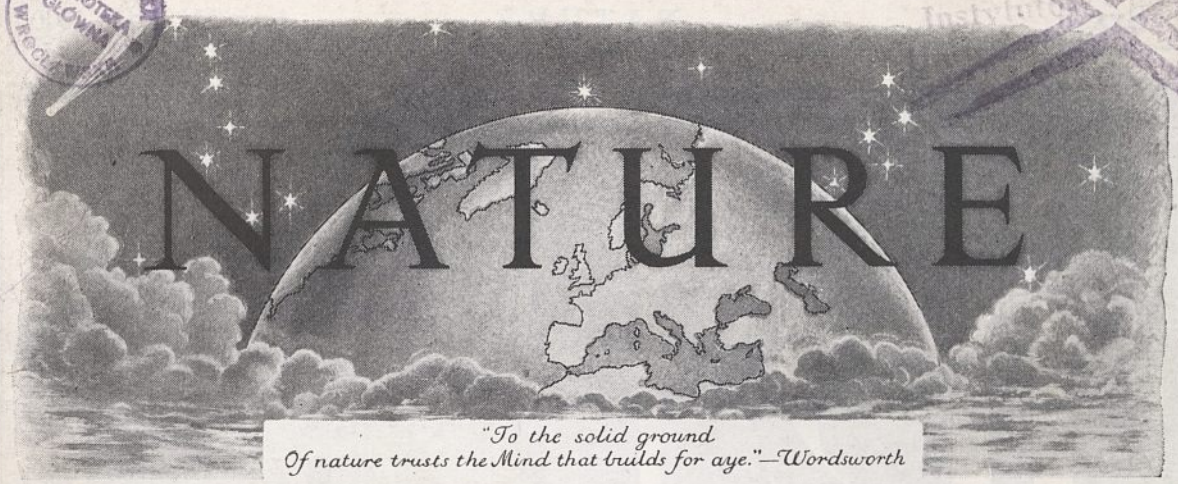

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NATURE

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BOOKS IN WAR-TIME

WILL books be made subject to the Sales Tax proposed by the Chancellor of the Exchequer, and if so what may be the results ? So far as can be ascertained up to the present it is not proposed to allow any exceptions in the home market, outside the domain of food and drink, and the resultant anxiety of all who are familiar with book-trade economics would undoubtedly be shared by every thinking man if the very special facts of the case were generally understood. In the following very brief survey of a very complex problem, it has been impossible to attempt more than the sketchiest of outlines, but it may be hoped that it will do something to correct some common misapprehensions and perhaps enlist some sympathy for the claim of books to special consideration. This claim has been emphatically put forward by the National Book Council, in an urgent call for action recently circulated to every society and association of a cultural nature.

To the printed book we owe the preservation of the philosophy, the scientific knowledge, the religion and the poetry of the past. Upon the book depends the comparative examination of rival theories, the precise record of all experimental work. In short, civilization as we know it to-day is the child of the printed word, and upon the printed word, written under the twin inspirations of intellectual freedom and love of truth, depends all hope of further progress.

Out of the almost universal recognition of these truisms there has arisen a tradition, never yet over-ridden in Great Britain, that a tax upon books would constitute an unfortunate impediment to free speech and a tax upon literature and learning. It is therefore not surprising to find that the National Book Council is exerting itself actively to organize, before it is too late, effective opposition to the proposition now under review. The National Book Council was founded in 1927 to promote the use and appreciation of books of all kinds, from the novel to the technical treatise, and the membership is open to all who care for books.

The letter to which reference has already been made was sent at the instance of this body's Consultative Committee, through which is maintained liaison with many of the most important educational bodies, learned societies and social organizations in the country.

In this Committee's manifesto, it is claimed that the application of a sales tax to books would be "inimical to the best interests of research, study and recreation", and that "in addition it would tend to disrupt still further the whole educational programme of the nation—a programme already suffering from disorders caused by the war". Let us examine this claim.

The Chancellor of the Exchequer, in introducing the principle of the sales tax, made it clear that its purpose is at least as much to discourage internal expenditure as to raise funds towards the successful prosecution of the War, and from this it is fair to assume that in the eyes of the Government books are to be regarded simply as a commodity, just like any other, the consumption of which must be discouraged as cheerfully as, perhaps, the luxury cosmetic or the unnecessary spare suit. This attitude, which is discouraging to all who deplore the widespread tendency to regard books as luxuries, cannot be allowed to pass unchallenged, if the nation is not to find itself without books, publishers to produce them or

booksellers to sell them. Fortunately there is hope of persuading the Government that books have, quite apart from their cultural influence, a very considerable economic value to the nation at war, besides being absolutely essential to the presentation of the British case to the eye of ally and neutral.

In this connexion we cannot do better than quote the following paragraph from a "Memorandum on the Export of Books" submitted to the Export Council by the Publishers' Association: "The 'cultural' value of books is unique. The word 'cultural' does not at all adequately express what we have in mind and has narrow academic associations which we would gladly avoid. Nor is 'propagandist' a better word. What the book trade does, in general and apart from the particular purposes of particular books, is to publicize British habits, ideas and ideals over the entire world. It is consequently a continuing proof of the reality of the Allied Cause. The variety, vigour and freedom of British civilization are demonstrated through the whole range of its literary output, from the ordinary novel to the most serious critical and scientific works: and this continuous process cannot be allowed to flag without endangering British influence and prestige everywhere."

It has been repeatedly stressed that, for economic reasons, whatever happens to our internal trade, neither the proposed sales tax nor any other war-time legislation should interfere with British export trade. But apparently it is not realized that books, unlike most commodities or manufactured products, cannot be divided up into two water-tight compartments—home and export. The largest part of a book's production cost is the cost of setting up the type, and as this remains the same whether it is to be printed by the hundred or the thousand, it is clear that the largest possible circulation must be aimed at if the price is to be kept at an economic level. Another large fixed expense is the cost of placing the type on the printing machine and of 'making ready' for printing, a skilled and laborious job which is carried out by highly paid craftsmen. By the influence of these two factors is to be explained a large part of the price differences between newly printed books at 7*s*. 6*d*. and more, cheap editions and reprints from standing type at 3*s*. 6*d*. to 1*s*. 6*d*., and "Penguins" at 6*d*. each which, though completely reset, spread the cost over editions of thirty to fifty thousand.

This being so, it is clear that if attractive price-levels are to be maintained in the export markets, the maximum home demand must be encouraged. If the home demand is artificially cut down editions will shrink, and prices will rise so sharply as to destroy the potential demand abroad and make impossible the publication of many books of the first importance. There are unfortunately no reliable statistics in the book trade, but a recently circulated *questionnaire* has shown not only that at least one third of the total book production of Great Britain is sold abroad, but that, in addition, valuable invisible exports are created by the sale of American film rights. If we add to this consideration the claim that the export of British books does much to unite the Empire, to demonstrate the British outlook and ideals all over the world and, incidentally, to prepare the way for the exporters of other British goods, we may reasonably conclude that its importance to the nation is out of all proportion to its monetary value.

It will be generally agreed that on cultural grounds alone, book prices should be maintained within a reasonable distance of pre-War levels. Unfortunately this aim becomes increasingly difficult of achievement, and it seems likely that the strenuous efforts to stabilize prices, which maintained them at pre-War level for the first three months of the War, will be utterly defeated by the situation in Scandinavia. An important factor in price fixing is the cost of paper, and the cheaper the book the more relatively important does this factor become. At the onset of the War, the Government took over the control of all paper supplies. A controller was appointed and a schedule of maximum prices was worked out, promptly imposed, and linked to a drastic rationing scheme which reduced the nation's consumption to 60 per cent of pre-War requirements. This restriction, combined with a heavy percentage increase in the price of paper, had already forced up the price of the standard cheap editions and of many, but not all, of the new spring books, when the Germans invaded Norway and attained the control of the Skagerrak by the occupation of Denmark.

The larger part of the wood pulp supplies which form the basis for most of our paper was cut off at a stroke and no one knows when, or if, it will be available again. The result was immediate and startling. A further increase in prices coincided with a 50 per cent cut in permitted consumption, and this was followed by an

announcement that after the current licensing period a further severe cut in consumption, possibly up to another 50 per cent, will be necessary. At the time of writing, therefore, the book trade is wondering what it can usefully do with 15 per cent of its pre-War paper consumption, at prices more than 60 per cent above pre-War levels.

With wages, rates and fuel costs rising in competition, with compulsory war risks insurance to pay, and with the problems of evacuation to contend with, the situation was already critical for bookseller and publisher alike. Increased production costs call for 'longer runs', but such a scarcity of material will not only make this impossible but also will necessitate, on the contrary, much smaller editions than usual. It is difficult therefore to see how publishers will be able to avoid for much longer a dangerous increase in price-levels at a time when Government policy is to prevent general inflation and, by taxation, both direct and indirect, to limit internal expenditure. Already, we believe, the sale of new fiction and general literature has dwindled to a fraction of its pre-War volume, but the demand for books on the War and international politics, official Blue Books, memoranda and handbooks, together with standard cheap editions of the classics, old favourites and popular reference books, has gone far to cancel out the drastic effect of the evacuation in London and other evacuation areas, while elsewhere business has been quite brisk. But the War has scarcely begun, paper shortage has only just begun to take effect, and the real price increases are not yet upon us, though close at hand. The outlook of the immediate future, so far as book production is concerned, is gloomy in the extreme.

To this situation is now added the threat of a sales tax which may be anything from 5 to 25 per cent on to prices which by then will already have risen. Such an impost would be a veritable tax on literature and culture. Books are often the first objects of personal economy, and this can unfortunately also be said with equal truth of the councils and committees of local government and public education. Even in peace-time conditions expenditure per head on books in Great Britain is very much below that which is accepted as normal to the Finns, the Germans the Scandinavians or the French. As has been said, no statistics exist, but it has been possible to make approximate estimates within a generous margin of error, and as a typical illustration it may be of interest to recall that according to the estimate of the Consultative Committee on Books in Public and Elementary Schools which reported to the Board of Education in 1928, the average annual expenditure on books, per head, was certainly not in excess of 1*s.* 8*d.*, and it has not shown much sign of improvement since that date.

Were there greater mental alertness and intellectual curiosity, books would be able to perform adequately the service which they now offer too often in vain, and their producers would be able to supply, at prices within the range of every pocket, new works of literature, of learning and of reference which at present are confined to the shelves of the libraries and the dwindling regiment of the bibliophiles. It is to extend and develop this wider interest in, and appreciation of, books that the National Book Council was formed.

The production of books is authoritatively stated to consume only 2 per cent of the nation's normal paper supplies, and a reversion to the earlier allowance of 60 per cent of normal, which would enable the publishers to carry on with reasonable efficiency, would therefore call for the re-allocation of about 1 per cent of the nation's pre-War supplies. In practice, by careful selection and economy in production, it would probably be possible for the book trade to carry out its important functions on an even lower allowance ; but precisely how much this would be is probably best left to the Publishers' Association.

The present international crisis threatens to bear with undue weight on book production. Learned and educational organizations may be expected to give active support to the appeal for special consideration for books. If disaster to the intellectual life and the intelligent recreation of the nation is to be avoided, books should be exempted from the sales tax and accorded a wholly disproportionate share of the available supplies of their raw material—paper.

Long-range planning is a necessity in book-production as in many other fields, and without an early pronouncement on the position, an important part of the nation's effort is being held up. The case appears to be so strong that the urgent representations now being made can, one may hope, scarcely fail to have their effect. But the desired result will be more quickly and more completely attained if all those who realize the place of books in the social, intellectual and economic fabric of the nation use their influence wherever it may be most effectively applied.

DESCRIPTIVE AND PREDICTIVE SCIENCE

Science To-day and To-morrow

By Waldemar Kaempffert. Pp. 262. (London: Ivor Nicholson and Watson, Ltd., 1940.) 10*s.* 6*d.* net.

MUCH more is done in the United States than in Great Britain to interest the general public in scientific progress. Nearly twenty years ago, the late Mr. E. W. Scripps, a newspaper proprietor and editor, provided a sum of more than 100,000 dollars to establish the organization called Science Service, with a staff of competent writers who simplify and illuminate scientific news for the public Press; and newspapers in all parts of the country are subscribers to this service. Many of the leading newspapers have, in addition, permanent members of their editorial staffs to describe and comment upon scientific matters. Dr. Kaempffert, the author of this book, occupies an honoured position of this kind, as science editor of the *New York Times*; and his contributions are widely read and appreciated. Some of the material in the book appeared originally in that newspaper and other magazines; and all of it represents the reactions of an informed and thoughtful mind to the results of scientific investigations in the realm of natural knowledge.

Each of the eighteen chapters can be read and understood independently of what precedes or follows it, though the general arrangement seems to represent successive aspects of the heavens, terrestrial forms of matter, life, man and the machine. Under the title, "A Star Explodes", the first chapter deals with modern observations of new stars and presents views held by leading authorities as to their origin and nature. There are reasons for believing that, in the course of their existence, most stars are likely to have immense stores of energy suddenly released by the near approach of another body or by conditions of internal instability. The planets of the solar system were formed from streamers drawn out of the sun by the gravitational influence of a passing mass; and a similar explosion may be caused in the distant to-morrow by another approach or by changes of atomic structure. Either of these events would mean the end of the earth and the possible beginning of a new world—organic as well as inorganic. The end of the sun as we know it is inevitable, whether by celestial accident or by loss of radiation through atomic changes discussed in the succeeding chapter; and "man will be blotted out by forces that were hostile to him from the beginning of time and over which he triumphed for a brief hour".

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R. A. GREGORY.

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A. D. IMMS.

ECONOMIC WARFARE

(1) Economic Warfare
By Paul Einzig. Pp. x+151. (London: Macmillan and Co., Ltd., 1940.) 7*s*. 6*d*. net.

(2) The Economic Effort of War
By R. W. B. Clarke. Pp. 252. (London: George Allen and Unwin, Ltd., 1940.) 7*s*. 6*d*. net.

THE volume of informed criticism of the Government's economic policy and the continued pressure for the inclusion in the Cabinet of a Minister for Economic Affairs, which were in no way dispelled by the speeches of the Prime Minister or the Chancellor of the Exchequer in the recent debate on economic organization in the House of Commons, indicate that there is a far more widespread appreciation of the importance of economic questions at the outset of the present War than at almost any time during the struggle of 1914–18. This difference is brought out strikingly in the early chapters of Dr. Einzig's book, and the existence of such interest and informed opinion make the more regrettable the failure of the Government to take the public into its confidence, to explain what is happening and to enlist its co-operation.

To some extent, what the Government failed to do is being done by an admirable series of pamphlets and books on economic questions of the War. The Oxford series of pamphlets on world affairs have included lucid expositions by Geoffrey Crowther of the economic and financial aspects of our war effort. The same aspects have also been discussed in a number of broadsheets issued by Political and Economic Planning (P E P), and Dr. Einzig's volume is a more detailed but no less lucid exposition of these matters, more particularly with reference to the use of economic policy and methods in pursuance of our war objective. If the reader couples with this volume, for example, a study of Mr. R. W. B. Clarke's "The Economic Effort of War", he could scarcely be better equipped to appreciate the significance of the economic factor or exactly what is required of him in the way of intelligent co-operation as a citizen. The Government should be grateful for the invaluable contribution which both these books make towards the education of public opinion and the preparation of the citizen alike for the contribution and the sacrifices which the prosecution of our war effort inevitably entails.

(1) Dr. Einzig does not exaggerate the importance of the economic factor and of economic warfare. While economic factors are likely to play a very important part in determining the outcome of this War, they can only produce their full effect in conjunction with military, naval and air force operations, and in his realistic analysis of the situation he emphasizes the necessity to prepare for a prolonged struggle. In regard to productive capacity, he stresses the importance from the outset of taking steps to increase the production of those goods which are required directly or indirectly for national defence purposes or are essential for the maintenance of the civil population, as well as to reduce or stop the production of non-essential or luxury goods, even if they only interfere with the increase of production of essential materials. Stress is also laid on the collection of statistical material as a basis for reorganization to enable national production to replace imports as far as possible.

The Government is criticized by Dr. Einzig for not taking adequate measures in some such fields, notably in regard to agriculture, prior to the outbreak of the War, but pays tribute to the rapidity with which emergency legislation was adopted within a few weeks of the outbreak of the War. After examining problems of production, distribution and consumption, foreign trade, public finance and foreign exchange he proceeds to discuss the methods of economic warfare and the war economy of Germany, France, Japan, the Soviet Union and the United States, as well as of Italy, before reaching his emphatic but reasoned conclusions that the superiority of the economic resources at the disposal of the Allies compared with those of Germany will in the long run be of decisive importance.

Dr. Einzig is under no illusion as to the intensity of the effort or sacrifices involved. He advocates ruthless rationalization, for example, and strong measures against luxury consumption, and he is prepared to support both industrial conscription and the conscription of labour. In this he differs from Mr. Clarke, who considers that from the military point of view, or that of public morale or increasing output and efficiency, it would be a mistake to try to impose industrial conscription at the present time. Mr. Clarke stresses the important contribution which the trade unions have to make to the national effort, and the necessity of enlisting that co-operation freely.

Dr. Einzig is, indeed, on the whole less critical of the Government effort than Mr. Clarke, though no less bold in his outlook or suggestions. His criticism is indirect or implied rather than direct, whereas Mr. Clarke's two chapters on Government control and the first six weeks of the War are among the most valuable in his book and

should be of special interest to scientific workers. Their constructive criticism affords one of the best presentations of the argument for Cabinet reconstruction and the necessity of a Ministry of Economic Planning with its appropriate General Staff that has yet appeared.

Both these books should, in fact, be widely and appreciatively read, and should, as already indicated, assist in that educational work indispensable in our war effort, which the Government itself has largely neglected. It may well be hoped that their constructive criticism and suggestions—Dr. Einzig makes a shrewd comment and suggestion regarding economic propaganda and its use to undermine German economic morale which it is to be hoped will not fall on deaf ears—will be duly weighed by the Government as well as the general public. At least it is certain that these excellent contributions to the growing mass of useful literature on the economic side of the War will contribute to the rapid formation of a public opinion which will render it impossible for the Government to continue its hand-to-mouth policy and attitude of drift in economic matters. They should force upon it the coherent policy, planning and organization which form the indispensable basis for that drastic limitation of non-essentials, comprehensive mobilization of industrial resources and vigorous prosecution of every aspect of economic warfare which are essential to the success of our war effort.

R. BRIGHTMAN.

THE INDIAN FRAGMENT OF GONDWANALAND

Regionale Geologie der Erde

Herausgegeben von Karl Andrée, H. A. Brouwer und W. H. Bucher. Band 1, Abschnitt 6: The Indian Peninsula and Ceylon, by G. de P. Cotter. Pp. 66 + vi. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.)

DR. G. DE P. COTTER, until recently a superintendent of the Geological Survey of India, has utilized the experience of a lifetime spent in the field in India in summarizing the present state of knowledge of the geology of the peninsula. There are no Palæozoic rocks there older than the Talchir Boulder Bed at the base of the Gondwanas, which is regarded, with fair confidence, as Upper Carboniferous. The glaciation was more intense in the south, where ice-scratched rockfloors and boulders occur, whereas in the Himalayas (in Spiti and Kashmir) the representative of the Boulder Bed is a basal conglomerate which may have been deposited by floating bergs. Since India is the only land north of the equator where the Boulder Bed occurs, Cotter is inclined to accept the hypothesis of continental drift and to regard the Indian fragment of Gondwanaland as having drifted northwards from its original home south of the equator, leaving behind it portions of its mass in Madagascar, the Chagos archipelago and the submerged land which forms the platform of the Maldives and Laccadives. Elsewhere the latter is regarded as the extension of the Aravalli Range.

The impact of this great land mass with the "northern continent" occurred, according to Cotter, in the close of the Cretaceous, and is associated with the outpouring of the Deccan Lavas now assigned definitely to the Danian. Incidentally, the evidence is steadily growing that the folding of the Indo-Malayan mountains and the intrusion of the tin-bearing granites of Burma and Malaya are of the same age. Further drifting of the land mass helped in Tertiary times to build the Himalayas and to elevate Eocene marine rocks to heights of more than 20,000 feet.

Cotter accepts the work of Spath on the cephalopods from Upper Gondwana beds of the Madras coast. These beds, once claimed by Waagen as Neocomian but long since regarded on the evidence of plant remains as Middle Jurassic, are now classed as Upper Neocomian, possibly Aptian, so that the Upper Gondwanas range in age from Upper Trias to Aptian, most of Jurassic time being represented by a stratigraphical break.

