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The Imperial Forestry Institute, Oxford

THE future policy of the Imperial Forestry Institute, Oxford, is set out in its twelfth annual report—the first issued since the new scheme of management was introduced. Briefly, it is proposed "to develop the Institute as a centre for the study of world forestry in relation to Empire forest problems and as a forum for the interchange of professional knowledge amongst foresters from all parts of the Empire, rather than as a place of instruction *ex cathedra*". Every opportunity is to be taken of maintaining a closer liaison with the services concerned. It is hoped that ultimately it may be possible for forest officers from different parts of the Empire to be seconded to the Institute for the purpose of giving instruction.

In the meantime, it is proposed to make the fullest use of the fund of knowledge and experience brought to the Institute by the constant stream of forest officers and research personnel who visit it for refresher courses or other purposes, by drawing upon it systematically and placing the results on record. The staff of the Institute will not only act as *rapporteurs* of experience brought to the Institute, but also study and analyse the various techniques of utilization, sylviculture, land conservation and improvement, and their reasons for success or failure, in the light of the fundamental sciences applicable to them. They will carry out research, especially team research, by which plant physiology, soil science, ecology, systematic botany and other sciences may be applied to the solution of complex problems. It is considered axiomatic that the teaching given should be based on research carried out by the staff.

In order that the staff may be better fitted to carry out the role assigned to them, it is essential that they should have some first-hand knowledge of forest conditions in the Empire at large, and opportunities of establishing contact with other workers overseas. It is hoped that it will be feasible, ultimately, to arrange for members of the staff to make tours of some length, during which the duties of the member of the staff on tour will be carried out by a *locum tenens* from some other part of the Empire. Meanwhile, as a beginning, financial provision has been made for one of the senior members of the staff to undertake such a tour.

The fullest development of the Institute as a centre for the diffusion of knowledge by personal contact, implies not only the interchange of knowledge between the permanent staff and visiting officers of experience, but also between the students themselves. One important suggestion from this point of view has been put forward to the Colonial Office, namely, that the year's course at the Institute taken by probationers before taking up their posts in the services to which they are appointed, should be postponed until they have completed an apprentice tour of, say, two years. Their experience, though limited, would enable them to appreciate more fully the problems they have to face than can be expected from any student without experience of tropical conditions. They would be in a position to concentrate on these problems, compare notes with their fellow students from other territories, and refer difficulties to the Institute's staff and to more experienced officers undergoing refresher courses.

Whilst the dissemination of knowledge by personal contact will form such an important feature of the activities of the Institute, it will also, so far as its financial resources permit, act as a clearing house for information on world

forestry available in documentary form. As a beginning, the practice of scanning all incoming forestry literature and indexing important contributions has been resumed in a modified form, involving the use of the 'Flury' international decimal classification and the issue, to the services, in multigraphed form, of a *Current Monthly Report*. There is some hope that an Imperial Forestry Bureau may be set up under the Imperial Agricultural Bureau scheme, and attached to the Institute.

With regard to the subjects to be included in the curriculum of the Institute, it is intended to provide more teaching of economics, as the basis of forest utilization and management, and of ecology, plant physiology and soil science as fundamental to the study of sylviculture, not only on the productive side, but also in the widening field of the protective and reclamatory influences of vegetation. The main object, on the teaching side, is to make the initial training and refresher courses more useful to serving forest officers.

Points in the report which may raise questions in the minds of scientific foresters, are the tendencies to emphasize economics as against sylviculture, and to minimize the importance of the study of European forestry as part of the training of a forest officer. It is proposed to hold the study tour of the present year in Finland, on the ground that the highly specialized forms of forestry of Germany, France and Switzerland, seen in the usual study tours, have little application to average conditions overseas. Though, in a literal sense, this contention is true, the forestry of these countries provides the finest examples available of the adjustment of forestry practice to local conditions, and the field in which the ecological, economic and sociological foundations of forestry have been most fully worked out. Students in British forestry schools probably receive sufficient grounding in European forestry, but those officers whose training has been outside Europe should be given an opportunity of making a first-hand acquaintance with the finest examples. Finland is an excellent field for the special study of the economics of exploitation in conditions which are analogous to those of parts of the Empire in some respects, but even more remote in others (climate, number of species, etc.).

The practice of arranging special tours for individuals wishing to study particular aspects of forestry is an important feature of the Institute's work, and it is recognized that it is desirable to extend them into the nearer tropics and even the United States of America on occasion. The advisability of making the Scandinavian countries the venue of ordinary instructional tours is more doubtful.

The policy outlined in the report should commend itself to the forest services of the British Empire, and it is to be hoped that the financial and other support, necessary to implement it fully, will be forthcoming.

Application of Medical Science in Tropical Countries

A Doctor's Odyssey:
Adventures in Forty-five Countries. By Dr. Victor Heiser. Pp. 547. (London: Jonathan Cape, Ltd., 1936.) 15*s*. net.

ABOUT few books can it be said that they have the combined qualities of being interesting, elevating and amusing; but such a claim can certainly be made in the case of Dr. Victor Heiser's book. Dr. Heiser has passed a wonderful life, first in developing the public health service in the Philippines at the time when the United States of America took over these islands, and, at a later date, as one of the executive officers of the Rockefeller Foundation, whose mission it was to organize measures for the suppression of tropical disease, and especially of hookworm infestation, in many parts of the world.

There are probably not many people who realize the extent to which preventible disease develops in tropical countries—plague, smallpox, malaria, typhoid and typhus fevers, hookworm disease, and many other disorders. On arriving at the Philippines, Dr. Heiser says, "I set myself the goal of trying to save 50,000 lives a year." Such a statement may seem grotesque to the average reader, but there is no doubt at all that the Health Board more than succeeded in this object. Millions of people die of these diseases, and those who survive are usually crippled in one way or another for life, in spite of the fact that the knowledge for suppressing most of them is available. In India alone there are said to be 100 million people suffering from malaria. What are we to think of this state of affairs? If human life and health are sacred and precious, why is no united effort

made to eliminate or at least to control these death-bringing diseases ? Why are such efforts left in the hands of a few people who, however successful, may have their work hindered, or even stopped, at any moment by the whim of the politician or political administrator ? A good instance of this kind of interference in public health administration is given by Dr. Heiser when he deals with the period of Governor Harrison's presidency over the destinies of the Philippines. Harrison believed that the natives of a country ought to control their own legislation and administration, even in the case of malaria and plague prevention. It can be readily imagined what these primitive people thought of sanitation and clean houses ; and only after the death-rate had again mounted to enormous figures was it decided that a proper standard of health was incompatible with home rule founded on ignorance, superstition and vested interests. The American medical men again got their chance with the arrival of a new governor.

The kernel of the matter is that eighty per cent or more of all social and political problems of tropical countries are essentially biological in nature. When politicians and administrative officers recognize this fact and encourage the medical scientist and biologist to the utmost, many difficulties of administration will disappear, and the standard of health and mental development in these countries will be completely revolutionized.

But it is not only politicians who will profit by reading this book. It might be of some advantage to that large number of people, even educated people, whose idea of modern science centres around aeroplanes, high explosives, poison gas, and the metaphysical interpretations of mathematico-physics sponsored by our modern scientific Schoolmen. It is representatives of this group who state so frequently from the pulpit and through the medium of the British Broadcasting Corporation on Sunday evenings that "modern science has failed".

It will be evident that Dr. Heiser not only had his chances but also that he seized them with both hands. In the Philippines, at least, he seems to have met with almost unreasonable success in most things he attempted, apart from the Governor Harrison episode referred to above. This success was, according to his own account, often due not so much to his own skill as to the fact that most people who stood in his way seemed to be not only slightly weak-minded but completely complacent. In my experience, obstruction and complacency in public life do not generally go together, but Dr. Heiser wins through most of his difficulties and pleases everybody, including the reader of his adventures.

Dr. Heiser is a man to whom things 'happen', as I suppose they happen to most of us at times ; but he also has the faculty of remembering the incidents, and sufficient humour to appreciate them. About whom but Dr. Heiser could the following incident revolve ? He had a quarantine officer called Dr. Turnipseed, and it was the duty of this Dr. Turnipseed to board a ship one morning for quarantine purposes. He knocked on the captain's cabin door and said, "I am Dr. Turnipseed," to which the answer was, "Well, you have nothing on me, I am Captain Garlic."

The book is full of amusing incidents and suggestions. For example, at one time Dr. Heiser was travelling in a ship which was infested with cockroaches. These cockroaches used to run over the feet of passengers when they were asleep, so that if they had corns these were neatly removed by the cockroaches, who gnawed down until they reached a sensitive spot on the foot, when they would be automatically shaken off by the disturbed patient. What chiropodist could compete with this perfect and costless procedure ?

But, however light the tone adopted by Dr. Heiser in describing his life's work, it must be realized that he is really dealing with the fundamental problem of extending modern knowledge to combating disease and death. The fact that he has written in this most acceptable form must not be regarded as evidence of the lack of seriousness of purpose in his endeavours. The general reader will enjoy reading this book greatly, but for those with an intimate knowledge of tropical medicine the fun will not be so unadulterated. The expert will often be made to jump by the cleverly concealed but obvious egotism of the author and by his wrong appraisal of the relative importance of some medical discoveries. Will, for example, Dr. Heiser kindly remember in discussing beriberi in any future edition, that Eijkman is a figure reverenced by all with real knowledge of nutritional disease ? Still, it is improbable that a book of such excellence could have been written by anyone who had not the failings as well as the good qualities of Dr. Heiser.

Now that Dr. Heiser has retired from the tropics and returned home, the Government of the United States ought to put him in charge of a campaign to attack the dreadful situation of venereal disease in that country. If it is true, as stated by those with intimate knowledge, that there are 681,000 new cases of syphilis annually in the United States, it is high time that somebody with Dr. Heiser's qualities for successful administration in preventive medicine should tackle this scourge of public health.

E. MELLANBY.

The Tsetse Fly Problem

The Tsetse Flies of East Africa: a First Study of their Ecology, with a View to their Control. By C. F. M. Swynnerton. (Transactions of the Royal Entomological Society of London, Vol. 84.) Pp. xxxvi + 579 + 22 plates + 7 maps. (London: Royal Entomological Society, 1936.) £5 10*s*. 0*d*.

THE greater part of tropical Africa is covered by the range of one or more of the twenty-one species of tsetse fly (*Glossina*) indigenous to that continent. In much of this vast territory it is not possible to keep cattle owing to the ravages of nagana disease, while the human population is being decimated by sleeping sickness. It is well known that the trypanosomes responsible for these diseases are carried by one or other of the species of *Glossina*. The future prosperity of great tracts of the African continent depend, therefore, on discovering means by which such areas can be inhabited by man and his domestic animals free from risks of infection by these diseases.

Mr. C. F. M. Swynnerton, director of tsetse research in the Tanganyika Territory, has now provided the most comprehensive detailed compendium on the problem that has yet appeared. Published by the Royal Entomological Society with the aid of a monetary grant from the Tanganyika Government, it runs to nearly six hundred pages, with a table of contents alone extending to thirty-six pages. It will be understood, therefore, that it is far too detailed and lengthy for anything more than a very general notice in these columns.

In Tanganyika, two-thirds of the Territory is under infestation by tsetse; and over the remaining one-third, infestation is rapidly spreading. Mr. Swynnerton's problem is how best to rid the land of the scourge of *Glossina* by a reasonable expenditure of money and labour. His equipment for this campaign has amounted to £15,000 per annum, with a European staff of three entomologists, a zoologist, botanists, field officers, etc., together with an office staff of Asiatic clerks. His method of attack is to concentrate on intensive research in co-operation with experimental reclamation of defined areas. The striking success that his methods have already produced is the best argument that his schemes deserve the fullest support from all concerned with the welfare and administration of a great Territory. His policy is to study the ecological requirements of each species of tsetse with the view of depriving it of the minimum necessary for its existence. It appears that each of the eight species of *Glossina* present in Tanganyika needs a concurrence of different vegetational types. If, therefore, any essential type is modified or destroyed, to a required degree, the tsetse is no longer a menace in a given area.

Mr. Swynnerton's bulky volume is a great storehouse of tsetse ecology treated from every point of view. Each species of the fly presents its own series of problems while sub-problems seem to be innumerable. *Glossina morsitans*, for example, affects seven different types of country, each of which requires individual consideration. The term environment includes not only vegetation but also nearly the whole of the vertebrate fauna of a given area. Domestic animals, man and his operations and practices, soil conditions, climate and its smaller units, native settlement, besides matters of medical and veterinary concern, are also comprised within the comprehensive term environment.

Mr. Swynnerton lays down the axiom that effective attack on the fly in the bush offers the only full solution. In the first instance, after the making of a thorough preliminary study, it is necessary to form barriers for enclosing great tsetse-infested areas of bush. Once these barriers have been established, the destruction of the tsetse in the main bush has to be taken in hand. Complete clearing is objectionable not only on grounds of expense but also on account of the erosion which results. Discriminative clearing is therefore to be aimed at. As regards barriers, it is considered that cleared zones two miles wide will be permanent. Barriers formed by certain types of thickets also prevent the crossing of the fly, evergreen thickets being effective in narrow width. Barriers of deciduous thickets are also advocated, but they need to be of considerable width. Apart from the application of the foregoing measures, direct attack on flies by trapping and other means is only likely to be effective in limited areas. An intensive field study of each species of tsetse is stressed, and this needs to be followed by laboratory analysis of the factors involved. Good progress has already been made in this field with the aid of a number of workers.

The connexion between different kinds of tsetse and the wild game, and other fauna, is a great problem in itself. Mr. Swynnerton points out that the only form of game destruction, likely to prove of benefit at all, is highly organized hunting directed by Europeans—otherwise it is useless or

directly harmful. Organized game hunting, however, is only feasible in types of more open wooding but not in dense thicket. It also involves great expense which is liable to grow into an indefinite commitment.

Once areas are cleared and reclaimed, problems of native settlement then arise. All means, also, have to be employed to prevent re-growth of vegetation. Co-operation of the natives themselves is essential, and in this respect Mr. Swynnerton's personality has already worked with great success among the peoples of Tanganyika.

Our congratulations go to Mr. Swynnerton. By his boundless energy and enthusiasm, the way is now pointed towards the solution of a great problem in this Territory. His encyclopædic document will prove a boon, as a storehouse of information, that will also guide and stimulate workers in other parts of the continent of Africa menaced by the tsetse.

A Programme for the Social Sciences

The Science of Social Adjustment

By Sir Josiah Stamp. Pp. vii+174. (London: Macmillan and Co., Ltd., 1937.) 7*s*. 6*d*. net.

IT needs no more than the painful experience of the Special Areas or a study of the social and industrial surveys of South Wales and Merseyside, with which the University of Liverpool and University College, Cardiff, have recently been associated, to demonstrate how sadly we need to develop a science of social adjustment. If under this new title Sir Josiah Stamp had merely given us his earlier valuable addresses on the calculus of plenty and the impact of science upon society, we might have welcomed this book for its further stimulus to much overdue action in this field. He has, however, done more. The theme of his recent presidential address to the British Association has been expanded by rearrangement and additions, and with the revised lectures on eugenic influences in economics and on the calculus of plenty, we are given three successive chapters in which his argument is continuously developed until he comes to consider in the final chapter some projects for research.

Wherever and whenever new science touches society, it creates a disturbance which has hitherto been mostly accepted as inevitable, but is often a high price for progress. The study and control of this impact constitute the science of social adjustment, and Sir Josiah's insistence that this is no new problem but one that has been with us in lesser degree for centuries does not encourage continued neglect, but calls more imperatively to action. Indeed, Prof. A. N. Whitehead's assertion that we are living in the first period of human history for which we can no longer assume that each generation will live substantially amid the conditions governing the lives of its fathers, and transmit those conditions to the succeeding generations, is emphatically endorsed.

For all this, we have no adequate technique of change, and treat life as mainly static with occasional and exceptional periods of change, instead of regarding it as continuously changing with occasional and abnormal periods of rest, and we have to secure all the changes of social outlook implied by that reversal of view. Even if we have come to accept change as normal and not the exceptional, we are still faced with the fact that it is almost impossible to predict what social life would be under a very different regime. The decay of social cohesion caused by industrial growth, the increased severity of industrial depressions could scarcely have been predicted in any detail. With T. N. Whitehead in his "Leadership in a Free Society", Sir Josiah reminds us that foresight at long range is not possible when dealing with anything so complex as a modern society.

Sir Josiah, however, does not leave us with a purely negative diagnosis; though he makes no proposals for action, he puts forward theories of proposals which are the working hypothesis as a basis for research and fact-finding. Essentially his book is a challenge to thought, and whereas Whitehead has primarily thrown down a challenge to leaders in industry to accept the responsibility of supplying social leadership to repair the disintegration which industry is working in society, and to see industry as essentially a part of society, Sir Josiah's challenge is rather to academic thought. He warns us indeed that economic life must pay a heavy price, in this generation, for the ultimate gains of science, unless all classes become economically and socially minded, and large infusions of social direction and internationalism are carefully introduced. The emphasis above all, however, is on the quality of thought. "A great draft on the highest mental ability for such social studies is essential." Courses in social science should be as difficult and call for as much thought and scholarship as any of the natural sciences. They are in many senses more exacting in thought processes because they cannot employ the same concrete methods available in the physical sciences.

This emphasis on the need for sustained economic analysis by more first-class minds does not mean government by scientific technique or any other transferred technique, appropriate as these may be to the physical task of production. When the requisite facts have been assembled and analysed, the leadership required must take account also of social wisdom and allow for the slow and halting development of interlocking human relations. Even in this era of change, the motives ensuring predictable and organized activities are the social sentiments surrounding accustomed routines.

It is, however, in presenting a programme for research that this book has the widest claims on the interest of scientific workers. Throughout the book and not only in his final chapter, Sir Josiah gives us examples of lacunæ in existing knowledge which adequate research in eugenics and economics could fill, and in the absence of which a wise direction of national affairs is scarcely possible. He reiterates proposals for research into population changes and distribution, recommending the establishment of a Royal Commission to examine and report upon the probable consequences of the decline in population and change in age groups, and to recommend upon the measures required. He urges a new view of census responsibilities, a census every five years with allied studies of unemployment and of educational adjustments of major significance.

A further proposal is the development of a practice, by the responsible body in each branch of science, of reviewing periodically the immediate *hinterland* of its subject, setting out for each period the chief discoveries, their application, effect on employment and location of industry and the like. He adds another voice to the many who in the last ten or fifteen years have questioned the fundamental suitability of the present patent system to industrial conditions to-day. He suggests very tentatively the possible advantage of confining all patent protection to a six-year period, and urges strongly the need for careful research into the record of recent invention and into the existence of economic and human waste and disturbance in the direction and stability of industry. Scientific research of a close inductive type is required to determine how far the penetration of inventive ideas is fortuitous and dependant on reaching the right man and the right purse at the right time.

Obsolescence provides yet another subject for research which should be approached from the social point of view, and over the last twenty years might provide a model picture and give the basis for a proper treatment. The investigation of taxation adjustments, the co-ordinated study of human heredity and the selective direction of financial support in research are other matters drawing strong support from Sir Josiah, who pointedly directs attention to the disparity between research resources both in men and finance, in the economic or social fields and those available for the physical sciences. University scholarships in the social sciences are negligible in number compared with those given in classics and humanities, and while not suggesting that any of the social sciences should be made school subjects, he pleads for further scholarships in such sciences or a redistribution of funds which will encourage the supply of competent research workers in these fields. Sir Josiah also urges pertinently that to determine, for example, whether a considerable element of under-employment is or is not actually and preventably inherent in the present industrial and economic system is a first-class issue much transcending in importance any current problem in physics or engineering. The resolute and vigorous analysis of the "Douglas Credit" diagnosis of deficient purchasing power, of J. A. Hobson's theories of under-consumption dependant upon maldistribution of income, and of J. M. Keynes' equation between saving and investment and of his analysis of the "propensity to consume" and the issues raised by them, are other examples cited as deserving the attention of a considerable number of thinkers of the front rank. Finally, he raises the question of the various forces which decrease the mobility of personnel in industry, and allied problems—the need for research on the psychological reaction to unemployment relief in relation to the incentive for seeking work, to change of occupation and readiness to train for such changes or to accept a change of neighbourhood—and the social consequences of our facilities for technical education, and its relation to industrial and social activity.

To those who believe that the problems of to-day can only be dealt with by a radical transformation of the nature of society, even if revolutionary, Sir Josiah Stamp's programme for study and development of a science and technique of social adjustment may be of little interest. To those, however, who believe in the possibility of a step-by-step advance, in the development of a mental attitude or discipline competent to guide society through habitual change in an orderly manner, in man's capacity if wisely guided to develop once more the powers required for mastering his environment, it is a challenge both to thought and action. It should win the sympathy and support of even the most ardent protagonist of the physical sciences, to make his own contribution to the great redistribution of our scientific resources and research effort involved when we seriously undertake the programme of social adjustment.

R. BRIGHTMAN.

A Manual of Pharmacology

By the late Dr. Walter E. Dixon. Revised by W. A. M. Smart. Eighth edition. Pp. viii+483. (London: Edward Arnold and Co., 1936.) 18*s*. net.

W. E. DIXON'S well-known text-book has long enjoyed a wide popularity. It is almost the only text-book of pharmacology in the English language of suitable length for those students who regard pharmacology merely as one of the obstacles on the road to a medical qualification. It has always contained a spice of unorthodox and entertaining information which has delighted its readers, and sometimes puzzled their instructors. The seventh edition appeared in 1929, and is now out of date. The eighth edition, prepared by Dr. W. A. M. Smart, represents a drastic revision. The number of figures has been reduced from 97 to 79, but the figure which appears to portray inhibitory nerves to voluntary muscle has been retained.

A large number of chemical formulæ have been inserted, so that it is now possible to find the structure of nearly all drugs of importance. These formulæ are useful for reference, but the detailed chemical structure of most of these substances throws little light on their action, and a knowledge of these details is really only of value to those engaged in research. The bulk of the book has been reduced by the use of a thinner and better paper, but the number of pages is about the same. The general arrangement has not been altered, and the allocation of space to different sections is about the same as before. The chapter dealing with vitamins, hormones, vaccines and sera occupies only fourteen pages. This section might well have been expanded.

It cannot be said that this new edition represents a reliable guide to all the drugs in common use to-day. There is no mention of the agranulocytosis caused by pyrazolon derivatives or of the action of plasmoquine on the sexual forms of the plasmodium, or of coramine, or dinitrophenol. Salyrgan and mersalyl appear as two different substances. The section dealing with the chemical structure of the cardiac glycosides contains no reference to the cyclopentenophenanthrene skeleton. On the other hand, the book is still the most attractive of its kind. The use of different types for subheadings makes reference easy, and the introduction of a number of prescriptions will probably be a popular feature.

A Modern Biology

By Ernest J. Holmes and Dr. R. Darnley Gibbs. Pp. xvi+272. (Cambridge: At the University Press, 1937.) 3*s*. 6*d*.

THE introduction of biology into the school curriculum and the School Certificate examination syllabus has resulted in the production of many text-books, several of which tend to regard biology as a mixture of botany and zoology. To many biologists, the division of the subject is regrettable, and the question has been raised whether it is possible to teach biology to a pupil of school certificate stage. It is much easier for a young pupil to grasp concrete facts about specific plants and animals than to grasp generalizations, but if biology is really to be appreciated then these generalizations must be grasped.

This book is a praiseworthy effort to establish biology on its own feet instead of on botanical and zoological crutches. The subject matter is treated biologically throughout, and in no place is there an obvious separation made into plant and animal work. The result is a very readable book on which it should be possible to base a good course in biology. The authors indicate in their introduction that the book is intended to succeed a course in nature study, in which it is assumed that many structural features of plants and animals will have been studied. On this foundation the authors have built a course, the theme of which is function rather than structure.

The book is well produced, well printed, and beautifully illustrated. At the end of each chapter are suggestions for practical work based on the subject matter of the chapter. The treatment of the subject matter is modern and refreshing, and should be read and carefully examined by every teacher of school biology.

The Hair in Health and Disease:

a New Explanation of Diseases of the Hair, Scalp and Skin and of "Barbers' Diseases" in Particular. By Edward Lawrence. Pp. xvi+181. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 5*s*. net.

THE author of this book is a barber, and he feels that barbers have been badly treated. They have been punished for being dirty and spreading infectious diseases. Stirred by a strong sense of injustice, he says that 'barbers' rash' is not due to germs, and that diseases in general are not due to micro-organisms but to heredity. He adds that medical men, who have testified against barbers, may themselves be responsible for conveying the infection of puerperal fever. He counters dogmatic statements with the lie direct. The relative importance of the different possible factors in the causation of such diseases is not in fact known with certainty. Scientific workers in general are more open-minded than the author supposes, but they are not likely to be convinced by rhetoric.

Statistical Methods for Research Workers

By Prof. R. A. Fisher. (Biological Monographs and Manuals.) Sixth edition, revised and enlarged. Pp. xiv+339. (Edinburgh and London: Oliver and Boyd, 1936.) 15*s*. net.

