference, being accessible without undue travelling to most European nations. To those from the west, the opportunity of seeing a country which, during Quaternary times, took on the character of a pronounced steppe, was a great temptation, and the thick loess deposits of the Austrian Weinviertel north of the Danube came in for much attention. Here in both fossil and recent examples it was possible to study two of the climatically controlled soil types which the researches of Russian scientific investigators have recently brought into prominence, namely, the black-earth or *chernozem* which margins the steppes, and the brown-earth or forest soil of the better-watered areas. This utilization of the physical character and colour of the soil to interpret the climatic conditions under which it was formed is a novelty to glacialists from the leached podsol areas of the north-west, and seems to afford a subtle and useful criterion of changing climate. The main fossil soil zone of the Austrian sections lying between the Younger and Older Loess is locally dated by archæological finds of Aurignacian type just above it, and is therefore presumably of interglacial or Riss-Würm age, the loess being glacial. These sections were ably demonstrated by Dr. Götzinger, who, with others, wrote a descriptive guide book for the Congress.

During the visit to Krems, a halt was made at Spitz in order to be present at the unveiling of the memorial to Josef Beyer, the celebrated Austrian archæologist. On a subsequent visit to Eggenburg, Beyer's collections were inspected in the museum, and those who visited this town will long remember the hospitality of its inhabitants. An excursion in the Austrian Alps on September 9–23 was largely attended and enabled the participators to see the terraces and moraines of the quaternary glaciers and a number of interglacial deposits, including the famous Hötting breccia.

The difficulties of language were keenly felt by many members of the Congress. Most of the papers were delivered in German, but, one understands, not always in German as spoken north of the Danube. Many were read from manuscript at undue length and at a speed which made them unintelligible to foreigners. It is surely possible to find some cure for this. Much would be gained if authors would make a point of reading their papers in abridged form in some language other than their own. This

procedure, which enables preparation to be made, would not be much of a linguistic feat for most members of the Congress and would add greatly to the intelligibility of the proceedings.

There was a universally expressed desire on the part of the members to meet in England at some future date in order to see the classic sections of East Anglia and Yorkshire.

Contributions of Chemistry to Pharmacy and Medicine

THE Hanbury Gold Medal of the Pharmaceutical Society of Great Britain, which is awarded for "high excellence in the prosecution or promotion of original research in the Chemistry and Natural History of Drugs", was presented to Dr. F. Pyman at the opening of the School of Pharmacy on October 7.

Dr. Pyman afterwards delivered the inaugural sessional address, in which he reviewed the contribution made by chemistry to pharmacy and medicine during the twentieth century. He pointed out that whereas medicine has contented itself for many thousands of years with the use of drugs of animal, vegetable and mineral origin and of their simple extracts, it is only within a comparatively short period of the world's history—barely 130 years—that the development of organic chemistry and other sciences has enabled these crude drugs and pharmaceutical preparations to be replaced in many instances by principles isolated from them in the form of pure chemical compounds. This tendency has been reflected in the diminution in the number of crude drugs and galenical preparations included in successive British Pharmacopœias. This isolation of the pure active principles of drugs has been of importance not only as an end in itself, but also as a means of giving the organic chemist opportunities of working on the constitution of these compounds both analytically and synthetically.

Expense may prevent the widespread substitution of the synthesized product for that obtained from natural sources but, Dr. Pyman noted, the improvement in the methods for the production of tropinone by Robinson is at least one example of a laboratory synthesis which has brought the time appreciably nearer when both atropine and cocaine may be commercially available as synthetic products. The extraction of chemical constituents of vegetable drugs has stimulated the search by biochemists for the active principle of biological products. Raw liver taken by sufferers from pernicious anæmia over long periods caused nausea, and many patients were unable to continue the treatment. The work of Cohn led to the introduction of a method by which the activity present in the original liver could be concentrated in a fraction which represented about one thirtieth of the original bulk, while further work has enabled still more concentrated preparations to be made. Attempts to effect still further concentration and to isolate the active principle are making slow progress, firstly owing to the instability of the active principle and secondly to the fact that there is no satisfactory animal test for its efficiency in pernicious anæmia.