Most of the book is naturally devoted to the Pre-Cambrian—falling into the two great groups, the Purana or Algonkian and the Archæan. The Purana as a whole are unaltered sediments and in the Peninsula generally horizontal or only slightly disturbed, but in the Aravalli Range there was marked folding in Middle Purana times. The threefold division of the Puranas is into Lower (Cuddapahis and Delhis), Middle (Lower Vindhyans) and Upper (Upper Vindhyans and Karnuls). Cotter admits the many problems still unsolved in the geology of the Archæans but regards as definite that the Bundelkhand gneisses, Singhbuhm metamorphics and Berach granites (Group I) are the oldest rocks of the country; that the Closepet Granite, Charnockites (Group V) and Peninsular or Foliated Gneisses (Group IV) are newer than the metamorphosed sediments (including the Dharwars and Aravallis, Groups II and III) with which they are associated.

L. DUDLEY STAMP.

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

TWENTY-FIFTH ANNIVERSARY

WHEN Mr. J. A. Pease, the then president of the Board of Education, in introducing the Board of Education estimates in the House of Commons on May 13, 1915, announced the impending appointment of an Advisory Council for industrial research in Great Britain, to be specially entrusted with the supervision and encouragement of scientific research particularly in relation to industry, he laid special stress on the importance of providing for the training of the scientific and technical personnel. Already the early months of the War of 1914–18 had revealed the dangers and difficulties in which Great Britain was placed through the neglect of science by industry and the absence of an adequate scientific personnel. We had not merely to make the best use of the scientific men we then possessed, but also to provide a further supply in the future. The debates in the House of Commons on the proposals eventually issued by Mr. Pease's successor at the Board of Education, Mr. Arthur Henderson, in a White Paper (Cmd. 8005), as in the original statement, thoroughly endorsed the Government's proposal to deal with this problem as an integral part of a comprehensive improvement in our educational system. It was indeed originally proposed that the whole scheme should be supervised by the Board of Education, to which the expenditure of £1,000,000 over a period of five years would be entrusted on the advice of the proposed Central Council of Commercial and Industrial Research.

The reports of these debates reveal after twenty-five years the immense debt of the nation to those whose vision and courage launched this venture even in the days of war. That the outbreak of war in September of last year found Great Britain with resources in scientific and technical personnel adequate to meet all demands is due in no small measure to the foresight and energy of such men as Lord Haldane, Lord Balfour and Dr. Addison, and the wise guidance of such successive chairmen of the Advisory Council as Sir William McCormick and Lord Rutherford. Whatever concern may have been expressed as to the use which is being made of available scientific personnel or resources, except perhaps in a few fields such as those of the social sciences, the ability of the scientific workers and the research organization of the country to meet whatever demands may be made upon them by the War is beyond question. Even before the War of 1914–18, scientific workers in Great Britain, if few in number compared with those of some other countries, had many outstanding achievements to their credit and were playing their full part in scientific advance. For the great advance in the numbers of British workers, and unprecedented expansion in the application of scientific research in industry and in every phase of national life in the last quarter of a century, without any impairment of that capacity, no small share of the credit must be given to the Advisory Council of Scientific and Industrial Research, first established by Order in Council on July 28, 1915.

The White Paper which outlined the scheme alluded to the difficulties in which many of our industries had been placed in 1914–15 through our inability to produce at home certain articles and materials required in trade processes, the manufacture of which had become localized abroad, because science had there been applied more thoroughly and effectively to the solution of scientific problems bearing on trade and industry and to the elaboration of economical and improved processes of manufacture. To advance or even maintain our industrial position it was essential to aim at such a development of scientific and industrial research as would place us in a position to expand and strengthen our industries and to compete successfully with the most highly organized of our rivals. The scheme was designed to establish a permanent Department for the promotion of industrial and scientific research.

For this purpose a Committee of the Privy Council was set up, responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research, and an Advisory Council, responsible to the Committee of Council, and composed mainly of eminent scientific men engaged in industries dependent on scientific research. The prime functions of the Advisory Council were and are to advise the Committee of Council on proposals for instituting specific researches, or for establishing or developing special institutions or departments of existing institutions, for the scientific study of problems affecting particular industries and trades, and on the establishment or award of research scholarships or fellowships. The Advisory Council is also available to advise the education departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

The Advisory Council, which met for the first time on August 17, 1915, was further directed to frame a programme for its own guidance in recommending proposals for research and for the guidance for the Committee in Council in allocating such State funds as might be available, designed in advance to operate over some years, having regard to the relative urgency of the problems requiring solution, the supply of trained investigators available, and facilities in laboratories or equipment which could be provided. The method of approach adopted by the Council is indicated in its first report. The Council was under no misapprehension as to the relation between pure and applied science. It was decided to give science in its application to industry precedence over pure science in the Council's deliberations, and after a period of careful inquiry and consultation to initiate a gradual and systematic attack upon a wide and carefully selected front.

The soundness of the policy and principles outlined in the first report of the Advisory Council is attested by the results which have followed from these modest beginnings. Realizing from the start the dependence of the success of its work upon a greatly increased supply of research workers and upon a hearty spirit of co-operation among all concerned, whether scientific workers, business men, professional and scientific societies, universities and technical colleges, local authorities and Government departments, it was recognized also that neither condition would be effective alone. The first condition of success was at the start unattainable, and even at the end of the War of 1914–18 the number of trained research workers was insufficient for the demand. Effective research, particularly in its industrial application, calls increasingly for the support and impetus that come from the systematic team-work of investigators of mediocre ability, working intelligently under the direction of first-class leaders.

The problem of the supply of investigators of the requisite abilities in sufficient number is largely a matter for the education departments. It is not entirely a matter of the provision of scholarships, but depends also on the standard of students entering the universities. None the less, in the first ten years, as the report of the Advisory Council for the year 1925–26 shows, much was done to re-establish a body of scientific workers of the highest rank for purely scientific work, and to enable men who intended to make some branch of industry their profession to equip themselves for scientific work in industry by postgraduate research work.

Of the seven hundred allowances given in the first seven years, nearly four hundred were to students of chemistry, and in its report the Advisory Council expressed the opinion that too many men were encouraged to specialize in chemistry. The records of the Department showed that large numbers of applications were received whenever a post for chemical research was advertised, while the demand for men who combined a study of chemistry with other subjects such as agriculture, biochemistry or botany outstripped the supply. There was also a scarcity of men interested in, and capable of, the application of general physics in industry, a position which has hardly been improved in the subsequent fifteen years, as the experience of the Central Register indicates. Although the proportion of grants held by students in training in biology has steadily increased in recent years, and has for some years been equal to or greater than those held by students in physics, students of chemistry have consistently been at least twice as numerous as those of students in any other branch of science in receipt of grants.

The service which the Department of Scientific and Industrial Research has rendered to the development of pure science is far from being limited to the provision of maintenance allowances for students or even special assistance to independent research workers, whether by helping young research workers of exceptional ability to pursue their work for a limited period without the necessity of finding other employment, by the provision of funds for research or technical assistants or the purchase of special apparatus and equipment, or, in special circumstances, by making really substantial grants. The Advisory Council has consistently shown in its reports a wise concern for the conditions of employment of the research worker, whether in regard to salary or security of tenure ; this is a contribution to the raising of standards in the last two decades which has earned the cordial appreciation of all scientific workers.

In regard to the actual prosecution of research, the record of the twenty-five years work of the Department makes impressive reading. It includes the development and expansion of such institutions as the National Physical Laboratory and the Geological Survey and Museum of Practical Geology, which were already in existence and were taken over by the Department. It includes the establishment of the Fuel Research Station at Greenwich, the Building Research Station at Watford, the laboratories of the Food Investigation Board at Cambridge, East Malling, Chipping Campden and Torry, the Forest Products Research Laboratory at Princes Risborough, the Radio Research Station at Slough, the Chemical Research Laboratory at Teddington, and the Road Research Station at Harmondsworth.

At these stations and under the direction of the various boards or committees of the Department, research has been initiated on a national scale into such fields as fuels, forest products, food, water pollution, transport problems. Simultaneously, through the co-ordinating boards set up in 1920, the research departments of the Fighting Services have not only been placed on a secure footing but also brought into effective contact with the work of the Department. Medical research and agricultural research have also expanded considerably in the period, often in co-operation with the work of the Department, while in 1925 there was formed the Committee of Civil Research to advise on broad questions of national policy involving scientific and industrial research on much the same lines as the Committee of Imperial Defence.

Besides all this co-ordination of existing organizations and initiation of fresh lines of work, the Department has done much to stimulate research on questions of interest to the Dominions and Colonies, and to secure co-ordination with the corresponding departments formed overseas, such as the Council for Scientific and Industrial Research of the Commonwealth of Australia, the Department of Scientific and Industrial Research of New Zealand, or the National Research Council of Canada, notably in investigations on food problems or such matters as Empire timber. In such imperial problems and in the more domestic problems of Great Britain, the Department has succeeded in promoting co-operation between the different interests concerned, whether consumers, manufacturers, Government departments or others in the attack on common problems.

To the extent of that co-operation the development of the research association movement in Great Britain bears emphatic witness. On December 1, 1916, in receiving a deputation of the Board of Scientific Societies, Lord Crewe, as Lord President of the Council, announced the intention of the Government to ask Parliament to place a million pounds at the disposal of the Department to enable it to co-operate with the industries of the country in the foundation and maintenance of approved associations for research during the following five years or more. This fund was duly voted by Parliament and became available in July 1917 ; the scheme had been outlined in detail in a paper issued by the Department in June 1917. The scheme visualized the systematic development of research and the co-operation of science with industry carried out under the direct control of the industries themselves. In this way it was hoped to avoid the danger that, if the work were done by the State or the universities, the results would not be put into immediate operation, and as they would necessarily be published, might become of equal or greater benefit to foreign competitors. Moreover, it was hoped that co-operation of the firms engaged in any one industry might enable research work to be undertaken which could not have been dealt with by a single firm.

The rapid progress made under the scheme was indicated in the excellent account issued in 1927 under the title "Co-operative Industrial Research", and when on the exhaustion of the Million Fund the Advisory Council devoted the greater part of its annual report for the year 1932–33 to a review of the scheme, it was able to point to important practical achievements as well as to evidence that the scheme had contributed to a definite acceleration in the advance of industrial science. The first four associations were licensed by the Board of Trade under the scheme in 1918, followed by ten more in 1917, nine in 1920 and one each in 1921, 1923, 1930, 1937 and 1938 ; two more were formed in 1926, as well as similar organizations in 1929 and 1931, though not of the same formal and legal status, by the National Federation of Iron and Steel Manufacturers and the Institution of Automobile Engineers.

Certain of the associations never became effective, and some after several years active work ceased to operate or became merged in other bodies fulfilling similar functions. The last report of the Department shows, however, that there are still twenty-two research associations in existence, serving a very wide range of industries, and achievements to their credit already offset very largely the expenses of their work. For example, it has been computed that, in the first ten years of its work, the researches of the Electrical Research Association on insulating oils, costing £8,500, had involved savings to the industry of at least £100,000 a year. Further researches on buried cables, costing £18,000, had represented a saving to the industry of at least £250,000 per annum and added four millions to the value of the existing cables. Investigations of the British Cast Iron Research Association, if fully adopted, would result in the saving of fuel and other economies of £200,000 per annum. Almost equally striking savings have resulted from investigations conducted by the Non-Ferrous Metals Research Association on ternary lead alloys used in sheathing cables and for water-pipe service, and by the Refractories Research Association on prolonging the life of saggars.

The significance of such achievements in the present urgent need for national economy in every sphere is obvious, but too much stress should not be laid on such concrete examples. Often it is difficult to assess at all accurately either the direct or the indirect results of such research in stimulating a scientific approach to industrial problems

and the application of scientific knowledge in industry. The Advisory Council has from the start been alive to the importance of securing not merely the initiation of industrial or scientific research but also the utilization of its results by industry. "One of our most important tasks", wrote Lord Rutherford in the 1935–36 report, "is so to organize the conduct of research as to promote contact with industry", and this is one of the main reasons for attaching so much importance to the development of the research association movement. The application and development of scientific ideas in industry depend upon a complete understanding of the way in which industry can make use of science and scientific method.

So far back as its 1930–31 report, the Advisory Council noted the extent to which the time of the staff of a research association was occupied in work for the firms which constitute it and in visits to works, thus functioning as the 'general staff' of the industry; further, increasing attention has been given to the presentation of the industrial and financial implications of scientific data in publications so as to facilitate their utilization on a wide scale in industry.

However admirable the results achieved by many of the research associations, the movement has been open to criticism on account of the inadequate scale on which it has been financed. Moreover, the success which has attended the scheme of block grants which was initiated as a result of a review of the situation during 1933–34 and later discussions with the various associations should not lead us to overlook the fact that, although the total sum subscribed by industry has increased by forty per cent to more than a quarter of a million pounds per annum since the scheme came into operation, there are still associations receiving insufficient financial support from the industry to qualify for the block grant.

Important as the research association movement may be, it provides only one example of the way in which the work of the Department has led to increasing value being placed upon research by the leaders of industry. An admirable example of the way in which progress has been made in gaining the confidence of industry is provided by the work of the Water Pollution Research Board, the youngest of the major research activities of the Department, notably in relation to the disposal first of polluting waste waters from the beet sugar industry and later in the treatment and disposal of effluent from dairies and the manufacture of milk products. The developments referred to in the last report of the Advisory Council in relation to the testing of electrical switchgear by the National Physical Laboratory provide a further example of this tendency, while equally striking illustrations might be found in such fields as the testing or specification of building elements for their resistance to fire, or the work of the Building Research Station or Steel Structures Research Committee in co-operation with various branches of industry. The importance of the work of the Building Research Board of the Department in securing the most economical use of all building materials in war-time need scarcely be further stressed, whether in view of the magnitude of the Government's building programme alone, which for 1940 is estimated to cost about £200,000,000, chiefly for aerodromes, storage depots, and factories, or with regard to the necessity for conserving to the utmost our resources of steel and timber and reducing imports. Dr. E. V. Appleton, the present secretary to the Department, recently indicated that adoption of the Board's recommendations would permit substantial economies in timber and steel, and special arrangements have been made by the Government for dealing with the technical problems of building created by the War.

The research work which the Department itself has developed in the national interest has in general been that required to deal with such primary needs of man as his food, fuel, building, the use of timber and the protection of his drinking water or the atmosphere from pollution. The impressive review given in last year's report of the Advisory Council of the twenty years work of the Food Investigation Board shows how important are the advances which have flowed from work initiated in 1917 in face of the serious shortage of food then existing. It is difficult indeed to assess the importance to our war effort of the increased knowledge gained in regard to the storage and transport of food of all classes. Victory might indeed turn on the elimination of waste in this manner by the preservation of existing stores or supplies from damage by disease or pests, but it may equally depend on the further increase in our resources coming from more effective utilization, through the Department, of the resources and knowledge already available for the elaboration and execution of a sound policy of food production and supply.

Great as have been the achievements of the Department and admirable the work of its numerous research stations, boards or sections, the nation cannot rest content with what has already been done. There are still industries which suffer from the absence of scientific direction and failure either to prosecute research or utilize existing scientific knowledge. Five years ago, the Advisory Council wrote in its report: "The scientific outlook of these industries leaves much to be desired. Neither in the directorates nor among the technical and executive staffs is sufficient weight yet given to scientific attainment and experience, and until

a radical change has taken place in this respect the position is bound to be that the industries as a whole will remain unable to obtain the full benefit of the results of scientific investigation." The scale upon which research is organized, and even its extent in Great Britain, still compare unfavourably with that in some of its competitors, and it cannot yet be contended that with all the advances of the past twenty-five years the value of scientific research and its contribution to industrial progress or national welfare is generally appreciated either by the general public or by the Government.

The increased attention which is now being given to the general structure of the organization of research in Great Britain itself shows that the work of education has progressed. The twenty-five years' work of the Department will be considered not by itself but in relation to the research proceeding in industry, at the universities, and under more direct Government auspices, such as through the Agricultural Research Council or the Medical Research Council. If the expansion still required for the full service of the needs of individual industries or of national needs is to be secured, more than additional financial resources is required. There is still need for close co-ordination of existing effort, and for the re-distribution of available resources, whether of personnel or equipment. The lack of proportion between scientific advance in different fields is a handicap which requires correction and involves further attention to our educational system, possibly by more fundamental methods than the distribution of grants to students or research workers. Progress here depends on the education both of public opinion and of the administrator. We may well hope that, in glancing over the twenty-five years' work of the Department of Scientific and Industrial Research, scientific workers may be led to take a further part in that task of education and give firmer and more united support to the elaboration of a national policy and programme of scientific and industrial research which will serve the nation's changing and growing needs, whether in peace or war, on a more adequate scale.

SCIENCE IN THE ROYAL ACADEMY, 1940

By Lieut. W. E. Swinton, R.N.V.R.

THE one hundred and seventy-second exhibition of the Royal Academy of Arts, which opened on May 6, is a typical "Royal Academy". That is to say, it is conservative and consists of the same kind of interesting, promising, or sometimes even satisfying works largely by the usual artists. Its subjects for the most part are retrospective, concerned with the personalities and events of the past rather than reflecting the tendencies and affairs of the present. It is therefore natural that the general tendency of the works is to portray the splendours of the seasons and those rural and coastal charms accessible to the country cottage rather than the stirring, if unpleasant, realities that confront us now. Artistic licence, however, like that of the poets, stipulates no adherence to the apparently stupendous events of the day, a fact which may explain why art is more enduring than the news-sheet.

There are, of course, a few works devoted to the more spectacular events of the last few months. Of these, pride of place goes to Norman Wilkinson's "River Plate Action", an inspiring representation based on the account given by Captain Woodhouse, R.N., and the same artist's "Air Battle, December 18th, 1939", painted from a description given by the leader of the formation. The *Altmark* incident is recalled by "The Stranded Prison-ship", by Charles Gere, R.A. "The Convoy and her Guard", by A. J. W. Burgess; "Suburbia, 1939", by C. R. W. Nevinson, A.R.A.; and "Retribution", the end of a U-boat, by Arthur Burgess, bear testimony to the less spectacular necessities of these times.

So far as strictly scientific activities are concerned, this exhibition is no more lavish than its predecessors. If the highways and byways of scientific endeavour have any artistic stimuli, it must be admitted that the results do not pass the strait gate of Burlington House. Of the seventeen hundred works now shown, only about ninety can be said to be even incidentally of scientific interest, and that is taking both science and the subjects of the pictures at a very wide estimate.

As usual, the botanists and the geologists have nearly all the spoils, largely because flowers are amongst the most convenient themes for both indoor and outdoor painting, and because, on the other hand, landscape painters of even the most modern school can scarcely avoid some hint of the geological background.

Agriculture, as in last year's exhibition, has one of the best pictures of the year, by that habitual author of 'best pictures', Dame Laura Knight. It is entitled "January, 1940", and depicts a land-girl at work in wintry surroundings.

Archæology is represented by Charles Oppenheimer's large and pleasing "Roman Wall, Northumberland", and by Mr. W. P. Robins's more topical "The Saxon Ship at Sutton Hoo". There is a score of castles from many parts of this and other countries, and in various stages of disrepair, which may also attract the antiquary, but space does not permit their catalogue here.

For the anthropologist there is a small number of pictures of distinguished artistry and origin. Negroes, Chinese and Gypsies are the favourite subjects: and of these Laura Knight's "The Gypsy" (purchased under the Chantrey Bequest); Sir John Lavery's "Gypsies in Ireland", a work painted some years ago; and the continuation of Mr. Gerald Kelly's charming Burmese studies must be mentioned.

For the botanist, or perhaps more accurately the flower-fancier, the Academy must be a delight. Art does more than memory, for it gives us roses all the year round. Here, there are roses in plenty, and lilies, pinks, cornflowers, cinerarias and tulips, "Spring Flowers", "June Flowers", "Summer Flowers", from anemones to zinnias. Trees there are, too, trees casting their cool and leafy shade, trees burdened with snow, and trees brilliant with blossom. Attractive and somewhat unexpected examples of the latter group are Mr. George Belcher's "Tugley Farm", with its contrast of summer sun and shade, and the luxuriant foliage of Mr. A. J. Munnings' "Drifting", a large and colourful canvas with a canoe on the limpid waters of a tree-shaded stream.