THIS book has done more than any other to popularize the use of modern statistical methods. Thousands of workers have been taught to use statistical machinery without the burdensome necessity of knowing exactly how it works. Six editions have appeared in twelve years, and the number of pages has been steadily increasing. To facilitate reference the numbering of the sections has been kept constant. It would be convenient if the numbers of the sections could be printed at the top of each page. The book maintains its place as the standard work on its subject for the ordinary scientific worker.

Water-Power Developments in the United States

By Dr. Brysson Cunningham

I

THE United States Geological Survey, among its other activities, renders an important service to hydrological science by collecting and publishing information on the amounts of developed and potential water-power throughout the world, the returns of the former and the estimates of the latter, of course, requiring periodical revision as the development of water-power proceeds. From the latest statement issued by the Survey, it is to be gathered that the total amount of horse-power actually harnessed at the end of 1934 was 55 millions, as compared with 46 millions in 1930, 33 millions in 1926, 29 millions in 1923, and 23 millions in 1920—an increase of nearly 140 per cent in fourteen years.

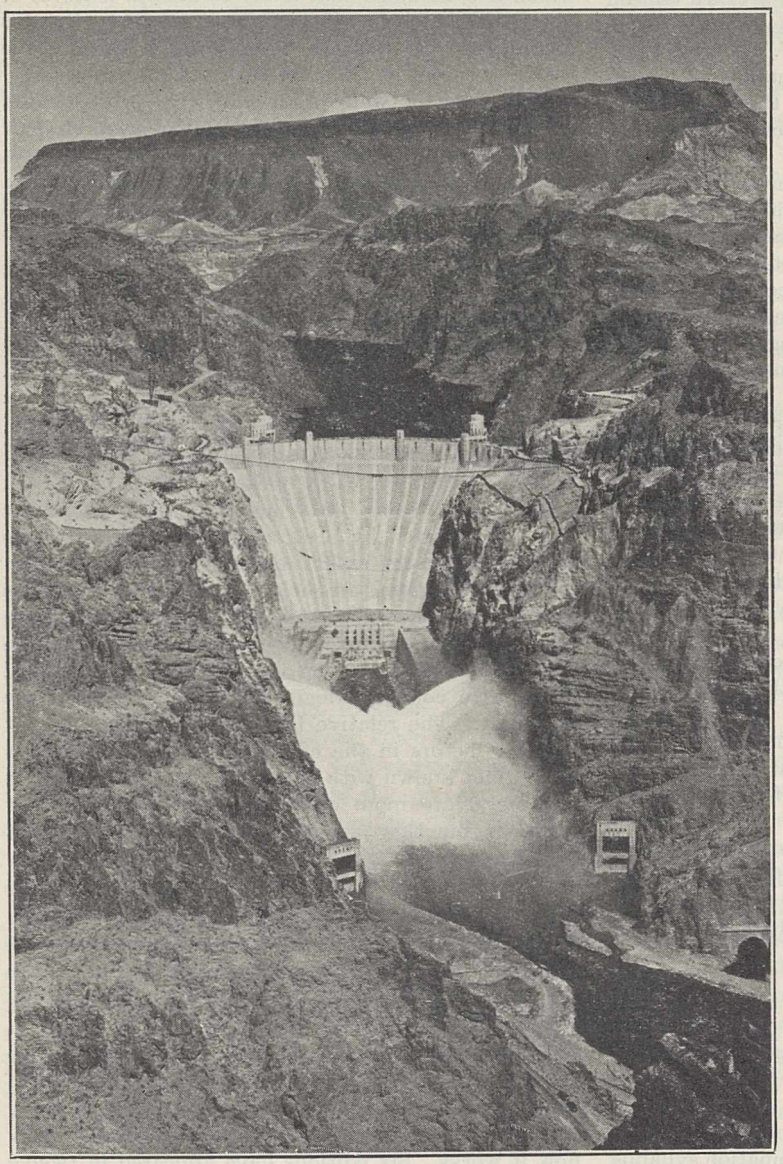


Fig. 1.
VIEW OF DOWNSTREAM FACE OF BOULDER DAM; IN THE DISTANCE IS FORTIFICATION MOUNTAIN.

As regards the potential developments, estimated on the basis of ordinary minimum flow and an efficiency of 70 per cent in installation, the following brief summary of continental aggregates is of interest: Europe, 58 million horse-power; Asia, 80 millions; Africa, 190 millions, of which no less than 125 millions is located in the basin of the Congo and adjacent territory; Oceanica, 17 millions; and America, 127 millions, of which 73 millions is in the northern hemisphere, and 54 millions in the southern.

Developed horse-power at the present time is spread over the world in the following approximate amounts: Europe, 24,300,000; Asia, 4,900,000; Africa, 115,000; Oceanica, 550,000; North America, 24,400,000, and South America, 1,000,000. In comparing these figures with those for potential exploitation, allowance must be made for the fact that the former are based on the actual capacity of the machinery installed, which averages from two to three times the potential power at low flow at the same sites.

A notable fact from the statistics is that Europe has practically caught up with North America in the capacity of actual installations. As against this must be set the fact that the unit magnitudes of certain installations in hand in the United States far exceed those of any other installation under construction in the world. Four outstanding

examples may be mentioned: the Boulder Dam, on the Colorado River on the joint boundary of the States of Nevada and Arizona; the Norris Dam, on the Clinch River in North-Eastern Tennessee; the Bonneville Dam, on the Columbia River, at Bonneville, Oregon, and the Grand Coulee Dam, also in the Columbia Basin, but in the State of Washington. These undertakings are of such striking magnitude as to claim some detailed notice. The following descriptions are compiled from information kindly supplied by the authorities concerned.

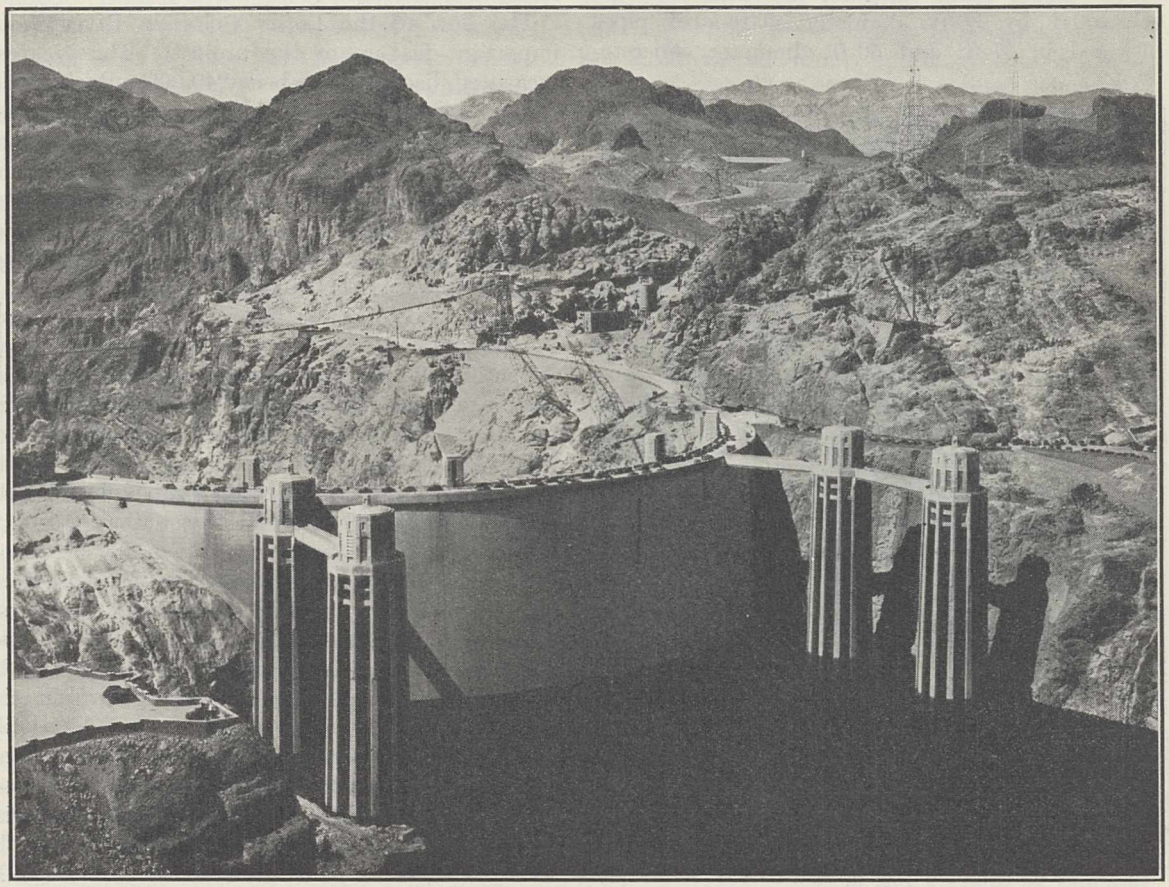


Fig. 2.
VIEW OF UPSTREAM FACE OF BOULDER DAM, SHOWING IMPOUNDED LAKE MEAD.

THE BOULDER DAM

The Boulder Dam, perhaps the most notable of the four, has already received a brief preliminary notice in this journal (NATURE, Feb. 9, 1935) just before its completion in May 1935*. It is by far the highest dam in the world, with a height of 726 ft. above bedrock foundation, as compared with 450 ft., the height of the Chambon Dam in France, which at present ranks second in altitude. The crest length is 1,282 ft., and the structure enables the water surface of the Colorado River to be raised 584 ft. It is located on the Arizona-Nevada State boundary line, in upper Black Canyon on the Colorado River, about 30 miles south-east of Las Vegas, Nev., and 80 miles north of Needles, Calif. The natural geological formation of the site is andesite breccia, hard and very durable.

The dam, the downstream face of which, as it appears from a mountain top on the Nevada side of the Black Canyon, is shown in full extent in Fig. 1, is of the arch-gravity type, and contains 3,255,000 cubic yards of concrete, weighing somewhat less than seven million tons. The artificial reservoir formed by the dam has a capacity of 30½ million acre feet: it is 115 miles long, with a superficial area of 146,500 acres, or 229 square miles, and the filling with water is taking a period of about three years to complete. The view (Fig. 1) shows twelve discharge outlets fully open, resulting in two great cascades with a fall 13 ft. more than the Niagara Falls.

The upstream face elevation above the level of an intermediate impounding stage in Lake Mead

* It also formed the subject of a lecture delivered to the Institution of Civil Engineers on April 15 (*vide* NATURE, April 24, p. 706).

with a depth of more than 330 ft., is shown in Fig. 2. Motor-cars can be seen parked in the four-lane roadway across the dam. As will be seen, there are four reinforced-concrete towers located adjacent to the dam, two on each side of the river, and about 165 ft. apart in a direction parallel to the stream. The towers are 375 ft. in height, and average 75 ft. in diameter, decreasing from 82 ft. at the base to 63 ft. at the summit. Each tower controls a quarter of the water supply to the power plant turbines, to which they are connected by 30-ft. diameter plate-steel pipes installed in 37-ft. and 50-ft. diameter concrete-lined tunnels. Each tower has two cylindrical gate valves, 32 ft. in diameter and 10 ft. high, one near the bottom, and the other about mid-height.

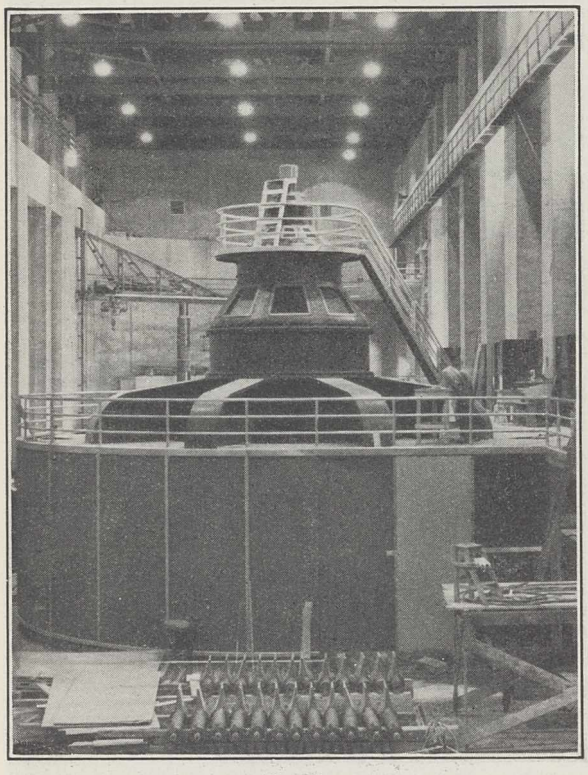


Fig. 3.

82,500 KILOVOLT-AMPERE GENERATOR IN BOULDER DAM POWER HOUSE.

Power development is contemplated to the extent of 1,835,000 rated horse-power. For comparison, it may be mentioned that the total horse-power at Niagara (United States) is 452,500, and at Dnieprostroy (U.S.S.R.) 750,000. A view of the power house is given in Fig. 1 above, and a view of the interior, showing one of the gigantic generators (capacity 82,500 kilovolt amperes) in operation since October 1936, is given in Fig. 3. Four 115,000 horse-power turbines are being installed at the outset, together with a fifth of 55,000 horse-power. The main plant units are unexcelled in magnitude in the world: they have a capacity nearly twice as great as any previously constructed—the nearest approaching them being the 83,000 h.p. turbines and the 76,500 kilovolt ampere generators at Dnieprostroy. The Boulder installation will be complete with fifteen large, and two smaller units about 1940, when about 663,000 horse-power will be continuously available, based on 83 per cent plant efficiency and 10 per cent maximum shortage.

The flow of the Lower Colorado River is an important feature of the project. The greatest measured discharge has been 240,000 cusecs (cubic feet per second) at Yuma, Arizona, but an abnormal flood is believed to have reached 300,000 cusecs for a short period in 1884. At the other end of the scale, the discharge has fallen to 66 cusecs, also measured at Yuma. At the site of the dam, the average discharge is 21,000 cusecs with an average annual run-off of 15,069,000 acre feet.

In addition to power generation, the water from the impounded area is to be used for irrigation purposes. Below the Boulder Canyon reservoir there are some 1,900,000 acres of irrigable land in the States of Arizona, California and Nevada, of which hitherto only 660,000 acres have been under irrigation. There is, therefore, abundant scope for further extensions of supplies of water for irrigation purposes.

Another feature of the project which should not be overlooked is the "All American" Canal, so called because it lies entirely in the United States, while the present Imperial Main Canal is largely in Mexico. The new canal will lead from the Colorado River to the Imperial and Coachella Valleys. The intake is at the Imperial diversion dam, at a site about 15 miles north-east of Yuma, Arizona. The length will be 80 miles to the Imperial Valley, and that of the main canal to the Coachella Valley, 130 miles. A maximum diversion of 15,000 cusecs of water is planned. The canal widths are 232 ft. at the surface and 160 ft. at the bottom, with 20·6 ft. depth. There are only two larger canals in the United States, both ship canals.

The Boulder Canyon Act authorized expenditure up to 165 million dollars (33 million pounds) on the project, of which 70 million dollars is the estimated cost of the dam and reservoir, 38 millions the cost of power development, and a similar sum the cost of the "All American" canal. Up to 1936 about 110 million dollars had been expended.

The photographs illustrating this article have been courteously supplied by the Bureau of Reclamation, Department of the Interior, Washington, D.C., U.S.A., as also, in conjunction with the U.S. Geological Survey, the information on which the article is based.

The Geological History of the Maidenhair Tree and its Allies

By Sir Albert Seward, F.R.S.

IT is probably true to say that *Ginkgo biloba*, the maidenhair tree, is the most interesting and impressive link with the past in the plant kingdom. Does it still exist as a wild tree ? Most botanists would probably answer that far-travelled plant collectors in China have never seen a maidenhair tree growing under conditions in which man was not involved. It would, however, be rash definitely to assert that the question is settled. In 1933, a Chinese botanist, W. C. Cheng[1], after recording the occurrence of *Ginkgo* in certain localities in the Chekiang province, added : "This tree is very common in Tienmu-Shan, growing in association with coniferous and broad-leaved trees. It seems to grow spontaneously in that region." The word "seems" implies a lack of conviction. It may still be true to say that *Ginkgo* would have ceased to exist centuries ago had not man adopted it as an object of religious veneration and carefully tended it in the groves of temples and other favoured places.

This sacred tree is an isolated and primitive type ; the solitary living representative of a comparatively large family distinguished by certain important peculiarities from other families of naked-seeded plants. About forty years ago, *Ginkgo* was removed from its former association with the yew among the Conifers and placed in a separate family, the Ginkgoaceæ, and even in a group of its own, the Ginkgoales. Ginkgoalean trees were formerly almost cosmopolitan ; and there were many genera.

My present purpose is neither to follow through the ages the gradual rise into prominence of the Ginkgoales, nor to attempt a description of the wanderings of the several genera over the world's surface ; it is simply to direct attention to some recent work which has greatly extended our knowledge of ginkgoalean trees in Arctic floras separated in time from the present by at least one hundred million years and more. It has long been known that *Ginkgo* and other members of the family were common trees in arctic lands, and flourished so far north as 80° N. lat. Professor Nathorst of Stockholm, writing in 1911, spoke of fossil leaves of a *Ginkgo* covering the surface of Lower Cretaceous shale in Spitsbergen as completely as the leaves cover the soil beneath a living *Gingko* tree in autumn.

The first contribution to be briefly considered is by Dr. Rudolf Florin of Stockholm, the author of a well-illustrated paper entitled "Die fossilen Ginkgophyten von Franz-Joseph-Land nebst Erörterungen über vermeintliche Cordaitales Mesozoischen Alters"[2]. Some of Dr. Florin's conclusions, which are of minor importance and do not affect the soundness of the work as a whole, may be questioned ; but all botanists who regard the past history of recent genera as worthy of attention will heartily welcome this very valuable contribution from a leading expert in a special branch of palæobotanical research.

We are concerned only with the Ginkgoales. Improvement in methods of examining fossil leaves microscopically has greatly facilitated the discovery of more trustworthy evidence of natural affinity. It is seldom possible to cut microtome sections of petrified leaves or other plant remains, but Dr. Florin has succeeded in doing this with some of the Franz-Josef Land material after treatment with hydrofluoric acid. Petrified plants are relatively rare, and most fossil leaves occur as thin carbonized films on the surface of shale and sandstone. By the employment of a suitable technique, Florin and other palæobotanists have made substantial additions to a more exact knowledge of the histological structure of epidermal layers, which throws welcome light on relationship to recent plants.

Dr. Florin's paper is mainly devoted to an intensive and comparative study of ginkgoalean leaves from rocks of Lower Cretaceous age, approximately contemporaneous with the Wealden beds of south-eastern England. In 1880, Mr. Leigh Smith collected a few fossil plants in Franz-Josef Land : a larger collection was brought to England in 1896 in the steamship *Windward* chartered by the Jackson-Harmsworth Expedition. The plants were partially described in 1897 by Messrs. E. T. Newton and J. J. H. Teall : specimens collected by Dr. Nansen were described by Prof. Nathorst, and others by Graf zu Solms-Laubach. These descriptions have now been revised and greatly supplemented by Florin. The best material was found on the southern coast of the archipelago, where horizontal layers of basaltic lava, thickly covered with ice, overlie a few hundred feet of sedimentary rocks. These early Cretaceous plants afford a striking contrast to the few flowering plants, barely thirty in number, which are now able to withstand the long arctic night. There were trees in those days, and a flora clearly demanding much more genial climatic conditions.

The genus *Ginkgo* was represented by two, possibly more, species : *Ginkgo polaris*, originally described by Nathorst, with small semicircular leaves about 3·5 cm. broad and 2·5 cm. long, more or less deeply dissected into linear or wedge-shaped segments comparable on a smaller scale to the lobed leaves of the maidenhair tree borne on young shoots and seedlings. In venation and in the minute structure of the stomata and other epidermal cells, the arctic leaves closely resemble those of *Ginkgo biloba*. Another closely allied species is *G. coriacea* Florin. Some seeds from the same beds revealed epidermal characters similar to those of the leaves. The most important part

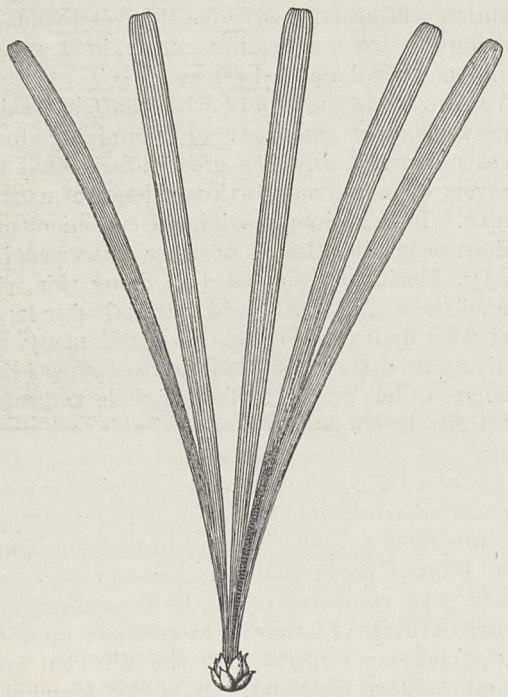


Fig. 1.

Windwardia Crookallii FLORIN. RECONSTRUCTION OF A SINGLE DWARF SHOOT. ¾ NAT. SIZE. AFTER R. FLORIN.

of Florin's paper is the description of other genera of the *Ginkgo* family differing from the maidenhair tree in bearing long and narrow leaves in tufts on very short, deciduous branches surrounded at the base by a few persistent bud-scales (Fig. 1). These deciduous leafy shoots may be compared superficially with the so-called dwarf shoots or foliage-spurs of pines with two, three or five needles : in the ginkgoalean trees the leaves were usually broader and flatter, and more of them on each dwarf shoot.

For the last sixty years, the name *Phœnicopsis* has been widely adopted for specimens of flat, linear, multi-veined leaves borne on very short shoots, or preserved singly. The generic name denotes a certain external form and venation, not a particular anatomical structure. Florin has now been able to assign certain distinctive types of leaves having the external form of species of *Phœnicopsis* to genera founded on anatomical character. One of these genera is *Stephenophyllum*, called after Cape Stephen on the south coast of Franz-Josef Land, where the best material was found. Seven leaves are borne on a diminutive axis surrounded by small, persistent bud-scales : such a shoot is comparable to the short branches of *Ginkgo biloba*, but differs in being much shorter and deciduous. *Stephenophyllum* is assigned to the *Ginkgo* family on the ground of similarity in certain important anatomical characters of diagnostic value. Another genus is *Culgoweria*, named after Culgower in Sutherland, a locality from which some linear leaves of the same form were originally described as a species of *Phœnicopsis*. This genus closely resembles *Stephenophyllum* in habit, but is distinguished by anatomical characters. A third genus, *Windwardia* (Fig. 1), differs from the other two in the absence of secretory ducts and in certain anatomical features. There are five leaves on each dwarf shoot. Among other new genera are *Sphenobaiera* and *Arctobaiera*, represented by leaves having the external form of the old genus *Baiera*, a name used for deeply dissected leaves, in some instances resembling the foliage of *Ginkgo* in outline, but with narrower lobes and without a leaf-stalk. In *Arctobaiera* the leaves were borne in tufts ; some of them are divided in the distal portion into two narrow lobes. The genus *Sphenobaiera*, founded on a piece of leaf with tissues excellently preserved, differs in the greater degree of lobing and in anatomical characters. Another genus represented in the arctic flora is *Czekanowskia*, a world-wide type, characterized by still narrower leaves once or twice deeply forked, borne in bunches on a dwarf shoot.

The important point is that Florin has demonstrated by his skilful handling of the material that the ginkgoalean group was represented by at least six genera in the Wealden flora of Franz-Josef Land. As Dr. Florin says, the genera "show clear affinities to *Ginkgo*, whereas they exhibit such great morphological and anatomical differences in comparison with other recent and fossil gymnosperm groups that no near relationship with them can be assumed".

Additional evidence of the former abundance and variety of trees of the *Ginkgo* family in arctic floras has been furnished by Prof. T. M. Harris of Reading in a series of remarkable papers, published in the *Meddelelser om Grønland* during the last ten years, on the Rhætic flora of Scoresby Sound on the east coast of Greenland (lat. 70° 25′ N.). This exceptionally rich flora affords a most

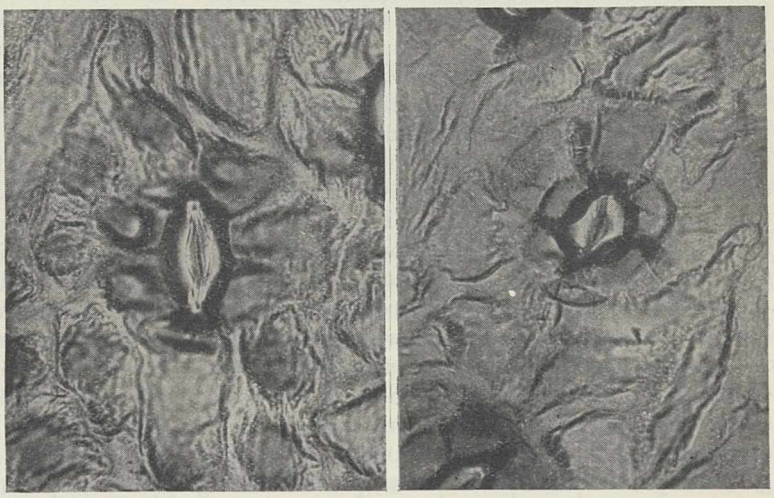
impressive example of the problem of climatic conditions raised by arctic fossil plants. Prof. Harris has been able to distinguish many species of *Ginkgo* (or *Ginkgoites*) by an examination of the epidermal structure of the leaves. He has also described species of *Czekanowskia*, *Baiera*, *Phœnicopsis*, and *Torellia*, a ginkgoalean genus previously recorded from Grinnell Land, still farther north; together with a new generic type which he has named *Hartzia*.