The consideration of these researches led Dr. Pyman to review the development of chemotherapy, research in which postulates co-operation between chemist and biologist. It is a commentary upon the difficulties in this field of research that the pioneer work of Ehrlich and Bertheim in 1907 still remains the outstanding example of the application of chemotherapeutic principles. That the laboratory worker will steadily add to the products available for the physician is certain, and there is no doubt that in many directions laboratory products will produce results not otherwise attainable. Nevertheless, the isolation of an active principle does not mean the death of the original vegetable or biological product. Tincture of nux vomica, tincture of digitalis or extract of ergot will have their place in medicine and may well produce physiological effects which cannot be obtained by their isolated active principles.

Educational Topics and Events

CAMBRIDGE.—The Central Committee for Agricultural Research Organizations has appointed H. Hunter, of St. Catharine's College, to be director of the Plant Breeding Institute in succession to Sir R. H. Biffen.

The director of the Solar Physics Observatory has made the following appointments: W. Moss, to be first senior observer, J. C. Dobbie, of Trinity College, to be second senior observer, E. G. Williams, of Trinity College, to be first junior observer.

OXFORD.—Dr. H. M. N. H. Irving, of Queen's College, has been appointed tutor in natural science at St. Edmund Hall—a new appointment.

Mr. Alec Naylor Dakin, formerly Lady Elizabeth Hastings Scholar of Queen's College, has been elected to the Lady Wallis Budge Fellowship in Egyptology at University College. Mr. Dakin was educated at Heath School, Halifax, and was placed in the first class in Classical Honour Moderations and in the second class in the Final Honour School of *Literæ Humaniores*.

The Right Hon. W. G. A. Ormsby-Gore has been elected to an honorary fellowship at New College. Mr. Ormsby-Gore's work when Under-Secretary of State for the Colonies in a former administration, as well as his archæological writings, which have achieved a wide success, and his work in the preservation of ancient monuments while acting as Chief Commissioner of His Majesty's Office of Works, thus receive well-deserved academic recognition.

SHEFFIELD.—The following appointments have been made: Dr. R. Rado, to be assistant lecturer in mathematics; Mr. T. L. Morgan, to be assistant lecturer in civil engineering; Dr. W. A. Kirkby, to be lecturer in fuel technology.

THE formal opening of the thirty-fifth session of the Sir John Cass Technical Institute took place on the evening of October 6, when an address was delivered by Bishop Paget to those assembled in the Great Hall, which forms a part of the recently erected extension of the Institute. The chairman of the Governors, the Rev. J. F. Marr, who presided, remarked that during the past two sessions, in which the additional accommodation provided by the extension has been in use, the volume of work has increased 15 per cent. This continued expansion is creating a new demand for additional laboratory accommodation for chemistry and biology, and also for lecture rooms for chemistry and physics

capable of seating more than 70 students. The policy of fostering research has been followed consistently throughout the history of the Institute and during the past session 35 students were engaged in this type of work. In discussing the financial help which the Institute has received, Mr. Marr referred particularly to the generous support of several of the important oil companies in connexion with the courses in petroleum technology. New developments of the present session include advanced courses in botany of final degree standard and post-graduate courses in biochemistry and chemical engineering. An extension of the course in bacteriology will give additional facilities for post-graduate work. The Principal, Mr. Geo. Patchin, said that, of the 62 students successful at London post-matriculation examinations, 1 obtained the degree of Ph.D., 10 the degree of M.Sc., 5 the B.Sc. degree with first class honours, 6 the B.Sc. degree with second class honours, 15 the pass degree and 1 the B.Sc. Engineering (Metallurgy) degree with first class honours.