Geologists with imagination have an even richer field this year in which to exercise their fancy. Scottish scenery vies with the English moorland for pride of place, with coastal attractions of the south and the staccato splendour of the Alps following on; a variety which is happily knit by the versatility of Oliver Hall, R.A., who shows typical highland features in his "Bridge in Inverness-shire", the characters of its English counterpart in "Rothbury Moors, Northumberland", and supplies the continental contrast of a recently dissected plateau in "Ronda, Spain". A somewhat sharper contrast in topography is seen in the gently rounded features of the old landscape of "A Fifeshire Farm", by R. W. Stewart, and the jagged boldness of the "Dents du Midi" of the late Melton Fisher. "Winter in a Cotswold Village" (A. G. James) and "Winter in Perthshire" (McIntosh Patrick) are gentler variations of the same theme, to be compared with the sterner work of snow and ice visible in "Zermatt" by Mrs. Elwell. For a complete contrast there is the attractive panorama by Charles Gere, R.A., entitled "The Tidal Severn", with its well-displayed meanders. Typical cliff and coastal scenery, which is perhaps even more attractive to the field geologist, is supplied by Gerald Kelly in his "Golfo Tigulio, II"; in "Swanage", by R. R. Gill; and especially in "The Mewstone: Entrance to Dartmouth from Seaward", by Charles Pears.

Applied geology is represented only by "The Derelict", a tempera painting by Mr. Harry Allen, which shows an old quarry and its abandoned crusher.

Mineralogy is almost entirely unrepresented. Hitherto it has been safe to rely upon the jewelled richness of Gerald Brockhurst's portraits, but Mr. Brockhurst is one of many academicians who have not exhibited this year. The meteorologists, too, must take what they can from a very few landscapes, of which Sir A. Brown's "A Passing Shower", with its thundery sky, and Bertram Priestman's "Storm Clouds, North Wales" call for special mention.

The important and attractive field of industry and engineering is unexpectedly neglected, although Alan Blyth's two topical pictures "Building an R.A.F. Aerodrome" and "Evening at an R.A.F. Aerodrome" do something to alleviate the deficiency.

The number of pictures of zoological interest is also smaller this year. Mr. Munnings' studies of racehorses as usual command attention, and Dame Laura Knight contributes a delightful scene of a quieter kind in her "Suffolk Mare and Foal". Miss Jessie Hodge also has a pleasant study of a swan with its chicks in "All Aboard!". Phillip Connard's "Pelicans", which has been bought for the Academy under the Chantrey Bequest, is of interest, as is Mrs. Daisy Smith's "Amherst's Pheasant". The farmyard aspect is supplied by "Gloucester Spots at Abnash", by J. A. Colquhoun Morrison.

"The Aviary", by James Fitton, is suggestive of a zoo; while "Painting the Air Balloon", a tempera by Ernest Dinkel, reveals a glimpse of the museum workshop.

There are several items of architectural interest for scientists: "Scaffolding at Winchester College, 1938"; "Canterbury Quad, Christchurch, Oxford"; "Hertford College Bridge, Oxford"; "The University of London, Interior of Great Hall"; "Goldsmiths' Library, University of London"; and an interesting model of the new University buildings in Bloomsbury by Charles Holden. There are also drawings and plans of the Courtauld Science and Art Block of Felsted School, and of the Garden Court Wing of the British Medical Association.

Portraits or statuary of scientific and university men are not numerous, but the few are worthy of attention. Pre-eminent among them is the splendid life-size painting of the late Lord Crawford by James Gunn, one of the best pictures in the

exhibition. Augustus John celebrates his return with a fine portrait of the Hon. Vincent Massey; and Mr. R. G. Eves, R.A., has deposited as his diploma work his portrait of Sir Joseph Barcroft. The Rev. E. Schomberg, Master of Charterhouse (Ronald Gray), the late Dr. H. R. Rathbone (L. Campbell Taylor), and Sir Herbert Baker (A. K. Lawrence, R.A.) are other notable portraits. Physicians are well represented by Sir Robert Hutchison (James Gunn), the late Prof. Edward Mapother (A. R. Thomson, A.R.A.), and Dr. E. B. Gunson (James B. Manson). There is also a charming miniature of Dr. Cyril Horsford by his daughter.

Museum men will be pleased to see the miniature of Dr. Charles ffoulkes by Dorothy Garratt, and the sanguine by Robert Swan of Mr. F. W. Troup. Miss Helen Campbell has done a chalk study of Sir Dennison Ross.

Amongst the sculpture there must be mentioned the bronze bust of Lord Cadman (Donald Gilbert), the bronze bust of Sir David Milne-Watson (Eric Schilsky), and the model of a bronze memorial to Sir Archibald Denny (L. S. Merrifield). Miss Barbara Tribe has done an excellent bust of that distinguished soldier and master of Peterhouse, Lord Birdwood. Mr. Bertram Pegram exhibits a bust of Sir Daniel Lleufer Thomas, a welcome testimony to services to the University and National Museum of Wales, and Mrs. Bingguely-Lejeune has a bronze relief of that great patron of the sciences, Lord Nuffield.

DISTRIBUTION OF MARINE ORGANISMS

AT the general meeting of the Linnean Society of London on April 25, a discussion regarding the extent to which the distribution of marine organisms can be explained by, and is dependent on, the hydrographical conditions present in the great oceans was opened by Lieut.-Colonel R. B. Seymour Sewell.

After dealing with the main categories of marine organisms—plankton, nekton, and benthos—and defining the various types of plankton, Col. Sewell considered the ancient Tethys Sea and the effect of its subsequent closure on the distribution of corals. The view has often been advanced that species found to be limited to-day to the North Atlantic and northern part of the Indian Ocean are relics from this early Tertiary sea; but recent investigations have so greatly increased the number of these species that this explanation is unlikely. A study of the ancient group of Crinoids provides an alternative explanation, and suggests that, while some species have reached the Atlantic and Arctic Oceans from the centre of origin in the region of the Malay Archipelago through the Tethys Sea, others have been dispersed along lines which correspond closely with the surface and deep-water currents of the present day.

There can be no doubt that the character and direction of flow of marine currents have had a profound influence on the fauna and flora of different regions, and are sufficient to account for the frequency with which species are found to be cosmopolitan in their habitat. Further, the convergence zones set up in regions where the different current systems abut upon each other may provide temperature barriers across which only the most tolerant species are able to pass, and thus give us sharp boundary lines between two types of fauna or flora.

Detailed studies of various groups of animals and plants within the limits of a single ocean have produced an important body of evidence as to the correlation between the distribution of the organisms and the presence of water of a particular origin, as well as the direction and extent of flow of this water. This has been well shown in investigations on both phyto- and zoo-plankton of the North Atlantic, as well as on the diatoms of the Southern Ocean, and evidence is also accumulating that benthonic organisms may be affected in much the same way, as shown by recent work on sea-urchins, barnacles and sponges.

A study of the various zoogeographical regions which have been delimited as the result of work on the surface plankton reveals that these correspond fairly closely with the surface currents, and that the main line of dispersal for such plankton runs from east to west. A systematic study of the weed-haunting Harpacticid Copepods or of the surface-living Calanoids suggests that a very large percentage of the species of these crustaceans must have originated in the region of the Malay Archipelago, and that the farther we get away from this region the smaller is the number of Indo-Pacific species to be found, as might be expected if their dispersal is due to the surface currents. Similar evidence has been provided by the distribution of other groups of animals and of the littoral algæ.

In regard to the deeper levels, a study of the distribution of the meso-planktonic Calanoids again shows a distinct correlation with the general trend of the mid-water and deep currents. In this group the centre of origin appears to have been largely

in the North Atlantic, and their distribution can be shown to follow the lines of the deep currents from west to east. Investigations on the Scyphomedusæ of the Indian Ocean suggest that these organisms have followed the same route, but we find that their distribution in the Indian Ocean is limited by the recently discovered azoic area in the Arabian basin and the Gulf of Oman. In this area, between depths of about 500 and 1,250 metres, there is a marked deficiency of oxygen, and the effect of this is well shown in the vertical distribution of two species of Calanoid copepods within and without the affected area.

With regard to the nekton and the benthos, the movements of the water masses must play a part in the dispersal of the eggs and larval stages while these are planktonic. The distances to which such forms can be carried by currents, however, will depend partly on the rapidity of the current and partly on the length of the larval period, but at the same time a study of the bottom topography reveals the presence of a number of 'stepping stones' by means of which a species could pass from one ocean to another in a series of successive generations.

In conclusion, Colonel Sewell pointed out that the cosmopolitan habitat of many species might well be accounted for by the influence of ocean currents on distribution. Further, a uniformity of the fauna and flora has not yet been achieved in spite of the long period of time that has elapsed since the oceans assumed their present positions and connexions in the middle of Tertiary times; nor can this be achieved while new forms continue to make their appearance. The ability of a given species to obtain a cosmopolitan range seems to depend to a great extent upon the ocean in which it made its original appearance.

Dr. Maurice Burton dealt with the distribution of marine sponges, and stressed the importance of sound systematics as a preliminary to zoo-geographical investigation. He agreed with Colonel Sewell as to the important part played by ocean currents in the dispersal of species, and pointed out that the distances reached depend to a great extent upon the duration of the larval life. The metamorphosis of a larval sponge on the surface film, which has been recorded under laboratory conditions, might well have a decided effect upon the dispersal of certain forms in the sea.

Dr. Anna Hastings considered the distribution of antarctic and subantarctic Cellularine Polyzoa. She showed that the distribution of the species is very closely related to hydrographic conditions, only 20 per cent of subantarctic and antarctic species being common to the two regions as limited hydrographically by the Antarctic Convergence. A similar separation is noticeable, and usually even more marked, in the few other groups of animals for which data have been obtained.

On the other hand, the distribution of the genera of antarctic Cellularine Polyzoa does not appear to be specially related to hydrological conditions. Their distribution points to eastern rather than western affinities, that is, with the Australasian, Malayan and Japanese faunas rather than American. This is also found in other groups, but not in the antarctic Echinoderms (D. D. John, 1937). These tendencies are difficult to relate to present hydrological conditions, and are more probably due to interrelations of the geological history of the region and the phylogeny of the groups.

Mr. J. R. Norman pointed out that fishes, being for the most part active swimmers, are not dependent upon the ocean currents for their distribution to nearly the same extent as the invertebrates already mentioned, although these may be an important factor in transporting pelagic eggs and larval stages, as in the case of the European eel. In the case of coastal fishes, including the littoral forms as well as those occurring at no great distance from the shores in water down to about 500 metres in depth, the most important hydrological factor influencing their distribution is the temperature of the sea. By taking the mean annual surface isotherms of 6° C., 12° C., and 20° C. respectively, it has proved possible to delimit a series of zones of distribution in the sea, each with its more or less peculiar types of fishes. For example, the distribution throughout the world of the genus Sardina has been shown to lie roughly within the area bounded by the isotherms of 12° and 20°. The isotherm of 12° runs very roughly to the mouth of the English Channel, and it is just here that such warm-water forms as the pilchard, anchovy and red mullet are replaced by the herring, cod and plaice, and other cold-water types. This is also near the southern limit of the salmon and trout as marine fishes.

The islands of Tristan da Cunha and St. Paul, lying in the southern Atlantic and the southern Indian Ocean respectively, are about 4,000 miles apart but situated more or less on the same mean annual surface isotherm : there are certain species of fish common to these islands but found nowhere else. The fact that the Antarctic Drift runs direct from one island to another may have been a factor in assisting the spread of these fishes. There are about 90–100 species of fishes commonly found in the Patagonian – Falkland Islands region, but only three of these are found at the island of South Georgia, a bare 800 miles away but separated by the Antarctic Convergence, corresponding closely to the isotherm of 6° C.

Of the oceanic fishes, the pelagic forms, although

they appear to have on the whole a wider distribution than most coastal fishes, still seem to be limited mainly by temperature. In the case of the abyssal forms, the contour of the sea floor may play an important part in limiting their range, and it may be noted that the submarine ridge running from Scotland to Iceland and Greenland, less than 1,000 metres in depth, is the northern limit of the Macruridæ, the most characteristic family of bottom-living oceanic fishes. Our knowledge of the distribution of the bathypelagic fishes is still very incomplete, but it may be said that a number of them have a cosmopolitan range and that recent investigations have tended to add greatly to this number. Some of them are capable of extensive vertical migrations, and it may be that they are able to negotiate barriers which would be effective in limiting the spread of coastal fishes.

Dr. Stanley Kemp emphasized the importance to the general question of marine distribution of the comparative stability of species in the sea, and instanced the occurrence of identical species of fish and crustacea on both sides of the Isthmus of Panama in support of the view that species can remain identical over a long period of time. He thought that this would account for some of the instances of bipolarity, and mentioned a Euphausian common in the north and south but absent over a large stretch of the middle Atlantic. If species have remained unaltered for long periods of time, any arguments which base distribution upon existing ocean currents must be fallacious.

As an example of the adaptation of a planktonic fauna to hydrographical conditions Dr. Kemp mentioned the work of Mackintosh, who had shown that plankton at the time it approaches the Antarctic Convergence sinks to a deeper level and in this way is carried back to its proper habitat in the Antarctic. The deep-water prawns of the genus Acanthephyra, which are abundant in tropical and temperate parts of the oceans, have recently been investigated in detail, and have been found to have become differentiated in the various oceans. The species are separated by quite trivial characters (the number of spines on the telson), which are, however, astonishingly constant. One species in the Atlantic shows a widely discontinuous distribution.

Dr. G. P. Bidder wondered whether the length of the larval life was really so important a factor in the dispersal of sponges, and suggested that in the case of calcareous sponges these might be carried to new localities on the bottoms of ships. He pointed out that the largest and finest specimens found at Naples and Plymouth were collected from vessels anchored in harbour for a month or so.

Prof. W. Garstang suggested that an interesting approach to the problem as far as pelagic animals are concerned would be to tabulate the differences in distribution of those forms with large and small larval stages respectively.

OBITUARIES

Prof. Jules Schokalsky

THE distinguished Russian geographer Prof. Jules Schokalsky died in Leningrad on March 26 at the age of eighty-four. He was widely known throughout Europe and America, where he made many friends at international scientific gatherings. As a boy he lived much in the country and acquired a love of Nature by his comradeship with a son of the poet Pushkin, and this æsthetic sentiment opened the way to serious scientific study. He led a life of ceaseless activity from the time he entered the Naval School at St. Petersburg in 1874 until his death, and for forty-five years I have had the privilege of enjoying his helpful friendship. Even the shock of the Russian revolution of 1917 did not check the continuity of his work; to him science was superior to politics. He continued under the Soviet system in Leningrad to give full expression to the enthusiasm for oceanography and cartography which had animated him during half a century under the Empire.

Schokalsky studied at the Naval School in St. Petersburg, and in 1877 he went to sea as a midshipman in the Imperial Navy. After two years he turned to shore work connected with naval research and education, spending three years at the National Physical Observatory under the great meteorologist, Dr. H. Wild. After this he joined the teaching staff at the Naval Academy and was professor and then emeritus professor of physical geography, meteorology and oceanography from 1910 until 1930. For a time he was librarian of the Central Library of the Russian Admiralty, and he ended his academic career and his life as professor in the University of Leningrad. He found time for innumerable honorary appointments, culminating in the presidency of the Imperial Russian Geographical Society, which he held for many years, and on his retirement was appointed honorary president of the same Society under the U.S.S.R.

He was a tireless writer with nearly five hundred entries of publications under his name, many of them, of course, being official reports, summaries and criticisms. His most important book was the "Treatise on Oceanography", in Russian, published in 1917. This is a work of originality and distinction, showing much ingenuity in the design of illustrative

diagrams. He produced or edited with valuable introductions many atlases of the physical features of Russia. He paid special attention to hypometrical work and completed a map of the altitudes of European Russia in six sheets on the scale of 1 : 2,500,000.

Schokalsky planned and carried out an important series of researches on the temperature regime of Lake Ladoga during the years 1897–1902. The supreme contribution which he made to oceanography was the organization of physical investigations in the Black Sea. This was carried out under his personal leadership during 1924–27 in conditions of much difficulty and even privation. The result was to throw new light on the remarkable physical and chemical changes proceeding in the lifeless deep water of this anomalous land-locked basin. A special feature of the work was the collection for the first time of very long cores of deep-sea deposits; the length of these ranged up to one and a half metres.

Prof. Schokalsky had much charm of manner and great kindness of heart combined with dignity and a fine sense of honour. He made himself welcome wherever he went despite the deafness which latterly grew upon him. His later years were cheered by the companionship of a devoted daughter, herself distinguished in the modern science of soil analysis.

HUGH ROBERT MILL.

Sir James Mackenna, C.I.E.

SIR JAMES MACKENNA, who died on April 3, aged sixty-seven, belonged to the small band of members of the Indian Civil Service who, though not scientific workers themselves, employed their long service in India in encouraging the application of science to the solution of the agricultural problems of the country. I first met him in 1904, when he had been some ten years in Burma and was already recognized as one of the most successful directors of agriculture of his time. Even then he showed those qualities which distinguished him throughout his career—a thorough grasp of the problems of rural development, a strong belief that agricultural research was likely to lead to a great improvement in Indian crops and stock, and a faculty for getting things done. From this time on, his work as a member of the Indian Civil Service was chiefly concerned with agricultural development in Burma, until he was appointed agricultural adviser to the Government of India in 1916.

Mackenna's work in the last-named position was of outstanding importance. On his recommendation, two committees were appointed to consider, respectively, cotton and sugar production in India in all their aspects, and the results on the development of these industries have been very great. The former committee, among other things, recommended the establishment of the first self-supporting research organization for a purely Indian industry, and the existence of the Indian Central Cotton Committee, a permanent body with ample funds which controls research on cotton problems throughout India, has been very much of a landmark in the later agricultural history in India. Similar bodies have more recently been formed in connexion with other industries, but the idea came from the Mackenna Committee, and was probably the idea of Mackenna himself.

In 1920 he went back to Burma, and for the next five years he was the life and soul of many development projects which date from that period. After retirement to England in 1925, he was almost at once appointed a member of the Royal Commission on Agriculture in India, and toured the country again between 1926 and 1928. The chief result of that Commission has been the establishment of the Imperial Council of Agricultural Research and it is impossible not to see Mackenna's hand in a good deal of the organization of that Council, which has become the centre of scientific activity in connexion with Indian agriculture.

After his final retirement from India, Mackenna continued his interest in scientific work, especially as concerns Indian agriculture. He remained active to the end and was still the same inspiring personality as he had been in his prime. His principal claim to scientific recognition is that he never ceased to use the strong influence which he could exert, for the encouragement of research, while he had the faculty of inspiring those who were entrusted with the carrying out of the work which he had in mind.

H. H. MANN.

Sir Gilbert Barling, Bart.

SIR GILBERT BARLING, BART., died suddenly of heart failure at his home in Edgbaston on April 27, within three days of his eighty-fifth birthday. Sir Gilbert was the second vice-chancellor (afterwards pro-chancellor) of the University of Birmingham which he served for twenty years, having succeeded Charles Gabriel Beale in that office in 1913. From 1913 until 1933 he gave invaluable service to the University, which derived great benefit from his forceful personality and his unremitting personal devotion to its interests. Himself actively interested in outdoor sports, he did much to encourage the athletic side of university education. At the annual meeting of the Birmingham United Hospital, only a week before his death, Sir Gilbert was presented with an address of congratulation on completing sixty years of strenuous service to the hospitals of Birmingham.

WE regret to announce the following deaths :

Mr. Owen Cattell, director of the annual exhibition of the American Association, assistant to the editor of *Science*, on March 26, aged forty-two.

Prof. Alexandre Desgrez, emeritus professor of medical chemistry in the University of Paris, aged seventy-six.

Captain E. E. M. Joyce, the well-known Antarctic explorer, on April 2, aged sixty-five.

Mr. G. W. Partridge, a pioneer of electricity supply, on May 3.

NEWS AND VIEWS

André-Jean Marie Brochant de Villiers (1772-1840)

ON May 16 occurs the centenary of the death of the French geologist and mineralogist Brochant de Villiers, through whose initiative the construction of a complete geological chart of France was undertaken. Born at the Château de Villiers, near Mantes, on August 6, 1772, he was educated under the Oratoriens and acquired a taste for natural history. When nineteen, he went to Freiburg, in Germany, to study under Werner, by whom he was much influenced. In 1793, when the Revolutionary movement in France was at its height, he entered the École des Ponts et Chaussées and afterwards the École des Mines. In 1804, when the École des Mines had been removed to Pezay, in Savoy, Brochant de Villiers was made professor of geology and mineralogy, and he held this post for some years after the return of the school to Paris in 1815. He also became an inspector-general of mines and a member of the Paris Academy of Sciences.