It is noteworthy that several species of these different members of the Ginkgoales recorded from Mesozoic floras north of the Arctic Circle are either identical with or closely allied to species previously described from Europe and the Far East.

The genera already mentioned do not exhaust the list of ginkgoalean trees discovered in Mesozoic floras of the world: we are concerned only with arctic forms.

The two photographs, Fig. 2 (*a*) and (*b*), for which I am indebted to Dr. Florin, illustrate the striking similarity in the stomatal apparatus of a fossil leaf and a leaf of the existing species. In both preparations of the epidermal film there is the same general arrangement of subsidiary cells encircling the stomatal pore. The thick black bands mark the position of strongly cuticularized cell walls. Fig. 2 (*a*) shows the epidermal structure of a leaf of *Ginkgo adiantoides* from Upper Tertiary beds (Pliocene) near Frankfort-on-Main: Fig. 2 (*b*) is from a leaf of *Ginkgo biloba*. The Frankfort leaves and others recorded from Pliocene beds in the Rhone Valley prove the existence of *Ginkgo* in Europe so late as the latter part of the Tertiary period shortly before the beginning of the Great Ice Age. We know that *Ginkgo* was a member of an early Tertiary (Eocene) flora on the basaltic plateau of which the Island of Mull is a detached fragment. The *Ginkgo* leaves from Mull in the Starkie Gardner collection in the British Museum (Natural History) are exceptionally beautiful examples of fossil foliage.

We cannot say with certainty when the *Ginkgo* family first appeared in the vegetation of the world; there is, however, some evidence of its existence as early as the Permian period. We know that it had reached an advanced stage of development before the end of the Triassic period in both the northern and the southern hemisphere. The family continued to occupy a prominent position almost throughout the world in the Jurassic and in the early part of the Cretaceous period. The genus *Ginkgo* persisted as a widely distributed tree well into the Tertiary era.



(*a*) (*b*)

Fig. 2.

STOMA AND ADJACENT CELLS ON THE LOWER SURFACE OF A LEAF OF (*a*) *Ginkgo adiantoides* (UNGER) HEER; (*b*) *Ginkgo biloba* L. × 400. AFTER R. FLORIN.

This brief account may serve to give point to Darwin's description of the maidenhair tree as "a living fossil", and especially to emphasize the fact that this sacred tree is the solitary living representative of a large company of genera which played a conspicuous part in the vegetation of the world through successive geological periods.

[1] *Contrib. Biol. Lab. Sci. Soc. China*, **8**, No. 3, 3 (1933).
[2] *Palaeontographica*, **81** and **82**, Abt. *B*. (1936).

The Nottingham Meeting of the British Association

THE preliminary programme of the British Association meeting at Nottingham has been issued, and is obtainable from the offices of the Association at Burlington House, London, and at Commerce Chambers, Elite Building, Nottingham. The meeting will be held on September 1–8, and Sir Edward Poulton will be the president.

This will be the third time the Association has met in Nottingham. In 1866, the versatile Queen's Counsel and fellow of the Royal Society, William

R. Grove, presided over a meeting there, and in 1893 the president was Burdon Sanderson. On the first occasion, it was necessary to use 'the theatre' for the major meetings; on the second, the Albert Hall was available, and here again, next September, the presidential address will be given. In it, Sir Edward Poulton will review the history of evolutionary thought, as recorded in the meetings of the Association, a subject of very wide general interest, peculiarly appropriate to the Association which maintains Darwin's home as a national memorial, and fortunately chosen by one whose personal relations with the Association have been so intimate, over so long a period, as the president's.

For the rest, practically the whole of the meeting will find a new and very attractive venue in the University College. The old building in the centre of the city was in use in 1893, but now a fine new college occupies a beautiful and even inspiring site three miles from the centre, and here, or in the immediate vicinity, all the sections will meet, the reception room will be established, and many of the visiting members will be housed in the excellent hostels. Lest any who live or will be staying in the heart of the city should fear that the distance of the College will be a drawback, it should be stated that ample means of conveyance will be arranged, and that the city authorities are making generous provision for the free transport of visiting members. The convenience of concentrating so much of the business at a single centre is manifest.

The first evening discourse will be given by Dr. R. E. Slade on the suggestive subject of grass and the national food supply, and the second—arranged too late to be included in the preliminary programme—by Prof. J. Gray, who will deal with the movements of fish. The provision of lectures to the public, which the Association always undertakes if asked to do so, has found a wide welcome, for such lectures have been asked for, and will be given, in Nottingham itself (by Prof. H. Hartridge, on illusions of colour) and in Derby, Lincoln, Long Eaton, Mansfield, and Newark.

The sections already announce a number of principal items in their programmes, of both general and special interest. The full list is too long to detail, but reference may be made to the unusual feature of six sections (Geography, Geology, Zoology, Botany, Agriculture, and Economics) contributing to an evening discussion on planning the land of Britain. An extensive series of excursions and visits is planned. Nottingham itself is a centre of unusually varied scientific interest, in respect of its manifold industrial and historical features, and it commands a district, from Derbyshire on one hand to Lincolnshire on the other, possessing a scenic and economic variety remarkable even in England. A civic reception will be given in Nottingham Castle, and a garden party at the University College.

Occasion is taken to announce in this preliminary programme certain matters not relating to the annual meeting, among them the new activity of the Association in arranging the Alexander Pedler and Norman Lockyer lectures, taken over from the British Science Guild since that institution was incorporated into the Association. The Pedler lecture will be given by Prof. Allan Ferguson in Leicester, in co-operation with the University College in that city, on Monday, May 3, at 8 p.m. The Norman Lockyer lecture will be given in the Goldsmiths' Hall, Foster Lane, London, by kind permission of the Goldsmiths' Company, on Wednesday, November 24, by Dr. R. E. Mortimer Wheeler.

Obituary Notices

Prof. D. A. Low

TO Prof. David Allan Low, emeritus professor of engineering, East London College, University of London, who died on March 24, a host of distinguished engineers, and architects and chemists scattered throughout the Empire are a living memorial. Few men in fact have had greater influence on the technical education of Great Britain by his lectures and by his text-books. Probably the most successful writer of engineering text-books who ever lived, his influence has extended to every university and technical college throughout the English-speaking world.

Prof. Low was extraordinarily patient, rarely angered, amazingly thorough, great beyond words in his efforts to help his friends, a man to whom a man could anchor his affections and loyalty, a man whom it was a privilege to serve, a great engineer. He never said a word against anyone. Perhaps his greatest characteristics were his extraordinary thoroughness and imperturbability. Was not the great success of his students in after-life are flection of these characteristics ?

On his seventieth birthday, a banquet and presentation was held in his honour by a large number of old students, and on February 9 last—his eightieth birthday—some of his intimates dined together at the "Cheshire Cheese". It was one of those simple, informal, unforgettable occasions, with everyone in perfect harmony inspired by an abiding affection.

The quality of those men and the affectionate intimate speeches were an ample testimonial of the worth of "Daddy Low".

Prof. Low's early general education was received at the High School and West End Academy, Dundee. During apprenticeship, he attended evening classes for science and technical subjects and afterwards studied at Owens College, Manchester, and the University of Glasgow. Altogether he spent seven years in engineering workshops and drawing offices before taking up a lectureship in engineering at Allan Glen's Institution, Glasgow. He was headmaster of the Day Technical School for Boys at the People's Palace, London, a school which set a high standard to technical education never surpassed. For twenty-six years he was professor of engineering in East London College, University of London.

Many very successful text-books stand to Prof. Low's credit, dealing with machine drawing and design, practical geometry and graphics, engines and other engineering topics. Most of these books, which are singularly free from mistakes, have seen many reprints. His "Heat Engines" took about five years to write. He loved his book writing and was never satisfied until he had everything as perfect as he could make it. As the result of this meticulous care, most of his books are as good to-day as when they were written.

For many years, Prof. Low was greatly interested in the theatre and opera, went to many 'first nights' and particularly to his favourite place of entertainment, the "Old Vic". He was very fond of travel, went to Canada and the United States four or five times, the last time being in 1932 with the Institution of Mechanical Engineers, of which he was one of the oldest members. Since his retirement he made eight or nine trips in the Mediterranean with his wife, and did a good deal of motoring with two devoted daughters.

On his last day, Prof. Low smoked two cigars—his great luxury, the gift of his old students—went to bed in the library where his books were written. At 11.30 p.m. he was sleeping peacefully, at 12.30 a.m. he had ceased to sleep. To Mrs. Low and her family his old students unite in deepest sympathy. They will never cease to hold him in grateful memory and abiding affection. He will ever remain an inspiring example to British engineers.

Mr. Adolf Gallenkamp

ADOLF GALLENKAMP, whose death at the age of eighty-eight years occurred on February 26, founded the firm which bears his name about fifty years ago. He was a shrewd observer, and foresaw that a wider recognition of science in academic and industrial circles in Great Britain was inevitable. In conformity with this view, he devoted the early part of his business career to the provision of apparatus for schools, of a better and more varied type than that previously in use. The success achieved in this direction led him to extend his work to higher educational institutions, and he found a special field in the technical colleges and polytechnics which were being established in different parts of the country. Later, he extended his activities to the special requirements of industrial laboratories and the medical and other professions, and always strove to provide the latest and best types of apparatus.

Mr. Gallenkamp frequently visited laboratories in other countries in search of new ideas, and always welcomed suggestions from those who had dealings with him. He was a diligent reader of scientific publications, from which he frequently extracted information which enabled him to improve on many of the instruments then in use. His time was so completely occupied in his business that he was unable to take an active part in the work of scientific bodies in London, and few to whom the name of his firm was well known were personally acquainted with this genial and gifted man, whose face bore a striking resemblance to that of Victor Hugo. He gathered round him a staff of competent men who shared his enthusiasms, and had the satisfaction of seeing his business grow from a very humble beginning to one with a world-wide connexion.

All scientific men recognize the debt they owe to those who provide the instruments upon which the quality and quantity of their work so largely depend, and amongst the many who have contributed in this way to the advancement of science, the name of Adolf Gallenkamp will be honoured by all those who knew or had dealings with him. C. R. D.

WE regret to announce the following deaths :

Dr. Katharine J. Bush, formerly of the Zoological Department of the Peabody Museum, Yale, known for her work on annelids, molluscs, and other marine invertebrates, on January 19, aged eighty-one years.

Prof. H. Bechhold, director of the Institute for Research in Colloid Chemistry at Frankfort-on-Main, known for his work on colloids in biology, on February 18.

Mr. J. W. Capstick, fellow of Trinity College, Cambridge, on April 27, aged seventy-eight years.

Dr. A. H. Church, F.R.S., formerly University lecturer in botany, Oxford, on April 24, aged seventy-two years.

Dr. Milton J. Greenman, director of the Wistar Institute of Anatomy, Philadelphia, an authority on the nervous system, on April 7, aged seventy years.

Major J. Herschel Hardcastle, an authority on small arm ballistics, on April 21, aged sixty-six years.

Dr. T. G. Macaulay Hine, O.B.E., known for his work on pathology, especially cerebrospinal fever, on April 25, aged sixty-six years.

Prof. Enrique Paschen, formerly director of the Vaccination Institute of Hamburg, an authority on smallpox and vaccination, aged seventy-five years.

Prof. Julius O. Stieglitz, professor of chemistry in the University of Chicago, known for his work in organic chemistry, on January 10, aged sixty-nine years.

Prof. W. M. Wheeler, professor of entomology in Harvard University, on April 19, aged seventy-two years.

News and Views

Prof. T. G. B. Osborn

THE Sherardian chair of botany in the University of Oxford has been filled by the appointment of Prof. T. G. B. Osborn, at present professor of botany in the University of Sydney. Prof. Osborn graduated in 1908 in the University of Manchester with first-class honours. His exceptional abilities were recognized by his immediate appointment to a lectureship in economic botany in Manchester which he held until 1912, when he was elected professor of botany, vegetable pathology and parasitology in the University of Adelaide. The excellence of his teaching and the energy with which he threw himself into his academic work is attested by the fact that when he left Adelaide in 1927, large and commodious laboratories had been built as well as an experimental greenhouse. While in Adelaide, Osborn acted as consulting botanist to the Government of South Australia and in furtherance of the pastoral interests of the country he established a field laboratory at Koonamore, some two hundred miles north of Adelaide, where he and his assistants could study the vegetation of an arid region and make useful suggestions to the grazing interests. Certain pastoralists interested in this ecological work which Prof. Osborn was carrying on presented an area of 1,200 acres to the University to extend these investigations.

IN 1927, Prof. Osborn was appointed to the vacant professorship in Sydney, and here, too, the number of the botanical students soon increased and necessitated laboratory and greenhouse extension. In addition to his academic work, Osborn was asked by the Commonwealth Council for Scientific and Industrial Research to review the botanical work in progress in the various universities and other research institutes in Australia, and in 1927 he was appointed adviser to the Council and was offered the directorship of the Division of Plant Industry; but he preferred to continue to devote himself to teaching and research. As an investigator, Osborn, in spite of his heavy teaching and administrative work, has been continuously active. His earlier published researches dealt with mycology and morphology, but since he has been in Australia he has devoted himself largely to ecological work. Not only has he made valuable contributions to the ecology of the arid regions of South Australia, but also more recently he has devoted some attention to forest problems in New South Wales, and journeys in Australia and elsewhere have given him a wide outlook on ecological problems. Since the Biology Board at Oxford has indicated that an ecologist would be most suitable for the Sherardian chair, the selection of Prof. Osborn would seem a most suitable one.

Dr. John Louis Tiarks, F.R.S. (1789-1837)

THE report of the council of the Royal Astronomical Society read at the eighteenth annual general meeting contained an appreciation of the services rendered by Dr. John Louis Tiarks, who died on May 1, 1837, at Jever, Germany, his native town. Born in May, 1789, Tiarks had been educated at the University of Göttingen and in 1810 came to England, and was given a post in the library of Sir Joseph Banks. His knowledge of mathematics and astronomy led to his being appointed British astronomer to the commission appointed under the Treaty of Ghent of 1814 to settle the American Boundary Line, the United States at the same time appointing Ferdinand Rudolph Hassler (1770–1843) as their representative. The survey of contested points was carried out, but certain matters were referred to the King of the Netherlands for decision. His views, however, did not prove acceptable to the United States, and even in 1838 an extent of 10,000 square miles remained disputed territory. On his return to England, Tiarks was entrusted by the Admiralty with several important scientific missions. In 1822 he determined the position of Funchal by means of fifteen chronometers sent from Greenwich to Madeira. He afterwards made observations at Dover, Falmouth and Portsmouth, bringing to light errors in the trigonometrical survey. In 1825 he made other observations in the North Sea in H.M. Steam Vessel *Comet*, on which occasion Sir Humphry Davy accompanied him in order to make observations on the compass. He left Great Britain in March 1835, and in the spring of 1836 was struck down by paralysis from which he never recovered.

Regulations for German Scholars Travelling Abroad

THE following is a translation of an extract from a decree of the German Minister of Education entitled "Foreign Travel by University Teachers and Students" and dated December 24, 1936, recently received at NATURE office: "It has frequently been observed of late that Germans and especially professors and students, when travelling abroad for cultural or scientific purposes, have failed to establish contact with their local national official representatives. Such contact is specially important in countries where Jews occupy a predominant influence in cultural affairs, and where emigrants seek to press into the foreground in questions concerning German cultural life. In these countries it is particularly necessary that German national guests, local or official, shall be informed of these local relationships by the official national representatives abroad. I therefore order that all under control of my Ministry who travel abroad for study, research or lectures, or

for congresses or similar purposes, shall on their arrival in a foreign country forthwith get into contact with the competent local representative of Germany, with the Foreign Organization of the Nazi Party and with the branch office of the German Academic Exchange Service, whenever possible. If this be not done, a short report of the reasons must be furnished to me. I take this opportunity to point out that previous decrees concerning foreign journeys are still not always obeyed by all concerned. For example, news of a proposed journey abroad by persons under control of my Office often reaches me first through the German Centre for Congresses. This results in delay, and the person involved not only risks refusal of the necessary foreign exchange, but is also acting in defiance of my orders. I therefore hereby order all controlled by my Office to obey in every detail the Decree on Foreign Travel, and to lay before me, through the official channels, any applications for permission to travel abroad."

German Refugees at the University of Istanbul

MANY former members of staffs of German universities and other institutes have, as is now well known, either been forced to leave or have voluntarily vacated their posts, for political, racial and other reasons. Some have obtained analogous posts in the universities of countries outside Germany, and we have recently received a list of those who are now working at the University of Istanbul. Among these are Prof. H. Winsterstein (physiology), Prof. M. Brauner (botany), Prof. M. Dember (physicist), Prof. M. von Mieses (mathematics), and nearly thirty others, most of whom have been appointed to chairs in the University of Istanbul. Prof. M. Freundlich, who is at present professor of astronomy, leaves at the end of the academic year for the University of Prague, and Prof. F. Dessauer, professor of röntgenology, is going to the University of Fribourg, Switzerland.

Broadcasting and the Coronation

CORONATION day, May 12, is likely to mark an interesting and notable event in the history of radio communication, for it will witness the most complicated outside broadcasts yet undertaken by the British Broadcasting Corporation. The arrangements for the sound programme were explained in the issue of the *Radio Times* of April 23, while some details of the means to be adopted for televising the Coronation procession were given in *World Radio* of the same date. On the sound side, apart from the arrangements necessary for the home and Empire programmes, the B.B.C. is providing facilities for about a dozen foreign observers to broadcast commentaries in their own languages direct to their own countries. Two separate control rooms will be established, one at Westminster Abbey for the British programmes and the other at the Middlesex Guildhall for the foreign commentaries. In addition to supplying all the B.B.C. transmitters, the 'home' programme will be distributed to loud-speakers within the Abbey and to others on some of the stands along the route followed by the procession. By this means, a large number of the public will be enabled to follow the progress of the procession and to hear the service in the Abbey. At the foreign control room, provision is being made for ten separate commentaries in different languages to be fed by land-line to the International Trunk Exchange of the British Post Office, whence the programmes will be distributed to the countries concerned. Some 472 miles of special wiring are involved in the whole installation, which is being carried out by the General Post Office in co-operation with the B.B.C. Engineering Division. This one outside broadcast will involve the use of fifty-eight microphones, and, not least among the technical difficulties, is the necessity of rendering the installation of these as inconspicuous as possible, particularly inside the Abbey.

ON the television side, May 12 will go down in history as the first day on which the direct television of a remotely controlled outside programme has been attempted from the London ultra-short-wave station. For this purpose, the Post Office has installed a special co-axial cable, connecting the Alexandra Palace transmitter with Broadcasting House and the observation point at Hyde Park Corner. In addition, and as a stand-by service, the B.B.C. will use a van equipped with an ultra-short-wave transmitter for feeding the programme to Alexandra Palace. The observation point at Apsley Gate, Hyde Park Corner, was selected on account of its having a combination of several advantages. The afternoon sun had to be behind the 'cameras' and preferably on the objects to be televised; on account of the small receiver screen, the site must allow close-up views on a level with the windows of the royal coach; at the same time, the site must permit an extensive view of the procession as a whole; finally, and not least important, the apparatus must be remote from the huge crowd of the general public. At this site, three 'cameras' will be used for converting the visible scene into the high-frequency electrical currents to be passed along the cable: one of these 'cameras' will be near the main arch at a height of five feet above the pavement; the second will be about ten feet above ground-level and will be used for viewing the crowd and the approach of the procession to within a few yards; the third will be on the other side of the arch and used for following the procession as it disappears towards Constitution Hill. A separate circuit with microphone will be used for providing the sound commentary to this programme. Much of the apparatus to be used on this occasion will be new and untried except on an experimental basis, while very special conditions will prevail on Coronation day itself. The occasion will, however, most decidedly mark the beginning of a new era in television.

British-American Understanding

SIR FREDERICK WHYTE presided over a discussion, held on March 4 under the auspices of the English-Speaking Union, on "The Contribution of British Schools, Universities and other Educational Bodies to British-American Understanding". The discussion

was opened by Mr. J. Wickham Murray, who outlined some of the work of the Union in developing contacts between Britain and America. He specially stressed schemes such as the Page Scholarships scheme for men and women teachers, reciprocal scholarships under American direction, exchange of school boys and school masters and mistresses, and assistance given to visitors in both countries. He indicated, however, that the Union desires now to widen its work and to face the greater responsibilities which the present state of the world suggests it should undertake. To that end it has formed a Research and Discussion Committee, which is seeking the advice and guidance of experts in such fields as foreign affairs, economics, the Press of both countries, and general relationships such as would arise as a result of neutrality legislation and American grievances against British policy. Already meetings of experts in these matters have been held, and, at every meeting, the importance of closer attention to matters of education has been stressed.

MR. WICKHAM MURRAY added that, in thinking it important for British students at school and university to get an accurate picture of English-speaking countries, the Union believes that because of similarities in our joint democratic institutions, experiments in those countries might be of greater relevance to Britain than experiments in such very different countries as Soviet Russia, Italy or Germany. In asking the meeting to consider what might be done to improve the contribution of British educational bodies so far as an understanding of problems in English-speaking countries is concerned, he raised the question of possible changes in examination syllabuses, special facilities for providing books on American and Dominion history and affairs, the increase of scholarships and fellowships, and the introduction of special courses on the subject into curricula.

MR. H. G. WELLS, president-elect of Section L (Education) of the British Association, who contributed to the discussion, thought there will be no peace in the world until education has been recast into a common basis of understanding throughout the world. He had little confidence in what has been called 'scientific' American, British, or other history. There is but one history—the history of mankind. The world is involved in great issues of human ecology and of economics, but little of these things is taught. He said that we shall have to realize—and it will be a wrench—that much of the history at present taught is stale, unprofitable and out of date. British people are curious about America. They devour American publications ; they patronize American films ; they are learning to think and speak American ; but they are not interested in the history of the Constitution or local points of pre-Civil War days. The public is willing to react against limited histories and get into general understandings, but the schools hold up this natural development towards the human understanding of the world.

The National Maritime Museum

THE National Maritime Museum, opened by H.M. the King on April 27, is a notable addition to the public galleries of Great Britain. Housed in a building with historic associations from which can be seen on one side Greenwich Park and the Royal Observatory and on the other the Royal Naval College and the Thames, the Museum will make an appeal to all who take an interest in the history of naval affairs, the growth of the British Empire and the lives of great British seamen of the sixteenth, seventeenth and eighteenth century. It has come into existence through the enthusiasm of the members of the Nautical Research Society, the munificence of Sir James Caird and finally the passing of the National Maritime Museum Act of 1934. The buildings it occupies include the Queen's House finished three hundred years ago, and the wings erected during the nineteenth century when the place was used for the Greenwich Hospital School, now removed to Holbrook, Suffolk. After restoration by the Office of Works, both the Queen's House and the other buildings have been turned into galleries, which now contain the most magnificent series of sea pictures in existence. In addition to the portraits, seascapes, and battle scenes, the great Macpherson collection of prints, drawings, etc., there are beautiful models of ships of the various periods, collections of navigational instruments and a spacious library. No attempt so far has been made to illustrate the great revolution in maritime affairs during the nineteenth century or the historic events of more recent times, but these no doubt will be taken into consideration in due course. The thanks of the whole community, no less than those of students of maritime affairs and of marine art, are due to Sir James Caird, who has made the nation his debtor by the support he has given to the formation of the museum.

The Newcomen Society

ON April 21, simultaneous meetings of the Newcomen Society took place in London and New York, when two papers were read. The first of these was by Dr. A. Raistrick, and was entitled "The Steam Engine on Tyne Side, 1715–1778" and the second was by Prof. J. W. Roe on "Interchangeable Manufacture". Dr. Raistrick's paper was based on the records preserved by the North of England Institute of Mining Engineers, Newcastle-upon-Tyne ; these records consisting largely of "View books" compiled by the colliery 'viewers', the forerunners of the present-day mining engineers. The reports of the 'viewers' contain much information as to the flooding in the mines and the cost of the engines and the pumping. By means of the various papers, Dr. Raistrick has been able to trace the erection of no fewer than 104 'fire engines' built between 1733 and 1778, before the improved engines of Boulton and Watt came on the scene. A rough figure for the first cost of an engine with a 33 in. cylinder was about £1,200 and the annual cost of working it £400. Though 13 engines were built between 1715 and 1733, all of the Newcomen type, it has been impossible to

trace any connexion with them of Newcomen or of the "Proprietors of the Invention for Raising Water by Fire" who had exploited the engine. The paper was accompanied by a valuable map of the coal field showing the sites of the engines. In Prof. Roe's paper it was shown that interchangeable manufacture had begun with firearms early in the nineteenth century and had afterwards spread to clocks, watches, sewing machines, bicycles and motor-cars. Of all the products of modern industry, the motor-car has pushed interchangeable manufacture furthest, and to the benefit of the widest public.