Science News a Century Ago

Caroline Herschel and Sir John Herschel

ON October 20, 1836, Caroline Herschel, then eighty-six years of age, wrote from Hanover to Sir John Herschel at the Cape. In the course of her letter she said: "I have four complete years of the 'Astronom. Nachrichten' ready bound for you. . . . I wished to give you the number of the paper (but cannot find it again) where Bessel speaks of Saturn's satellites, but my eyes are so dim and I am too unwell for doing anything. I will therefore only say he has seen the 6th but not the 7th, the ring being in the way. In No. 293 two of Bessel's assistants, Beer and Mädler, say a great deal about the observations of your father, but that goes for nothing. I will only say in general that he did in one season more than any one else could have done, and would have resumed the *hunt* the next fifteen years if nothing had interfered. And the Georgium Sidus was followed as long as anything could be obtained from that planet, and it will yet be some twenty years before he will be in that favourable situation in the ecliptic where he was at the time the satellites were discovered. . . ."

Warwickshire Natural History and Archæological Society

ACCORDING to the *Analyst* (5, 303), the first quarterly meeting of the members of the above society was held at Warwick on October 22, 1826, Sir H. Dryden, Bart., being in the chair. After some preliminary remarks by the chairman, the gathering was addressed by Dean Buckland, who is reported as saying that "the walls of Warwick Castle, the walls of the town, and the walls of the cathedral, were composed of strata till recently unknown to geologists. He saw them twenty years ago, but he did not know what was their composition, but still in his travels he had borne in mind the remains of the animals contained in the strata, in the hope that the time might come when the darkness in which these fragments were eclipsed would be dissipated; and when he should be able to make some important discovery to the scientific world. It was a matter of gratification to him that within the last two hours that darkness *had* dissipated; and he was now able to say that in Warwick—under their feet—and on Guys'-cliff there were the remains of many extinct species and genera of animals, whose names were as yet unuttered in England. . . . He ventured to say with as much confidence as if endowed with the spirit of prophecy, for he knew from geological inspection, and from example added to example, that under this town, Leamington and the surrounding neighbourhood, were the remains of thousands of Elephants, of Rhinoceroses, of Tigers, of Buffaloes, and a variety of other animals which he could enumerate."

Ehrenberg's Microscopical Discoveries

IN its column of "Miscellanea", the *Athenæum* of October 22, 1836, said: "M. Alexandre Brongniart writes from Berlin that a discovery has been made by M. Ehrenberg of a very interesting nature. It is, that the homogeneous rocks, which are not very hard, but friable, easily split, entirely composed of silex, and known under the name of Tripoli, or the Polierschiefer of Werner, are entirely composed of perfectly recognizable skeletons of infusory animals, of the family Bacillaria. . . . These remains having perfectly retained their forms, the siliceous carcases of these infusoriæ are to be seen very clearly in the microscope, and may be easily compared to the living animals as observed and delineated by M. Ehrenberg. In many instances there are no appreciable differences. The species are determined by the form, and more surely by the number of chambers or transversal lines which divide these minute bodies. M. Ehrenberg has been able to count them, by aid of the microscope, and has recognized the same number of divisions in the living and the fossil species."

Spontaneous Combustion

THE *Medico-Chirurgical Review* of October 1836 gives the following account of a case of spontaneous combustion reported in the French Press to have taken place at Aunay in the Department of Avalon: "A very fat woman, aged 74 years, addicted to drinking brandy at 27 degrees, lived alone, and one evening returned home as usual, but, as she did not appear among her neighbours the next morning, they knocked at her door. No answer being returned to repeated demands, they summoned the mayor, who forced the door and exposed a horrible spectacle, accompanied by an extraordinary smell. Near the chimney lay a heap of something burnt to cinders, at the end of which was a head, a neck, the upper part of a body, and one arm. At the other end were some of the lower parts, and one leg still retaining a very clean shoe and stocking. No other traces of fire were to be seen, except a blue flame which played along the surface of a long train of grease, or serous liquor, which had been produced by combustion of the body. The mayor found it impossible to extinguish this flame, and summoned all the authorities; and, from the state of the apartment and comparison of circumstances, it was concluded among them that previous to going to bed, for which she had evidently been making preparations, the woman had been trying to ignite some embers with her breath. The fire communicating with the body by means of the breath, combustion probably took place, and would appear to confirm an opinion entertained by several learned men, that that which is called spontaneous combustion of the human frame never takes place without the presence of some ignited body near the person predisposed to combustion."