So early as 1811, Brochant de Villiers had submitted a plan for a chart of France, but it was not until 1822, when a copy of Greenough's geological map of England was received in Paris, that any definite steps were taken to further his plan. That year, however, he was entrusted with the construction of geological charts for the whole of France, and with his two assistants, Elie de Beaumont and Dufrenoy, he visited England to become acquainted with British methods of geological surveying. With the help of the engineers of the Corps of Mines, steady progress was made, and by 1835, fifty-nine charts of various districts had been prepared, but Brochant did not live to see the first complete map, which was published in 1842. This map was on a scale of 1 in 500,000, but the geological chart of France undertaken later, and completed only a short time since, is on a scale of 1 in 80,000.

Leopoldo Maggi (1840–1906)

LEOPOLDO MAGGI, an eminent Italian protozoologist and craniologist, was born at Varese, on May 15, 1840. He was educated at Pavia, where he was assistant first to Paolo Panceri and then to Balsamo Crivelli, and in 1864 was appointed lecturer in mineralogy and geology. In 1874 he was appointed professor of zoology and comparative anatomy and physiology at Pavia, and afterwards, when zoology became a separate subject, he occupied the chair of comparatve anatomy and physiology from 1875 until his death. He carried out studies in palæontology as well as various zoological and anatomical researches, but his principal work was concerned with protistology and craniology. He was the first Italian to direct attention to Protozoa, to the knowledge of which he made important contributions. His chief publications were as follows: "Nuovi orizzonti della protistologia medica" (1884), "A proposito dei protisti cholerigeni" (1885), "I piccoli benefattori dell'umanita" (1886), "Intorno alla determinazione della specie batteriche secondo Pflügge" and "I microbi vantaggiosi all'uomo" (1888). He died on March 7, 1905.

International Spirit in Science

THE award to Sir Harold Carpenter of the Honda Prize was announced in NATURE of March 30. It is of interest to know that this is the second occasion only when the prize has been awarded. The first award was to Prof. K. Honda himself, in whose honour the Japanese Institute of Metals established the prize a short time ago. Prof. Honda's work on the magnetic and other properties of metals is well known to scientific men in many countries outside Japan. It is a striking tribute to the international feeling among men of science that the Japanese Institute of Metals should have chosen, at the present time, a British scientific man as the recipient of what may be regarded as the first 'open' award of its highest honour. During the Napoleonic Wars a century ago, it was possible for scientific men, even those in belligerent countries, to maintain fairly free intercourse and to obtain safe conducts for visits. To-day, the difficulties of the international situation have made such relations most difficult, and the recent recognition by the Japanese of Sir Harold Carpenter's achievements is thus doubly precious.

The Pharmaceutical Society: Honorary Members

IT will be gratifying to medical circles in India to learn that Colonel Ram Nath Chopra, head of the Faculty of Pharmacology in the School of Tropical Medicine, Calcutta, has been elected an honorary member of the Pharmaceutical Society of Great Britain. This distinction is conferred upon a very limited number of scientific workers, the list of honorary members being not more than twenty-five at the present time. Colonel Chopra has been, and still is, an earnest worker in the cause of reform of the drug trade in India; it was upon the recommendations of the Drugs Enquiry Committee, of which he was chairman, that the Indian Drug Bill, the provisions of which measure were commented upon in a recent issue of NATURE (May 4, p. 716), were based. At the May meeting of the Council of the Pharmaceutical Society at which the election took place, two other names were also added to the list of honorary members: Sir Ernley Blackwell, who was chairman of the Society's Statutory Committee during 1934–1939, and Sir William Willcox, the Visitor for the Privy Council to the Society's Examinations.

Nuclear Fission of Separated Uranium Isotopes

SOME recent accounts in the daily Press referring to the separation of uranium (235) would suggest developments arising from a letter in the *Physical*

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Review (57, 546), by Dr. A. O. Nier. Nier there describes fission experiments conducted with small quantities of ^{235}U and ^{238}U separated by deposition in a mass-spectrograph. The masses of ^{238}U samples were of the order of 10^{-7} gm. and those of the ^{235}U samples about 10^{-9} gm. The samples were bombarded with slow neutrons obtained originally from a cyclotron. Fission products were observed in an ionization chamber when the ^{235}U isotope was used, but not with the more abundant ^{238}U. The ^{234}U isotope was not separated from ^{235}U, but its abundance is very small. It seems almost certain that ^{235}U is responsible for the slow neutron fission, as predicted theoretically by Bohr and Wheeler.

Shining in Human Eyes

FROM time to time, reports have appeared of the occurrence in human eyes of the phenomenon of "night-shining", which as was indicated in a recent paragraph (NATURE, March 30, p. 506) has been observed in many animals by Ernest P. Walker, assistant director of the National Park of the Smithsonian Institution. It was there stated that Mr. Walker had no definite proof of such cases, although he had encountered reports of them. That statement has led Denis G. A. Dyson, King Edward VI School, Stratford-on-Avon, to write saying that for many years he has known of an "undoubted case" of shining eyes in a shop assistant in Birmingham. Although, not being aware of the rarity of such an occurrence he made no particular observations, his impression is that the glow was of a "dark red colour". In view of the apparent lack of information about such a condition in human beings, it would be of interest if some scientific worker could follow up Mr. Dyson's clue.

War-time Ventilation Problems

THE question of ventilation is demanding special attention as the warm weather approaches. Mr. A. Peel's article on "War-Time Ventilation", published in the *Electrical Times* of April 18, is therefore a timely one. Special attention has to be paid to factories, mills, offices, etc., where a large number of people occupy one enclosure. It is an annual problem the solution of which in peace time is not always adopted as soon as it should be. Now certain factors due entirely to the War have greatly aggravated the working conditions in many factories and sometimes added very definite causes of bad ventilation. So far as 'black-out' is concerned, the Government insists that the obscuration must be complete. Whatever form this takes, the blacking-out process is responsible for a marked deterioration compared with the natural ventilation existing before the black-out. Many firms who were obliged hurriedly to arrange their black-out schemes and did so by painting windows or sealing them up by fitting wooden or metal shutters, or in other semi-permanent ways, have already had to strip this material away from windows. This has been necessary in order to get back to something like normal operating conditions as an alternative to serious labour trouble on account of high sickness rates, due to continuous working in artificial light and with poor ventilation.

The proper solution of some of these war-time ventilation problems may involve only the fitting of a small propeller fan or even the opening of all the windows. In other cases it will be essential to use a complete air-conditioning plant whereby a factory or section of a works may operate for twenty-four hours a day all the year round under constant conditions of temperature and humidity, and with an ample supply of clean fresh air to meet all the requirements of the personnel and of the process carried on. Between these two extremes there will be numerous combinations and modifications of method, and every case has to be studied on its own merits. Complete air-conditioning plant is already in operation in Great Britain in certain sections of the following industries: textiles, printing, biscuit and chocolate manufacture, pharmaceutical chemicals, food manufacture and packing, optical and other fine instrument making, and grinding wheel manufacture. In addition, complete air conditioning is also successfully and economically used for offices and other important rooms. By means of a well-designed plant it is possible to provide in a given space almost any combination of dry bulb temperature and relative humidity. Many different combinations of temperature and humidity are used in practice. Anything which can be done to reduce the variation of heat and moisture load and so cut down the total amount of heat to be dissipated will result in smaller and less costly equipment.

Criminal Anthropology in the U.S.A.

THE crime wave of appalling dimensions, accompanied by a vast increase in organized crime, which appeared in the United States of America in the years following on the War of 1914–18, continues to constitute one of the gravest of the social problems of State and Federal administration, notwithstanding the repeal of prohibition, which offered an almost unlimited field for illicit gain. In consequence, attention has been directed once more to the possibility of segregating the potential as well as the actual criminal through a method of detection depending upon an anthropometric examination which would weed out or mark down individuals who in their physical characters showed traits characteristic of a criminal type. When crudely stated, this suggests a reversion to the ideas in criminology held by C. Lombroso in the later years of the last century, which anthropologists believed had been laid to rest when it was shown to general satisfaction that no distinctive criminal type could be said to exist. Nevertheless, a vast survey of criminal anthropology in the United States has been instituted under the ægis of the Division for the Examination of Prisons of the Massachusetts Department of Mental Diseases. It has been carried out by Prof. Earnest A. Hooton of Harvard University, with the assistance of a body of field-workers and statisticians.

The dimensions of the investigation may be gauged from the fact that the case material for native white

prisoners consists of 4,212 individuals; and foreign, foreign born, negro and negroid criminals were treated on the same scale. Dr. Aleš Hrdlička has been moved by the discussion to revive and review material which he collected more than forty years ago, when the question was previously under discussion (*J. Criminal Psychopathology*, **1**, 2; 1939). In 1897–99, the New York Juvenile Asylum contained 1,000 inmates of both sexes, 5–16 years of age, of whom 77 were criminal or vicious, and 61 were the offspring of criminal, insane, intemperate or dissolute parents. Anthropometric measurement of each child in the institution showed that the transgressors could not be separated physically from the remainder, or probably from similar classes outside. Apart from their conduct they could not have been recognized as criminal. Of the children of the intemperate and other undesirables, however, it was found that almost 60 per cent were "inferior in their principal measurements to the general averages of the corresponding class of the asylum children", or subnormal. Dr. Hrdlička's conclusion, therefore, is that it is "hopeless to expect that anthropometry and physical examination can ever aid in this detection".

Malting Barley

THE agricultural data derived from five conferences on malting barley held at Rothamsted Experimental Station in the years 1934–38 have been described and discussed by H. V. Garner and J. W. Weil (*Empire J. Exp. Agric.*, **8**, 65). More than a thousand samples of English malting barley were sent in by growers from the more important barley-growing districts, grading being carried out by the Valuation Committee of the Institute of Brewing. Six malting grades were distinguished, three for pale-ale and three for mild-ale barleys, the largest number always falling into the latter groups. Spratt Archer and Plumage Archer were by the far the most popular varieties, and their stiffer straws had encouraged generous manuring. Autumn-sown crops usually proved superior in quality but inferior in yield to the spring-sown barleys of the same district and year, and early sowing was generally found to improve the quality in the latter case.

The effect of the crop preceding the barley was also examined. Sugar beet predominated in Norfolk and Suffolk, and in other districts, including Yorkshire, Lincolnshire and the West, folding roots were frequent, whereas elsewhere a cereal crop was more usually taken. Yield was greater after sugar beet or roots than after corn, in spite of the heavier manuring usually given to the straw crop. Lodged crops yielded more than those which were standing, but the quality of the grain was slightly depressed. Analysis was also made of the inter-relationship between soil, season and quality.

Hygiene of Swimming Baths

IN his inaugural thesis (*Thèse de Paris* 1940, No. 17), Dr. Marcel Mazillier remarks that it has been known from remote antiquity that certain diseases may be spread by swimming baths, as is shown by the fact that admission to them was forbidden to lepers and others suffering from contagious diseases. The micro-organisms found in the water of bathing places are numerous and of various kinds, the water becoming rapidly contaminated by bacteria derived from the mouth, nose, fæces and urine of the bathers. The diseases contracted in swimming baths chiefly affect the throat, ears and eyes. Cases of spirochætal jaundice, in which the disease may be localized in the meninges, may occur as well as skin diseases, especially that known as 'athletes' foot'. It is therefore important that in constructing a swimming bath care should be taken so far as possible to eliminate causes of contamination, whether derived from the bather himself, who should give himself a douch before entering the bath, the water used for washing out the bath, or other sources. Provision must also be made for the proper heating, ventilating and lighting of the establishment. The drinking water, which must possess all the requisite qualities, may be purified by ultra-violet rays, though this is rather a difficult and expensive process, or by the addition of bactericidal chemical products such as chlorine and its derivatives, colloidal metals and ozone.

Tung Oil

THE supply of tung oil has been so profoundly affected by the war in China that considerable interest is attached to a report by Dr. M. Ashby upon his tour of the area in the United States in which the tung tree is now being cultivated (*Bull. Imperial Inst.*, **38**, No. 1; 1940). It is estimated that some 175,000 acres in the States bordering on the Gulf of Mexico now carry plantations of this tree, but many earlier plantations were on land that has since proved unsuitable, the great difficulty proving to be frost damage. The species cultivated is almost exclusively *Aleurites fordii* Hemsl.

Details are given of cultivation, harvesting and mill treatment of the crop, etc., and it is clear that a very high-grade quality of oil can thus be obtained, but until 1938 the yield had been uncertain owing to frost damage. Although three million pounds of tung oil were produced in the States in 1938 (against an import of 108 millions in that year), until now the paint and varnish industry practically bases itself upon the Chinese supply, though the war has made this a very uncertain source.

Cinchona Production in the Netherland Indies

AN article by Dr. M. Kerbosch in the *Bulletin of the Colonial Institute of Amsterdam* (**3**, No. 1, December 1939) gives some notes on cinchona culture and the world consumption of quinine. Existing plantations in the Netherlands Indies could produce considerably more than the present world consumption. The Netherlands Indies Government has at its disposal sufficient guarantees to prevent the agreement between the manufacturers and producers being used in a way which would hamper malaria control. Cinchona growers would welcome the opportunity to increase their output, and the agreement, which

has united practically all producers and manufacturers, makes it possible to put regularly at the disposal of malarial areas large quantities of quinine for longer periods. Obstacles to the use of this superabundance of the Java cinchona estates are largely financial and technical. Disbursements for defence in all countries cripple other projects, including health or hygienic measures. In addition, malaria control with quinine requires an efficient administrative machine for the distribution of the drug under medical supervision. For mass treatment of malaria, quinine is unlikely to be replaced by other cinchona alkaloids or synthetic drugs.

United States National Museum

THE report of the United States National Museum for 1939 is a stimulating document, particularly in the evidence it contains of widespread activities in exploration and field work. No fewer than fifteen expeditions or trips were made, mostly to chosen localities in the United States, but also to regions ranging from the South Pacific Ocean to Alaska and West Greenland, for the collection of data or specimens bearing upon archæology, anthropology, stratigraphic palæontology, and animal and plant distribution. Specially noteworthy seem to have been the results of Dr. Hrdlička's tenth visit to Alaska and the Aleutian Islands, where many skeletons and artefacts of a pre-Aleut stock were collected. The educational activities of the Museum, apart from the usual special exhibits, fourteen of which ran almost continuously throughout the year, include an admirable scheme for the allocation of duplicates to schools and other institutions, which benefited to the extent of 3,293 specimens. Exchanges involved the dispersal of 13,362 specimens, and it is gratifying to note that the British Museum (Natural History) was a very active partner in this useful form of scientific co-operation. The catalogues of the various departments now record the collections as containing more than 16 million specimens. The popularity of the exhibited galleries is indicated by the total of 2,233,345 individuals who visited the various Museum buildings, and a glance at the monthly lists shows that the holiday periods of April and August afford welcome opportunities to visitors. The cost of running the Museum during the year was 771,880 dollars.

Rabies Treatment in Southern India

THE annual report of the director, Lieut.-Colonel Iyengar, for 1938 of the Pasteur Institute of Southern India, Coonoor, surveys the anti-rabic treatment given at the Institute and the subsidiary treatment centres during the year. A total of 12,396 persons were treated at the Institute and centres during the year, with twenty-one deaths, a mortality rate of 0·17 per cent. Animals to the number of 561 were also treated. Paris fixed virus, now in its 1,011th passage, was used in the preparation of the vaccine, which consisted of a 5 per cent carbolized sheep-brain suspension prepared by Semple's method. Under research work, experiments were carried out on the cultivation of the rabies virus. Attempts to culture the rabies virus on the chorio-allantoic membrane of the developing hen's egg, so useful for propagation of some viruses, were unsuccessful. In media containing chick embryo brain, propagation of the virus was apparently attained, though the method does not promise to be of much practical importance.

Medical Research in Egypt

THE fifth annual report of the Research Institute and the Endemic Diseases Hospitals, Cairo, by the director, Dr. M. Khalil Bey, contains a summary of the reports of the scientific sections and the clinical reports, including investigations on Egyptian splenomegaly, anæmias and various parasitic affections. A report is also included of the work of the Khanka Malaria Research Station. This gives the results of a mosquito survey of the area, with the species of mosquitoes found, and a description of some of the preventive measures undertaken. These include drainage, filling up of water holes and clearance of water-weeds in places. Breeding places of mosquitoes are treated with Paris green when there are Anophelines only, or with mazout oil if Culex larvæ are also present. In future, the Institute will be named the "Fouad the First Institute and Hospital for Tropical Diseases".

Bermuda Seismograph Station

IT is reported in *Earthquake Notes* (11, No. 4; April 1940) that through the co-operative effort of the Bermuda authorities, the Woods Hole Oceanographic Institute, the United States Coast and Geodetic Survey and Dr. George P. Woollard of Princeton University, the second component of the Milne-Shaw seismograph at Bermuda has been installed, the first records being obtained on December 10, 1939. The significance of this station is not only that earthquakes in eastern North America and the West Indies will be located more accurately, but also satisfactory studies of wave transmission over all mid-Atlantic paths have become possible. The position of this St. Georges, Bermuda, meteorological and seismological station is latitude 32° 22′ 47″ N., longitude 64° 40′ 57″ W., elevation 136 ft.; Mr. C. P. Bartram is in charge.

British Empire Naturalists' Association

THE British Empire Naturalists' Association announces the retirement of its honorary general secretary, Mrs. G. B. Thomason, which took place at the end of April after thirty-five years work. She is a niece of E. K. Robinson, who founded the B.E.N.A., and has been responsible for most of the routine business work of the Association. It is also announced that plans have been made to hold the usual B.E.N.A. summer gathering in the first fortnight of June, and the Ludlow district has been selected: local arrangements will be put in the hands of the Shropshire Branch, and, despite the War, the local interests of fauna, flora and scenery are hoped to attract a good attendance.

Summer School in Social Biology

THE Educational Advisory Board of the British Social Hygiene Council is arranging a summer school for teachers to be held at Westminster College, Cambridge, during August 1–8. The school is to focus on "Social Biology in the School: War-time Problems". The services of distinguished speakers are being secured. A series of symposia is also being arranged, at which teachers will be invited to express their views. Further particulars can be obtained from the Education Officer, Educational Advisory Board, Tavistock House South, Tavistock Square, London, W.C.1.

International Congress of the History of Sciences

THE fifth International Congress of the History of Sciences will be held at Lausanne next September if the political and social conditions of Europe permit. M. Aldo Mielli, the perpetual secretary of the International Academy of the History of Sciences, having now settled at Santa Fé in the Argentine Republic, as director of the history of sciences at Santa Fé University, M. J. A. Vollgraf of Leyden has been appointed assistant secretary for Europe and the Mediterranean countries. The review *Archeion*, the official organ of the Academy, will henceforth be published at Santa Fé instead of at Rome as hitherto.

National Research Council of Canada: Awards

SIXTY-SIX Canadian university students will take training in research in Canadian institutions under National Research Council Scholarships during 1940–41. While the majority of these students will be engaged in chemical and physical investigations, such biological studies as genetics, plant pathology, physiology and zoology will each have a quota of students. Two Special Scholarships of 1,000 dollars each will be held in the Division of Chemistry at the National Research Council laboratories, by R. L. Cunningham and R. B. Harvey of McGill University. Four Fellowships of the value of 750 dollars each, and thirty-seven Studentships of the value of 650 dollars each, will be held at Canadian universities directly under the auspices of the National Research Council. With the co-operation of Canadian universities, the National Research Council is also awarding twenty-three bursaries of 250 dollars each. These bursaries are available to students of high attainments who have just graduated and are ready to take their preliminary training in research.

Announcements

ON May 19, 1939, the seventieth anniversary of his birth (see NATURE, **143**, 813, May 13, 1939), a number of Prof. Henry H. Dixon's friends, colleagues and students presented him with an address expressing their regard for him and appreciation of his work. This address, with more than seven hundred signatures, beautifully bound, has now been handed to Prof. Dixon, and he asks us to convey his sincere thanks to all who shared in doing him this honour.

PROF. J. C. DRUMMOND, scientific adviser to the Ministry of Food, will give an informal luncheon talk at the Chemical Club, 2 Whitehall Court, London, S.W.1, on May 20. He will take as his subject "Essentials of Wartime Diet".