Low Temperature Carbonization Plant

THE recent opening by the Duke of Kent of a new plant erected near Chesterfield by Messrs. Low Temperature Carbonisation Ltd. has once again directed public attention to the commercial possibilities of carbonizing coal at comparatively low temperatures (about 600° C.). This method of treating coal has as its main product a smokeless fuel which can readily be burned in any open grate, and in consequence is a valuable contribution towards a solution of the important problem of reducing atmospheric pollution. In addition, the process yields as by-product a tar from part of which a fuel suitable for use in Diesel engines can be prepared and a motor spirit of high antiknock value. The tar is also amenable to treatment by hydrogenation for the production of further motor spirit if desired. In view of a possible national emergency, there is a tendency, particularly among those not acquainted with all the relevant details, to stress the value of low temperature carbonization as a source of home-produced motor spirit. It is, therefore, well to bear in mind that although any method of producing oil or spirit from coal is of national importance, the spirit is in this case only a by-product, and that even if all the tar were hydrogenated to produce additional motor spirit, the total yield would be extremely small when compared with the quantity now imported.

Centenary of the University of Athens

THE University of Athens is the richer to-day by the congratulations of the world of learning on its centenary. Elaborate celebrations have marked this event, which was enhanced by the active participation of H.M. the King of Greece, members of the Government, of the Church and of the Services, the French Minister of National Education, and 150 delegates representing eighty foreign universities. Eloquent addresses, official receptions, musical festivals and classical performances added to the splendour of the occasion. During the past hundred years, the University of Athens has grown from a small establishment with fourteen students, to a mighty seat of learning with nearly ten thousand students of both sexes, an imposing list of professors, and manifold extensions, laboratories and institutes as additions to the original faculties. Parallel with the development, learning has found in Athens the old spirit which made the town famous throughout the classical and Byzantine periods. To-day, science and letters are steadily pursued by a band of investigators who have made substantial contributions to knowledge. To give just one example, mathematicians are familiar with the names of Hatzidakis, Zervos, Sakellariou and Eginitis. Even the history of science is represented by Prof. Stephanidis, who has many important monographs to his credit. If the English language and literature were not hitherto adequately represented, the omission has been made good by the creation of a Byron chair, which was announced as a gift of Great Britain to the most ancient seat of learning of Western civilization.

Witchcraft in Bechuanaland

WIDESPREAD interest has been aroused by the trial for witchcraft of Bagakgametsi, the former wife of Tshekedi, son of Khama, and regent chief of the Bamangwato tribe. This chief, it will be remembered, earned notoriety a little while ago for inflicting punishment on a white man, as it was held, illegally, and was deprived of his chieftainship in consequence. In February 1936 he married his cousin, Bagakgametsi, but secured a divorce from her on March 7 of this year. She is now twenty-seven years old, and was described by Sergeant Lewis, the prosecutor in the present case at Serowe, as "an educated woman". With her were accused two men, who are described as witch-doctors. The offence alleged was "practising witchcraft calculated to injure the Queen-Mother, Semane"; but it was asserted in evidence, as reported, that Bagakgametsi herself was in fear, or stated that she was in fear of witchcraft by the Queen Mother, and consulted her two co-defendants to verify her suspicion and secure protection. One witch doctor in giving evidence in defence stated that he blew on a horn and threw the bones—the usual divinatory procedure in such cases—and said, "If Semane is bewitching Bagakgametsi she should die from blood". He added that Semane would die within two months. The other witch doctor said that the woman came to him for medicine and said she was afraid that Semane, who was jealous of her, would kill her. On the other hand, it was alleged by the prosecution that Bagakgametsi had asked one of the men for a poison root to get rid of the Queen Mother so that she alone should share Tshekedi's power. The verdict was "guilty", and a fine of £50, or twelve months imprisonment was imposed. The case is interesting as illustrating the strong hold of a belief in witchcraft on this people, even among the more enlightened, as well as the illogical working of the attempt to suppress the belief, which concentrates on the witch doctor, who though in many instances undoubtedly fraudulent, is at least working against an anti-social force which in such circumstances as these goes free. The British code, however, does not recognize witchcraft as such.

Synthesis of Large Molecules

AT the Friday evening discourse at the Royal Institution on April 23, Prof. H. Mark discussed "The

Synthesis of Large Molecules". In Nature, all organized objects consist of large molecules. The great importance of the natural highly polymerized substances has led to the conclusion that very valuable mechanical and physiological behaviour is associated with these macro-molecules. Therefore the industries concerned with synthetic rubber, artificial silk and synthetic resins have worked out a number of synthetic high polymers, which are, in fact, of great use in making insulators, fibres and solid materials of high resistance and valuable properties. It appears that the kinetics of polymerization reactions is very complicated, but one can already distinguish three main processes which play an important role in every polymerization reaction. First a nucleus of high reactivity must be built. This can be done by a thermal collision of high energy, or photochemically, or by means of a catalytic agent. The production of these nuclei requires a high activation energy, and is therefore rather slow. The nuclei react quickly with the molecules of the monomeric substance and grow with rather high velocity stepwise to a chain. The activation energy of the growing reaction is low (about 5,000 cal./mol.) and therefore the probability of the growth is large. The chains would grow infinitely if there were not break-up reactions of different kinds. There is the possibility that the growing of the chains may be ended by lack of monomeric substance; it is possible that the decreasing steric factor of the association reaction may diminish the velocity of chain growth to a very low rate, and one must consider that different side-reactions may break up the chains suddenly. In the case of styrene, we have succeeded in distinguishing these three different stages and developing a reaction mechanism which seems to be in fair agreement with the experimental data.

Recent Acquisitions at the Natural History Museum

AMONG recent additions to the Zoological Department at the British Museum (Natural History) is a specimen of the pigmy scalytail of West Africa received from the Basle Museum. The Department has also acquired a large number of small mammals and birds from Yugoslavia collected by Mr. V. Martino. This collection, comprising a number of new forms, is of considerable scientific importance and will help to fill one of the chief gaps in the study collections of mammals and birds. An important purchase for the Department of Entomology is the remainder of the Fruhstorfer collection of butterflies. 13,799 specimens, comprising the Lycænidæ and Hesperiidæ, were purchased by the Trustees in 1933, and a small section of the collection (the oriental Nymphalidæ) have in the interval been sold to the Paris Museum. The balance now acquired consists of 48,677 specimens, of which about 3,000 are the actual specimens upon which the original descriptions of the species were based. The Mineral Department has been given by Mr. J. D. Hague a specimen of native gold in beautiful bright crystals, from the North Star mine, California. Mr. Felix F. Wilson has presented a small collection of gold which has been picked up from burns at Leadhills, in Lanarkshire, by the late Mr. Thomas Newbiggin, who was for many years engaged in mining there. A magnificent, clear blue, step-cut, flawless blue topaz, 614 carats in weight, from Brazil has been bought. Owing to the easy cleavage of this mineral, it is seldom that a coloured stone of this size is so free from flaws.

Fourth International Grassland Congress

THE fourth International Grassland Congress is to be held in Great Britain on July 8–23 under the presidency of Prof. R. G. Stapledon. The paper-reading sessions will be held in Aberystwyth on July 14–18. Before and after these sessions, delegates will be shown the leading types of grassland in Great Britain, in a tour from Oxford to Aberystwyth and from Aberystwyth to Edinburgh. Fifteen plenary papers are to be presented to the Congress by delegates from Great Britain, Sweden, Germany, Italy, Finland, United States, Canada, Australia, New Zealand and South Africa. The remaining papers will be read to sectional meetings of the Congress, which will deal with the following aspects of the grassland problem: (1) grassland ecology, (2) seeds mixtures, (3) plant breeding and seed production, (4) fertilizers, (5) nutritive value and fodder conservation, and (6) pastures. Full details regarding plans for this Congress and a list of all papers to be presented are obtainable from the Joint Secretaries, Fourth International Grassland Congress, Aberystwyth. Particular attention is directed to the closing dates for receipt of applications (May 15 and June 19, according to the option selected).

The Parliamentary Science Committee

THE latest addition to the constituent bodies of the Parliamentary Science Committee is the British Institute of Radiology. For some time past the Committee has been engaged in investigating how the Patent Office Library could be brought up to date in such a manner as to serve the interests and convenience of the public who make use of that Library. The British Science Guild undertook a similar inquiry some years ago, and the Parliamentary Science Committee made its report the starting point for the investigation. A report has been completed, and the Parliamentary Science Committee has been in communication with the Chartered Institute of Patent Agents. Dr. Leslie Burgin, M.P. (Parliamentary Secretary of the Board of Trade), has now consented to receive a deputation from the Parliamentary Science Committee on the subject on May 3. The deputation will be introduced by Sir Arnold Wilson, the chairman of the Committee, and it will include two or three members of parliament who are also members of the Committee.

The Mellon Institute

THE new building of the Mellon Institute, Pittsburgh, will be dedicated on May 5–9. At the formal dedication of the building in the afternoon of May 6

in Carnegie Music Hall, with Dr. Weidlein presiding, addresses will be given by three Nobel prizemen, namely, Dr. Irving Langmuir (chemistry), Dr. H. C. Urey (physical chemistry), and Dr. W. P. Murphy (medicine). Brief addresses will also be given by Andrew W. Mellon and Richard K. Mellon, representing the founders. A symposium on "Recent Progress in Science" will be held on May 7. Speakers will include Dr. G. O. Curme, jun., Dr. F. B. Jewett, Sir Frederick Banting and Dr. W. W. G. Maclachlan. The new building, which has taken six years to complete, is to be dedicated to science and humanity in honour of Andrew W. and Richard B. Mellon, founders of the institution, who in 1911 gave support to the research fellowship system advanced by the late Robert Kennedy Duncan by establishing a specific department at the University of Pittsburgh, and in 1913 placed the system on a permanent basis with the organization of Mellon Institute.

Discharged Soldier Settlers in New Zealand

ACCORDING to the report of the New Zealand Department of Lands and Survey on Discharged Soldiers Settlement for the year ended March 31, 1936, a further twelve applications for land were received during the year, seven of which were granted, making a total of 4,093 allotments, covering 1,440,818 acres in the twenty-one years the Act has been in force. A grand total of 1,452,829 acres has been proclaimed for this purpose since the inception of the scheme. Loans authorized during the year numbered 719, involving an amount of £66,517. Reports from the District Commissioners of Crown Lands indicated that the soldier settlers, most of whom are engaged in dairy farming or sheep farming, have had a better year, although those engaged in orchards again had a poor season owing to inclement weather.

Rockefeller Foundation China Programme

THE Chinese Mass Education Movement, the Colleges of Public Affairs and Natural Sciences at Yenching University and the Institute of Economics of Nankai University received aid from the Rockefeller Foundation during 1935. In the part of the China programme centring round Nanking in south China, support was extended to the national health administration; to the Commission on Medical Education, and to three institutes interested in agricultural development; to the University of Nanking for its departments of agricultural economics and science; the National Central University for work in animal husbandry and veterinary preventive medicine; and the National Agricultural Research Bureau for insect control work. Local fellowships in China granted by the Foundation numbered 140.

Maintenance of Isothermal Chambers

AT the Institution of Electrical Engineers, Savoy Place, W.C.2, on May 5 at 6 p.m., Mr. L. B. Turner, a well-known radio-physicist of Cambridge, will present a paper describing a method he has devised of keeping a mains-operated isothermal chamber at a temperature constant to one thousandth of a degree centigrade. Although designed for a specific engineering application, it is likely to prove of interest to biological research workers and they are invited to attend the meeting. Biologists are specially interested in the maintenance of extremely constant temperatures; for minute changes of heat production in living tissue, detected by thermocouple, have been used as an index of vital process; and these changes can be measured only when the body under examination is protected from temperature fluctuation imposed from outside.

Conference on Large High Tension Systems

THE International Conference on Large Electric High Tension Systems will be held in Paris on June 24–July 3. It was established in 1921 with the sole object of studying the problems connected with the high-tension transmission of power. The organization and interpretation facilities will enable anyone speaking English to profit fully by the work of the Congress. An attractive programme of visits and excursions has been arranged and special terms are offered by many of the hotels and railways to registered members of the Congress. Further details may be obtained from the Secretariat, Avenue Marceau, 54, Paris, or the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Travelling Fellowships in Medicine

THE Medical Research Council invites applications for six Rockefeller medical fellowships for the academic year 1937–38. They are intended for British graduates who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and who are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. The Council also invites applications for four Dorothy Temple Cross research fellowships in tuberculosis. The object of these fellowships is to give special opportunities for study or research to suitably qualified British subjects of either sex "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". Further information and forms of application, returnable not later than June 1, are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Royal Aeronautical Society Awards

ON April 26, Mr. H. E. Wimperis delivered his presidential address to the Royal Aeronautical Society on the subject of the natural limits to human flight, and the following medals and awards were presented: Society's Gold Medal to the late Señor J. de la Cierva, for his work on the development of the autogiro; Society's Silver Medal to F. W. Meredith, for his work on the automatic pilot; Society's Silver Medal to P. A. Cooke, for his work on the automatic pilot; British Gold Medal for Aeronautics to A. Gouge, for his achievement in the development of

flying boats; Simms Gold Medal to Dr. H. J. Gough, for his paper "New Light on the Strength of Materials afforded by Modern Physics"; Simms Gold Medal to W. A. Wood, for his paper on "New Light on the Strength of Materials afforded by Modern Physics"; Taylor Gold Medal to Dr. G. P. Douglas, for his paper on "Cooling Problems with particular Reference to the work of the 24 ft. R.A.E. Tunnel"; Edward Busk Memorial Prize to Mr. G. H. Dowty, for his paper on "Retractable Undercarriages"; Pilcher Memorial Prize to H. Leaderman, for his paper on "The Fundamentals of Boundary Layer Theory with Some Applications to Aircraft".

Current Sunspots

AFTER some weeks of only moderate solar activity compared with the great activity shown from about last November until January, the recent appearance of an extensive active area of the sun may be noted. There are three chief groups of spots, one of them showing a rapid development from April 19, when the total area was only about 50 millionths of the sun's hemisphere, to April 22 when the area had increased to 1,750 millionths. Particulars of the groups of spots are as follows:

Date on Disk	Central Meridian Passage	Maximum Latitude	Maximum Area
April 15–28	April 22·4	10° S.	650
,, 16–29	,, 23·2	25° N.	900
,, 18–30	,, 24·6	19° N.	1750

Bright hydrogen eruptions were observed in association with the largest group on April 21 between 11^h and 12^h and 15^h–16^h U.T., whilst a series of small but very bright eruptions occurred on April 23. Another bright eruption, more extensive than any of these, was observed at Greenwich on April 25 between $8\frac{1}{2}^h$ and $11\frac{1}{2}^h$. Two magnetic storms were recorded at Greenwich beginning on April 24 at $12^h\ 0^m$ and on April 25 at $15^h\ 45^m$. For the first storm, the ranges in declination, horizontal force and vertical force were 46′, 275γ and 145γ respectively, and for the second (up to April 26 10^h) 30′, 310γ and 105γ respectively. The second of these storms would seem to be related to the display of aurora reported by Mr. E. L. Hawke in *The Times* of April 27 as seen on April 25 from the Chiltern Hills.

The Night Sky in May

DURING the month, the duration of night decreases in the latitude of London by nearly $1\frac{1}{2}$ hours. The moon is new on May 10 at $13{\cdot}3^h$ and full on May 25 at $7{\cdot}6^h$, when a penumbral eclipse takes place. The greatest altitude of the moon at meridian passage (61·2°) is on May 12, and the least altitude, 15·9°, on May 26. Venus is a morning star rising just over an hour before the sun; on and about May 24 the planet is at its greatest brilliancy (magnitude −4·2). Conjunction with the moon occurs on May 8 at 15^h. On May 11 at 11^h, Mercury is in inferior conjunction with the sun, and a partial transit (invisible from Great Britain) of the sun's disk occurs the same day between $8\frac{1}{2}^h$ and $9\frac{1}{2}^h$. The planet Mars is conspicuous low down in the night sky and souths about midnight in the middle of the month. On May 19, Mars is in opposition, and nearest to the earth on May 28, when the apparent diameter of the planet is $18\frac{1}{2}''$. On May 24 at 18^h, there is a conjunction with the moon, Mars being 0·6° northwards. Jupiter is a morning star of about mag. −2·0 in Sagittarius. Saturn rises in the dawn and can only be located with difficulty. About May 5, the maximum of the η Aquarid meteors occurs, the radiant being at R.A. $22^h\ 32^m$; Dec. −2°, and on May 24 that of the Herculids, the radiant of which is at R.A. $16^h\ 36^m$ and Dec. +30°. Approximate positions for Comet Whipple (1937*b*) are given by Möller's ephemeris in I.A.U. Circular No. 653, as follows:

Date	R.A.	Dec
May 3	$14^h\ 21{\cdot}9^m$	+60° 28′
,, 7	22·7	60 18
,, 11	23·7	59 58
,, 15	25·0	59 29
,, 19	26·5	58 49

All times in this note are in U.T.; add 1^h to convert to Summer Time.

Announcements

THE proceeds of the Daniel Pidgeon Fund for 1937 of the Geological Society of London have been awarded in equal proportions to Dr. G. F. Claringbull, who proposes to investigate the geology and petrology of the Ross of Mull granite, and Mr. F. W. Cope, who proposes to map the central region of the Derbyshire dome, and to correlate the Lower Carboniferous rocks of the area with those of North Wales, Westmorland, and the type section of the Avonian.

PROF. GEORGE R. MURRAY, emeritus professor of medicine in the University of Manchester, has been made a member of a Departmental Committee appointed by the Home Secretary to consider the question of compensation for card-room and other workers in the cotton industry disabled by respiratory diseases.

DR. JOHN B. GRANT, of the Rockefeller Foundation, was recently decorated by the National Government of China on the occasion of the New Year with the Fifth Order of Beautiful Jade for his meritorious services in China. This order was awarded especially for his pioneering and developing public health work and in promoting medical education in China.

A ROYAL Rumanian Society of Genetics and Eugenics has recently been founded at Bukarest under the presidency of Prof. G. Marinesco.

WE have received from the Association of British Chemical Manufacturers, 166 Piccadilly, London, W.1, a copy of the second edition of the "Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry", which comprises supplements bringing the work up to date to December 31, 1936. Copies may be obtained from the Association at the price of 2*s*. 6*d*. post paid, remittance accompanying the order.

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. 762.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some New Characteristic Properties of Certain Industrial Dusts

WITH the assistance and encouragement of the Institution of Mining and Metallurgy and the Medical Research Council, we have continued an investigation, initiated four years ago under the auspices of the Institute of Chemistry, upon the chemical nature of dusts causing silicosis. Using the salicylic acid dust filters described in a recent communication[1], we have now obtained, probably for the first time, analysable samples of mine dust as breathed by the miner. The dust was produced by wet drilling and blasting of granite in a Cornish mine. On beginning the analyses of these samples, we immediately found that the loss on ignition, determined on the material dried at 105° C., was between 8·0 and 9·0 per cent, whereas the corresponding figure for the powdered granite rock was 0·6 per cent. Further analyses showed that the high loss on ignition was probably due to hydration of the dust, since it increased progressively from 3·7 to 5·7 and 8·5 per cent in samples taken at 10 ft., 20 ft. and 40 ft. from the working face.

On discussing these observations with our collaborators, Dr. Brammall and Mr. Leech, it was apparent that their recent work[2] on the reactivity of minerals to water and the way in which water may enter the crystal lattice was highly significant in relation to our problem. It suggested, *inter alia*, that such hydration as we had found should release alkalis from the crystal lattice, and on examining the alcoholic extracts obtained in separating the dusts from the salicylic acid filter beds, we found evidence of the presence of alkali in quantities roughly proportional to the degree of hydration of the parent dust.

Following up this result, our colleagues have made the very interesting observations recorded in another letter (p. 754), and we have made some preliminary experiments upon the nature of the aqueous extracts of various dusts which are known to cause silicosis, including typical pottery dusts and the dusts produced by crushing or disintegrating calcined flint, asbestos and felspar. Though we propose later in typical cases to make a gravimetric examination of the aqueous extracts of mineral dusts, we have for the present relied on the well-known silico-molybdate colorimetric test for silica, and the 'soluble' silica here referred to is that so indicated.

In every case so far examined we find that the dust, on extraction with water, yields both alkali and 'soluble' silica, and that the amount of the latter greatly exceeds the normal solubility of quartz. The 'solubility' is a complex phenomenon and will require careful study as it depends not only on temperature but also on time, on particle size and on the quantity of dust submitted to the action of the solvent, and is largely affected by the presence of adsorbed films. Felspar dust produced by grinding the mineral under benzene and drying at 110° C. is unaffected by water, and even resists the prolonged action of steam at 110° C.; but it yields alkali readily on treatment with 95 per cent alcohol. The obvious inference, that felspar dust can hold very firmly a protective adsorbed film of benzene, suggests a possible means whereby dangerous dusts might be rendered innocuous.

Our experiments also indicate that the solubility of siliceous dusts may be profoundly affected by the presence of extraneous substances. For example, the apparent 'solubility' of finely divided silica (quartz) is greatly reduced (even to one tenth of the usual figure) by simple admixture with an equal weight of finely divided sugar charcoal, anthracite or bituminous coal. Further knowledge on this point may evidently serve to explain the remarkable differences, hitherto inexplicable, observed in the incidence of silicosis in different mining areas. On the other hand, the presence of sugar charcoal has little or no effect upon the quantity of soluble silica yielded under given conditions by asbestos, though it materially reduces the quantity of alkali liberated. Thus it is possible that the 'soluble' silica liberated from quartz by water is different in nature from the 'soluble' silica similarly liberated from asbestos, the former being presumably of greater molecular complexity.

The relationship of the alkali liberated from a dangerous dust to the simultaneous release of soluble silica is as yet obscure. The facts so far elicited are as follows: (1) the presence of sodium carbonate in water materially increases the yield of soluble silica by quartz dust; (2) extraction of asbestos dust with very dilute acid (sufficient only to neutralize the bulk of the liberated alkali) does not diminish the yield of soluble silica therefrom; (3) the presence of calcium hydroxide (but not calcium carbonate) in small proportion substantially inhibits the release of soluble silica from both quartz and asbestos. The evidence on this last point seems quite clear: the yield of soluble silica from 200 mgm. of a certain asbestos dust under standard conditions was reduced in presence of an equal weight of calcium hydroxide from 5·8 mgm. to 0·06 mgm., that is, to about one hundredth of the original value. Here again, evidently, is a very unexpected result which may quite possibly point to a means of making dangerous dusts safe. It is probably useless to supply lime dust, which would become largely carbonated before reaching the lung surface, but admixture of a dust such as that of fresh cement, capable of yielding caustic lime on hydrolysis, might well serve to mitigate the effects of dangerous dusts.

While much work remains to be done in following up these preliminary experiments, it seems already

to be clearly established that *freshly fractured* surfaces of silica and some mineral silicates are in a highly reactive state and readily yield both alkali and 'soluble' silica on contact with water, and that for the finest particles, of the order of 5–1 μ and less, in freshly formed mineral dusts this reaction to water, though superficial, is quantitatively important. Thus, chemical changes in minerals which normally are extremely slow may, in the case of very fine dusts, proceed very rapidly to a substantial extent. It follows that, in many cases, quite apart from any effect of sedimentation, dust solids by the time they reach the lung surface, are quite different chemically and mineralogically from the mass which has given rise to them.

As most medical opinion rejects the idea of mechanical damage as the cause of silicosis, it seems probable that the changes observed in the tissues must be attributed to the chemical effect of the dust particles, that is, to the chemical effect of the soluble substances they yield up to the tissues. Therefore there seems reason to hope that the further study of the solubility of dusts, both dangerous and non-dangerous, which is being actively carried on in these laboratories, may throw useful light upon the causation of silicosis and allied diseases such as asbestosis, and may possibly suggest methods of minimizing their incidence.

On several occasions we have found that fine dusts which have become aggregated by settlement or have been for some time exposed to air appear to be much less reactive than when freshly formed. This observation may explain the failure of attempts in the past to induce silicosis in animals by exposing them to artificially raised siliceous dust clouds. In the light of present knowledge, it might be anticipated that such 'dead' dusts would be relatively innocuous. When the present investigations have developed further, it may well be worth while to institute fresh animal experiments on the effects of dust inhalation; but if these are to be significant, it must first be clearly established that the dusts used are really dangerous, that is, that their chemical properties are similar to those of dusts which are known certainly to cause silicosis.

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March 30.

[1] Matthews, J. W., Holt, P. F., Sanderson, P. M., and Briscoe, H. V. A., "Porous Solid Filters for Sampling Industrial Dusts", *Bull. Inst. Mining and Metal.*, No. 386 (Nov. 1936).