Societies and Academies

Paris

Academy of Sciences, September 21 (*C.R.*, **203**, 549–572).

JACQUES DE LAPPARENT: The generating media of montmorillonite and of sepiolite. Deposits of montmorillonite should be classed as pyroclastic rocks, arising from the devitrification of a magnesian glass. Sepiolite can be produced under analogous conditions.

DOUCHAN AVSEC: The experimental verification of the fact, predicted by Lord Rayleigh's theory, of the existence of the stable preconvective regime and on the mechanism of the appearance of convective currents in a gaseous layer, heated uniformly from below.

ROGER TOURNAY: The existence of zinc metaborate. The author has been unable to obtain the zinc metaborate, ZnB_2O_4, of De Carli. The devitrification of the equimolecular mixture always gives two layers, one of which is formed by the borate $2B_2O_3,3ZnO$.

MARCEL PRETTRE: The influence of a chemically inert gas on the velocity of the chain reaction of mixtures of normal pentane and oxygen. Study of the influence of the addition of nitrogen on the oxidation and inflammation between 250° C. and 350° C. of mixtures of normal pentane and oxygen.

PIERRE TRUNEL: The electric moments of some fatty diamines.

ANDRÉ VIALARD-GOUDOU: The oxidation of some organic substances by perchloric acid. From the experiments described it is concluded that the attack of organic materials by perchloric acid is due to the direct action of the acid itself and not to that of its decomposition products.

JOSEPH BIECHLER: The organic tricyanomelamines and their relations with the polymerized dicyanimides.

RAYMOND GUILLEMET: The aphis of wheat and the effect of their attacks.

Copenhagen

Royal Danish Academy of Sciences and Letters, January 24.

NIELS BOHR: Properties and constitution of atomic nuclei. The fundamental discoveries of recent years regarding the transmutation of atomic nuclei, have exhibited the extraordinary facility with which nuclei react with each other as soon as direct contact is established. This circumstance may be brought into intimate connexion with the general properties of nuclei, when it discloses a characteristic difference between the problems of the ordinary atomic constitution and the structure of nuclei.

February 7.

L. S. FRIDERICIA: Influence of a vitamin deficiency on the rate of growth of the incisors of rats.

February 21.

HARALD BOHR: A theorem concerning stable motions in the plane.

ELIS STRÖMGREN: Ole Römer's meridian observations and the so-called Mayer formula for the correction of the observed time of transit for instrumental errors. Most of our knowledge of Ole Römer's work as a reformer of astronomy is derived from the work "Basis Astronomiæ", edited by Römer's pupil Peder Horrebow in 1735. During recent years, with the aid of Dr. Ræder, a series of chapters of this historically important work has been translated into Danish. These translations have been published in *Nordisk Astronomisk Tidsskrift* and partly also in German in *Die Sterne*. The work is being continued, and the next issue of the *Tidsskrift* will contain an exposition of the question of Römer's meridian observations and of the so-called Mayer formula, which, as has been previously proved by the aid of the Römerian "Adversaria" edited by the Royal Danish Academy, is in reality due to Ole Römer and not to Tobias Mayer.

March 6.

ØJVIND WINGE: Investigations on linkage in *Pisum*. An attempt is made to map the genes of *Pisum*, on the basis of crossing-experiments involving 17 genes, and the experiments of other investigators. In all, 37 genes are considered. They are provisionally arranged in eight linkage groups, while the chromosome number is only 7. The inheritance of seed weight has been studied. It is found probable that the genes for seed weight generally act upon the linear size of the seed (third root of its weight). Instances of dominance for high as well as for low seed size are also demonstrated. The genes I (yellow cotyledon) and *P*1 (dark hilum) show linkage to genes for seed size.