FIVE members of the Ling Physical Education Association have received decorations awarded by the Fédération Internationale de Gymnastique Ling in recognition of their services on behalf of physical education: they are Miss M. Stansfeld, principal of the Bedford Physical Training College; Miss M. Fountain, principal of the Chelsea College of Physical Education; Miss P. Spafford, secretary of the Ling Physical Education Association; Mr. F. Punchard, Scottish secretary of physical education, Jordan Hill; and Mr. K. Rofer, author of several books on physical education.

DR. J. W. LLOYD has been appointed acting head of the Department of Horticulture in the College of Agriculture, University of Illinois, to succeed J. C. Blair, who founded the department thirty-nine years ago. Dr. Lloyd, who has worked on the staff for many years, has directed research on fruit and vegetable crops.

DR. DETLEY W. BRONK, director of the Eldridge R. Johnson Foundation for Medical Physics and of the Institute of Neurology, University of Pennsylvania School of Medicine, has been appointed managing editor of the *Journal of Cellular and Comparative Physiology* of the Wistar Institute of Anatomy and Biology in succession to Edmund Newton Harvey, of Princeton University.

THE Pan-American Congress of Tuberculosis will be held at Buenos Aires and Córdoba during October 13–17 under the presidency of Prof. Gumersindo Sayago. Further information can be obtained from the general secretary, Dr. Raúl Denis, Calle Pasteur 346, Buenos Aires.

THE lowest maternal mortality ever recorded in the United States—43·5 per 10,000 live births—has recently been recorded by the United States Bureau of the Census for the year 1938. For the first time on record less than 10,000 (9,953) deaths were assigned to puerperal causes.

ACCORDING to an official report there are at present 1,941 foreign students in German universities representing the following countries: Bulgaria, 532; Norway, 142; Greece, 101; with Yugoslavia, Italy, China, the Baltic States, the Scandinavian countries and the United States showing small numbers.

WITH its February issue the *Journal of Contraception* was renamed *Human Fertility*; it will continue to be issued under the auspices of the Birth Control Federation of America.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They 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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 749. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Relation between Breaking and Melting

IN a recent paper[1], M. Born has given a new theory of the melting of crystals which is in good agreement with the experimental facts. The stability conditions of a lattice at a certain temperature and a certain uniform pressure for arbitrary small homogeneous deformations are derived, and it is stated that melting will take place when, on raising the temperature, at least one of these conditions is violated. In another paper by Prof. Born and myself to be published shortly, an attempt is made to calculate the tensile strength of a crystal at zero temperature. Here again, the stability conditions of the lattice, stressed in the direction of one of the axes, against any small homogeneous deformation, are derived, and the crystal is supposed to break if one of these conditions is violated. Thus a close relation between the two phenomena of melting and breaking seems to exist, melting being nothing else than a breaking due to the action of the heat movement of the atoms; or putting it the other way round, breaking is nothing else than melting enforced by the action of the stress. Unfortunately, the theory mentioned above, like other former theories, gives results not in agreement with experiment: the tensile strength as well as the critical deformations calculated from this theory with plausible assumptions are about a hundred times larger than the real values given by experiment.

Now, one of the results of the theory of breaking is that the tensile strength should be of the order of magnitude of the heat of sublimation per unit of volume. But, as a consequence of what is said above about a connexion between breaking and melting, one would expect a connexion between the tensile strength and the heat of melting rather than the heat of sublimation. Indeed, comparing the experimental values, one can see immediately that the tensile strength is of the same order of magnitude as the heat of melting per unit of volume. This observation has led me to consider the connexion between these two quantities more thoroughly, and I have succeeded in deriving an equation from which the tensile strength F of an isotropic body at low temperature can be calculated exactly, if the melting heat Q (per unit of mass), the density (ρ), and the Poisson constant (μ) of the substance are known. This theory and a number of other considerations concerning Born's theory of melting and the thermodynamics of crystals, and other relations between melting and breaking will be published shortly.

The main idea of the theory is that one has to compare two 'states' of a system: (1) the uniformly stressed rod with a volume $V + \delta V$, and a certain potential energy U distributed uniformly over the whole rod; and (2) the rod just before it is broken, the energy U concentrated in the volume δV and melting the matter in it, and the rest of the matter unstressed and with no potential energy. The condition for breaking is that the energies of these two states should be equal. The external conditions must be chosen so as to prevent movement of the broken pieces and to allow of an exact energy balance, including the device for the production of the breaking force. In this way one gets the equation:

$$F = Q\rho \frac{1-2\mu}{3-5\mu}.$$

In the following table the experimental values of the tensile strength, extrapolated to very low temperatures, together with the values of Q, ρ, and μ are tabulated for all elements for which experimental data for the dependence of tensile strength on the temperature were available.

Element	$F \times 10^{-2}$(kgm./cm.^{2})	Q(cal./gm.)	ρ	μ	$\frac{Q\rho}{F}\frac{1-2\mu}{3-5\mu}$
Ag	29	25	10·5	0·38	0·85
Al	23	90	2·7	0·345	1·1
Au	27	16	19·3	0·42	0·89
Cu	32	50	8·9	0·35	1·4
Fe	80	66	7·8	0·28	0·75
Ni	55	63	8·8	0·31	1·2
Pb	4	6	11·3	0·445	1·03
Pt	34	27	21·4	0·385	1·6
Sn	12	14	7·3	0·33	1·08
Zn	30	26	7·1	0·33	0·66

The last column gives the values of $\frac{Q\rho}{F}\frac{1-2\mu}{3-5\mu}$, which quantity should equal unity, if our formula is correct. The average value is 1·065 and the mean deviation from that average 0·255, which is not larger than the uncertainty of the experimental values. The mean error of the average is accordingly 0·085, and the deviation of the average from unity is within the experimental error. Thus the theory is in perfect agreement with the experimental facts.

R. FÜRTH.

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University of Edinburgh.

[1] Born, M., *J. Chem. Phys.*, **7**, 591 (1939).

THE most important and conspicuous property of matter, namely, the strength of solid materials, the fundamental quantity for building, engineering and textile industries, has been hitherto completely unexplained; Prof. Fürth's results should remove physics from this embarrassing situation.

Quite apart from the theory, Fürth's empirical result, that magnitude of tensile strength and heat of melting are of the same order, is new and surprising. His formula expresses this relation quantitatively

with the help of Poisson's elastic constant and is in perfect agreement with the experimental data available. The theoretical derivation uses a kind of thermodynamical equilibrium which differs from the usual methods; this is due to the fact that a solid under stress is not a genuine statistical equilibrium. This question needs further investigation though one can scarcely doubt the correctness of the resultant formula. The view due to Smekal that breaking strength belongs to the structure-sensitive (*strukturempfindlich*) properties of solids must be abandoned, since it can be derived by thermodynamical reasoning without even mentioning atomic structure.

MAX BORN.

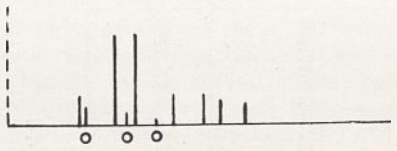
Department of Applied Mathematics,
University of Edinburgh.

An Electron Diffraction Study of the Surfaces of Alkali and Alkaline Earth Metals Exposed to Air

THE most corrodible metals are those of the alkali and the alkaline earth groups. The products forming on a freshly cut surface of these metals on exposure to air were studied.

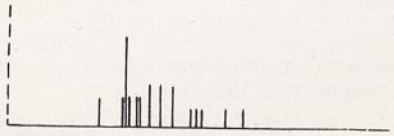
A fresh clean surface of lithium was allowed to stand in air for about five minutes. The diffraction pattern obtained from such a surface clearly showed the formation of lithium oxide (Li_2O) mixed with a small amount of lithium hydroxide.

The pattern obtained from the surface of sodium similarly treated showed the formation of sodium bicarbonate; a micro-chemical analysis also verified the presence of the CO_3^{--} radical.

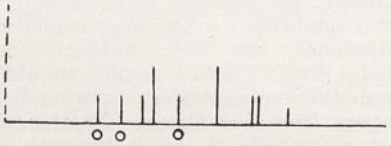


DIFFRACTION PATTERN FROM LITHIUM SPECIMEN. o, LiOH; OTHER LINES, Li_2O.

PATTERN FROM SODIUM SPECIMEN, SHOWING MAINLY THE EXISTENCE OF $NaHCO_3$.



PATTERN FROM POTASSIUM SPECIMEN, SHOWING MAINLY THE EXISTENCE OF $KHCO_3$.



THE PATTERN FROM CALCIUM SPECIMEN. o, Ca; OTHER LINES, CaO.

The formation of potassium bicarbonate on the surface of potassium in similar circumstances also occurs, but in this case the diffraction rings are sharper than those of sodium bicarbonate on sodium; this suggests that the reaction producing potassium bicarbonate is faster than that producing sodium bicarbonate.

Similarly, a moderate quantity of calcium oxide (CaO) was found to be formed on the surface of calcium exposed to air for about five minutes. On comparing this pattern with that obtained in the magnesium experiment under similar conditions[1], it is apparent that the oxide film on calcium is much thicker than that on magnesium.

These results reveal the fact that the carbon dioxide in air can act on potassium or sodium within the limited period of about five minutes, but not on lithium or calcium; while oxygen and the moisture in air act on all metals here investigated.

Full details of these experiments will be published in the *Scientific Papers* of this Institute. The work has been conducted under the direction of Dr. Ichiro Iitaka.

SHIGETO YAMAGUCHI.

Institute of Physical and
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Tokyo.

[1] Iitaka, I., and Yamaguchi, S., NATURE, **144**, 1090 (1939); Yamaguchi, S., *Sci. Pap. Inst. Phys. Chem. Research*, **36**, 463 (1939).

Separation of Uranium Isotopes

THE separation of the uranium isotopes is of interest because only one of the isotopes, ^{235}U, is believed to undergo fission when bombarded by slow neutrons. The best way to check this theory would be to change the relative particle density of ^{235}U and to see if that has any influence on the number of fissions caused by a certain number of neutrons. If the theory proves correct, one might be able to cause a nuclear chain reaction by concentrating ^{235}U and removing the other isotopes, which only catch neutrons without producing new ones.

To begin with, the most suitable method for concentrating ^{235}U seems to be the thermal-diffusion method of Clusius and Dickel[1] or Brewer and Bramley[2], this method being a universal one, applicable to all elements. Of course, other methods, specifically suitable for uranium, may be found later on. The thermal diffusion method can be used both for liquids and for gases, but it works extremely slowly when applied to liquids. It is much better to use gases. The only volatile compound of uranium is uranium fluoride (UF_6). The dimensions of a thermal-diffusion tube system, using this compound, can be calculated from the formulæ of Furry, Jones and Onsager[3]. We shall use the same notation as these authors.

The molecular weight of uranium fluoride being 352, the factor α is about $1{\cdot}5 \times 10^{-3}$. The temperature of the colder outer tube must be about $T_1 = 333°$ K. $= 60°$ C., if the apparatus is run at ordinary pressure, as uranium fluoride is a solid below 59° C. at a pressure of 760 mm. mercury. The temperature T_2 of the hot tube can be about $2T_1 = 666°$ K. $= 393°$ C., as experiments have been made with uranium fluoride at 440° C. without decomposition of the gas. Too high a temperature would

increase the difficulties of getting materials resistant to uranium fluoride and the loss of energy caused by radiation of the hot tube. For the length of the tubes we take $2l = 10$ m.; for the outer diameter of the inner tube 4 cm. and for the pressure 1 atmosphere. The natural abundance of ^{235}U is 1/139, and if we demand a tenfold increase of the relative particle density of ^{235}U in the equilibrium state of discontinuous operation, we must put $A_d = 1{\cdot}49 \times 10^{-3}$ cm.$^{-1}$. For uranium fluoride no value has been measured for D, the coefficient of thermal diffusion, and η, the viscosity, but we may assume $D \sim 0{\cdot}05$ cm.^{2}/sec. and $1{\cdot}4\ \ \eta/\rho = D$ (ρ = density). This assumption gives us for $2w$, the distance between the tubes, $2w = 1{\cdot}34$ mm.

If the top reservoir contains 5 gm. uranium fluoride, the relaxation time would be 80 days. After this time, the concentration of ^{235}U would have increased to 6·7 times of its original value, or to about 4·8 per cent. If we remove the fluoride after this time from the top of the apparatus, we should get about 62·5 mgm./day of uranium fluoride, or 42·5 mgm./day of uranium, 4·8 per cent of the uranium removed being ^{235}U. In continuous operation we should get only 41·7 mgm./day of uranium fluoride or 28·3 mgm./day of uranium, if 4·8 per cent of the uranium removed be ^{235}U.

Thus a considerable quantity of uranium fluoride with the abundance of ^{235}U several times greater than its natural value can be produced by an apparatus which would not be too difficult to construct and to run. I began to construct such an apparatus together with B. Grabe, in August 1939, but the work had to be discontinued because of the political situation.

WILHELM KRASNY-ERGEN.

Wenner-Grens Institute,
University of Stockholm.

[1] *Naturwiss.*, **26**, 546 (1938).
[2] *Phys. Rev.*, **55**, 590A (1939).
[3] *Phys Rev.*, **55**, 1083 (1939).

Radio Wave Reflections in the Troposphere

IN recent publications, Friend and Colwell[1,2] have reported the reflection of radio waves at vertical incidence from temperature inversions in the troposphere, and have estimated the reflection coefficient to be of the order of 10^{-3} at a frequency of 2398 kc./s. On the assumption that atmospheric reflections are due to discontinuities in water content, Piddington[3] has calculated the reflection coefficient to be not greater than 10^{-4}.

The reception of ultra-short wave signals at distances of the order of 100 km. is known to be correlated with the existence of atmospheric irregularities[4], and these signal strength measurements may be used to calculate the reflection coefficient for longer waves at vertical incidence. Since the air-mass boundary occurring at a temperature inversion must occupy a finite thickness, the effect of this diffuse boundary must be taken into account.

The propagation of electromagnetic waves in a stratified medium has received considerable attention in view of its application to optics and reflections from the ionosphere[5]. In the case of tropospheric reflections, where the variations in dielectric constant are very small, the calculation is much simplified and the method adopted by Darwin[6] and Hartree[7] of integrating the wavelets scattered by each part of the medium may be readily modified to give the required result. If the dielectric constant ε of the atmosphere is taken to be a continuous function of the height z only, and the diffuse boundary extends from z_1 to z_2, the reflection coefficient for radio waves of wavelength λ incident at an angle θ is

$$\rho(\lambda,\theta) = \left| \tfrac{1}{4}(\sec^2\theta - A) \int_{z_1}^{z_2} \frac{d\varepsilon}{dz} \cdot \exp\left(-\frac{i4\pi z \cos\theta}{\lambda} \right) \cdot dz \right|,$$

where A is 0 for horizontal polarization and 2 for vertical polarization. At normal incidence this is equivalent to the expression given by Försterling[8]. Whatever variation with height is assigned to ε, there is a simple relation between oblique and normal incidence, namely:

$$\frac{\rho(\lambda, \theta)}{\rho(\lambda \sec\theta, 0)} = \sec^2\theta - A.$$

The measurements of Englund, Crawford and Mumford[4] on the propagation of 4·7 metre waves over a distance of 112 km. may by this relation be used to calculate the corresponding reflection coefficients for a wave-length of approximately 160 metres at vertical incidence. The result lies between 10^{-6} and 3×10^{-5}, the upper limit being in agreement with the experimental values of Appleton and Piddington[9] for random echoes from the troposphere.

It is interesting to compare the values of reflection coefficient for diffuse and sharp boundaries. If reasonable assumptions are made as to the height variation of ε, the reflection coefficient at normal incidence falls to half that for a sharp boundary when the transition layer is about one quarter wave-length thick. For a typical case of ultra-short wave transmission at grazing incidence, where θ differs from $\pi/2$ by about 0·03 radian, the corresponding thickness is about eight wave-lengths.

L. G. STOODLEY.

Physical Laboratory,
University College,
Southampton.
April 8.

[1] Colwell, R. C., and Friend, A. W., NATURE, **144**, 31 (1939).
[2] Friend, A. W., and Colwell, R. C., *Proc. Inst. Rad. Eng.*, **27**, 626 (1939).
[3] Piddington, J. H., *Proc. Phys. Soc.*, **51**, 129 (1939).
[4] Englund, C. R., Crawford, A. B., and Mumford, W. W., *Bell Syst. Tech. J.*, **17**, 489 (1938).
[5] See for example, Wilcken, J. A., *Phil. Mag.*, **49**, 107 (1925). Rawer K., *Ann. Phys.*, **35**, 385 (1939).
[6] Darwin, C. G., *Trans. Camb. Phil. Soc.*, **23**, 137 (1924).
[7] Hartree, D. R., *Proc. Camb. Phil. Soc.*, **25**, 97 (1929).
[8] Försterling, K., *Ann. Phys.*, **11**, 1 (1931).
[9] Appleton, E. V., and Piddington, J. H., *Proc. Roy. Soc.*, A, **164** 467 (1938).

Blue Rocksalt

IN a letter in NATURE of February 17 under the above title, Dr. J. Newton Friend and John P. Allchin suggest that the blue colour of rocksalt may be derived from colloidal gold present in the sea-water from which the rocksalt has crystallized out, and give a content of 1 p.p.m. of gold as sufficient to produce a decided tint to a crystal.

From an oceanographer's viewpoint, it may be observed that this proportion of gold to sodium chloride would correspond to a gold content in the original sea-water of about 25 mgm./ton, whereas

the highest gold content found by F. Haber and co-workers (in water from the East Greenland polar current) was 0·04 mgm./ton, the average value for the South Atlantic surface water being at least ten times less.

HANS PETTERSSON.

Oceanografiska Institutet,
Göteborg.
March 29.

Rhythmical Impedance Changes in the Trout's Egg

MANY measurements have been made in recent years of the electrical impedance of cells such as those of nerve, Nitella and of marine eggs, and it has been found that such measurements yield valuable information as to cellular structure and reactivity.

Fertilized and unfertilized trout's eggs undergo rhythmical impedance changes when they have been in water for about six hours[1]. Further experiments show that this effect is not associated with the cytochrome system, as sodium nitride, carbon monoxide and lack of oxygen do not affect it. On the other hand, suitable concentrations of phenyl urethane reversibly abolish the effect. The action of the anæsthetic is shown in Fig. 1. The recovery part of the record has been omitted as it has no features of special interest.

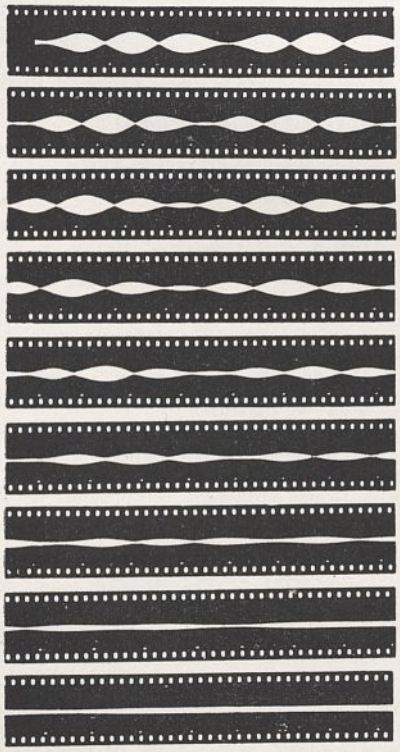


Fig. 1.

THE EFFECT OF PHENYL URETHANE ON THE IMPEDANCE CYCLE IN AN UNFERTILIZED TROUT EGG. THE ANÆSTHETIC WAS APPLIED AT THE BEGINNING OF THE RECORD. TIME-MARKER, MINUTES.

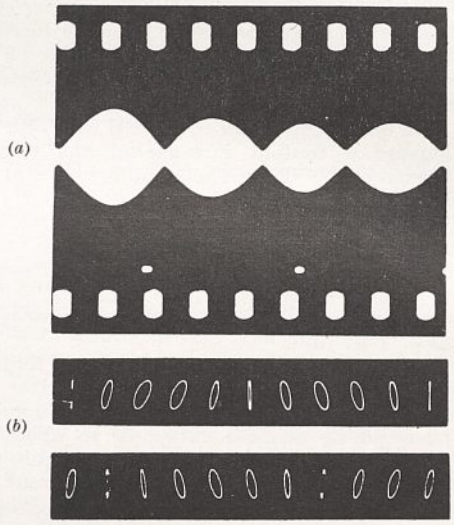


Fig. 2.

a, TWO COMPLETE IMPEDANCE CYCLES. TIME-MARKER, MINUTES.
b, SIMULTANEOUS RECORD OF THE RESISTANCE AND CAPACITANCE CHANGES IN THE EQUIVALENT CIRCUIT. THE ELLIPSES ARE 7·5 SEC. APART.