[2] Brammall, A., Leech, J. G. C., and Bannister, F. A., Mineralogical Society, Jan. 28, 1937; Abstr. *Geol. Mag.*, 74 (March 1937).

Hydrolysis of Rock-forming Minerals

As members of a small team organized by Prof. H. V. A. Briscoe to study, geochemically, the hydrolytic effects of humidity on mine dusts ($< 1\ \mu$), we have recently investigated the conditions under which various mineral silicates are degraded by simple aqueous extraction towards layer-lattice end-products belonging to the sericite, chlorite and clay types, and have examined the sols obtained.

The alkalinity imparted, instantly, to cold water by powdered soda-glass is a commonplace fact—readily demonstrable by using water containing an indicator such as phenolphthalein. Tamm[1] has recently shown that finely powdered orthoclase, muscovite, stilbite and wollastonite are very hygroscopic and are partially dissociated in water, which then gives an alkaline reaction. Incidentally, he suggested that the end-product of leached orthoclase dust is related to muscovite. The behaviour of beryl, calcite, orthoclase, albite and wollastonite was studied by Stevens[2] on similar lines. Thugutt's work on the hydrolysis of leucite and labradorite[3] involved the use of closed tubes at high temperatures, 182°–238°.

We find that, by moistening dust-fine mineral particles with cold water, a similar reaction, variable as regards intensity, is readily obtainable with most of the common rock-forming minerals: for example, biotites and other basic micas; hornblendes and other amphiboles (including asbestos); wollastonite, diopside, hypersthene, augite, aegirite and other pyroxenes; olivine, apatite, sphene and some varieties of tourmaline; grossularite, melanite and some varieties of almandite; members of the chlorite and epidote groups; calcite, aragonite, magnesite, dolomite; brucite and chondrodite; all feldspars, notably the more calcic plagioclases.

Sericite, hydromuscovite and true muscovite are among the less readily reactive species. Some chlorites and 'sericites' isolated from slates are essentially inert, though there is evidence that a clay species akin to pyrophyllite is admixed with the 'sericite' in some of these cases. The behaviour of common clays under the same experimental conditions is somewhat erratic, and often in strong contrast with their individual responsiveness to base-exchange conditions.

Sericite, hydromuscovite[4], muscovite and the basic micas yield up an appreciable amount of their alumina, etc., on treatment with weak solutions ($< N/5$) of salines such as salt and potassium chloride, extraction being accelerated by heat. Paver and Marshall[5] noted this reaction, and its rapidity, in the case of certain clays. Seven basic micas treated by us yielded hydroxides of aluminium and ferric and ferrous iron (with some magnesia), which were readily removed from the mineral particles by very dilute ($< N/40$) hydrochloric acid and precipitated from the filtrate by ammonia. The residues in the two cases tested had the properties of a true mica, grading towards 'bleached biotite'.

Tamm[1] noted that orthoclase dust produced by grinding under benzene was neutral towards water. We confirm this finding, and extend its application to mineral dusts in general if they are produced by grinding under either benzene, or bromoform, or methylene iodide, which appear to endow the particles with a protective film. This neutrality to water is partly overcome by further attrition, and may be entirely cancelled by the use of aqueous alcohol.

The comparative ease with which dust-fine mineral particles are partially dissociated and leached of some portion of their bases by cold water alone shows that 'mineral solubility' can be a misleading term[6]. The facts merit adequate consideration in relation to the genetic history and petrology of sedimentary rocks: they bear directly on (*a*) the geochemistry of weathering processes; (*b*) the extent to which mineral change is dependent on the grade size of the detrital particles and on the solutes present in surface and underground waters; (*c*) the metastability of sedimented mineral particles under environmental conditions

liable to oscillate between aggradation and degradation; and (*d*) the extent to which original mineral composition (and parental sources) can be inferred from the actual mineral assemblage in any particular case.

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March 17.

[1] *Arkiv Kemi, Min. Geol.*, **11**, No. 14 (1934); *Min. Abstracts* (March 1935).
[2] Prof. Paper U.S. Geol. Surv., No. 185-A (1934).
[3] *Arch. Min. Soc. Sci., Varsovie*, 11 (1935); *Min. Abstracts* (March 1936).
[4] Brammall, A., Leech, J. G. C., and Bannister, F. A., Mineralogical Society, Jan. 28, 1937; *Abstr. Geol. Mag.*, **74** (March 1937); *Science Progress*, **31**, No. 124 (April 1937).
[5] *J. Soc. Chem. Ind.*, **50**, Nos. 49 and 51 (1931).
[6] Briscoe, H. V. A., Matthews, J. W., Holt, P. F., and Sanderson, P. M.; Brammall, A., and Leech, J .G. C., *Bull. Inst. Min. and Metal.*, No. 391 (April 1937).

Active Absorption of Anions in the Animal Kingdom

IN recent papers (1933–37), Lundegårdh[1] has demonstrated in the roots of plants a mechanism for absorbing and concentrating salts out of very dilute solutions. This mechanism utilizes energy derived from the oxidation of sugar and acts by transport of anions (in Lundegårdh's experiments, NO_3^- and Cl^-) from the outside medium through the active cells to the inside. It is a specially important point that the energy used up is proportional to the anion exchange, while cations cause no increase in respiration. In carbonate solutions no active transport can take place and the exchanges of cations are slight only.

I submit that a mechanism closely resembling Lundegårdh's is of widespread occurrence and of great biological significance in the animal kingdom.

H. Koch (1934)[2] discussed the occurrence in a number of freshwater arthropods of certain groups of cells which take up silver nitrate from very dilute solutions and become deeply stained when the silver chloride formed is afterwards reduced under the influence of light. He suggested that these special cells normally act by actively absorbing salts which go to maintain the osmotic concentration of the organism. Working in my laboratory, he was able to prove the correctness of this suggestion.

I studied[3] simultaneously the active absorption of salts by frogs. Frogs which have been deprived of a certain amount of salt will take up actively Cl^- ions from solutions down to 10^{-5} molar or less, either with Na^+, (K^+) or in exchange against HCO_3^-. While in plant roots the process is apparently going on indiscriminately all the time, in the frog's skin it is definitely regulated. It takes place only when the salt content of the body has been depleted, and when potassium chloride only is available it soon stops. Calcium is scarcely taken up at all, but from calcium chloride there is a quantitative exchange of Cl^- ions against HCO_3^-. Br^- is absorbed just as rapidly as Cl^-, and I find now that the nitrate ion also is absorbed from a $n/1{,}000$ solution. In an experiment with sodium chloride plus nitrate, each 0·002 molar, the initial uptake of Cl^- was thrice as rapid as that of NO_3^-. Iodine penetrates only slowly and probably by diffusion.

Corresponding mechanisms exist in a large number of freshwater animals where they seem to be located in the gills. I have found them in several fishes, crustaceans, gastropods and mussels.

In the eel in sea water, a mechanism for excreting Cl^- through certain cells in the gills was demonstrated by Keys (1931)[4], and it is significant that this mechanism cannot act in the opposite direction when the eel is living in fresh-water.

Ingraham and Visscher (1936)[5] describe a mechanism, which is probably similar, for the absorption of Cl^- from the intestine, and I venture the prediction that the Cl^- absorption taking place in the kidney tubule is also similar in nature. It is well known that bromide is not distinguished from chloride by the kidneys.

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April 12.

[1] Lundegårdh u. Burstrøm, *Biochem. Z.*, **261**, 235; **277**, 223. Lundegårdh, *Biochem. Z.*, **290**, 104 (1933–37).
[2] Koch, H., *Amer. Soc. Sci. Bruxelles*, **54**, 346 (1934).
[3] Krogh, A., *Skand. Arch. Physiol.*, **76**, 60 (1937).
[4] Keys, A., *Z. vergl. Physiol.*, **15**, 364 (1931).
[5] Ingraham and Visscher, *Amer. J. Physiol.*, **114**, 673 (1936).

A Lead Extrusion Phenomenon

IT has been known for the past two decades that in the extrusion of lead cable sheaths and pipe on the hydraulic press, the presence of oxides may result in the existence of irregularities in the structure which are brought to light by suitably etching a polished section. In this case, the feature originates in the oxidation of a surface of the metal exposed at an earlier stage in the process, and the layer of oxide, formed at right angles to the direction of flow, may be folded over, and appear afterwards as a radial line of weakness in the finished pipe. An important distinguishing feature in this type of irregularity is the fact that the crystal structures on the two sides of the feature are quite separate and distinct; there is no growing of the crystals across the line of oxide (see Fig. 1).

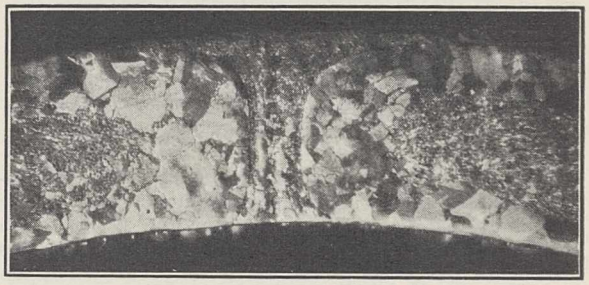

Fig. 1.

WELL-KNOWN INCIPIENT FISSURE DUE TO OXIDE LAYERING. CRYSTAL SYSTEMS DISTINCT ON TWO SIDES.

In the production of pipe and cable sheath by the continuous lead extrusion machine, the formation of oxide layers has been avoided by the exclusion of air from the device. Notwithstanding the complete absence of oxidation, however, it has been found possible, by the use of bridge supports dividing the flow of lead on its passage to the forming die, to produce radial lines in the etched section of the finished pipe showing that an impression has been left on the structure of the lead. In this case, although the crystals grow continuously across the line, it

seems to be quite clearly established that the splitting of the lead stream by a steel part before final amalgamation results in a modification of the structure which may be brought to light by subsequent deep etching.

The former well-known defect consisted of a 'mush' of small non-crystalline particles, dross, etc., and was frequently backed up on each side by sandwiches of crystals and mush, evidently on their way to form the defect. In that case, however, the crystal structure was definitely broken at the boundary line, whereas with this new phenomenon, all my observations indicate that the line brought out by deep etching is not a boundary between two separate crystal systems, but actually passes through the crystals themselves and, moreover, passes continuously from one crystal to the next.

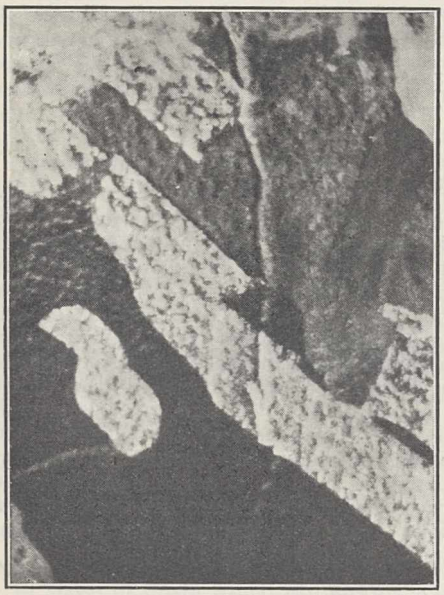

Fig. 2.

LINE IN STRUCTURE, BROUGHT OUT BY DEEP ETCHING, WHERE METAL HAS FLOWED OVER A DIVIDING MEMBER AND JOINED UP AGAIN. ONE HOMOGENEOUS CRYSTAL SYSTEM.

The distinction is shown in the two photomicrographs (Figs. 1 and 2). There are one or two possible explanations of the phenomenon of Fig. 2. Although oxide is excluded from the machine in which this structure has been produced, it may easily happen that a small quantity of oxide disseminated throughout the mass of lead, probably in solution, could be segregated at the dividing barrier and produce the effect, at the same time being so small in quantity as to permit the free recrystallization of the metal as in Fig. 2, after the divided stream has joined up again beyond the barrier. A second possible explanation is that in rolling and rubbing over the dividing steel surface, a segregation of the very small quantities of impurities always found in lead may take place, and that the 'line', therefore, indicates a difference in alloy which, while very slight and insufficient to interfere in any way with the formation of the crystals, is still sufficient to cause differential solubility through electrolytic local action and the bringing to light of the feature through the local depression. As would be expected from the integrity of the crystal system, the existence of the feature does not reduce the bursting strength of the pipe and, while suitable modifications of the machine have been made to obviate the effect, its appearance would not seem to share the disadvantages of the former type of split lead due to oxide inclusions.

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A Method of Measuring the Magnetic Moment of Free Neutrons

F. BLOCH[1] has recently pointed out the possibility of producing partly 'polarized' neutron beams, that is, beams which contain more neutrons of one direction of spin than of the other. The method consists in passing a beam of slow neutrons through a plate of magnetized iron, the 'polarizer'; the polarization of the beam can be demonstrated by passing it through another iron plate, the 'analyser': a change in the intensity of the beam would be expected, according to Bloch, on reversing the magnetization of the analyser. Such a change has in fact been observed by Hoffman, Livingston, and Bethe[2].

The magnitude of the polarization effect was shown[2] to be in agreement with the value $\mu_n = 2$ N.M. (1 N.M. = 1 nuclear magneton = 1/1840 Bohr magneton) for the magnetic moment of the neutron deduced from the moments of the proton (2·5–2·9 N.M.[3,4]) and the deuteron (0·8 N.M.[5,4]). This calculation is based on a careful study of the density distribution in the iron of those electrons which produce ferromagnetism.

We would like to point out a direct method of measuring μ_n which also permits a determination of its sign (that is, its direction relative to the direction of spin). Our method makes use of the Bloch effect for obtaining polarized neutron beams, but does not necessitate the application of the theory of ferromagnetism.

The method consists in studying the depolarizing effect of a magnetic field through which the neutrons pass on their way from the polarizer to the analyser. If this field, H, is perpendicular to the polarizing (and the analysing) field the neutrons start to precess with an angular velocity $\omega = 4\pi\mu_n H/h$ (h = Planck's constant). On leaving the field the neutrons have turned through an angle $\varphi = 4\pi\mu_n Ha/hv$ (a = length of field, v = neutron velocity), and consequently the polarization effect (the change in beam intensity when the analysing field is reversed) is diminished by a factor $\cos\varphi$. Thus the study of the polarization effect on H permits a determination of μ_n. Taking $v = 2 \times 10^5$ cm./sec., $a = 3{\cdot}5$ cm., $\mu_n = 2$ N.M., we find that a field of about 4 gauss should turn the neutrons through 90° and thereby make the polarization effect disappear.

We have made some preliminary experiments to demonstrate the existence of this depolarization effect. (Qualitative evidence has been obtained by Powers, Beyer, and Dunning[6].) Our arrangement was similar to that of Hoffman, Livingston, and Bethe[2]. As polarizer and analyser we have used flat iron rings which were wound throughout their length in order to minimize any external field action of the magnetizing current. Still, it was soon found best to switch off the magnetizing current during the measurements and to work with the permanent field only. A long solenoid was

placed between the iron rings in order to produce the depolarizing field H.

With $H=0$, the polarization effect was found to be $(0{\cdot}65\pm0{\cdot}28)$ per cent of the total count (of which about one half was due to thermal neutrons). With $H=4$ gauss, the polarization effect was negative, but at the limit of error $(-0{\cdot}36\pm0{\cdot}31)$ per cent. At $H=2$ gauss an intermediate value of $(+0{\cdot}29\pm0{\cdot}36)$ per cent was obtained. These results are in qualitative agreement with the assumption $\mu_n=2$ N.M. The errors given are mean square errors; similar figures were obtained on computing the errors in the traditional way from the fluctuations of the single results. Altogether, 1·2 million counts have been made.

A new and improved apparatus is being prepared in order to determine the amount and the sign of μ_n; the sign can be found by placing polarizer and analyser at an angle and by studying the direction of precession depending on the direction of the magnetic field.

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April 7.

[1] Bloch, *Phys. Rev.*, **50**, 259 (1936).
[2] Hoffman, Livingston, Bethe, *Phys. Rev.*, **51**, 214 (1937).
[3] Estermann, Stern, *Z. Phys.*, **85**, 17 (1933).
[4] Kellogg, Rabi, Zacharias, *Phys. Rev.*, **50**, 472 (1936).
[5] Estermann, Stern, *Phys. Rev.*, **45**, 761 (1934).
[6] Powers, Beyer, Dunning, *Phys. Rev.*, **51**, 371 (1937).

Radioactive Neon

IN a previous note[1] it has been reported that the radioactive helium formed by bombarding fine-grained beryllium hydroxide with neutrons can be transferred by a stream of gas through a tube from the place of activation around a neutron source to a Geiger counter placed at some distance.

By bombarding sodium or magnesium with fast neutrons, a radioactive substance of 40 sec. half-value period is produced[2], which is generally assumed to be $^{23}_{10}$Ne. So far as I am aware, no chemical proof has been obtained. It therefore seemed of interest to attempt to use the above method to decide whether the active substance in question is a gas. Magnesium hydroxide was precipitated together with ferric hydroxide in various proportions by the method of O. Hahn[3] in order to give it a high emanating power. The dried precipitates were bombarded with neutrons from a beryllium-radon source of 200 millicuries, and air from an aspirator was passed at a suitable rate through the samples and then through a glass tube to the thin-walled jacket around the counter. No definite effect was found; it follows from the relative yields by bombardment of beryllium and magnesium with neutrons, that if radioactive neon is given off by the bombardment of magnesium, one would expect only a very weak effect (just detectable) by this method. This is mainly due to the small relative abundance of $^{26}_{12}$Mg.

In the case of sodium, the effect to be expected is much larger if the radioactive neon can be removed from the crystals of the sodium compound during an interval comparable to 40 sec. Commercial sodium stearate[4] proved suitable, and an unambiguous effect was found. In Fig. 1, the number of counts per minute is plotted against the rate of the air stream in cubic centimetres per second. From the volumes of the activation chamber, the connecting tube and the jacket around the counter, one can calculate the shape of the curve to be expected when the radioactive gas has a given half-value period T. The curve drawn in the figure corresponds to $T = 40$ sec. The experimental points are not in disagreement with this, although a slightly smaller value of T (35–40 sec.) would fit a little better. With sodium butyrate, a similar effect was obtained.

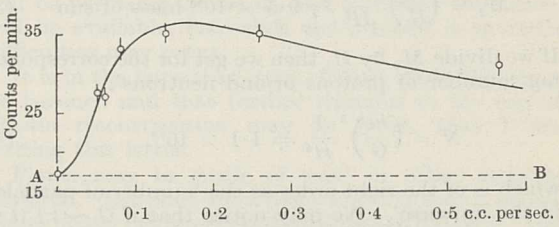

Fig. 1.

RELATION OF NUMBER OF COUNTS TO RATE AT WHICH THE AIR STREAM PASSED TO THE COUNTER. AB REPRESENTS THE γ-RAY EFFECT.

The effect here described may be of interest for the study of the emanating power of sodium compounds.

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March 19.

[1] NATURE, **138**, 400 (1936).
[2] Fermi, Amaldi, D'Agostino, Rasetti and Segrè, *Proc. Roy. Soc.*, A **146**, 483 (1934).
[3] Hahn, O., *Naturwiss.*, **17**, 295 (1929).
[4] Strassmann, F., *Z. phys. Chem.*, B, **26**, 362 (1934).

The Cosmological Constants

PROF. P. A. M. DIRAC'S recent letter in NATURE[1] encourages me to direct attention to certain 'coincidences' which I had noticed some years ago, but which I have been hesitating to publish from the conviction that purely 'dimensional arguments' will not lead one very far.

If we consider the natural constants h (Planck's constant), c (velocity of light), H (mass of the proton), G (the constant of gravitation), we can form the following combination M_α which is of the dimension of mass:

$$M_\alpha = \left(\frac{hc}{G}\right)^\alpha \frac{1}{H^{2\alpha-1}}, \qquad (1)$$

where α is an arbitrary numerical constant. Now a particular case of the above occurs in the theory of stellar interiors, namely, when $\alpha = 3/2$. Then

$$M_{3/2} = \left(\frac{hc}{G}\right)^{3/2} \frac{1}{H^2} \doteqdot 5{\cdot}76 \times 10^{34}\ \text{gm.}, \qquad (2)$$

which is about thirty times the mass of the sun. Now, the apparent success of steady state considerations in 'explaining' the observed order of stellar masses can be traced to the circumstance that the above combination (2) of the natural constants gives a mass of the correct order. It may be noticed that apart from numerical constants, (2) is the same as the upper limit to the mass of completely degenerate (degenerate in the sense of the Fermi-Dirac statistics) configurations[2]. The occurrence of (2) in stellar structure equations need not cause any surprise,

since one can easily convince oneself by considering two homologous stellar configurations that if a formula for mass exists, it must contain the mean molecular weight μH with an inverse power 2, and this would, according to (1), fix the value of the exponent α as 3/2.

It is of interest to see what (1) leads to for other values of α. If $\alpha = 2$, then

$$M_2 = \left(\frac{hc}{G}\right)^2 \frac{1}{H^3} \doteqdot 9{\cdot}5 \times 10^{20} \text{ mass of sun} \qquad (3)$$

If we divide M_2 by H, then we get for the corresponding 'number of protons or/and neutrons',

$$N = \left(\frac{hc}{G}\right)^2 \frac{1}{H^4} \doteqdot 1{\cdot}1 \times 10^{78}, \qquad (4)$$

which is of the right order as the 'number of particles in the universe'. We may notice that if $G \sim t^{-1}$ (t is Milne's cosmological time), then $N \sim t^2$, which agrees with Dirac's speculation.

It may be further pointed out that if $\alpha = 1\frac{3}{4}$, then

$$M_{1\frac{3}{4}} = 1{\cdot}7 \times 10^{11} \text{ mass of sun}, \qquad (5)$$

which is of the same order as the mass of our Milky Way system. If we 'identify' $M_{1\frac{3}{4}}$ as representing the mass of a galaxy (external or otherwise), then we should have, according to Dirac's ideas, that the 'number of particles in the galaxy' should vary as $t^{1{\cdot}75}$. Similarly, the number of particles in a star should vary as $t^{1{\cdot}5}$.

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Wisconsin.

[1] NATURE, **139**, 323 (Feb. 20, 1937).
[2] Chandrasekhar, S., *Mon. Not. Roy. Ast. Soc.*, **91**, 456 (1931).

Sources of Inaccuracies in Spectrographic Research

IT may be of interest to point out that there is considerable evidence entirely confirmatory of Mr. D. A. Webb's observation[1] that very intense spectra due to element A, present in minute concentration in electrodes B, can be brought out by addition of C.

Development of spectra in discharges is in the main due to one of two causes, namely, direct collisional excitation as a kinetic effect, or receipt of energy from another excited body, that is, a collision of the second kind. Other processes such as chemiluminescence, recombination reactions, etc., are generally of much smaller account.

As regards the first of these, it seems permissible, in view of the very wide variations in electrical factors such as electron speeds, etc., to suppose that in spite of considerable differences in excitation functions and excitation potentials, among both the various elements and their different spectral series, the genesis of excited states will be so much a matter of probability that the ratio of the intensity integrals of spectra due to A and to B, may be taken as a fair measure of their relative concentrations.

Excitation according to the second of these causes may lead to very different results. The probability that transfer of energy will follow the contact of excited and unexcited bodies, is here governed by two principles. From energy considerations alone (Franck's 'resonance rule'), it is expressed by a somewhat complex function which in practice means that the chance of such excitation increases very much as the discrepancy $\triangle E$ between the energy of the donor, and that of the nearest excitable level of the acceptor, decreases. In the mercury-sensitized fluorescence of sodium, for example, the line $\lambda = 4423$ A. is extremely intense, since it proceeds from a level lying within 0·02 v. of the mercury 2^3P_1 state, other lines (for example, 6 D, 8 S) being only one eighth to one quarter as bright, although $\triangle E$ is here[2] only about 0·15 v.

Excitation is also markedly favoured, given good energy resonance, if the process can take place without change in the overall multiplicity, S, of the system (Wigner's rule). To this is due the thirtyfold enhanced probability of:

$$Kr(2^3P_2) + Hg(1^1S_0) \rightarrow Kr(1^1S_0) + Hg(5^3D_n) + 0{\cdot}038 \text{ v.}$$

as compared with:

$$Kr(2^3P_2) + Hg(1^1S_0) \rightarrow Kr(1^1S_0) + Hg(5^1D_2) + 0{\cdot}033 \text{ v.}$$

In the first reaction, where the mercury triplets are excited, S remains constant at unity, whereas in the second case, where the singlets appear, S has fallen to zero[3]. It would appear not improbable that there may be yet a third factory, depending upon the *type* of level being excited, but the evidence here is as yet very slender[4]. So many cases are known, however, where the first principles are valid[5], that it will be clear that considerable caution must be adopted, in spectographic analysis, as regards metrical interpretation of the results. Mr. Webb's communication is a welcome and timely reminder to this effect.

E. J. B. WILLEY.

Davy Faraday Laboratory,
Royal Institution,
W.1.
March 30.

[1] Webb, NATURE, **139**, 248 (1937).
[2] Beutler and Josephy, *Z. Phys.*, **53**, 747 (1929).
[3] Beutler and Eisenschimmell, *Z. phys. Chem.*, B, **10**, 89 (1929).
[4] Manley and Duffendack, *Phys. Rev.*, **47**, 56 (1935).
[5] Willey, Monograph on "Collisions of the Second Kind" (in the press).