KNUD JESSEN: Some new archæological datings in Danish pollen diagrams. Some archæological finds from the passage grave period of the younger stone age and from the Celtic iron age on the Danish isles of Langeland and Als afford an opportunity of fixing the age partly of Zone VIII in the pollen diagrams and partly of a phase in the immigration history of the beech in the southern part of Denmark.

Tokyo

Imperial Academy, July 13 (*Proc.*, **12**, 179–204).

T. NAKAYAMA: Note on the sum and intersection of two ideals in an algebra.

M. MORIYA: Division algebras over a $\mathfrak{p}$-ad manifold of an infinite algebraic manifold.

M. HASEGAWA: A statistical study of the type of diurnal variations of terrestrial magnetism on quiet days.

Y. ŌSHIMA: Chemical studies on the tannin substance of Formosan tea leaves. Two crystalline catechins, an amorphous tannin and gallic acid have been isolated and their constitutions determined.

T. YOSHIDA: The reaction between ammonia and carbon dioxide. The reaction $2NH_3 + CO_2 = CO(NH_2)(ONH_4)$ proceeds only in the presence of water. It is a consecutive reaction of the second order, involving the formation of the intermediate complex $NH_3.H_2O$, and has a negative temperature coefficient.

C. MORIYA: Notes on the germicidal properties of the soil flat-worm *Rhabditis pellio* Schneider.

K. KIKUCHI: A new species of *Diaptomus* from Formosa.

S. OKUDA: Description of a new non-motile polychæte, *Thoracophelia ezoensis* n.sp.

S. HIRAYAMA: Germination of pollen obtained from mosaic tobacco plants. Mosaic virus is found to be without effect on the germination.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 19

UNIVERSITY OF LEEDS, at 5.30.—Prof. N. V. Sidgwick, F.R.S.: "Resonance in Organic Chemistry".*

Tuesday, October 20

EUGENICS SOCIETY (at the Linnean Society), at 5.15.—Eliot Slater: "The Inheritance of Mental Disorder".*

Thursday, October 22

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. T. Young: Presidential Address.

Friday, October 23

INSTITUTION OF MECHANICAL ENGINEERS, at 7.—Sir Nigel Gresley: Presidential Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6.—Annual General Meeting. Prof. C. J. Hawkes: Presidential Address.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 2, No. 12: The Brackish-water Lochs of North Uist. By Dr. Edith A. T. Nicol. Pp. 169–195. 2*s.* 3*d.* Vol. 56, Part 2, No. 13: Cytological Studies on the Reproductive Organs—Chromosome Behaviour in the Male Grey Squirrel (*Sciurus carolinensis leucotus*). By Dr. P. C. Koller. Pp. 196–209. 1*s.* 3*d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [189

Imperial College of Science and Technology: Department of Aeronautics. Pamphlet, Session 1936–37. Pp. 6. (London: Imperial College of Science and Technology.) [219

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 39: A Contribution to Knowledge of the Irish Fungi. By Dr. P. O'Connor. Pp. 381–417. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 3*s.* [219

The Iron and Steel Institute. (Special Report No. 15): Second Report of the Steel Castings Research Committee; being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. Pp. vii+117+38 plates. (London: Iron and Steel Institute.) [219

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1935. Pp. x+232. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [229

Forestry Commission. Utilization Series, No. 3: Report on the Demand for Timber in Wood-Turning in Great Britain. Pp. v+53+4 plates. (London: H.M. Stationery Office.) 1*s.* 3*d.* net. [229

Imperial Agricultural Bureaux. Seventh Annual Report of the Executive Council, 1935–1936. Pp. 102. (London: H.M. Stationery Office.) 5*s.* net. [239

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 101: Report of the Proceedings of the Special Scientific Meetings held in May 1936 at Copenhagen. 1ère partie: What Physiological Problems are of Interest to the Marine Biologist in his Studies of the Most Important Species of Fish? Pp. 14. 1.00 kr. 2ème partie: The Measurement of Submarine Light and its relationship to Biological Phenomena. Pp. 64. 3.00 kr. 3ème partie: Comparative Studies of the Fluctuations in the Stocks of Fish in the Seas of North and West Europe. Pp. 90. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [189