A change in impedance is due to a change in resistance and/or capacitance. (Inductances need not at present be considered in biological systems.) By using the 'ellipse' method of resolution[2], one can evaluate the resistive and capacitative components of the egg impedance cycle in the parallel circuit equivalent at a particular frequency to the trout egg in tap-water. This is shown in Fig. 2. Here, simultaneous moving film records of the impedance cycle, the resistive (R_p) and the capacitative (C_p) components are recorded. If R_p (as the angle of tilt of the ellipse) and C_p (as the minor ellipse axis) are plotted against time, the resultant curves are in phase every other cycle and approximately sinusoidal.

ROTHSCHILD.

Zoological Laboratory,
Cambridge.
March 23.

[1] Hubbard and Rothschild, *Proc. Roy. Soc.*, B, **127**, 510 (1939).
[2] Cole, K. S., and Curtis, H. S., *J. Gen. Physiol.*, **22**, 37 (1938).

Fluorescence and Oxidation in Conjugated Ring Systems

THE study of the fluorescence of organic substances has shown that strong fluorescence is almost entirely confined to conjugated ring systems, which possess the highly mobile electrons. Theoretically, it is clear that a substance can only then exhibit fluorescence if the potential curves of the ground state and the excited state do *not* cross each other (or come very near to each other) so that the transformation of electronic excitation energy into heat cannot occur.

Thus the essential conditions for fluorescence are: (1) the excitation of the electron must not change appreciably the internuclear distance; (2) there must be no favoured position for the electron where it can be 'trapped' and thereby its kinetic energy transformed into potential energy.

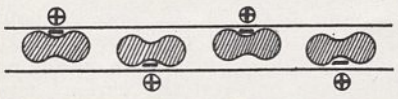
Consequently, only the more symmetrical conjugated systems or those which do not give rise to strongly ionic structures will show intense fluorescence.

The increase of the number of 'mobile' electrons, for example, in the series benzene → naphthalene → anthracene → . . . . → graphite, makes them behave increasingly like 'metallic' electrons as regards their optical and electrical behaviour.

We have found that this analogy to a metal can also be applied to some extent to the chemical structure and the reactivity of conjugated ring systems in general. It should be possible to prepare stable *positive ions* from the more 'metal-like' hydrocarbons by the action of oxidizing agents, and these positive ions should be capable of forming salt-like compounds. Various ionic compounds (bisulphate, perchlorate, etc.) have actually been prepared more recently from graphite by Hofmann[1] and collaborators by acting on it with an oxidizing agent in the presence of strong acids (sulphuric, perchloric). A certain number of hexagons in the layer planes loose an electron to form a monovalent positive (macro)-ion and this ion combines with HSO_4^- or ClO_4^- ion which goes between the layer planes of the graphite.

In view of the above-mentioned analogies with the metals, there can be no doubt that at least some of the peroxides of highly conjugated hydrocarbons, and in particular graphitic oxide, are essentially of ionic nature. The general formula of these compounds is most probably [(Hydrocarbon$^+$)O_2^-]. They are sometimes formed in a thermal reaction as in the case of triphenyl methyl[2], giving [$(C_6H_5)_3C^+.O_2^-$]. In the case of the diamagnetic hydrocarbons (for example, rubrene[3] or 3 : 10 dimethyl 1 : 2 benzanthracene[4], the peroxide is only formed under the influence of light, which decreases the ionization potential in the excited state and thus helps the formation of a positive ion.

The existence of O_2^- ion in peroxides like KO_2 has been shown by Pauling and Neuman[5] and its electronic structure has been discussed in detail[6]. Graphitic oxide should then be considered as a salt similar to the other graphite salts where the anion HSO_4^- or ClO_4^- is now replaced by O_2^- (or possibly partly by HO_2^-) (see diagram). This structure, of course, only refers to the *'active' oxygen* in graphitic oxide. The rest of the oxygen is present partly in the form of OH groups (possibly OH-ions) or as molecular water.



SCHEMATIC REPRESENTATION OF THE STRUCTURE OF GRAPHITIC OXIDE (SHADED PARTS REPRESENT O_2^- IONS BETWEEN THE LAYER PLANES OF THE GRAPHITE).

The ionic nature of graphitic oxide is also confirmed by the observed distance of layer planes, and by the fact that interplanar swelling can only be effected by *polar* solvents[1], a fact which was not understood previously.

The positive ions of graphite can be easily reduced[1] (reversibly) again to graphite, and this is also true for some of the hydrocarbon-peroxides which are decomposed by light or heat giving the unchanged ring systems.

Conjugated systems are of great biological interest and their biological significance seems to lie in the fact that they can undergo reversible oxidation, as has been made very probable in the case of chlorophyll[7]. The carcinogenic hydrocarbons also belong into the group of fluorescent conjugated ring systems[8] and it is quite possible that the oxido-reduction of these 'metal-like' hydrocarbon ions, namely,

$$(\text{Hydrocarbon}^+) \underset{\text{oxidation}}{\overset{\text{reduction}}{\rightleftharpoons}} (\text{Hydrocarbon}),$$

is an essential factor in causing the abnormal metabolism.

A full account will be published elsewhere.

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King's College,
Newcastle-on-Tyne.
March 21.

[1] Hofmann, U., *Ergeb. exact. Naturwiss.*, **18**, 229 (1939).
[2] Ziegler, K., and Ewald, L., *Ann. Chem.*, **504**, 162 (1933).
[3] cf. Dufraisse, C., *Bull. Soc. Chim.*, (5) **16**, 422 (1939).
[4] Cook, J. W., Martin, R., Roe, E. M. F., NATURE, **143**, 1020 (1939).
[5] Neuman, E. W., *J. Chem. Phys.*, **2**, 31 (1934).
[6] Pauling, L., *J. Amer. Chem. Soc.*, **53**, 1367, 3225 (1931).
[7] Rabinovitch, E., and Weiss, J., *Proc. Roy. Soc.*, A, **162**, 251 (1937).
[8] cf. Cook, J. W., NATURE, **145**, 335 (1940).

Ionization of Calcium Phytate

IT has been pointed out by Bruce and Callow[1], and again recently by Harrison and Mellanby[2], that the rachitogenic property of cereals may be due to the formation of a sparingly soluble salt of phytic acid and calcium. In this laboratory, investigations on the chemical properties of this compound have shown that sodium phytate can only form an insoluble precipitate when an equivalent or an excess of calcium is added. Under such conditions the filtrates are clear and contain only a trace of phytic acid. When less than half the equivalent quantity of calcium is added, no precipitate is formed and the solution remains clear. *The calcium in the solution is not precipitated by the addition of phosphate or oxalate.* This indicates complex ion formation, and also that the degree of ionization of free calcium is extremely small. When the amount of calcium is between one half and one equivalent the solution is turbid and difficult to filter.

The magnesium ion reacts with sodium phytate in the same way. When a mixture of calcium and magnesium ions is added in excess of that required by the phytate, magnesium can take the place of the calcium in the precipitate to a certain extent.

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[1] Bruce, H. M., and Callow, R. K., *Biochem. J.*, **28**, 517 (1934).
[2] Harrison, D. C., and Mellanby, E., *Biochem. J.*, **33**, 1660 (1939).

WITH reference to the above letter, we should like to point out that we showed in a recent paper on phytic acid and the rickets-producing action of cereals[1], that the greater part of the calcium in a hydrochloric acid extract of oatmeal is, in fact,

precipitated as phytate on bringing the solution to the neutral point, even though the total amount of calcium present is much less than equivalent to the phytic acid in the solution. Possibly the magnesium which is also present in the extract assists in the precipitation of calcium by forming an insoluble magnesium-calcium phytate instead of a soluble sodium-calcium double salt[2] which may be formed under the conditions described by Yang. Unfortunately, he does not state the hydrogen ion concentration under which his observations were made.

We found, too, that the filtrate from the neutralized oatmeal extract still contained a small amount of calcium in solution in spite of the presence of excess of phytic acid, and that addition of further amounts of calcium caused precipitation. We suggested that the residual soluble calcium was probably in an unionized form and therefore nutritionally unavailable. The observations of Yang appear to lend support to this suggestion, though as stated in our paper, we feel that there is not sufficient evidence to decide whether phytic acid exerts its rickets-producing action by actual precipitation of calcium or by lowering the ionization and diffusibility of calcium of the food. It seems possible that it may act in both ways, the depression of ionization being of relatively more importance at a faintly acid intestinal *p*H where precipitation of calcium would be less great.

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[1] Harrison, D. C., and Mellanby, E., *Biochem. J.*, **33**, 1660 (1939).
[2] Posternak, S., *Helv. chim. Acta*, **4**, 150 (1921).

Action of Œstrogens on the Female Genital Tract

IN an attempt to elucidate the mode of action of œstrogens on the female genital tract, we have conducted tests with cover-slip cultures of rat vagina and uterus.

Fragments of vagina from young albino females about three weeks old were explanted in the following

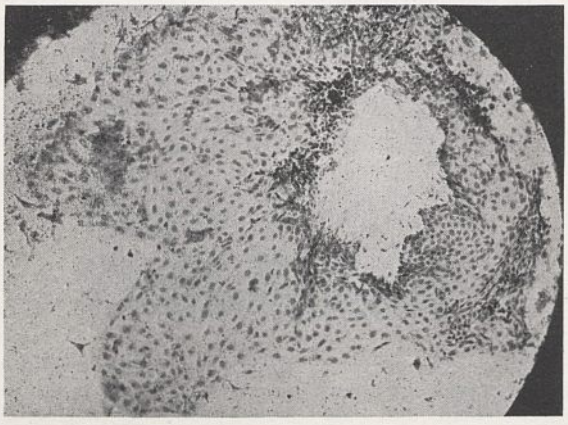

FIG. 1.

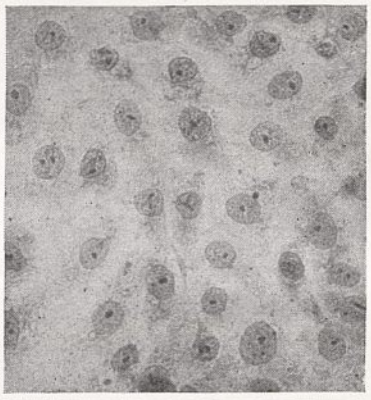

FIG. 2.

media : (*a*) normal male rat serum ; (*b*) normal male rat serum diluted with (i) 25 per cent of distilled water, or (ii) 25 per cent of an aqueous solution of diethylstilbœstrol containing 7·5 μgm. per ml. ; (*c*) male rat serum ground up with a few crystals of œstradiol and filtered.

Six cultures were prepared with each type of medium. The explants became rounded after twenty-four hours. Afterwards some desquamation of the epithelium occurred, but there was little cellular outgrowth. After three and after four days, explants were fixed and sectioned. No histological difference was detectable between those incubated in the different media. There were very few mitoses in the epithelial cells, and no indication of active proliferation or cornification having occurred.

A further series of cultures was set up in a medium composed of equal parts of chick embryo extract, and a mixture of three parts of rat plasma to two parts of fowl plasma. Fragments of the uteri and vaginæ of five-day-old rats were explanted. After twenty-four hours incubation there were outgrowths of sheets of epithelial cells from most of the uterine explants, but the vaginal explants showed less growth. The cultures of each tissue were then divided into four sets of six cultures, *A*, *B*, *C* and *D*, exhibiting approximately equal growth from set to set. Different treatments were then given to the cultures of the four sets. *A* received a drop of arachis oil, *B* a drop of arachis oil containing 1·0 mgm. of œstradiol per ml., *C* a drop of distilled water, and *D* a drop of distilled water containing *ca.* 50 μgm. of colloidal œstradiol per ml.

Cultures were fixed 24, 48, and 96 hours after treatment for cytological examination. However, the hormones had no demonstrable action, and there was no difference between the various sets of the same tissue.

The type of culture with which we have been working is illustrated in Fig. 1, the explant having been removed after fixation. This represents four days growth *in vitro*, and two days treatment with a drop of distilled water. Fig. 2 shows at a higher magnification a part of a similar culture after treatment with colloidal œstradiol for two days. Both of the cultures were of uterine fragments. We are satisfied that the cultures were brought in contact with more than sufficient œstrogen to cause the changes characteristic of œstrogenic stimulation *in vivo*, and in view of the healthy state of the cultures, it appears improbable that œstrogens act directly on the vaginal or uterine epithelia.

While this work was in progress, Hechter, Lev and Soskin[1], following the work of Reynolds[2] and Pompen[3], showed that vaginal cornification in the mouse produced by œstradiol benzoate may be inhibited by atropine, and that cornification follows the administration of yohimbine. The uterine response was only partially inhibited by atropine. Hechter and his co-workers believe that the vaginal response, and part of the uterine response to œstrogens, is dependent upon hyperæmia, a conclusion which is complementary to our own, since we found no indication of a direct action of œstrogens upon the epithelial cells.

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[1] Hechter, O., Lev, M., and Soskin, S., *Endocrinology*, **26**, 73 (1940).
[2] Reynolds, S. R. M., *J. Physiol.*, **95**, 258 (1939).
[3] Pompen, A. W. M., "De Invloed van Menformon op der Baarmoeder". Thesis. Amsterdam, quoted by Reynolds (1933).

'Coupling' of Phosphorylation with Oxidation of Pyruvic Acid in Brain Tissue

LIPMANN[1] found that, although adenylic acid does not influence the rate of oxidative decarboxylation of pyruvic acid by preparations of lactic acid bacteria, it is phosphorylated to adenosine-polyphosphate. With brain dispersions it has been shown in this laboratory[2] that oxidation of pyruvate requires the presence of both inorganic phosphate[3] and adenine nucleotide (adenylic acid, adenosine-triphosphate). These observations suggested that a cycle of phosphorylation is involved in the enzymatic oxidation of pyruvate.

Brain preparations contain an active adenosine-triphosphatase[2] and, in the presence of adenylic acid (without or with creatine), only small amounts of adenosine-polyphosphate (or creatine phosphate) accumulate. However, that oxidation of pyruvate in brain tissue is accompanied by an intensive esterification of phosphate has now been shown by using hexosemonophosphate as an acceptor for the labile phosphorus groups of adenosine-triphosphate[4]. When hexosemonophosphate is added to a dialysed brain dispersion containing phosphate, Mg^{++}[5], adenylic acid, fumarate[2], pyruvate, and NaF (phosphorylation also occurs in the absence of NaF), and the mixture is incubated aerobically, inorganic phosphorus is taken up (Table 1) and an equivalent amount of hexosemonophosphate is converted into hexosediphosphate. As much as 0·8 mgm. hexosemonophosphate phosphorus can thus be phosphorylated in 35 min. at 38°. The hydrolysis curve (in *N* HCl at 100°) of the resulting ester is that of hexosediphosphate which, under these conditions, does not seem to react further significantly; this is confirmed by the failure to detect formation of phosphoglyceric acid by Rapoport's[6] method. No esterification of phosphate occurs in the absence of pyruvate plus fumarate and very little in the absence of adenylic acid. Thus oxidation of pyruvate is accompanied by phosphorylation of adenylic acid to adenosine-polyphosphate which, in presence of hexosemonophosphate, transfers its labile phosphorus to the latter instead of being hydrolysed by the adenenosine-triphosphatase. Table 2 shows that, in 30 min., approximately 2 atoms phosphorus are esterified for 1 mol. pyruvate disappearing and 1 mol. oxygen taken up.

TABLE 1.

1·5 ml. dispersion from pigeon brain (dialysed 2·5 hours) to 2·2 ml. with phosphate buffer *p*H 7·3 (0·05 *M*) Mg^{++} (0·2 mgm.), adenylic acid (0·0007 *M*), Na fumarate (0·005 *M*), Na pyruvate (0·013 *M*) and NaF (0·04 *M*). Air, 38°.

(O_2 uptake = difference between complete samples and samples containing no pyruvate + fumarate).

Time (min.)	O_2 uptake (μ l)	Pyruvic acid (mgm.)	Inorg. Phosphorus (mgm.)
0	—	2·17	1·42
5	48	1·62	1·13
10	96	1·51	1·00
20	143	1·34	0·92
30	190	1·24	0·83

TABLE 2.

Time (min.)	O_2 uptake		Pyruvic acid disappeared		Phosphorus esterified	
	μ l	μ mol.	mgm.	μ mol.	mgm.	μ atoms
30	190	8·5	0·93	10·5	0·59	19·0

The necessity of inorganic phosphate and adenine nucleotide for the oxidative breakdown of pyruvate in brain is thus explained. The recent work of Warburg and Christian[7], by which the mechanism of enzymatic oxidation of triosephosphate and the true nature of the 'coupled' esterification of phosphate are made clear, will throw much light upon the undoubtedly similar mechanism of pyruvate oxidation.

I am indebted to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

S. OCHOA.
Department of Biochemistry,
Oxford.
April 11.

[1] NATURE, **143**, 281 (1939).
[2] Banga, Ochoa and Peters, NATURE, **144**, 74 (1939); *Biochem. J.*, **33**, 1980 (1939).
[3] cf. Lipmann, *Enzymologia*, **4**, 65 (1937) as regards bacteria.
[4] Ostern, Guthke and Terszakowec, *Z. physiol. Chem.*, **243**, 9 (1936).
[5] Ochoa, NATURE, **144**, 834 (1939).
[6] *Biochem. Z.*, **291**, 429 (1937).
[7] *Biochem. Z.*, **303**, 40 (1939).

Influence of Spermathecal Stimulation on the Physiological Activities of *Anopheles subpictus*

THE introduction of spermatozoa into the spermatheca is not known to influence the physiological activities of a mosquito or of any other insect except that it serves the purpose of fertilization of the ovum. That it has a marked action on egg formation in *Anopheles subpictus* has now been demonstrated.

While successful mating of *A. stephensi* and *A. annularis* can take place in ordinary feeding cages in the laboratory, *A. subpictus* do not pair under similar conditions, a fact which has also been noted by Christophers[1]. The proclivity of the three species of anophelines mentioned above to feed on blood is independent of mating, though *A. subpictus* do not

feed to the same extent as in Nature. While a blood feed will lead to egg formation in virgin *A. stephensi* and *A. annularis*, it fails to do so in virgin *A. subpictus*, even when this mosquito has been allowed to feed to repletion on man, goat, or cattle, and evidence of follicular stimulation is the only noticeable change. This led Christophers[1] to abandon his observations on egg development in *A. subpictus* in the laboratory.

The presence of two distinct phases in the egg formation in *Aedes aegypti*, one stimulation of the follicle and the other formation of the ovum, was tentatively suggested by me[2]. The stage of follicular stimulation can be clearly demonstrated in *A. subpictus*, and is characterized by the appearance of very light peppery granules scattered irregularly. These are distinct from yolk granules, which are much coarser and are deposited in a much more compact manner. Distinction between these two stages in *A. annularis* is not possible unless the latter are allowed to ingest a very small quantity of blood, as otherwise the second phase overlaps the first.

It has also been observed in *A. subpictus* caught in Nature that ingestion of a large quantity of blood and yolk formation are solely dependent on the presence of sperms in the theca.

While reception of blood into the stomach is sufficient to cause stimulation of the follicles and yolk formation in virgin *A. annularis*, and only the former change in virgin *A. subpictus*, the introduction of sperms into the theca in the latter species can alone lead to yolk formation. The specific substance of the blood which is concerned with yolk formation in *A. subpictus* is intimately associated with the stimulation of the theca, and it is presumed a specific hormone is thereby produced.

Any suggestion that the failure of laboratory-fed *A. subpictus* to produce yolk owing to the ingestion of a smaller quantity of blood than the minimum amount necessary for egg production is untenable on account of the constant association between yolk formation and the presence of sperms in the theca, and also the reverse phenomenon noticed in mosquitoes caught in Nature[2]. Besides, the amount of blood ingested by *A. subpictus* in the laboratory does not seem to be insufficient for egg production.

Collections of the mosquitoes, *A. annularis* and *A. subpictus*, were made from the salt-lake area adjacent to Calcutta, and dissections were performed from day to day. Nearly five hundred specimens of each species were dissected.

The above conclusions have been arrived at from observations made during the winter months.

D. N. ROY.

School of Tropical Medicine,
Calcutta.
Feb. 27.

[1] Christophers, S. R., Paludism. Government Central Branch Press, Simla (1911).
[2] Roy, D. N., *Bull. Ent. Res.*, **27**, 423–429 (1936).