Germination of Oospores of Onion Mildew, *Peronospora Schleideniana* W. G. Sm.

IN a previous letter[1], the germination of the oospores of the downy mildew of onions, *Peronospora schleideniana* W. G. Sm., was briefly discussed. Commenting on this letter, Miss Blackwell[2] remarked on the general difficulty experienced in germinating such fungal spores, and points out that time is a factor as well as maturation.

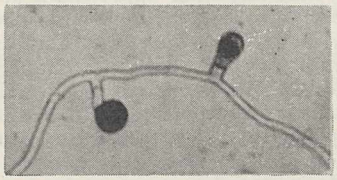
Since then, Wolf and his associates[3], working on somewhat similar lines to mine, have recorded the germination of oospores of the downy mildew of tobacco. They state that less than a dozen oospores germinated out of several thousands tested, and growth of the germ-tubes was very limited. In view of our general lack of knowledge concerning the behaviour of such oospores, the following additional information regarding those of the downy mildew of onions may be of interest to other workers.

One per cent of the oospores germinated at the end of four years, but it was evident that the remainder had not lost their vitality, since:

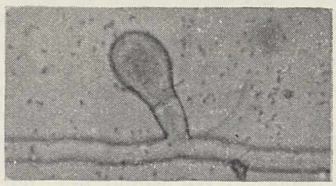
(*a*) The changes occurring in the oospores indicated that they were not dead.

(*b*) A slight increase in germination occurred after four years, though two per cent was the highest obtained in water.

(*c*) Eventually it was found that on adding potassium permanganate solution (0·01–0·02 per cent) to water containing the oospores, the latter being 5–6 years old and weathered out-of-doors, 60–85 per cent germination occurred inside forty-eight hours at 15°–20° C., 0·05–1 per cent occurring in controls. The oospores were placed in water on microscope slides, sufficient of the permanganate solution added to give a definite pink colour to the water, and cover slips applied. The reagent did not appear to act directly on the oospores, as scarcely any germination took place when they were mounted perfectly clean. If, however, plenty of organic remains were present, germination occurred.



(*a*) × 200



(*b*) × 400

Fig. 1.
Peronospora Schleideniana.

The germ-tube produces a hypha which grows to a length of 2–8 mm., with more or less subsidiary branching, when longitudinal growth apparently ceases. After this, at any time in 3–10 days, a second type of branch arises usually on the main hypha. These branches are very short, and may be either scattered along the hypha or adjacent to each other, when they are often on alternate sides, as shown in Fig. 1 (*a*). These short branches are terminated by a single cell (Fig. 1 *b*), the latter varying in size. Three to nine of these bodies may occur on a hypha produced by a single oospore, so that we have here a limited saprophytic existence of the fungus in water. Some oospores germinate without forming any of these bodies; the significance of this is not yet known.

The treatment of eighteen-months old oospores with the permanganate solution gave no result. This confirms Miss Blackwell's observation that the time factor as well as maturation is necessary for the germination of these fungal spores.

ROBERT MCKAY.

20 Wigan Road,
Drumcondra,
Dublin.

[1] NATURE, **135**, 306 (Feb. 23, 1935).
[2] NATURE, **135**, 546 (April 6, 1935).
[3] *Phytopath.*, **26**, 760–770 (1936).

The Technique of Plastic Reconstruction

PLASTIC reconstruction is desirable in almost any structural embryological investigation. At the best of times it is a laborious process, yet I feel that the difficulty of obtaining or preparing suitable plates may often be a determining factor in preventing the still more frequent use of this method. In a department where there is a constant demand for plates, such difficulty will not arise as the necessary apparatus will be permanently set up and a trained technician will be available, but when the demand is sporadic difficulties may occur.

It is in the hope that some of these difficulties may be lessened and that further stimulus to the use of plastic reconstruction may be given, that I am writing this letter.

Plates may be made of wax[1] or other suitable material. The chief advantage of wax is that it allows plates of any predetermined thickness to be made. The plates are usually rolled on a lithographic stone[2] or on a cast-iron plate[3,4]. The former is cumbrous and very liable to crack, the latter is incorporated in a special apparatus; neither is readily transported and set up wherever happens to be immediately convenient.

Some time ago, I tried a sheet of plate-glass (24 in. × 15 in. × ¼ in.) as a substitute for the lithographic stone, and I have been using the method since with considerable satisfaction. The glass is placed on any suitable end-supports, so that it rests about 4–6 in. clear of the bench. After levelling, it is gradually heated by waving a gas poker underneath the free surface between the supports. (The 'poker' is easily made by sealing the end of a piece of brass tubing and punching a series of suitably spaced holes in it.) When the glass is sufficiently hot, it is painted with turpentine, a sheet of Flint paper is placed on it and brushed down with turpentine so that all the air between the paper and the glass is expressed, the guide rails are placed in position, and the wax is poured and rolled in the usual way. The wax maintains the temperature of the glass without further heating. Overheating of the wax and of the roller must be avoided, otherwise there is a risk of cracking the glass.

The advantages of this method are that the plate-glass is cheap and readily obtainable, it is easily moved from place to place and set up wherever desired, and it is speedily heated: it is, in fact, easier to handle in every way than a lithographic stone.

There are obviously great advantages in using material of more resistant qualities than wax, apart from the fact that the need for making the plates is eliminated. "Holzpappe" was suggested by His[5] so long ago as 1885; cardboard was used by Broman[6] in some of his reconstructions, and this method was elaborated by Triepel[7].

The blotting-paper method, originally suggested by Gage[8], appears now to be in general use. It is, however, expensive, and I wish to direct attention to the use of a wood-pulp board which serves the purpose equally well and is less than half the price of blotting-paper. I have been using what is termed "4 sheet pulp board 44 in. × 32 in.", the retail price of which is eight shillings per quire. After impregnation with paraffin wax (melting point about 55° C.) I find that this board approximates closely to a thickness of 1 mm., and it cuts very readily. This wax impregnation, which is carried out by soaking

the sheets in the melted wax until all the air has been driven out, is important as it facilitates the process of cutting to a marked degree; it may be that it is a well-recognized step in the technique, yet I have only noticed it mentioned once in the literature[9].

I have found that it is useful to fill in the 'steps' in the completed model (if it is desirable to do so) with plastic wood instead of the usual wax; considerably greater rigidity is thus obtained, and the use of fine sand-paper gives a finished surface.

H. L. H. H. GREEN.

Anatomy School,
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[1] Born, *Morph. Jahrb.*, **2**, 577 (1876).
[2] Strasser, *Anat. Anz.*, **2**, 392 (1887).
[3] Fleischmann, *Z. wissen. Mikro.*, **21**, 445 (1905).
[4] Berner, *Z. wissen. Mikro.*, **27**, 44 (1910).
[5] His, "Anat. mensch. Embryonen", **3**, 5 (1885).
[6] Broman, *Anat. Hefte*, **11**, 558 (1899).
[7] Triepel, *Z. wissen. Mikro.*, **35**, 89 (1918).
[8] Gage, *Anat. Rec.*, **1**, 166 (1907).
[9] Pohlman, *Anat. Rec.*, **15**, 389 (1919).

Air Raid Precautions

WHILE we appreciate the fulness of the treatment which has been accorded to our book "The Protection of the Public from Aerial Attack", we should be grateful for the opportunity of commenting on certain points in the review in NATURE of April 10, p. 606. Regarding the purpose of the book, General Foulkes says, "It suggests no better defensive measures than those recommended by the Home Office". Better methods are not lacking, and our object simply was to provide some scientific data concerning the proposed precautions—because no such data had been published and we felt that the unsupported statements of Government spokesmen concerning their efficiency were no substitute for scientific fact.

The reason why a privately manufactured mask was tested is expressly stated in the book. Although we applied to the Home Office for specimens of the Government mask for civilian use and attempted to procure them through other channels, we were unsuccessful in obtaining any. The type of filter in the mask which we used was, however, the same as that described in the Press for the Government mask. General Foulkes does not mention the passage of arsenical smokes through gas masks of the type of the Government mask. From simple experiments with cigarette smoke on the free masks on exhibition at the Royal Horticultural Hall, it seems probable that they could transmit a few per cent of any arsenical smokes drawn through them. Is it therefore justifiable to claim that these masks give complete protection against all air-dispersed poisons? The French Government uses an entirely different type of filter—a pleated paper one—in all its service masks, and this mask transmits very much less arsenical smoke.

General Foulkes remarks that "in many of the poorer homes completely gas-proof shelters can only be provided with great difficulty" and continues "but that is no reason why the remainder should not be protected". We agree, but the number of poorer homes which cannot be gas-proofed is disturbingly great. The reviewer in discussing the carbon dioxide experiments quotes from Mr. Geoffrey Lloyd that they "had been proved to be open to grave criticisms". What are these criticisms? They are still unknown to us, though they have been repeatedly asked for in the House of Commons. Since General Foulkes says that "experiments showing the rate of leakage *from the open air into a gas-proof room* would have been of far greater interest", it is surprising that he makes no mention of the experiments we did in which gas passed from the outside to the inside of a gas-proofed room. These were of two kinds (see pp. 95–105) and showed that air passes readily from the outside into a gas-proofed room under normal atmospheric conditions. The suggestion that conditions in dug-outs are comparable with those in ordinary houses is obviously false, as the kind of walls, ceiling and floor and the degree of exposure are different. When General Foulkes says, "I do not believe that anything approaching a concentration of 5 per cent of gas can be established in the open air by an aerial or any other kind of bombardment", we may well agree with him. But the strongest concentration of non-persistent gas we assumed for our calculations corresponded to 0·004 per cent by volume of phosgene. It is stated by Engelhard that concentrations higher than this can be reached in the field. It is stated in a recent book ("Chemicals in War", by Prentiss) by an author who seems to have had much experience of these matters, that seven aeroplanes could establish a concentration of mustard gas of 0·025 gm./cubic metre when the atmospheric temperature was 17° C. over an area of 2·5 square miles. Such concentrations would be fatal if breathed for an hour, so that our calculations would appear to be well founded on reasonable premises. General Foulkes would apparently trust a "good strong wall-paper". We would not, nor would we trust a brick built room, for the data published by Pettenkofer in 1865 and in the *Architectural Forum* of March 1924 show that the ventilation of a room is very largely through the actual brick of the walls and is much less through the windows and doors than is commonly supposed.

The chief burden of General Foulkes's argument is that our experiments have little relevance to actual war conditions, that they are essentially academic and not practical. He considers the measures proposed by the Government as adequate to deal with the kinds of attack which are probable and points to the experience of the Great War. We believe, however, that with the immensely increased potential force of modern air fleets, attacks of a different order of intensity are now possible, and that against such attack the measures are hopelessly inadequate. This is certainly the belief of the French Government as judged by the methods actually being put into practice, which include among other provisions: (*a*) evacuation, for the duration of the hostilities, of the inessential population (old persons, some women and children), (*b*) nightly evacuation of all those required for essential services, (c) bomb- and gas-proof shelters with filtered ventilation in cellars of large and strong buildings, (*d*) communal shelters for districts with old and small houses (underground stations will be used for the purpose). English towns are exposed to a danger at least as great and require no less effective protection.

We have no desire to create panic, but those who persuade the people of Great Britain to believe that they are safe when they are not are inviting panic and worse than panic in the case of war. We would

be lacking in our duty as scientists and citizens if we were to accept, without question, assurances of the validity of which we have not been convinced.

Finally, we must admit that we would prefer to obtain "a still greater degree of safety . . ." by stopping war altogether, but we do not feel that this preference invalidates our results. Experiments are to be believed, not on account of the authority or bias of the experimenters, but because they can or cannot be repeated by anyone who chooses to do so. We would accordingly urge that the whole question of the protection of the population from aerial attack should be studied openly by representative scientists; then a rational estimate can be made of the probable efficiency of any measures which are finally adopted.

J. D. BERNAL.
J. H. FREMLIN.
SHIRLEY GLASSTONE.
A. F. W. HUGHES.
A. J. P. MARTIN.
JOSEPH NEEDHAM.
N. W. PIRIE.
R. N. ROBERTSON.
R. L. M. SYNGE.
J. S. TURNER.
D. H. VALENTINE.
C. H. WADDINGTON.
ARTHUR WALTON.
NORA WOOSTER.
W. A. WOOSTER.

Cambridge.

ONE of the grievances of the authors seems to be that they issued a challenge to the Home Office to produce the data on which their gas protection experiments were based, and that this challenge has been ignored.

The Government has, no doubt, its own reasons for not publishing the data, but it would be fair to suppose that the recommendations it has made are well supported by scientific facts which have been established by its own advisers—men, as I pointed out, who have carried out all its poison gas experiments during the last twenty-odd years.

The authors quote from a book recently published in America by Colonel Prentiss, and they refer to him as one "who seems to have had much experience of these matters".

I agree; so let me in turn quote from the chapter "Protection of Civil Population": it will be seen that the Home Office recommendations are supported in full.

"Shelter from chemicals launched during air raids is to be obtained for the most part by the utilisation of existing structures with such gas-proofing as may be justified. The erection of special collective shelters designed exclusively for the protection of civilians during aerial attacks is only warranted under exceptional circumstances; at best, such buildings can accommodate no more than an insignificant proportion of the inhabitants of any community. . . .

"The individual or small-group shelter of this type will not require special air-purifying devices to counteract noxious gases, but instead will be air-sealed when occupied, its occupants depending on the air present in the room for the necessary oxygen. Arrangements should be made in advance to prevent all in-drafts of air, while the shelter is in use, and overcrowding with consequent rapid exhaustion of free oxygen must be avoided."

C. H. FOULKES.

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An Air-borne Plant Virus

IN a recent issue of NATURE[1], Dr. Kenneth Smith described the virus of a new disease of plants as being "air-borne". The term in this connexion implies: (1) that the virus agent can escape from the tissues of the infected plant into the air under natural conditions; (2) that it is carried in the air; and (3) that the air-carried virus can infect a normal healthy plant.

In the light of the generally accepted view that the virus is intimately connected with the protoplasm of the host cell, and that it is unable to enter an uninjured protoplast, the demonstration of the easy passage of a virus from a plant into the air would be of great interest. It is not clear that Dr. Smith has succeeded in demonstrating this. All he has shown is that in three out of an unstated number of experiments, plants were found to be diseased after they had been rubbed with cotton-wool pads through which the air of a glass-house had been drawn. If the virus is present in the soil, as Dr. Smith suggests, and if it resists desiccation as he now states[2], it is not unreasonable to suppose that in the dust of a glass-house some traces of the virus might be present. Even if this were demonstrated, however, it would scarcely prove that the virus is air-borne; tobacco leaf dust contains the virus of the tobacco mosaics.

Dr. Smith has not shown that the virus does in fact reach the air from the tissues of a living infected plant, or that being in the air it can infect normal healthy plants. Until this has been demonstrated under controlled conditions, Dr. Smith's description of his virus as "air-borne" would appear to be premature.

JOHN CALDWELL.

Department of Botany,
University College,
Exeter.

[1] NATURE, **139**, 370 (Feb. 27, 1937).
[2] cf. Smith, NATURE, **138**, 396 (Sept. 7, 1935).

DR. CALDWELL'S chief criticism is directed against a point which has already been proved[1], namely, the ability of this virus to enter the roots of a plant without the aid of any known external agencies. Dr. Caldwell says that the term "air-borne" implies "that the virus agent can escape from the tissues of the infected plant into the air under natural conditions". I fear this is wider than my conception of the term; I only meant that the virus was carried in the air, with the added implication that it was able to reach and infect virus-free plants by this means. It never occurred to me that anyone would suppose that the infected plant was discharging virus particles into the air after the manner of an influenza patient. Indeed, the following sentence from my letter makes my meaning quite clear: "It is not perhaps surprising that such a minute virus . . . and one capable of withstanding complete desiccation should be present in the air."

Dr. Caldwell further says, "tobacco leaf dust contains the virus of the tobacco mosaics". Of course it may do, but this disease cannot spread in the same way, even if a suspension of tobacco mosaic virus is poured round tobacco plants growing in pots, and herein lies an interesting difference between these two viruses. Again quoting Dr. Caldwell . . . "it has not been shown that being in the air it can infect normal

healthy plants"; this, of course, has been demonstrated experimentally. If a suspension of this particular virus is lightly sprayed into the air from an atomizer in the vicinity of tobacco plants growing *under controlled conditions*, a percentage of such plants is later found to contain the virus in the roots.

I take it that the main reason for Dr. Caldwell's strictures lies in his fear that my letter casts doubts on "the generally accepted view that the virus . . . is unable to enter an uninjured protoplast". If he will read my last paper[1] he will find this sentence on p. 90—"It appears therefore that some wounding must be necessary for infection, and this condition might be fulfilled by the breaking of root hairs as the root makes its way through the soil or sand". In this connexion I might perhaps mention that if a suspension of the virus is sprayed on to the leaves of French beans (*Phaseolus vulgaris*) by means of an atomizer, held at a distance of about 6 inches from the plants, numerous lesions develop on the leaves. One can of course explain this by saying that the virus is entering by broken hairs or minute wounds already existing, and this may be so, but it is a difficult point to prove or disprove.

Finally, I repeat what I said in my previous letter, namely, that the smallest quantity of virus which reaches the soil seems eventually to enter the roots of a plant growing therein, though the precise mechanism of its entry has not yet been demonstrated.

KENNETH M. SMITH.

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School of Agriculture and
Molteno Institute,
Cambridge.

[1] Smith, Kenneth M., *Parasitology*, **29** (1937).

Points from Foregoing Letters

THE solubility, in water, of various dusts (such as felspar, asbestos, calcined flint) known to produce silicosis, is found by Prof. H. V. A. Briscoe, P. F. Holt, J. W. Matthews and P. M. Sanderson to be a complex phenomenon depending upon tissue, particle size, quantity of dust submitted and presence of extraneous substances. Freshly fractured surfaces of silica and certain silicates appear to be in a highly reactive state, and yield alkalis and 'soluble' silica to water to a greater extent than in the normal state. The particles lose their reactivity after a certain time, and this may explain the failure to produce silicosis in animals in experiments with 'dead' dusts.

Prof. A. Brammall and J. G. C. Leech find that many rock-forming silicates, when finely powdered, yield alkali to cold water, and several micas yield an appreciable amount of alumina on treatment with weak solutions of sodium or potassium chloride. They direct attention to the possible importance of these observations in relation to the origin and composition of sedimentary rocks.

That the ability to absorb and concentrate salts out of very dilute solutions is widely present in animals as well as plants, is suggested by Prof. A. Krogh. The mechanism involved, as indicated by Lundegårdh's experiments on plants, appears to utilize energy derived from the oxidation of sugar, and to act by transferring negatively charged (acidic) ions.

In the production of pipe and cable sheath by the continuous extrusion machine, the splitting of the lead stream by a steel part before final amalgamation results in a modification of the structure which appears as a 'line' upon subsequent deep etching. A photomicrograph of such a 'line', possibly due to small quantities of oxide or other impurities, is submitted by Dr. P. Dunsheath. The 'line' passes continuously through several crystals and, unlike the well-known defects due to a mush of small non-crystalline particles, it does not reduce the bursting strength of the pipe.

A method of measuring the magnetic moment of free neutrons is proposed by Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. Jørgen Koch. The method consists in studying the depolarizing effect of a magnetic field on a polarized beam of slow neutrons, which is obtained by passing the neutron beam through magnetized iron, as suggested by F. Bloch. Preliminary experiments have given evidence of the existence of the depolarizing effect. The proposed method can also be used to determine the sign of the magnetic moment of the neutron.

By bombarding sodium or magnesium with fast neutrons, a radioactive substance of 40 seconds half-life period is produced which is generally assumed to be neon of mass 23. To decide whether the active substance is really a gas, Dr. T. Bjerge has applied the method of transferring the radioactive substance produced by means of a current of air, and has obtained positive results.

Dr. S. Chandrasekhar directs attention to a combination of certain 'natural' constants (the velocity of light, the mass of the proton, the constant of gravitation and Planck's constant, h) which has the dimension of mass. A particular form of this combination occurs in the theory of stellar interiors. By substituting simple values for the arbitrary constant in the formula, the author shows that one can obtain numbers comparable with the mass of the Milky Way, and with the total number of protons and/or neutrons in the universe—such as were derived by Prof. Dirac from similar dimensional arguments.

Commenting on sources of inaccuracy in spectrographic research due to the influence of foreign materials in intensifying the spectrum of a given element, Dr. E. J. B. Willey points out that in so far as the spectra are due to direct collisional excitation, the ratio of the intensities might be taken as a fair measure of the relative concentrations. But when the radiating particle receives energy from another excited body, this simple relation no longer holds, as shown for example by the mercury-sensitized fluorescence of sodium.

The addition of a small amount of potassium permanganate to water containing oospores of the onion mildew *Peronospora schleideniana* stimulated their germination if other organic matter was present, according to experiments by R. McKay. The oospores used were five–six years old and weathered out of doors. Eighteen months old oospores gave no results.

Research Items

Family and Clan in Hopi Economics

MR. ERNEST BEAGLEHOLD'S study of Hopi economics (*Yale Univ. Contrib. Anthrop.*, No. 15) is based on observations made in 1932 and 1934 of the culture of the two Second Mesa Hopi villages of Mishongnovi and Shipaulovi. The Hopi household, which is matrilocal and consists of father, mother, children, and unmarried or widowed brothers and sisters of the wife, is the ultimate unit of consumption and production. In marriage, both partners assume definite obligations to contribute to the economic welfare of the household; and the members of the enlarged family are brought within the partnership. A frequent cause of family quarrels is that a member is not fulfilling his economic duty. Marriage also brings together two kin groups, which then act as a closely co-ordinated unit in a number of economic activities. The clan, the maternal lineage, also has economic, as well as ceremonial duties. For example, it controls land, one of the most important items in the wealth of the community, and it is from the clan that are drawn the working parties for planting, harvesting, house-building, sheep-shearing and the like. It would, perhaps, not be incorrect to define the Hopi clan as a body of men, women and children, of common blood, periodically united for the co-operative production of food supplies and other major forms of wealth. It assumes the duties and obligations incidental to a scheme of social insurance. While the man owns only his personal effects and earnings, the woman, in addition to personal effects, if she is married, owns the house and its contents, bedding, furniture, utensils, etc. She also controls the clan lands assigned to the household. Individual ownership of lands by the male is recognized, when a man breaks in and plants land from the waste. As each household is a self-sufficing unit, specialization in economic activity, whether by individuals or by groups, is unknown.

The Nesting of Hornbills

WITH great success, R. E. Moreau has employed natives to record over long periods the feeding times of East African hornbills, and by co-operative observation he has been able to keep one nest under observation for a total of 400 hours in four successive seasons. The results present the first tolerably complete account of one of the most curious of nesting habits, and reveal unexpected differences between the three species which were studied (*J. E. Africa and Uganda Nat. Hist. Soc.*, **13**, 1; 1936). For example, the sealing up of the nesting hole in the case of *Bycanistes cristatus* was done by the female, which used mud pellets elaborated in the gullet of the male and disgorged by him, whereas in *Lophoceros deckeni* the material used was collected without help from the male and consisted of insect casts and rotten wood. In the former case the male disgorged up to 42 pellets at a visit, and during a day 235 pellets in 15 visits. The daily load involves the impregnation of some 33 cubic inches of dry mud with saliva, a very considerable call upon the secretory powers of the salivary glands. The female *Bycanistes* remained sealed up in the nest for 108 days, and during that period the male made about 1,600 visits with food, carrying about 24,000 fruits. A new observation of very great interest is that in both *Lophoceros deckeni* and *L. melanoleucos*, when the female issued from the nesting hole, the young, then about three weeks old, and unable to fly, at once replaced the plaster at the mouth of the opening, without any help from the parents.

Marine Research at Port Erin

IT is satisfactory to find that, according to the Director's report for 1936 (No. 49) of the Marine Biological Station at Port Erin, Isle of Man, people are now taking a keener interest in natural history. An increase is manifest both in enthusiasm of the visitors to the aquarium as well as in their numbers. Research work in various fields is progressing, and, besides the usual staff, many visitors have been using the laboratory. Hatching of plaice and lobsters still continues, and examination of herring shoals is carried on as before. It is of interest that some adult herrings were brought alive to the aquarium and that one of them, a female, lived for eight weeks, apparently dying of starvation. A steady flow of water, pumped daily from Port Erin Bay, was maintained in the tank containing the herring. It seems that it is comparatively easy to secure the fish alive from ring trawl boats, and if the food problem could be solved it would probably be fairly easy to keep the fish alive for long periods. The report of the oyster investigations by Mr. J. R. Bruce and Dr. Mary W. Parke shows two series of experiments, in 1936, growth experiments and settlement experiments. In the first, there has been no conclusive evidence this season that any advantage is gained by using running water. In the second, from the results obtained it appears that plunger jars are the most suitable for the settlement of larvæ.