Tanganyika Territory: Department of Agriculture. Annual Report, 1935. Pp. 148. (Dar es Salaam: Government Printer.) 4*s.* [219

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 141: On the Relation between the Performance and the Loudness of Sound of an Airscrew. By Jûichi Obata, Sandi Kawada, Yahei Yosida and Umeziro Yosida. Pp. 341–366. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 35 sen. [219

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1935. Pp. 130. (Bangalore: Indian Institute of Science.) 2 rupees; 3*s.* [219

Royal Agricultural Society. Summarised translation of Bulletin No. 19: The Importance of Phosphoric Acid Supply for Egyptian Crops as illustrated by the Results of the Bahtim Permanent Experiments and Others. By Ahmed Mahmoud. Pp. 86. Bulletin No. 23: The Influence of Size and Weight of Seed upon the course of Subsequent Growth and upon Yield of Wheat. By Dr. M. A. Fikry. Pp. 54+27 plates. (Cairo: Royal Agricultural Society.) [219

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 22, Memoir No. 2: Fossil Mollusca from Southern Persia (Iran) and Bahrein Island. By L. R. Cox. Pp. v+69+8 plates. (Calcutta: Geological Survey of India.) 5.8 rupees; 9*s.* [219

Field Museum of Natural History. Botany Leaflet 18: Common Mushrooms. By Leon L. Pray. Pp. 68. (Chicago: Field Museum of Natural History.) 50 cents. [219

Osiris. Vol. 2, Part 6: La première phase de l'évolution de la théorie des quanta. Par L. Rosenfeld. Pp. 149–196. Vol. 2, Part 7: Scope and Development of Indian Astronomy. By Sukumar Ranjan Das. Pp. 197–219. Vol. 2, Part 8: An Alchemical Manuscript by Arnaldas de Bruxella. By W. J. Wilson. Pp. 220–405. Vol. 2, Part 9: The Unity and Diversity of the Mediterranean World. By Dr. George Sarton. Pp. 406–463. (Bruges: The Saint Catherine Press, Ltd.) [219

Det Norske Videnskaps-Akademi i Oslo. Astrophysica Norvegica. Vol. 2, No. 2: Schwingungen und Wellenbewegungen in einer Atmosphäre mit nach oben abnehmender Temperatur. Von H. Solberg. Pp. 123–172. Vol. 2, No. 3: On the Theory of Rotating Stars, I. By S. Rosseland. Pp. 173–191. (Oslo: Jacob Dybwad.) [219

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 756: Surface Water Supply of the United States, 1934. Part 1: North Atlantic Slope Basins. Pp. x+383. 45 cents. Water-Supply Paper 757: Surface Water Supply of the United States, 1934. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vii+216. 25 cents. Water-Supply Paper 758: Surface Water Supply of the United States, 1934. Part 3: Ohio River Basin. Pp. x+387. 50 cents. Water-Supply Paper 767: Surface Water Supply of the United States, 1934. Part 12: North Pacific Slope Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp. vi+172. 20 cents. (Washington, D.C.: Government Printing Office.) [219

U.S. Department of the Interior: Geological Survey. Bulletin 847-D: Phosphate Rock near Maxville, Philipsburg and Avon, Montana. By J. T. Pardee. (Contributions to Economic Geology, 1934–36.) Pp. ii+175–188+plates 28–34. 20 cents. Bulletin 852: The Book Cliffs Coal Field in Emery and Grand Counties, Utah. By D. Jerome Fisher. Pp. iv+104+15 plates. 75 cents. Bulletin 863: Geology of the Salt Valley Anticline and Adjacent Areas, Grand County, Utah. By C. H. Dane. Pp. v+184+21 plates. 1 dollar. Bulletin 867: Geology of the Coastal Plain of South Carolina. By C. Wythe Cooke. Pp. v+196+18 plates. 60 cents. (Washington, D.C.: Government Printing Office.) [219

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontain) for the Year ending 31st December 1935. Pp. 32. (Kirstenbosch: National Botanic Gardens.) [229