Photodynamic Hæmolysis by 3 : 4-Benzpyrene

IN a recent communication, Wolman[1] described the photodynamic hæmolysis of sheep's red corpuscles by carcinogenic hydrocarbons. Though unable to demonstrate this in 1937, we did succeed last year using long exposures to light. Our results agree closely with Wolman's. But we varied and further extended the experiments in order to try to see how benzpyrene sensitizes red corpuscles. We have carried out the following investigations.

(1) Colloid solutions of benzpyrene in normal saline were made up in a series of dilutions from 1 in 10,000 to 1 in 100 million. Washed human red corpuscles were added to these and the mixtures kept in the dark for three hours. Some were then put in sunlight and controls kept in the dark. After 45 minutes exposure the red corpuscles in the 1 in 10,000, 1 in 100,000, and 1 in 1 million solutions showed approximately the same amount of partial hæmolysis. This was complete in two hours, by which time a partial hæmolysis was present in the 1 in 10 million solution. There was no hæmolysis in the 1 in 100 million solution in the light and none in the controls kept in the dark.

(2) Colloid benzpyrene solutions were given a prolonged exposure to light. Red corpuscles were then added and the mixtures kept in the dark. No hæmolysis resulted.

(3) Suspensions of red corpuscles in benzpyrene colloid were left in the dark for various times and the corpuscles then washed free from benzpyrene. After this they were given a long exposure to light. Corpuscles which had been in contact with the hydrocarbon for five minutes showed a trace of hæmolysis, those in contact for one hour showed moderate hæmolysis, and corpuscles which had been in contact with the benzpyrene for three hours showed complete hæmolysis, in 45 minutes exposure to sunlight. The strength of the colloid was 1 in 100,000.

(4) Samples of red corpuscle suspensions in benzpyrene colloid (1 in 250,000) kept for 2½ hours in the dark at various temperatures were washed and exposed to light. Those which had been kept in contact with the benzpyrene at 0° C. showed only slight hæmolysis after prolonged exposure to a mercury vapour lamp. Red corpuscles which had been in contact at 37° C. showed a comparatively rapid hæmolysis under the lamp.

Thus, using red corpuscles, the photodynamic potency of benzpyrene is roughly the same in dilutions of 1 in 10,000 to 1 in 1 million. Paramecia gave a similar result (Doniach[2]). Washing red corpuscles which have been suspended in benzpyrene does not get rid of their sensitivity to light. This sensitivity is enhanced by prolonged contact with the hydrocarbon and by raising the temperature at which the corpuscles are suspended in the colloid. These results indicate that the benzpyrene must enter into the red corpuscles before a photodynamic action can start. If it were a matter of simple adsorption on to their surface one would have expected contact at 0° C. to have been more effective than contact at 37° C. The enhancement at higher temperature is likely to be due to an increased solubility of the benzpyrene in water, an assumption in accord with recent results of other experiments in this laboratory.

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April 20.

[1] Wolman, M., NATURE, **145**, 592 (1940).
[2] Doniach, I., *Brit. J. Exp. Path.*, **20**, 227 (1939).

Acetolysis of Carrageen Mucilage

IN a series of papers published between 1921 and 1929, Haas and his collaborators[1] showed that in the mucilage of carrageen moss (*Chondrus crispus*) there are two main constituents one of which can be extracted from the seaweed by cold water, the other only by hot water. They further showed that both constituents are ethereal sulphates of polymeric carbohydrates, occurring chiefly in the form of their calcium salts; but all their attempts to isolate the polymeric carbohydrates by hydrolysis led only to the production of simple hexoses. Galactose and fructose were easily recognized by them among the products of hydrolysis.

We have now acetylated the mucilage by treatment with acetic acid and acetic anhydride under the catalytic action of sulphur dioxide and chlorine, and on removal of the acetyl groups from the product we have obtained two polymeric carbohydrates each containing about 0·1 per cent of ash and giving analyses which agree well with the formula $(C_6H_{10}O_5)_n$. One of these bodies is soluble only in hot water and gives with iodine a wine-red colour similar to that given by glycogen, while the other is soluble in cold water and gives no characteristic colour with iodine. After hydrolysis neither compound gives glucosazone nor does either give the Seliwanoff reaction for fructose; the latter reaction is, however, given by the alcoholic liquid from which the polymeric carbohydrates have separated on deacetylation. From both polymers the characteristic α-methylphenylhydrazone of galactose was prepared and both gave mucic acid on oxidation with nitric acid.

Both polymeric carbohydrates appear to be galactans. In physical properties they resemble the body isolated by Hassid[2] from *Irideæ Laminarioides* more than that obtained by Percival and Sym[3] from agar.

Further investigation of these products is in progress, and detailed results will be published elsewhere.

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P. O'COLLA.

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March 30.

[1] Haas and Hill, *Ann. App. Biol.*, **7**, 352 (1921); Haas, *Biochem. J.*, **15**, 469 (1921); Russell-Wells, *Biochem. J.*, **16**, 578 (1922); Haas and Russell-Wells, *Biochem. J.*, **23**, 425 (1929).
[2] Hassid, *J. Amer. Chem. Soc.*, **57**, 2046 (1935).
[3] Percival and Sym, NATURE, **137**, 997 (1936).

Points from Foregoing Letters

A NEW formula connecting tensile strength with latent heat of melting and Poisson's elastic constant has been developed by R. Fürth and found to be in good agreement with experiment.

Electron diffraction studies show, according to S. Yamaguchi, that when potassium and sodium are exposed to air they are attacked within five minutes by carbon dioxide, but lithium and calcium are not attacked. Oxygen and moisture in the air attack all four metals.

W. Krasny-Ergen describes a suggested apparatus for the separation of uranium 235.

L. G. Stoodley has shown how measurements of the signal strengths of ultra-short waves reflected at grazing incidence at a diffuse boundary in the troposphere may be used to calculate the reflection coefficient for longer waves at vertical incidence. The results are in agreement with the experimental values of Appleton and Piddington.

Records of the rhythmical impedance changes undergone by an unfertilized trout egg are submitted by Lord Rothschild. From resistance and capacitance changes in an equivalent circuit, it is found that resistance and capacitative components plotted against time give curves which are in phase every other cycle and approximately sinusoidal.

J. Weiss states that the fluorescence of conjugated ring systems is essentially due to the presence of the 'mobile' electrons, which are also responsible for the chemical behaviour of these substances. The structures of some related hydrocarbon-peroxides and of graphitic oxide are deduced, and a possible mechanism for the action of carcinogenic hydrocarbons is suggested.

E. F. Yang finds that when sodium phytate is present in excess, calcium is not precipitated as the phytate but remains in solution in an un-ionized form which is not precipitated by addition of oxalate or phosphate. D. C. Harrison and Sir Edward Mellanby find that this non-precipitation of calcium as phytate does not hold for oatmeal extracts. Their experiments indicate that the rickets-producing action of cereals is due to phytic acid, which interferes with calcium absorption from the intestine. They suggest that the cereal phytic acid may exert a rachitogenic action partly by precipitating calcium in the intestine and partly by rendering the calcium un-ionized and thus impeding its absorption.

The application of œstrogens by C. W. Emmens and R. J. Ludford to tissue cultures of vagina and uterus failed to induce either proliferation or cornification of the epithelial cells. Hence it is concluded that the characteristic histological changes following œstrogenic stimulation *in vivo* are not the result of a direct action of the hormones on the epithelial cells.

S. Ochoa finds that oxidation of pyruvic acid in brain preparations, in the presence of phosphate, adenylic acid, and hexosemonophosphate, is accompanied by conversion of the monoester into hexosediphosphate with an equivalent uptake of inorganic phosphorus. This 'coupling' explains why both inorganic phosphate and adenylic acid are necessary for the oxidation of pyruvate in brain.

I. Doniach and J. C. Mottram report that human red corpuscles were sensitized to light with 3 : 4-benzpyrene. The hydrocarbon was active down to a dilution of 1 in 10 million. Washing red corpuscles which had been suspended in benzpyrene colloid did not rid them of their sensitivity to light. The photodynamic reaction was enhanced both by prolonged contact in the dark of the corpuscles with the benzpyrene and by raising the temperature at which contact was made.

By acetolysis of carrageen mucilage, T. Dillon and P. O'Colla have obtained two polymeric carbohydrates, one soluble in cold water and the other soluble in hot water and giving a characteristic colour with iodine. Both appear to be galactans.

RESEARCH ITEMS

Fertility Cults in East and West

A POSSIBLE link between the Mediterranean and adjacent regions of the ancient world and Japan in the symbolism of the cowrie as a fertility emblem is discussed by Kurt Singer (*Man* of April 1940). While Elliot Smith's theory of the cowrie as a "life-giver" and closely associated with parturition and other fecundity cults has been accepted, for example, by J. Gunnar Andersson, as a working hypothesis making it possible to range under a single point of view all the varying uses of the cowrie, a difficulty is that no Neolithic figurine of the Astarte type shows any recollection of the cowrie talisman. The Western evidence in figurine and cult observances is suggestive rather than conclusive, but a Neolithic (*Jōmon*) figurine from north-eastern Japan is unique in showing not only unusually strongly accented breasts, but also what appears to be a monstrous vulva but is probably the giant image of a cowrie shell hanging from a cord attached to the neck-band. The ritual use of powdered shell and water for various ceremonies may also be thought to confer life and force by administering a simulacrum of mother's milk produced from a simulacrum of the womb. Two masks recall the traditions about Baubo-Iambe and Demeter. They formed the central part of the autumn procession at the festival of the Gongoro Jinja in Kamakura, and were worn one by a woman showing signs of distraction and the other by a woman obviously with child who addressed ribald remarks to male onlookers. The procession closed with men carrying poles, recalling phallic symbols. Arguments and parallels may be cited in support of the suggested resemblance to Demeter and Baubo.

Stomatopoda from the John Murray Expedition

Two memoirs on the Stomatopoda have recently appeared (John Murray Expedition, Scientific Reports 6, No. 3, by B. Chopra, No. 6, by G. E. H. Foxon. British Museum (Natural History), 1939). The collection of Stomatopods is small but of interest. Some are of large size, more than 300 mm. in length. Sixteen species and varieties are recorded, one species of Squilla and one of Lysiosquilla being new. The variation in the raptorial teeth in *Squilla investigatoris* is remarkable; also the variation of the relation of rostrum to eyes in *Lysiosquilla multifasciata*. There are many varieties of *Gonodactylus chiagra*, some of which are regarded as distinct species. A small one was dredged at the unusual depth of 1,300 m. Fragments of *Squilla investigatoris* were also dredged at this depth, but it is, of course, not certain that the species was actually living there—a record depth for any Stomatopod. It is difficult to place the new species *Lysiosquilla sewelli*, which combines characters of this genus with those of several others. In his work on the larvæ, Foxon has modified his former classification (1932, Great Barrier Reef Report) which has been criticized by Guerney (*Proc. Zool. Soc.*; 1937) who regards the classification of Giesbrecht as the more natural one in which the two fundamental types of larva, antizoea and pseudozoea are separated. The revised key gives two main groups, the first containing Coronida and Lysiosquilla (antizoea larva), the second containing all the others. In the second group Squilla and Pseudosquilla are placed close together, in agreement with the adult classification of Kemp, and Odontodactyla and Gonodactylus which have early larvæ very similar to Pseudosquilla and different from Squilla, in another section. It is shown that Squilla larvæ occurred everywhere, but in great numbers near the coast. Pseudosquilla larvæ are likely to be found near land, and Lysiosquilla larvæ are the most likely to be found farthest from land.

Turbellaria from Bermuda and the Sargassum

L. H. HYMAN has recently described a valuable collection of Acoel and Polyclad Turbellaria derived from material collected by herself, by Dr. Wheeler and by Dr. Verrill in Bermuda, and also several Sargassum collections from the Bingham Oceanographic expeditions to the western and central North Atlantic, the Gulf of Mexico and the Caribbean (*Bull. Bingham Oceanograph. Coll.*, Peabody Museum of Natural History, Yale University, 7, Art. 1; 1939). Nine plates of clear drawings illustrate this paper, in which there are two new species of Acoela, eleven known and two new species of Polycladida, and one new variety of Polyclad. Many of these were collected on the shore at Bermuda, but there are also species from the floating Sargassum weed which is a fruitful hunting ground for these worms. The Polyclads are chiefly species originally described by Verrill in 1900 and 1901 and these are now assigned to their proper genera with details of their sexual anatomy. Use has been made of colour drawings made from live specimens by Dr. Wheeler, director of the Bermuda Biological Station, which makes the descriptions doubly valuable; the whole monograph forms a useful addition to the rapidly growing series of writings on the Bermudan fauna.

Identification of Plants of Tanganyika Territory

"A FIELD Key to the Savanna Genera and Species of Trees, Shrubs and Climbing Plants of Tanganyika Territory" by the late B. D. Burtt (published by the Tsetse Research Department) should prove extremely valuable to workers in this part of Africa, where it is difficult to get plants named locally, especially as the collections are housed in European herbaria. Many of the workers in Tanganyika are attached to technical departments, and the key will have added value from the fact that its use does not require a preliminary botanical training, so that anyone dealing with plants as indicators of soil conditions, timber trees or plants with poisonous or useful properties will be able to record his observations in the concrete form of a correct botanical name. Though primarily concerned with plants of Tanganyika, the savannah plants are very similar in the neighbouring parts of Northern Rhodesia, Nyasaland, Uganda and Kenya, so that, with reservations, the key may be applicable to the savannahs of these districts or serve as a basis for a similar key. It is much to be regretted that Mr. Burtt's death has interrupted this work, of which he had outstanding knowledge, but it is to be hoped that in time the key to the genera will be supplemented by a key to the species as originally intended.

A Fossil Link between North America and Asia

A MAIL report from Science Service and the Smithsonian Institution announces the clarification of a problem which has long puzzled American geologists. Large numbers of fossil leaves which somewhat resembled the foliage of living poplars have been collected between Greenland and south-western Tennessee, for the past seventy years. Roland W. Brown suggests that the leaves are similar to those of a present-day Japanese tree, the katsura. He further argues that if leaves were fossilized through being blown into mud, it ought to be possible to find also the fossil seeds. Katsura seeds have sickle-shaped wings and are wind-blown. Dr. Brown ultimately found a few of them fossilized in the localities where the fossil leaves occurred. A study of variation in leaf form of the present-day tree paralleled the various types of fossil foliage. This brilliant piece of palæontological investigation adds yet another to the fossil links, such as those of the horse, which bind North America and Asia.

Genetics of the Garden Pea

GENETICAL experiments with the edible pea, *Pisum sativum*, have been carried on since the time of Mendel. Nevertheless, the linkage relationships of even the well-known characters, round-wrinkled seeds or yellow-green cotyledons, are insufficiently known. C. Pellew (*J. Genetics*, **39**, 363–390; 1940) has published some of her extensive linkage data. She shows how reciprocal translocations and trisomics enable us to identify the chromosomes and positions on the chromosomes where a particular gene is placed. The *K* reciprocal translocation of Hammerlund has been used for the present report. The genes, *A*, *I*, *Gp*, *Fs*, *R*, and *Bt* have cross-over percentages of 1, 1, 1, 20, 40, and 40, respectively, with the point of interchange. In normal lines *A-L* has 12 per cent crossing-over, *R-Bt* 30 per cent, and *Fs-Sp* about 42 per cent. Between these pairs of genes independence is shown in normal lines; but experiments with several translocations indicate that *A*, *L*, *R*, and *Bt* are all on chromosome 1. *Fs* and *G-p* are on chromosome 2, which with chromosome 1 took part in the *K* reciprocal translocation. The author also shows that competition and possibly elimination of certain types take place in the male gametophyte and in the young sporophyte.

Oxygen Isotopes in Rocks and Ores

A STUDY of Grenville marble, Niagara dolomite and Pennsylvania limestone and shells, all carbonates of widely different ages, made by M. Dole and R. L. Slobod (*J. Amer. Chem. Soc.*, **62**, 471; 1940), reveals no significant difference in the ratio of the oxygen isotopes ^{16}O and ^{18}O as a function of the age of the rocks. The oxygen in iron ores of the Keewatin and Middle Huronian ages does not differ significantly in isotopic composition from the oxygen in normal water; the slight excess density observed in experiments on the oolitic and fossil type of Silurian ores is probably due to the presence of carbonates in the ores. The oxygen of Grenville marble when liberated as carbon dioxide and reduced with hydrogen gives water 9·2 p.p.m. heavier than normal, but when the carbon dioxide is driven out of the rock by heating, the resulting water is only 7·9 p.p.m. heavier. The difference is attributed to the isotopic fractionation which occurs when the carbonate ion is decomposed by acid. The authors discuss the question as to whether the isotope ratio corresponds with sea-water or rain-water.

X-Ray Diffraction of Liquid and Plastic Sulphur

THE anomalous behaviour of liquid sulphur in respect of viscosity, specific gravity, surface tension, thermal expansion, and specific heat at just above 150° has invited a study of the structure of liquid sulphur at different temperatures. Various workers have attempted to explain these anomalies on the basis of X-ray diffraction patterns, but recorded data are not consistent. In a recent publication (*J. Chem. Phys.*, 8, 29; 1940) Gingrich has attempted to clarify the position. He obtained and compared the X-ray diffraction patterns of liquid sulphur at eight temperatures between 124° and 340° and, in addition, that of plastic sulphur at room temperature. The intensity curve, as a function of $(\sin\theta)/\lambda$, for plastic sulphur is typical of an amorphous substance and shows three peaks. Those for liquid sulphur, corrected for absorption, polarization, and incoherent radiation, at 124°, 166°, 175°, 225°, and 340° show a main peak with two plateaux. The position of this peak shifts irregularly with temperature. Thus from 124° to 157° the value of $(\sin\theta)/\lambda$ decreases slightly, from 157° to 166° it gives a large decrease, and from 166° to 340° it decreases gradually. Atomic distribution curves show that (i) the first concentration of sulphur atoms in plastic sulphur is at 2·08 A. with two nearest neighbours, and (ii) 1·7 nearest neighbours are found at an average distance of 2·07 A. in liquid sulphur at all temperatures. (i) does not yield enough information to distinguish between closed rings of sulphur atoms and long coiled chains in plastic sulphur; and (ii) indicates that in liquid sulphur most atoms (about 70 per cent) still have two permanent neighbours which are covalently linked at the same distance as in the S_8 molecule, and about 30 per cent have one nearest neighbour.

The Mohammedan Calendar and the New Moon

J. H. REYNOLDS has discussed in a paper entitled "The Mohammedan Calendar and the First Visibility of the New Moon in Egypt" (*Occas. Notes Roy. Astro. Soc.*, No. 7; 1939) the months of the fast of Ramadan and the feast of Bairam, which commence when the thin crescent of the new moon is first visible after sunset. At the Helwân Observatory, two assistants are delegated to report both the beginning and ending of the month of the Ramadan fast, but sometimes a village sheikh in Upper Egypt or the Delta sends a wire to the Quadi's court announcing his discovery of the crescent. Occasionally the date of the alleged observation is known at the Observatory to be impossibly early. Reynolds applies J. K. Fotheringham's table (*Mon. Not.*, 70, 527; 1910), which shows the minimum true altitude at sunset or sunrise for the moon to be visible for true differences between the azimuths of the sun and moon, the latter ranging from 0° to 23°. While Fotheringham claimed that the table is independent of the latitude differences, Reynolds does not accept this view, and expresses the opinion that the table is probably inapplicable for latitudes of 50° and above. He suggests that the point would be worth verifying by observation, because of the importance of such factors as refraction and transparency of the atmosphere near the horizon.

ELECTRIC CABLES AND FIRE RISKS

MR. S. W. MELSOM, of the Cable Makers' Association, read a paper on March 13 on recent developments and investigations on electric cables and fire risks, before the Transmission Section of the Institution of Electrical Engineers.

During the last four years there has been general concentration on the problem of fire risks in electrical installations and on the precautions necessary to eliminate them. These problems, which apply to ships, power stations and mines, are probably mostly due to the immense spread of the use of electrical energy and the enormously increased size of the power units and of the distribution units and the distribution systems. As a result of the various inquiries that have been held, the encouraging news has emerged that nowadays the fire risk due to faulty cables is exceedingly small, so small, in fact, that it may almost be ignored, and that, as regards cables, the real precautions to be taken are in respect of the spread of extraneous fire along the cable.

So far as ships are concerned, shipping records justly direct attention to the excellent record of British shipping in this respect. Regarding power stations, the report of the Electricity Commissioners does not ask for any special protection from fires arising within cables, and as for mines, all the evidence of fires in mines has exonerated cables. However satisfactory the general volume of proof may be, it will be obvious that the cable-making industry was bound to make all possible investigations and, in particular, to help in the solution of the problem of resisting the spread of an extraneous fire along a cable run.