Parasitic Copepods from Belgium

J. H. SCHUURMANS STEKHOVEN, jun., continues his work on Belgian parasitic copepods ("Copepoda Parasitica from the Belgian Coast II; including some Habitats in the North Sea", *Mém. Musée Roy. d'Hist. Nat. Belgique*, Mémoire No. 74. Brussels, 1936). His material is extensive, and includes collections made under the direction of Prof. G. Gilson during the exploration of the North Sea by the Museum. A number of years is covered, and some species are represented by hundreds of specimens. Most of the species are well known, but many of the hosts are new and the geographical distribution is much extended. *Lernæocera branchialis* was available in such large quantities that a close examination of the oral parts was possible. These were chiefly on the whiting, *Gadus merlangus*, but there were also specimens on the cod, *Gadus morrhua*, and on the haddock, *Gadus aegelfinus*, whilst one full-grown female was found on the sand-eel, *Ammodytes tobianus*. The author finds that the mouth parts of *L. branchialis* differ considerably from the descriptions of Wilson (1917). The paper is illustrated by five plates of clear outline drawings.

Some Beetles of Jehol

IN the report of the First Scientific Expedition to Manchoukuo, 1933, the part published in September 1936 entitled "Insects of Jehol (VI)" (Tokyo: Waseda University, 1936) deals with certain families of Coleoptera. These have been studied by a panel of Japanese entomologists who describe and figure various new and other species. Each paper is written in Japanese, and is followed by an adequate English translation. A special feature of the report is the excellence of the illustrations, the coloured plates being exceptionally well executed. Among the species figured are well-known English and other European forms, of which the range is now extended into Manchoukuo.

Gardenia Canker

Mr. W. Buddin and Miss E. Wakefield direct the attention of gardeners to a canker disease of gardenias caused by a fungus belonging to the genus *Phomopsis* (*Gard. Chron.*, April 3, 1937, pp. 226–27). Canker may occur upon the stem, below ground-level, or it may appear if any 'snags' are left when the blooms are removed. The disease has appeared previously in Great Britain and in the United States, but it is reassuring to find that the present outbreak is not of serious proportion. Control of the disease appears to be effected if old cankered plants are burned, and cuttings are taken only from uninfected material.

Elastic Properties of Selenium

WORK carried out during the last two or three years has shown that the elastic properties characteristic of rubber are associated with the existence of the substance in the form of long chain molecules. These have been shown to occur in filiform sulphur and in polyphosphonitrilic chloride $(PNCl_2)_n$, which has been described as an inorganic rubber. K. H. Meyer and J. F. Sievers (*Naturwiss.*, **25**, 171; 1937) have now shown that amorphous selenium, when heated to 70°, possesses elastic properties. If the threads are rapidly stretched and allowed to contract at ordinary temperatures, they become crystalline, but the substance becomes elastic once more on warming to 72°. Selenium possesses, in the crystalline state, the necessary chain-like arrangement of atoms.

Structure of Polished Metal Surfaces

ACCORDING to the ideas first put forward by Beilby, polish on a metal surface consists of an amorphous layer of 'flowed' metal. Several attempts to investigate this layer have been made using electron diffraction, and while the experiments support the idea of an amorphous layer, there have been difficulties in their interpretation. In particular, the diffraction rings observed seem to have much the same size for all the metals examined. S. Dobinski (*Phil. Mag.*, March) points out that the process of polishing in air is likely to lead to the formation of an oxide layer. He has therefore ground and polished specimens of metal under benzene or pentane and transferred them, still wet with the liquid, to an electron diffraction camera which was at once evacuated. Diffuse haloes were observed in the diffraction pattern, showing that an amorphous layer was present, but the spacing of the atoms was in most cases appreciably different from that observed in specimens polished in air. The layer is apparently close-packed, with an atomic separation approximately the same as that in the crystal lattice of the metal in question, and differing considerably from metal to metal.

Photo-Decomposition of Acetone

IN certain circumstances acetone vapour has been found to decompose on absorption of ultra-violet light with the production of equal volumes of ethane and carbon monoxide. Hence the primary reaction is formulated as: $(CH_3)_2CO + h\nu = 2CH_3 + CO$. It is now shown by R. Spence and W. Wild (*J. Chem. Soc.*, 352; 1937) that, in the circumstances in which they worked, the value of the C_2H_6/CO ratio at room temperatures is 3/2, both in presence of hydrogen and with pure acetone. Diacetyl was found to be produced in considerable amount and they bring forward evidence that the primary decomposition is into the methyl and acetyl radicals: $(CH_3)_2CO + h\nu = CH_3 + CH_3.CO$. The composition of the products was found to depend largely on the experimental conditions. The presence of free methyl radicals (which is required by both alternative equations) has been well established. It is suggested that light absorption in the banded region leads to the production of an excited molecule which may dissociate directly into ethane and carbon monoxide without the intervention of radicals. The effective life of the acetyl radical decreases rapidly with rise in temperature, and increase of acetone pressure or decrease of light intensity increases the proportion of methane in the products at 60°, owing to the occurrence of the reaction: $CH_3 + (CH_3)_2CO = CH_4 + .CH_2.CO.CH_3$.

Railway Traction Problems

THIS is the title of an article by Lord Monkswell which appears in *Discovery* of March and in which the author discusses some of the present-day problems of railway transport. The resistances due to gravity and acceleration are invariable and easily calculable. The author is more concerned with the resistances, referred to as irreversible, such as friction, or only partly reversible, as the compression of the rail-bed. In well-lubricated axle-boxes, friction is inconsiderable, but when bogies and axles require to adjust themselves to curves it is perceptibly increased. In the steam locomotive itself, owing to the number of parts having reciprocating motion under heavy pressures, friction has to be reduced by the most efficient means of lubrication and by the use of metallic packings with lateral self-adjustment. The greatest possibilities of improvement are associated with the reduction of air resistances, but there is, as yet, little accurate knowledge on this subject. The practical value of stream-lining at speeds less than 50 miles per hour is problematical, but where it has been adopted on trains of higher speed the results have been beneficial. The author, however, expresses doubt as to the validity of the extent of the advantage claimed in some cases. On the subject of engine performance, some figures are given—notably those relating to that of a reconstructed locomotive of the Chemin de Fer du Nord when hauling a train of twelve vehicles weighing 559 British tons. It was able to maintain an average speed of 66 miles an hour for a length of 14 kilometres on the Survilliers bank of gradient 1 in 200 to 220, a performance representing about 32 h.p. developed per ton weight of locomotive. Although higher values have been obtained, it is regarded as improbable that so high a figure has been maintained over the same length of time.

International Association for Testing Materials

LONDON CONGRESS

IN opening the Congress of the International Association for Testing Materials at the Institution of Civil Engineers on April 19 and in welcoming the visitors from abroad, Sir William Bragg suggested that the name did not quite fully convey the extent of the Association's work and interests, which include the investigation of the nature and properties of materials and make use of the whole range of available methods, from the most highly scientific to those which are entirely empirical. This is well illustrated in the range of papers which have been presented by prominent workers in this exploratory field and engaged in most, if not all, of the twenty-five countries which were represented at this meeting. The function of the Association is to secure international co-operation and an exchange of views, experience and knowledge in regard to materials and their testing. As has been pointed out by Dr. H. J. Gough, chairman of the British Committee responsible for the arrangements, the achievements of this age of great scientific and technical development owe much to the present-day knowledge and skilful use of the properties of materials. Direct application of these are of prime importance in transport, power generation and supply, construction, inter-communication and even in some forms of entertainment. Further, the study of existing materials leads to the production of new and improved materials, and it is this study which the Association promotes and, by means of such as the present Congress, the results and ideas are discussed. Once entirely empirical, the study of materials is now developing along lines of scientific method and, in due course, may become established as a true science.

In connexion with this meeting, an exhibition of testing plant and apparatus was arranged; manufacturers of the instruments and machines used in this class of work have collaborated with the organizers in showing their most up-to-date and reliable products. Although described as limited in size and scope, the range and comprehensiveness are remarkable, so that only a few of the most recent apparatus can be referred to in detail.

Refractory laboratory ware in alumina, now manufactured in England, is suitable for temperatures up to 1,950° C. for the fusion of metals, alloys and alkalis, and is highly resistant to the action of fuzed metals, oxides, salts and acids, while its high electrical resistance makes it eminently suitable as an insulator at high temperatures. The possibilities of the practical applications of the fluorescence test in food testing, police work, banking, philately—to take just a few random cases—are indicated by the useful types of lamps made by several firms. The Smith wear and lubricant tester is a new type of machine using a steel ball as the active member and its worn impression on the sample as the means of measurement. The cement-testing pistol makes a ball impression by a blow on the surface of the standing cement, and is claimed to give a measure of the compressive strength. For the rapid and accurate estimation of the specific gravity of gases, the new type of balance devised by Messrs. Hales and Moss, of the Fuel Research Station, is of particular interest. It operates by measuring the loss of buoyancy of an air bulb in an atmosphere of the gas in question. The Griffin Gale testing machine enables tensile, compression, indentation and bending tests to be carried out on small samples of metals and other solid materials. In the same class is the Hounsfield tensometer, while the Quinney autographic testing machine is of larger scale and gives load extension diagrams recorded by a pointer moving on smoked glass. Several firms engaged in research exhibited apparatus devised for their own work, among them Metropolitan-Vickers Electrical Co., Ltd., which has an apparatus for detecting conducting particles in textile sleeving, a magnetic crack detector and a dilatometer for determination of coefficient of expansion. In addition, the Department of Scientific and Industrial Research arranged a special section illustrative of apparatus and methods used in the laboratories co-operating in this congress.

As regards the papers presented at the Congress, most of them were available in advance; the accounts which follow were prepared from such advance proofs.

GROUP A (METALS)

The 77 papers in the Metals Group were sub-grouped under four headings: (1) Behaviour as dependent upon temperature; (2) progress of metallography; (3) light metals and their alloys; and (4) workability and wear.

In Sub-Group 1, the mechanism of the creep of metals and creep testing methods receive considerable discussion. H. J. Tapsell (National Physical Laboratory) directs attention to the phenomenon of creep recovery, a continuous contraction after unloading, which may continue in certain cases for thousands of hours after the release of stress. Two possible hypotheses are put forward, and it is considered that the study of creep recovery should assist in furthering the knowledge of the nature of creep. Dr. C. L. Clark and Dr. A. E. White (University of Michigan) summarize two theories concerning the mechanism of creep, on the basis of which the known influences of a number of factors on creep resistance can be readily explained. Dr. A. Nadai briefly surveys the results of work at the Westinghouse Laboratories, and emphasizes, among other things, that methods are needed in industry to shorten the time of creep tests from a duration of three months or more to times of the order of hours or days; these must be based on a better knowledge of the speed law connecting stress with strain rate.

Dr. U. R. Evans discusses corrosion as influenced by increased temperature, pointing out that at high temperatures the rate of combination between metallic atoms and oxygen atoms is very rapid, and the rate of wastage of metals exposed to hot oxidizing gases is usually only limited by the rate of penetration of oxygen inwards through the oxide-coat, or by the rate of diffusion of metal outwards to the oxygen. The testing of high endurance oxidation-resistant alloys is described by F. E. Bash, of the Driver-Harris Co., New Jersey. Improvements in these materials have greatly increased the difficulty and

the time required in their testing; the present test temperature, 1,175° C., is 110° C. higher than that originally standardized, but wires last as long to-day at this temperature as was the case formerly with the lower temperature.

In the sub-group on the progress of metallography, the papers were again classified into sections on micrography, X-ray interference, electron diffraction and emissivity, equilibrium diagrams, non-metallic inclusions, solidification of ingots and recrystallization.

W. H. Dearden (University of Bristol), contributes a valuable survey of recent progress in the preparation of specimens for macro- and micro-examination, with a very full bibliography on etching reagents, and Dr. A. J. Bradley gives an account of the development of quantitative metallographic X-ray methods. Dr. H. J. Gough summarizes the results of his extensive study of the mechanism of deformation and fracture in metals, while Prof. G. I. Finch, in a paper on electron diffraction in the study of metal films and surfaces, emphasizes that the realization of the full advantages of electron diffraction and of the older methods must lie in their future co-operation. Dr. W. Burgers describes the method of electron-optical observation of metal surfaces. This method permits of the study of phases which are stable only at high temperatures, and of the direct observation of transition and recrystallization processes.

In a paper on "The Solidification of Ingots", Dr. C. H. Desch ably summarizes the somewhat conflicting views of various workers on the causes of inverse segregation.

The Sub-Group concerned with light metals and their alloys contains several papers of a more practical nature. Dr. A. G. C. Gwyer and Mr. H. G. Dyson report recent progress in aluminium casting alloys, and emphasize the increasing use of heat-treated alloys and of grain-refining additions such as titanium. Progress in this sphere in America is summarized by E. H. Dix and Zay Jeffries, while Dr. G. Siebel reviews improvements in magnesium alloys leading to increased resistance to corrosion. Dr. J. L. Haughton describes recent work at the National Physical Laboratory on the development of new magnesium alloys, particularly those containing aluminium and silver, and cerium, cobalt and manganese, which have improved physical properties.

Group B (Inorganic Materials)

Inorganic Materials (Group B) constitute a most interesting section, not only on account of the intrinsic importance of the cements, stones and ceramic materials which it includes, but also because the methods of testing are in a state of active development. Although these materials are in quite a different class, the methods of testing have been, in the past, greatly influenced by those devised and used for the ductile materials. The proceedings of the Conference may therefore be generally looked to for information as to the tests and procedure which are being found most practicable and reliable.

One of the difficulties met with in carrying out tests is the time required for the materials to mature or 'age', and a typical paper is that in which A. Brund (Härnösand, Sweden) submits the results of tests hastened by means of electric heating. Heat is generated in the paste by alternating current, and thereby accelerates the reaction between water and cement. The resistance is found to decrease during the first period of hardening, reaching its minimum as binding begins and increasing during the later period of hardening. It is claimed that the heat development and curing automatically regulate one another, thus ensuring uniformity of hardness throughout the specimen and a smaller amount of variation in the test results. Variations arising from the personal element introduced in mixing, mould filling and compacting are also a source of difficulty in standardizing tests, and the improvement in this respect effected by the use of a high-frequency vibrator, and the several steps and reasons which led to the use of this machine, are described by Dr. W. H. Glanville (Road Research Laboratory, Harmondsworth). In several papers, suggestions are put forward recommending variations which have been made in laboratory technique and found satisfactory.

Several reports of studies on the control and measurement of the heat of hydration of cements in large masses are presented. Dr. F. M. Lea (Building Research Station, Garston) discusses the merits of the present methods of measuring its value. The 'heat of solution' method is the calculation of the difference of the values for hydrated and unhydrated cement in a nitric-hydrofluoric acid solvent. The adiabatic calorimetric method, in which the samples are stored so that no heat is lost and the temperature therefore rises in proportion to the heat evolved by the hydrating cement, is considered to be more reliable. In "Methods of Testing Cements for Large Dams", B. Hellström, judging from comparative tests carried out at different laboratories in England, Sweden and Norway, regards this latter test as sufficiently accurate for adoption as a routine method. Dealing, on the other hand, with the control of this heat, P. H. Bates (U.S. National Bureau of Standards) directs attention to three different methods by which cements of low heats of hydration can be produced, the first and most usual being to effect a change in composition in one of several possible ways, the second being a process of pre-heating the clinker, and the third depending upon a system of partial pre-hydration in an atmosphere of steam at 212° F. No very definite data are, however, available as to the relative merits of these methods.

Numerous issues are raised in connexion with the action of different qualities of water on cement which is immersed, and several of the contributors deal with one or other of these. In describing some properties of *ciment fondu* and, in particular, its resistance to the action of soft waters, E. Rengade advances the view that the chemical resistance of a mortar is not necessarily directly related to the solubility of its individual constituents, but depends upon the manner in which these are arranged in the heterogeneous mass of which it is composed. Prof. G. Batta (University of Liège) submits some notes on several causes of disintegration, including solubility of constituents and attack by sea-water and by sulphated waters, this last case also being dealt with by G. Baire (Boulogne-sur-Mer Cement Laboratories) in a paper in which he gives the results of mechanical tests on specimens treated with solutions of the sulphates of magnesia and lime.

On the mechanical side, there are several papers devoted to testing, to the value of vibration as a means of compacting and improving the strength of the mixtures and to the grading and workability of aggregates. In his paper, Dr. Glanville sets out a

concept of the term 'workability' as a physical property of concrete, and explains its measurement by analysis of the applied work, the useful work and the useful internal work done on a mix, and by the introduction of a compacting factor to define the degree of freedom from air voids at each stage. Considerable interest is attached to a group of papers dealing with the influence of the compressive strength of concrete in relation to the yield point of steel on the degree of safety of beams, particularly those presented by Prof. Rudolf Saliger (Vienna) and by F. G. Thomas (Building Research Station, Garston). In this section, too, a prominent feature is the analysis by Prof. M. Roš (Zurich) of the stresses and deformations produced in cement pipes by internal and external pressures and by bending moments such as may be imposed upon them.

Group C (Organic Materials)

In Sub-Group 1 (Textiles), an extensive review of chemical tests at present applied to textiles as well as to accessory materials such as oils, sizes and wetting-agents, is given by Dr. H. Phillips, while B. H. Wilsdon provides a similar summary of mechanical tests. Among individual tests, determination of resistance of fabrics to wear is critically examined by R. Severi, who proposes the use of the fabric itself as an abrasive, and by Dr. F. Maillard, who maintains the desirability of abrading the fabric on both sides. Methods for measuring the fastness to light, washing and perspiration of dyed textiles are described by W. D. Appel, whereas a method for determining the fading of dyes and pigments, claimed to give reproducible results independent of the observer, is put forward by R. Toussaint. The detection of damage, especially of a chemical nature, produced during finishing of artificial silk, is discussed in considerable detail by W. Weltzen. Means of assessing the resistance to anærobic bacterial attack of textiles used for building and insulating purposes are described by Dr. J. P. Pfeiffer and H. Eilers. An accurate calorimetric method for determining cotton present in asbestos yarn is proposed by Dr. R. de Benedetti.

Sub-Group 2 (Wood Cellulose) consists of nine papers by authors representing six separate countries.

Cellulose has not yet been isolated as an absolutely pure chemical individual, but it has been established that the celluloses from all known sources have certain well-defined constitutional and structural factors in common. Dr. De Witt Smith (U.S.A.) points out that a wide gap exists between our knowledge of the cellulose molecular chain and the fibril, which latter is large enough to consist of several million molecular chains side by side. This gap has been bridged to some extent by the discovery that fibrils can be broken down to smaller units which have been variously named 'dermatosomes', 'granules', 'crystals' and 'fusiform bodies'. These smaller units appear to be held together in the fibril by a cementing material of a pectic nature.

So far as wood cellulose is concerned, W. G. Campbell (Great Britain) indicates that the chief constitutional point at issue is the relationship between that portion which consists of anhydroglucose residues and the remainder. The suggestion is advanced that, although immediately after formation all celluloses may be chemically identical, their respective constitutions may be modified by purely physiological agencies which may vary from species to species in the plant kingdom or even from organ to organ in the same species. A second paper on wood cellulose by Dr. Forster (Great Britain) is to be published in the Congress book. Prof. H. Mark (Austria) discusses the present position regarding the influence of fine structure on the properties of artificial fibres. Although artificial fibres, the properties of which emulate those of the natural fibres, have been prepared, research is still required in order to establish all the conditions necessary for the attainment of consistently reproducible results. Dr. G. Hostomský (Czechoslovakia) describes the Hoeppler viscosimeter and discusses its application to the control of rayon pulp manufacture. Four papers by Prof. G. Jayme (Germany), D. Johansson (Sweden) and L. G. Cottrall (Great Britain) respectively, offer a comprehensive review of current practice in the testing of pulp and paper.

Sub-Group 3 (Timber Preservation) consists of ten papers dealing with the structure, mechanical properties and preservation of timber. A. Nowak (Austria) mentions recent successful moisture proofing of plywood, etc., by impregnation with wax dissolved in an organic solvent, the solvent being afterwards recovered. Owing to the use of creosote for other purposes, many countries are turning to oil emulsions and water-soluble salts for preserving timber against decay. Leise (Germany) further describes the use of water-soluble salts, and mentions the development of the bichromate mixtures which, by depositing insoluble compounds in the wood, are rendered highly resistant to leaching. The lack of a uniform practical definition for the fire resistance of wood is mentioned by E. Azzarello (Italy), who describes four tests which he has adopted for inflammability, flame propagation, flame penetration and rapidity of carbonization. A. Breazzano (Italy) describes a laboratory toxicity test for wood preservatives in which thin samples of wood soaked in the preservative solution are placed in large tubes, and a small piece of active inoculum attached to one face of the sample. The toxicity of the preservative is measured by the minimum concentration which will prevent the hyphæ passing through the thin slip of wood and showing on the opposite face. The author claims that this method gives maximum accuracy and much quicker results than the method adopted at the Berlin Conference in 1930.

The use of large wooden beams built up of pieces of relatively small dimensions is an increasingly important aspect of wood utilization. P. T. Landsem (U.S.A.) describes the properties of such beams and quotes the efficiencies of the various types of connexions. Using the modern type of ring shear connectors, it is possible to obtain an efficiency of 95 per cent, whilst beams built up of laminations placed horizontally and glued together are easily made stronger and stiffer than equivalent solid beams by proper selection of material.

Products discussed in Sub-Group 4 (Ageing of Organic Materials) comprise hydrocarbon oils, bitumens, rubber and some textiles. Methods of following the course of oxidation of mineral oils in general are discussed by Dr. G. Barr, while the detection of ageing in oils and bitumens used for special purposes, chiefly lubrication and insulation, is dealt with by Dr. F. Evers and by Dr. H. Stäger. Rapid methods for testing the physical properties of asphalts and bitumens are described by Prof. R. Matthis, who also proposes the use of *p*H determinations for testing the ageing of materials soluble in or extractable by water. The causes, effects and methods of detection of ageing in vulcanized rubber are brought under review by B. D.

Porritt and Dr. J. R. Scott. Methods used in the United States for testing ageing of rubber, paper and silk are described by W. E. Emley. The testing of road tar is discussed by G. Batta and that of asphaltic bitumens by Dr. J. P. Pfeiffer and R. N. J. Saal.

A general tendency towards elimination of the personal factor in testing is discernible in Sub-Group 5 (Colours and Varnishes), as may be seen from the general review by Dr. L. A. Jordan of methods of assessing behaviour of paint films in practice, and the description by Dr. E. Rossmann of test methods used in Germany. An apparatus for measuring the fastness of colours to soap solutions, water and perspiration, also designed to eliminate the personal factor, is described by W. Kaczkowski, while Prof. A. R. Matthis puts forward a simple and rapid method of measuring fluidity of oils such as are used in the paint and varnish industry. The corrosive action of insulating varnishes on copper receives attention in a paper by Dr. G. Rossi. Theoretical considerations of the effect of oxidation, polymerization and addition of plasticizers on the molecular structure of oil films are made use of by Dr. A. V. Blom to explain the effect of such agents on the mechanical properties of the paint and varnish films afterwards produced. A plea for more rational terminology in the industry is brought forward by H. Rabaté.

Group D (Subjects of General Importance)

The papers comprising Group D of the Congress are described as covering "Subjects of General Importance". They actually fall into three sub-groups: (1) the relation between the results of laboratory tests and behaviour in use and service; (2) the bearing of recent advances in physics and chemistry on the knowledge of materials; and (3) the properties of materials for the thermal and acoustical insulation of buildings.

The papers under (1) deal in a general way with problems which are more fully discussed in other sections, in relation to specific materials. The reviews of testing methods do not bring anything new before the Congress, but three papers, which from their titles may raise more important questions, have not been received in time for printing in advance. A paper by Sir Robert Hadfield and S. A. Main directs attention to the impossibility of imitating service conditions exactly in any laboratory test, and to the fact that most such tests are really designed to ensure that a given material conforms to a standard which has been found in practice to be satisfactory. It is pointed out that there is still no satisfactory means of determining resistance to abrasion, or the wearing quality of cutlery, whilst the behaviour of such parts as the pistons and piston rods of steam and pneumatic hammers under repeated shock is still imperfectly understood. Accelerated tests for resistance to corrosion are also very uncertain in their indications. M. Roš deals with the general question of factors of safety, giving values for a number of concrete instances.

Sub-Group 2 includes, besides several papers of a general character, an account of the methods to be adopted in testing for flaws in metals by means of gamma rays, by F. Guyot, and a short comparison between the methods of testing by X-rays and by rádium, by Dr. V. E. Pullin. A. Pogány describes the study of the propagation of cracks in such masses as cement or concrete while under load in a testing machine by means of a microscope employing vertical polarized light. The gradual separation of the grains of sand from the matrix in a cement briquette can be clearly followed in this way. Sir Gilbert Morgan and his colleagues review the principal types of plastic materials of chemical origin, including synthetic resins and rubber-tar products, together with an account of the improvement of tar for road purposes by adding to it a calcium soap. The equations which have been proposed to describe the flow of dispersed systems are surveyed by M. Reiner.