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 7: Some Magnetometric and Gravimetric Surveys in the Transvaal. By O. Weiss, D. J. Simpson and G. L. Paver. Pp. 27+9 plates. (Pretoria: Government Printer.) 2*s.* [229

Royal Agricultural Society, Egypt. Bulletin No. 26 of Technical Section and No. 4 of Royal Agricultural Society, Imperial Chemical Industries, Ltd., and I. G. Farbenindustrie Aktiengesellschaft Joint Agricultural Research Scheme: Experiments in Egypt on the Interaction of Factors in Crop Growth. 4: Nitrogenous and Phosphatic Manuring of Cotton and their relation to Variety and Spacing. By Frank Crowther, Adolf Tomforde and Ahmed Mahmoud. Pp. 46. (Cairo: Royal Agricultural Society.) [229

R. Osservatorio Astrofisico di Catania. Annuario 1935. Pp. 60+10 plates. (Catania: R. Osservatorio Astrofisico.) [229

University of Illinois: Engineering Experiment Station. Bulletin No. 283: A Study of the Reactions of various Inorganic and Organic Salts in Preventing Scale in Steam Boilers. By Prof. Frederick G. Straub. Pp. 118. 1 dollar. Bulletin No. 284: Oxidation and Loss of Weight of Clay Bodies during Firing. By William R. Morgan. Pp. 42. 50 cents. Bulletin No. 285: Possible Recovery of Coal from Waste at Illinois Mines. By Prof. Cloyde M. Smith and Prof. David R. Mitchell. Pp. 44. 50 cents. Bulletin No. 286: Analysis of Flow in Networks of Conduits or Conductors. By Prof. Hardy Cross. Pp. 32. 35 cents. Circular No. 26: Papers presented at the First Annual Conference on Air Conditioning, held at the University of Illinois, May 4 and 5, 1936. Pp. 154. 50 cents. Reprint No. 6: Electro-Organic Chemical Preparations. By Sherlock Swann, Jr. Pp. 385–440. 35 cents. Reprint No. 7: Papers presented at the Second Annual Short Course in Coal Utilization, held at the University of Illinois, June 11, 12 and 13, 1936. Pp. 163. 1 dollar. Reprint No. 8: Second Progress Report of the Joint Investigation of Fissures in Railroad Rails. By Herbert F. Moore. Pp. 15. 15 cents. (Urbana, Ill.: University of Illinois.) [259

Journal of the Federated Malay States Museums. Vol. 8: An Expedition to Korinchi Peak, Sumatra (1914). Part 1. Edited by H. M. Pendlebury. Pp. 31+15 plates. (Kuala Lumpur: Selangor Museum.) [289

Forestry Pamphlet No. 4: Notes on the More Important Timber Trees of Trinidad and Tobago. Pp. 17+25 plates. (Trinidad: Government Printing Office.) 12 cents. [289

International Institute of Agriculture. Bibliography of Tropical Agriculture, 1935. Pp. vii+256. (Rome: International Institute of Agriculture.) 10 lire. [289

Government of India: Department of Industries and Labour. Irrigation in India: Review for 1934–35. Pp. 47. (Delhi: Manager of Publications.) 1.8 rupees; 2*s.* 6*d.* [309

Catalogues

Science in the XIXth Century: The Beginnings of Modern Physics; Electricity, Telephone, Telegraph, Wireless; Chemical Systems and Spectrum Analysis; Development of Transport and Industry, Photography; Evolution; Advance in Medicine. (List No. 22.) Pp. 40. (London: E. P. Goldschmidt and Co., Ltd.)

Dunns Seed Wheats. Pp. 24. (Salisbury: Dunns Farm Seeds, Ltd.)

Petrological Microscopes. (Section 'C'.) Pp. 20. (London: James Swift and Son, Ltd.)

Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. 200. The 'Carbosorb' Brand of Soda Lime and Soda Asbestos. Pp. 4. (London: The British Drug Houses, Ltd.)

Dulau's Catalogue of Botanical Books. (No. 249.) Pp. 40. (London: Dulau and Co., Ltd.)