The third sub-group is more homogeneous. The problems of insulating buildings against heat and sound are closely related, although the best materials for the one purpose are not necessarily the most suitable for the other. Several papers deal with the practical methods of studying the efficiency of different means of insulation against sound, particulars being given of the laboratories at Brussels, Berlin, Stockholm and Teddington, whilst P. Sabine, of the Acoustics Laboratory at Geneva, Ill., in describing the methods adopted by the American Standards Association, urges a careful standardization of test procedure among the various laboratories which are co-operating in this field. It is desirable that, by applying a correction factor to the results from any given laboratory, comparable figures should be obtained from which coefficients of wide practical applicability can be derived. Porous materials, such as slag or glass wool or various organic fibres, are used for both thermal and acoustical insulation, as is a construction consisting of sheets of solid material separated by air spaces. Dr. E. Griffiths refers to the use of lightweight concrete, made by mixing with the cement some substance which can cause the evolution of a gas and the production of a stable foam. With such an aggregate as pumice, foamed slag, or expanded slate, a very light concrete of open texture is obtained, with fair mechanical strength. The subject of protection against noise is one of public interest at present, and this series of papers provides much useful information concerning it.

Heredity versus Environment

IN a paper recently presented before the Eugenics Society, Dr. David Forsyth returns to that interminable argument 'Heredity *versus* Environment'. By him, heredity is taken to imply transmission from one generation to another, this transmission comprising structural and functional tendencies to develop organic life. By environment he understands the conditions around an organism. He has been examining the commonly accepted view that heredity and environment play indispensable parts in development, and that each operates separately from the other, and now finds it quite impossible to entertain this view any longer.

If, Dr. Forsyth argues, heredity and environment are indeed independent of each other, then it should be possible logically to trace the extent of the sphere of influence of each, their influences should be detectable separately, and their origins should be different. If this should prove on examination to be impracticable, then it must become necessary to jetison the present-day concept of heredity and environment as being two discreet forces, and to replace this by another more in harmony with the facts. If, as is done nowadays, heredity, as a term, is applied only

to the germ cell and to what that cell comprises at the moment of fertilization, all factors outside this fertilized ovum which may affect it being regarded as environmental, then, as Dr. Forsyth proceeds to show, the use of these terms quickly leads into error.

The fertilized egg, with its chromosomes and genes, has long been residing within its environment: the maternal body. It grows and differentiates, and soon, within the embryo that evolves, the gonads appear. These have now a multiple environment: the embryonic soma, the maternal body and the outside world. It is taught that the embryo's body is hereditarily derived, whilst the mother's is environmental; but, according to this argument, there must have been a time when the mother's body itself was the product of inherited factors exclusively, so that what was heredity at one time is now environment! The terms are apparently interchangeable, and therefore lose their distinctiveness. Then again, the embryo, just as do the chromosomes and genes themselves, grows because nutriment of every kind passes into it from its outer world. Thus the embryo itself must necessarily be a compound of heredity and environment, the two so inextricably intermingled that it is beyond our powers to disentangle them. This division of heredity and environment is purely hypothetical and artificial, and, Dr. Forsyth maintains, lacks experimental confirmation.

Dr. Forsyth then proceeds to argue that an environment itself can be inherited. The character of an individual is deeply moulded during early childhood by its parents. The latter are environmental influences. The characters of these parents were, in turn, largely fashioned in their childhood by their own parents; and these by theirs. Dr. Forsyth asks if this is not an instance of the transmission of hereditary psychological qualities. If so, then the moulding of a child's nature by its parents is environmental only when its own generation is taken into account, and, from the wider view of successive generations, it is hereditary.

These extracts, taken from Dr. Forsyth's paper, may serve to show that what he has to say must necessarily be of interest to the philosopher. The biologist, and especially the geneticist, will be provoked to wonder how Dr. Forsyth's difficulties arose. It is clear that they have their origins in the definitions he employs and in his lack of contact with experimentation. Did he but seek his solutions in the laboratory rather than in the library, he would quickly persuade himself that it is eminently possible to disentangle genetic and environmental forces and to study them separately. To all intents and purposes it is possible to stabilize and standardize the environment and, in this, examine the effects on development of different genes and, by using genetically identical individuals, to study the effects of different environmental factors. It is impossible to deny the facts revealed and abundantly confirmed by genetic experimentation, or to disregard the firm conclusions which have teen built so carefully upon them. There is no real conflict between the hereditarian and the environmentalist: each is right and both are wrong, for the simple reason that without an environment there could be no expression of genetic potentialities, and, in the absence of the power to become, no environment can evoke anything. Nevertheless, though the two are at all stages of the individual's development so interwoven, it is possible, by appropriate experimentation, to separate them and to study each alone.

Science News a Century Ago

The Royal Institution

ACCORDING to the *Gentleman's Magazine*, the anniversary meeting of the Royal Institution was held on May 1, 1837, the Duke of Somerset, president, being in the chair. "The report of the visitors announced that, after a long season of difficulty, the Institution was now placed in that independent station, which as the most active and popular establishment in the Empire, adorned with the celebrity imparted to it by more than one great philosopher, it ought always to have occupied. The whole of the debt had, during the past year, been cancelled, and a balance now existed in favour of the Institution. The premises were in a state of substantial repair, and the visitors expressed a hope for the speedy accomplishment of the proposal of giving to the exterior of the building an appearance more in accordance with the importance of the scientific body to which it belongs. The thanks of the meeting were voted to Mr. Faraday, for his devotion and services to the interests of the Institution, and the usual ballot for officers took place."

Power of Galvanism

THE issue of the *Dublin Journal of Medical Science* of May 1, 1837, contains the following note. "A paragraph is going the rounds, said to have been extracted from a late foreign Journal, but which, however, we cannot find in any of our exchange favours, which describes the restoration of speech, taste and hearing in a Polish officer who had been deprived of them ever since the battle of Ostrolenka in consequence of an unsuspected discharge of cannon. The concussion was so tremendous as to throw him down; and although there was not the slightest external wound, when he recovered himself he found that two of his senses, viz., taste and hearing, as well as the power to articulate words, were completely gone. All the eminent physicians of Vienna had made trial of their skill to restore the loss, but ineffectually. Being finally conveyed to Paris, the advice of M. Magendie was sought. He applied the galvanic fluid to the tympanum, and by that means speedily overcame the deafness."

Lyell and his "Principles"

WRITING to his sister on May 3, 1837, about his book "Principles of Geology", which had appeared during 1830–33 in three volumes, Lyell said: "I have at last struck out a plan for the future splitting of the 'Principles' into a 'Principles' and 'Elements', as two separate works, which pleases me very much, so now I shall get on rapidly. The latest news is, that two fossil monkeys have at last been found, one in India contemporary with extinct quadrupeds, but not very ancient—Pliocene perhaps—another in the South of France, Miocene and contemporary with Paleotherium. So that, according to Lamarck's view, there may have been a great many thousand centuries for their tails to wear off, and the transformation to men to take place."

William Henry Barlow on Lighthouse Illumination

ON May 4, 1837, Peter Barlow (1776–1862) communicated to the Royal Society a paper he had received from his son William Henry Barlow (1812–1902) entitled "On the Adaptation of Different Modes

of Illuminating Light-houses, as Depending on their Situation and the Object contemplated in their Erection". The paper was contained in a letter sent from Constantinople on March 14, 1837. The younger Barlow had been trained as an engineer at Woolwich Dockyard, and in 1832 had been sent to Turkey by Mandslay, Sons and Field, to erect cannon-boring machinery, and had then been employed by the Turkish Government on the erection of lighthouses at the Bosphorus entrance to the Black Sea. The object of his paper was to investigate the principles on which the illuminating power, resulting from the employment of reflectors and of lenses, depends. He had arrived at the inference that the advantage gained by the employment of lenses does not arise from their superior perfection as optical instruments, but from their using the light more economically, in consequence of their producing less divergence of the rays both horizontally and vertically, and illuminating a much smaller space on the horizon.

Peter Barlow was for forty-one years professor of mathematics at the Royal Military Academy, Woolwich; his son became famous as a railway and bridge engineer, and was one of the committee appointed to consider designs for the Forth Bridge.

The Worary Poison

At a meeting of the Medico-Botanical Society on April 26, reported in *The Lancet* of May 6, 1837, Dr. Hancock showed specimens of the worary plant gathered from the mountain Courantine on the Rio Parime, with a bundle of arrows poisoned thereby. Dr. Hancock said that worary was undoubtedly a species of *Strychnos*, although its flowers had never been seen by any botanist. The poison was put up in small gourds or fruit capsules of the worary plant, and the arrows were propelled by blowing them through a reed formed of a slender spike of palm. Divers false reports had been published with regard to the manner in which the poison was prepared and its toxicological effects on the animal economy. Many native charlatans living near the settlement made Europeans believe that it was formed of a great variety of substances, such as pepper, serpent's teeth and other such ingredients. The genuine poison, however, was undoubtedly prepared as an extract formed solely from the bark of the plant. Its mode of action was curious, for though when introduced into the blood it soon became fatal, when taken into the stomach, it produced no sensible effect, in which respect it differed from every other species of the *Strychnos* family.

United Service Museum, Whitehall

The *Gentleman's Magazine* of May, 1837, gives the following account of the activities of this museum at that date: "Dr. Ritchie has begun a series of lectures on experimental Philosophy—the properties of matter —statics, mechanics, strength of materials, laws of motion, hydrostatics, etc., and Dr. Lardner is delivering others on the particular subject of steam communication with India.—Captain Norton, late of 31st regt., is also about to discourse on rifles, shells and sundry modern projectiles, with some remarks on the Boomerang, or New Holland spear, and on the ancient Balista. . . . . Already has the Museum acquired respectable funds from which it is proposed by the Council to found a permanent Professorship for the instruction of the members in mathematical and experimental science."

University Events

Belfast.—Dr. J. H. Biggart, at present lecturer in neuropathology in the University of Edinburgh, has been appointed to the Musgrave chair of pathology as from October 1 next.

Birmingham.—Prof. L. G. Parsons has accepted an invitation to deliver the opening address at the annual meeting at Niagara Falls, Ontario, of the Canadian Society for the Study of Diseases of Children, and Prof. H. Beckwith Whitehouse, of the Department of Gynæcology, is to represent the British Medical Association at a conference at Ottawa in June next.

Cambridge.—It is recommended that the degree of M.A., *honoris causa*, be conferred upon Colonel F. J. Hayter, honorary keeper of the Australian and Fiji Collections at the Museum of Archæology and of Ethnology since 1928.

The Linacre Lecture will be delivered by Prof. A. V. Hill, Foulerton professor of the Royal Society, on May 10, at 5 p.m., in the lecture room of physiology. The title of the lecture will be, "The Heat-Production of Muscle and Nerve: A Critical Survey".

Oxford.—Prof. T. G. B. Osborn, of the University of Sydney, has been appointed Sherardian professor of botany, as from October 1 next (see p. 746).

Dr. J. L. Stocks, vice-chancellor of the University of Liverpool, has been elected an honorary fellow of St. John's College.

Societies and Academies

Dublin

Royal Irish Academy, March 16.

J. J. Dowling and T. G. Bullen: Precision measurements with a radial deflection oscillograph. The cathode beam is caused to revolve in the annular space between an extra pair of concentric conical electrodes in a modified cathode ray oscillograph. Two applications are specially considered. Using a double frequency synchronized circular time-base, the radial deflection results in a limaçon-like curve. This was employed to measure instantaneously small variations in the radio-frequency of the Droitwich carrier-wave during the U.R.S.I. emission of March 1935. The use of high-speed spiral time bases in 'comparator' measurements of long time intervals (Nature, **137**, 279; 1936) is also dealt with in detail. Preliminary results indicate that the difference in the periodic times of two two-second pendulums can be determined to one tenth microsecond in an experiment lasting less than half a minute. The method is being applied to the measurement of the gravitational attraction constant *G*.

Paris

Academy of Sciences (*C.R.*, 204, 925–1016; March 22).

Henri Lebesgue: A construction of the regular polygon of 17 sides due to André Marie Ampère, from some documents preserved in the archives of the Academy of Sciences.

Charles Achard, Augustin Boutaric and Mlle. Suzanne Thévenet: Viscosimetric researches on solutions of the various proteins of the serum.

JULES HAAG : The theory of oscillations of relaxation.

DIMITRI RIABOUCHINSKY : Some remarks on the vortex theory of the helix.

JACQUES DE LAPPARENT : The kaolinites capable of being rendered active.

HENRI LAGATU and LOUIS MAUME : The agricultural interest of the separate measurement of the nutritive effect and the improving effect of an addition of manure.

CLAUDE CHABAUTY : Series of powers with p-adic coefficients.

PAUL LÉVY : The arithmetic of the laws of probability and the finite products of Poisson's laws.

MLLE. BRITT RANULAC : The derivability of certain functions represented by an integral.

KARL MENGER : A new demonstration of the Euler-Lagrange equation.

CHI-TAI CHUANG : A theorem relating to the directions of Borel of meromorph functions of finite order.

ALBERT TOUSSAINT and SVETOPOLK PIVKO : An approximate method of calculation of infinite multiplane cells in plane stream.

PAUL DUMANOIS and GEORGES DESBROSSE : The classification of heavy combustibles. The relation between the ketene number and the delay in ignition.

HENRI GROUILLER : The light variations of Nova Lacertæ, 1936. A curve is given based on 810 observations made by twenty-five observers,. This nova can be classified definitely in the group II*a* (flash novæ properly so-called).

MLLE. PAULETTE FÉVRIER : The general form of the definition of a logical system.

FRANCIS PERRIN and RENÉ LUCAS : The mechanical actions of elastic thermal waves of liquids.

JEAN ROIG : Electrical and optical measurements on the illumination of helium in the high-frequency discharge.

RAYMOND ZOUCKERMANN : Curves of explosive potential in the case of ionization by collision of the second kind.

HENRI TRICHÉ : A method of studying the corrosion of alloys. By means of the high-frequency spark, extremely thin layers of metal can be analysed : advantage is taken of this to study the composition of the surface layers of an alloy after corrosion by a reagent.

MLLE. MARGUERITE QUINTIN : The hydrolysis of copper benzenesulphonate.

STEFAN PROCOPIU and GEORGE VASILIU : The torsion of an iron or nickel wire facilitates discontinuities of magnetization with an axial alternating current.

SERGE NIKITINE : Theoretical considerations on photodichroism (Weigert effect).

SALOMON ROSENBLUM and MARCEL GUILLOT : Certain regularities in the nuclear levels of radioactive atoms.

MLLE. JEANNE FORET : The synthesis under pressure of the hydrated calcium silicates.

LÉON MALAPRADE : The existence of crystallized cupriperiodates.

R. MICHAUD and E. SEGOL : The recrystallization of aluminium-magnesium alloys.

MME. YVONNE KHOUVINE : The reduction of α-d-glucoheptulose by Raney nickel.

RAYMOND CALAS : The preparation of camphorone and of two stereoisomeric dihydrocamphorols.

MAX MOUSSERON and ROBERT GRANGER : Some cases of reduction caused by organomagnesium compounds.

CHARLES PRÉVOST and JOSEPH WIEMANN : The halogen-argento-benzoic complex compounds. Bromine and chlorine react with silver benzoate like iodine, and the complex compounds formed possess properties very similar to those of the iodine compounds already studied.

LOUIS ROYER : New observations on the thermoluminescence of certain crystallophyllian rocks.

RENÉ BERNARD : The electronic origin of the nitrogen bands in the spectrum of the aurora borealis. Determination of the energy of the exciting electrons.

J. CLUZET and P. PONTHUS : The variations of the electrical conductivity of the air as a function of the barometric pressure, in the pneumatic caisson.

MME. CÉCILE SOSA-BOURDOUIL : The comparative elementary composition of some floral organs.

RENÉ MORICARD and PIERRE DE FONBRUNE : A new technique for the study *in vitro* of the maturation mitoses of the ovum in mammals. The case of parthenogenetic segmentation.

RAOUL LECOQ : Do the fatty acids of high melting point (above 50° C.) upset the food equilibrium in the same way as the fatty acids liquid at the temperature of the organism ?

RENÉ HERPIN : The role of sea-acorns and of serpulæ in the fouling of ships' hulls.

MME. PAULETTE CHAIX : The oxidation and fermentation of glucose by *Propionibacterium pentosaceum*.

CLAUDE FROMAGEOT and GEORGES BOST : The reducing power of living yeasts in the course of alcoholic fermentation.

HENRI COLIN and HENRI BELVAL : Cane sugar gum.

MICHEL WEINBERG and MLLE. MAYLIS GUILLAUMIE : The titration of antitoxic sera.

D. BROUN : The modifications brought about in the action of insulin by the addition of a colloidal suspension (gelatin).

Moscow

Academy of Sciences (*C.R.*, 14, No. 1, 1937).

M. KREIN : Some problems of the geometry of convexities situated in a complete linear space.

D. RAIKOV : Decomposition of Poisson laws.

V. I. SMIRNOV : Solution of a problem of limits for the equation of curves in the case of the circle and the sphere.

W. A. ISHNAILSKI and B. M. BOGOSLOWSKI : Colour of the nitrobenzol derivatives of aromatic amines (4). Auxo-enoid system separated from chromophore.

F. M. ŠEMIAKIN : A new kind of multiple emulsion and on spontaneous formation of emulsion systems.

A. A. JACENKO-CHMELEVSKIJ : Transformation of the plastic matter in wood after the cutting of a tree.

S. A. BOROVIK and A. F. SUSEDKO : Presence of gallium in the samples collected by expeditions of the Lomonsoff Institute of the Academy of Sciences of the U.S.S.R. Greater quantities of gallium are found in minerals of endogenous origin than in those of exogenous origin, and muscovite contains up to 0·1 per cent of gallium.

A. M. ARENSTEIN : Evaporation from water reservoirs overgrown with aquatic plants.

V. KIRPIČNIKOV : Principal genes of scales in carp.

N. N. MEDVEDEV : Body-colour mutants in *Drosophila* as studied by transplantation.

V. P. POPOV : The role of combined water in the frost resistance of winter wheat.

D. TRETIAKOV : Spectacles in the anchovy (*Engraulis encrassicolus*).

Forthcoming Events

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

Saturday, May 1

ROYAL INSTITUTION, at 5.—Annual Meeting.

Monday, May 3

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. H. Rein: "Some Economising Mechanisms as a Condition of the Body's Adaptation to Increased Activity" (succeeding lectures on May 4 and 6).*

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (Huxley Building) at 5.30.—Prof. H. H. Plaskett: "Problems in Astrophysics" (succeeding lectures on May 10 and 13).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Miss Isobel Hutchison: "Plant-hunting in the Aleutian and Pribilof Islands".

Tuesday, May 4

ROYAL INSTITUTION, at 2.30.—Prof. K. S. Krishnan: "Some Aspects of Crystal Physics" (succeeding lectures on May 5 and 6).*

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Sir Thomas Holland, F.R.S.: "The Permanence of Oceanic Depressions and Continental Elevations" (Huxley Memorial Lecture).

Wednesday, May 5

INSTITUTE OF METALS, at 8—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. E. N. da C. Andrade, F.R.S.: "The Flow of Metals".

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. A. W. Nash: "The Fuel Supplies of Great Britain".

Thursday, May 6

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

R. S. Whipple: "Electricity in the Hospital (Faraday Lecture).

Friday, May 7

INSTITUTION OF ELECTRICAL ENGINEERS (METER AND INSTRUMENT SECTION), at 7.—Sir Frank Smith, F.R.S.: "Fundamental Electrical Measurements".

GEOLOGISTS' ASSOCIATION, at 7.30—(at University College, London, W.C.1).—N. E. Odell: "Nanda Devi, Central Himalaya".

Appointments Vacant

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

TWO WOMEN ASSISTANTS at the Low Temperature Research Station, Downing Street, Cambridge, to prepare index of literature of food investigation—The Superintendent (May 3).

ASSISTANT (grade II, ref. 429 *O*), TWO ASSISTANTS (grade II, ref. 426 *O*), ASSISTANT (grade II, ref. 428 *O*), ASSISTANT (ref. 431 *O*), and ASSISTANTS (grade III, refs. 432 *O* and 433 *O*) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (May 7).

LECTURER IN MECHANICAL ENGINEERING in the County Technical College, Worksop—The Principal (May 8).

INSPECTORS OF AGRICULTURAL AND HORTICULTURAL EDUCATION AND RESEARCH for the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1—The Secretary (May 10).

HEAD of the Lancaster Storey Institute Technical College and Junior Technical School—The Director of Education, Education Department, High Street House, Lancaster (May 10).

SUPERINTENDENT OF COMMERCIAL HORTICULTURE for the Middlesex County Council—The Clerk of the County Council, Guildhall, Westminster, S.W.1 (May 11).

UNIVERSITY PROFESSOR OF BACTERIOLOGY in University College Hospital Medical School—The Academic Registrar, University of London, W.C.1 (May 14).

LECTURER IN CIVIL ENGINEERING in the University of Bristol—The Registrar (May 17).

A PHYSICIST and a BIOLOGIST at the Bermuda Biological Station—The Secretary, Bermuda Oceanographical Committee, The Royal Society, Burlington House, W.1 (May 20).

UNIVERSITY PROFESSOR OF PHYSICAL CHEMISTRY in Birkbeck College—The Academic Registrar, University of London, W.C.1 (May 21).

WOMAN LECTURER IN GEOGRAPHY AND PHYSICS in the Huguenot University College, Wellington—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (May 25).

METEOROLOGIST for the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (May 31).

CHEMISTS in the War Department—The Under-Secretary of State (C.5), War Office, S.W.1 (quote Appts. 30).

ASSISTANT IN ENGINEERING in the County Technical College, Dartford—F. L. Notley, 11 Essex Road, Dartford.

TWO ASSISTANT LECTURERS in MATHEMATICS in the Royal Holloway College, Englefield Green, Surrey—The Principal.

LECTURER IN ENGINEERING in University College, Rangoon—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, W.C.1.

HEADMASTER of the Worsley Junior Technical School and Technical Institute—The Secretary, Worsley Higher Education Committee, Town Hall, Walkden, near Manchester.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 51: Research on Thin Layers of Tin and other Metals. 3: The Interaction between Metals and Lubricating Oils. By P. J. Hariughauzen and D. A. Was. Pp. 10. (London: International Tin Research and Development Council.) Free. [94

Report of the Rugby School Natural History Society for the Year 1936. Pp. 58. (Rugby: George Over, Ltd.) [94

Other Countries

Stammering: its Cause and Cure. The Handbook of the Stammerers' Club of New South Wales. Pp. 72. (Sydney: Stammerers' Club of New South Wales.) [124

U.S. Department of Agriculture. Circular No. 411: A Study of Arsenical Dusting of Cabbage in relation to Poison Residues. By Chas. E. Smith, W. J. Reid, Jr., P. K. Harrison and C. O. Bare. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [124

Bulletin of the American Museum of Natural History. Vol. 72, Art. 7: Siwalik Antelopes and Oxen in the American Museum of Natural History. By Guy E. Pilgrim. Pp. 729–874. (New York: American Museum of Natural History.) [124

Publications of the Observatory of the University of Michigan. Vol. 7, No. 1: The Tower Telescope of the McNath-Hulbert Observatory. By Robert R. McNath. Pp. 56+19 plates. (Lake Angelus, Mich.: McNath-Hulbert Observatory.) [124

Universidad Nacional de Cordoba: Facultad de Ciencias Medicas. Registro e Interpretacion de la Actividad Cardiovascular del Lactante Normal. Por Dr. Angel S. Segura. Pp. 118. (Cordoba: Universidad Nacional.) [124

Ministero dell'Interno: Istituto di Sanità Pubblica. I medicinali e il metodo Rinaldi per la cura delle artriti. Per D. Marotta, G. Lazzarini, A. Calò. Pp. 38. (Roma: Istituto di Sanità Pubblica.) [134

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 13: An Annotated Catalogue of Sugarcane Varieties in Mauritius, Present and Past. Compiled by A. Glendon Hill. Pp. 37. (Port Louis: Government Printer.) [134

Union of South Africa: Department of Mines: Geological Survey. Memoir No. 30: A Bibliography of South African Geology for the Years 1931 to 1935 (inclusive). Authors' Index by Dr. A. L. Hall. Pp. 168. (Pretoria: Government Printer.) 5*s*. [134

U.S. Department of Agriculture. Circular No. 419: The Fir Engraver Beetle, a Serious Enemy of White Fir and Red Fir. By G. R. Struble. Pp. 16. 5 cents. Technical Bulletin No. 552: Trace Elements in the Soils from the Erosion Experiment Stations, with Supplementary Data on other Soils. By C. S. Slater, R. S. Holmes and H. G. Byers. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.) [134

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 3: Public Affairs Pamphlets; an Index to Inexpensive Pamphlets on Social, Economic, Political and International Affairs. Compilation revised February. Pp. 85. (Washington, D.C.: Government Printing Office.) 10 cents. [134

Washington University Studies (New Series). Language and Literature, No. 6: Ancients and Moderns; a Study of the Background of the "Battle of the Books". By Prof. Richard Foster Jones. Pp. xi+358. (St. Louis, Mo.: Washington University.) 3 dollars. [134

Ontario Research Foundation. Report for the Year 1936. Pp. 31. (Toronto: King's Printer.) [134

Imperial College of Tropical Agriculture. The Principal's Report for the Year 1935–36 and the Accounts for the Year ended August 31, 1936. Pp. 36. (Trinidad and London: Imperial College of Tropical Agriculture.) [134