The author said that a great deal of work has recently been done on the fireproofing of mains cables in power stations, generally with the view of protecting them from breakdown due to adjacent cables, more particularly in the manholes which are part of the large duct systems prevalent in the United States. It was not until 1937 that the subject was given serious consideration in Great Britain. The committee set up by the Electricity Commissioners as a result of painful experience worked energetically at the problem, and we are deeply indebted to this committee for its clarification of the problem and for the resultant proper provision for protection against fire.

It may be assumed from the published recommendations of the Commission that, so far as cables are concerned, the main problems to be faced arise from extraneous fires mainly due to flowing burning oil in a station or a substation. The recommendations of the Commissioners were made after full consultation with the industry, and with them the cable-makers are in full agreement.

It may be useful to discuss the manner of giving effect to these recommendations, and the effect that the protection may have on the performance of the cables under normal operating conditions. The essential requirement for the fireproofing of lead-sheathed paper-impregnated cables is that the fireproofing should be sufficiently heat-resisting fully to protect the cable, of sufficiently low thermal conductivity so as not to decrease unduly the current rating of the cable, and that either its composition is such that it does not set up corrosion of the lead sheath or, alternatively, that it is provided with protection against such corrosion.

A combination of all these properties was not easy to find, and a good deal of investigation was required before the best materials were found. Also in some cases the use of the best method was not possible on systems already installed, and alternative methods had to be sought. Dealing with the question of cables emerging from the floor and going upwards to connect to switchgear, etc., or to other cables run in the vicinity of such gear, etc., the method selected for new installations and for existing installations where space was available was to use moulded asbestos supplied by the makers in the form of split-tubes which could be clamped around the exposed length of the cable. Apart from the ease of fitting and the comparatively pleasing finish of the work, this material represents the nearest approach to the ideal characteristics mentioned above. Magnesia has probably a higher degree of resistance to fire than the asbestos mouldings, but the thermal resistivity of the material is so high that the current rating of the cable would be greatly diminished.

The thermal resistivity of moulded asbestos is of the order of 700 thermal ohms, a value which with the thickness of material used would normally decrease the current rating of the cables by about 20 per cent. Against this, however, may be offset the normal increase of rating due to the fact that the cables to the ground are probably grouped, whereas when they are taken to switchgear they are separated apart a distance sufficient to free them from 'proximity heating'. This generalization, however, must not be carried too far, since if the cables in the run are separated throughout and operated at or near their maximum current, the asbestos-covered section would reduce the permissible current to an extent which would require serious consideration.

The fire-resisting properties of the moulded asbestos material appear to be extremely good. From figures quoted by the makers, the white asbestos material only begins to suffer damage when subjected to a temperature of 2,500° F., and the asbestos compound can withstand much higher temperatures for short periods. Tests carried out by the E.R.A. on cables protected by moulded asbestos exposed to a serious oil fire showed that, while parts of the burning enclosure reached a temperature of about 1,100° F., the highest recorded temperature on the protected cable sheath was 176° F. More severe tests of the same material used as a protective covering for steel girders showed that after a period of more than four hours exposure, during which the ambient temperature rose to 2,100° F., the temperature of the protected ironwork was only 850° F. It should be noted that the material is somewhat alkaline and that, to ensure protection against corrosion, the lead sheath of the cable should first be protected with a layer of bitumen paint and wrapped with one layer of bituminized tape.

For existing installations in which the conditions of erection are such as not to allow the use of moulded asbestos, a very good degree of fire resistance can be ensured by stripping off all the existing protective

wrappings to the armour (or lead as the case may be), painting the cable with bitumen paint, wrapping with a layer of bituminized tape and then applying two layers of asbestos tape with a sensible overlap. The asbestos should be freely painted with silica paint.

For a number of years the research staffs of the associated firms of cable makers have been attempting to produce fire-resisting or self-extinguishing rubber compounds, and a fair degree of success has been obtained in imparting these properties to rubber. The fundamental difficulty has been that raw rubber is not self-extinguishing when once ignited, and the other materials which it is necessary to incorporate in the 'mix' to overcome the lack of self-extinguishing properties greatly modify its other desirable properties.

A new synthetic material has been discovered which belongs to the same general chemical group as rubber. This material in its raw state is very similar in its physical properties to raw rubber. It is converted into a suitable 'mix'. As, however, the material is fire-resisting, it is not necessary to obtain the fire resistance at the expense of other properties. Extensive tests have shown that this synthetic material is more resistant than rubber to deleterious influences.

Fires which have occurred in coal mines during recent years with deplorable loss of life raised the question in some minds as to how far electrical cables have been responsible for either initiating a fire or conveying an existing fire from one part of a mine to another. At the instigation of Mr. Horsley, electrical inspector of mines, the cable makers agreed to carry out experiments with the view of obtaining data which would answer certain specific questions. It was found that the application of a hot external flame for about 15 seconds was necessary to ignite the compound on the wrappings of a standard C.M.A. cable; hence it does not seem probable that such wrappings around the cable would be ignited as the result of a transient flame such as would arise, for example, from an explosion of fire damp. The experiments also showed that the armour wires practically completely protected the inside of the cable. The cable makers have to be congratulated on the way they have co-operated in very expensive researches for their mutual benefit.

NEW INTERNATIONAL COMMISSION OF SNOW AND GLACIERS

By F. E. MATTHES

AT the Seventh Assembly of the International Union of Geodesy and Geophysics, which was held in Washington last September, the International Association of Scientific Hydrology, one of the component units of the Union, effected the consolidation of two of its own commissions—the Commission of Snow and the Commission of Glaciers. The action was taken after a preliminary poll of the membership of the two commissions had shown an overwhelming majority in favour of the consolidation. Moreover, the presidents of both commissions, Prof. J. E. Church, of the University of Nevada, U.S.A. (snow), and Mr. J. M. Wordie, of St. John's College, Cambridge, Britain (glaciers), had strongly recommended it.

Prof. Church was designated acting president of the new Commission of Snow and Glaciers, to serve in that capacity until international relations will permit the holding of a formal election of officers. Like all other sections of the International Union of Geodesy and Geophysics, the Association of Hydrology has deferred election of officers for the present triennial period, in view of the sparse attendance of European delegates at the Washington assembly, due to war conditions.

The new Commission of Snow and Glaciers aims at taking into its purview all research relating to snow and ice in their varied forms. It might appropriately have been named Commission of Snow and Ice, but it preferred to adopt the name Commission of Snow and Glaciers in deference to the former Commission of Glaciers, which is by far the older of the two bodies that are now consolidated, and which, indeed, was in existence long before the Association of Hydrology was formed.

The original Commission Internationale des Glaciers had its inception in 1894, at the International Geological Congress at Zurich. It was charged, broadly, with the task of studying existing glaciers throughout the world; but actually its efforts have been concentrated on securing statistics of the secular variations—advance and recession—of glaciers in response to climatic fluctuations. Inasmuch as this task requires the making of annual measurements on large numbers of glaciers in different countries, with the aid of co-operating agencies, governmental, scientific, and other, it has inevitably grown into a vast enterprise. The results, however, have proved of value, not only to glaciologists but also to hydrologists, hydraulic engineers (making use of run-off from glaciers for economic purposes), and climatologists.

In 1914 the work of the Commission was stopped by the war, and co-ordinated effort ceased for a number of years. In 1927, however, at the invitation of the International Association of Scientific Hydrology, the Commission transferred its functions and its personnel to a new Commission Glaciologique created by the Association, and under these new auspices its work has been carried on ever since.

Meanwhile, at the Lisbon assembly, in 1933, the Association set up a Commission of Snow and appointed Prof. Church president of it. So rapidly did this Commission grow under the enthusiastic leadership of its president that by 1936, when the Association met in Edinburgh, it had become by far the largest and most active of all the commissions of the Association and had extended its field to cover all phenomena of snow and ice, with the exception of glacier variations. Overlap with the work of the Commission of Glaciers seemed almost inevitable,

and so the question naturally arose whether consolidation of the two commissions would not in the end be mutually advantageous to them. Their union was approved by the Executive Committee of the Association at its meeting in April 1939 at Montreux, Switzerland, and so the way was paved for its final consummation at the Washington assembly.

Provision has been made within the new Commission of Snow and Glaciers for a permanent Committee on Glacier Measurements, which will continue the work previously carried on by the Commission of Glaciers, securing systematic records of the annual variations of glaciers. It is Prof. Church's intention to expand the scope of that work, which heretofore was restricted largely to Europe and the United States, so as to take in all of the more important glacier districts of the world, including the Andes of South America, the great mountain chains of Asia, the Alps of New Zealand, and the Arctic regions.

Aside from this enterprise the Commission has planned for the triennium ending in 1942 the following formal programme :

(1) Study of the origin, drift, and dissolution of icebergs, with reference to the forecasting of their seasonal appearance.

(2) Physical changes in the snow-cover conducive to run-off, especially floods.

(3) Study of the crystalline texture of glacier-ice in relation to the mode of movement of glaciers.

In addition, the following four special projects have been assigned to temporary committees :

(*a*) Standardization of maps of snow-cover and ice-cover for the world.

(*b*) Uniform classification of different types of snow and snow-cover, and uniform nomenclature for the same.

(*c*) A system of classification for the international bibliography of snow and ice.

(*d*) Standardization of methods of snow-surveying and forecasting run-off from snow.

TRAINING INDUSTRIAL WORKERS

IN *Occupational Psychology* (14, No. 1), B. Ungerson discusses the important problem of the training of industrial workers. In spite of the improvement in methods of training learners during recent years, there are still numerous organizations where the only method of training is to let the beginner copy an experienced worker, or he is told what to do and left to get on as best he may.

The resulting efficiency frequently falls short of what he might have attained. It is strange that while it is recognized that games are best learned under the tuition and guidance of an experienced teacher, industrial processes are so frequently allowed to be 'picked up'.

Ungerson divides industrial training into two sections : (1) acquiring knowledge about the job ; (2) acquiring facility and speed in making the necessary movements.

The first includes knowledge of technical terms, the tools to use, how to deal with unusual circumstances ; such knowledge can best be taught by a skilled teacher—not necessarily equivalent to the most skilled worker—whose primary business is teaching, not production, and who shall have the requisite qualities for teaching and be given adequate facilities.

In order to teach the correct movements the teacher should himself have a conscious knowledge of them, and for this, motion study is essential. By motion study knowledge is gained of the adequate and useless movements, so that the learner is instructed from the beginning in the right method, and thereby saved from having to unlearn unnecessary movements later.

The principles of motion study which are based on the physiology and psychology of habit formation are no longer a problem for research ; it is their application that is needed.

The article is very well balanced and constructively critical, and is of immediate importance.

'SPIKE' DISEASE OF SANDAL

FOR many years after it was first reported in 1898 the so-called 'spike' disease of the sandal tree remained an enigma. Investigations were carried out in a desultory fashion, but no information of value resulted. It is only owing to its alarmingly rapid spread in many parts of the Madras Presidency and elsewhere in Mysore and Coorg that the work of the last few years has resulted in methods of control, the results of careful research work, being successfully elaborated and put into force.

In *Indian Forest Records* (New Series. Silviculture, 3, No. 7 ; 1939) appears a paper entitled "A Note on the Control and Eradication of New Outbreaks of the Spike Disease of Sandal (*Santalum album*)" by Rao Sahib S. Rangaswami and A. L. Griffith, Sylviculturist, Madras. The sandal, as is well known, is a root parasite which lives by haustorizing on the roots of other plants which act as hosts to it. These hosts may be many and varied, for the same sandal tree and the sandal haustoria may wander a considerable distance before a suitable host is found. The sandal tree is not necessarily parasitic on the plants growing nearest to it.

The action of the disease causes both new shoots and leaves to stand up stiff and bristle-like, from which the popular name was derived. The disease itself is a virus disease carried by insects which are probably between 1/20 in. and ¼ in. in size. In a diseased area the sources of infection are (*a*) diseased trees, (*b*) disease masking trees, and (*c*) insect vectors.

Factor (*a*) is removed by poisoning the diseased trees with 'Atlas Tree Killer' solution and thus killing them at once; factor (*b*) by tapping all the apparently healthy trees found in the diseased locality, and girdling and treating with poison all those that afterwards show the disease; and factor (*c*) is eliminated automatically, or the removal of the factors (*a*) and (*b*) naturally converts the viruliferous insects into non-viruliferous ones.

As indicating the rapidity of spread of this disease, in the North Salem Forest Division alone 'spike' first appeared in 1913. Twenty years later the infected area was 54,000 acres and in 1938 approximately 99,500 acres. Figures so far available indicate that the annual amounts spent on this research work have been but a fraction of the annual losses inflicted by the disease and of the sums saved. It is a classic example, as the authors say, "that 'academic' research can often be utilized by a practical forest department at a reasonably low additional expenditure to produce 'practical' results of immediate financial value". For quite contrary reasons the attention of the Governments of Burma and Nigeria may be directed to this valuable paper.

LYMPHATIC SYSTEM OF THE ANURA

A CONSIDERABLE amount of work on the lymphatic system of the lower vertebrates has been published in recent years. A recent treatise (*Amer. Anat. Mem.*, No. 18; 1939) is a survey of that work as it affects the Anura in particular. It is not simply a review of the literature, although this is fully taken into account and critically examined, but is also a description of the development of the lymph- and their relation to the blood-vessels, based upon hundreds of injections (both single and double) of five species of frogs, five species of urodeles, and two species of fish.

Dr. H. M. Knower, the author, first started investigating this problem in 1903, and in 1908 described a microinjector which has proved of considerable value in this rather difficult subject. The work is illustrated by forty excellent drawings on nineteen plates and five text-figures. The drawings are all of preparations of *Rana palustris*, save five which are of *R. catesbiana*. It is claimed that the method of injection, if carefully checked, provides a more satisfactory approach than the study of transverse sections of uninjected material, and with this most zoologists who have tried tracing these elusive vessels in sections will agree.

The first lymphatics appear when a complete blood circulatory system has been established, and are accessory or supplemental to the veins. They appear in connexion with the pronephric glands and the adjacent segmental glands, and this dorso-lateral plexus, in which the anterior lymph heart develops, drains into the pronephric sinus by a short vein. From this stage the development of the system is followed until the establishment of the definitive condition of the late tadpole. It is a pity that the zoological practice of putting specific names in italics has not been followed and that on p. 23, for example, *R. nig.* appears presumably for *R. nigromaculata*, and that throughout the name toad is used again presumably for some species of Bufo.

SEVENTY YEARS AGO

NATURE, vol. 2, May 12, 1870

A Building for the Learned Societies

THE Statistical Society has done good service to the cause of science in convening representatives of the learned societies, to consider whether it would not be possible to obtain a building for their accommodation worthy of the high position they occupy in this great metropolis. "Some of the societies have no reason to complain, the Royal Society, the Linnean, the Royal Astronomical, the Geological, the Chemical, the Society of Antiquaries, and a few others, are well accommodated, and a solid structure is being raised for them in Piccadilly."

The article goes on to point out that financial objections might be raised to a scheme for a new home for learned societies. To this the reply is that the Government should provide one or more buildings for the purpose. "Nowhere does the State do so little for science as in this country. The estimates for 1870–71 give the entire sum to be applied to the learned societies at 2,370 *l*—a sum distributed among very few of them. . . . In addition to this 160,000 *l* are appropriated to a building for certain learned societies in Burlington House; but it will serve for very few of them; and if we are rightly informed, the Government will reoccupy all the buildings in Somerset House now used by learned societies."

In the event that the Government refused to provide funds for a suitable building, the formation is suggested of a joint-stock company, the shares in which would be taken up by the members of the societies interested. "It has been estimated that the probable cost of a building sufficiently commodious, though not ornamental, in some eligible locality near Charing Cross, will be, with the ground-rent, 30,000 *l*. to 40,000 *l*."

Strange Noises heard at Sea off Grey Town

MR. CHARLES DENNEHY, of the R.M.S. *Shannon*, describes a peculiar noise heard on board iron vessels anchored off Grey Town, at the mouth of the River St. Juan, which separates Nicaragua from Costa Rica. Vessels are obliged to anchor in seven to eight fathoms of water outside the bar, and crews are regularly awakened at night by "a peculiar metallic vibratory sound". This noise, which commences "with a marvellous punctuality at about midnight", continues for about two hours with one or two very short intervals. The noise is not heard on shore, or on coppered wooden vessels. The bottom consists of a heavy dark sand and mud containing much vegetable matter brought down by the river. "The ship is undoubtedly one of the principal instruments in its production. She is in fact for the time being converted into a great musical sounding board."

The letter is followed by the brief comment: "Our correspondent should dredge.—Ed."

REFERENCE is made to the fact that a considerable number of papers are on hand at the Royal Society, and only two more meetings have been arranged for the session. Were not the present arrangements of the Royal Society meetings made to meet conditions long since passed away? And since the flow of papers into the Society has largely increased, why should not the outflow be a little accelerated?

FORTHCOMING EVENTS

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

Tuesday, May 14

ROYAL SANITARY INSTITUTE, at 5 p.m.—Lieut.-Colonel J. A. Dixon: "Centralized Slaughtering" (Benjamin Ward Richardson Lecture).

ROYAL INSTITUTION, at 5.15 p.m.—Sir Frederick Keeble, F.R.S.: "The Development of the Home Production of Food".*

Thursday, May 16

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 p.m.—Prof. A. D. Macdonald: "Experimental Spinal Anæsthesia".

CHEMICAL SOCIETY (at the Institution of Mechanical Engineers), at 6 p.m.—Prof. W. N. Haworth, F.R.S.: "Recent Developments in the Chemistry of Carbohydrates" (Seventh Pedler Lecture).

Friday, May 17

FARADAY SOCIETY (at the Royal School of Mines), at 2.30 p.m.—General Discussion on "The Hydrogen Bond".

(Speakers—Dr. W. T. Astbury, F.R.S.: "The Hydrogen Bond in Protein Structure"; Dr. C. E. H. Bawn, Prof. E. L. Hirst, F.R.S., and Dr. G. T. Young: "The Nature of the Bonds in Starch"; Dr. J. J. Fox and Dr. A. E. Martin: "Infra-Red Absorption of Hydroxyl Group in Relation to Inter- and Intramolecular Hydrogen Bonds"; Dr. J. M. Robertson: "X-Ray Evidence for the Hydrogen Bond"; Dr. G. B. B. M. Sutherland: "The Investigation of Hydrogen Bonds by Means of Infra-Red Spectra").

ROYAL INSTITUTION, at 9 p.m.—Prof. D. R. Hartree, F.R.S.: "A Great Calculating Machine; the Bush Differential Analyser and its Applications in Science and Industry."

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Thirty-first Annual Conference, at the Hotel Russell, Russell Square, London), May 11–12.

May 12, at 10 a.m.—S. H. Moorfield: Presidential Address.

APPOINTMENTS VACANT

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

ASSISTANT IN THE BACTERIOLOGY LABORATORY at Wray Castle—The Director, Freshwater Biological Association, Wray Castle, Ambleside, Westmorland (May 14).

PART-TIME EDUCATIONAL PSYCHOLOGIST—The Director of Education, Education Offices, 15 John Street, Sunderland (May 15).

LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 16).

DIRECTOR OF EDUCATION AND INSPECTOR OF SCHOOLS in the County Borough of Barnsley—The Director of Education, Education Department, Town Hall, Barnsley (May 17).

CONSTRUCTION ENGINEER FOR THE IRRIGATION DEPARTMENT, Government of Ceylon—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9322) (May 17).

DEMONSTRATORS (MALE) IN THE DEPARTMENT OF ANATOMY—The Secretary, King's College, Strand, W.C.2 (May 23).

TEACHER FOR COLOMBO-BRITISH INSTITUTE, BOGOTA—The British Council, 3 Hanover Street, W.1 (quoting 'Colombia') (May 25).

LECTURER IN CIVIL ENGINEERING—The Registrar, King's College, Newcastle-upon-Tyne (May 31).

LECTURER IN PLANT PATHOLOGY AND ZOOLOGY—The Principal, Swanley Horticultural College for Women, Swanley, Kent (May 31).

ASSISTANT IN THE DEPARTMENT OF EDUCATION—The Secretary, Queen's University, Belfast.

TECHNICAL OFFICERS—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting Ref. A.500).

ASSISTANTS I (Ref. A.501), ASSISTANTS II (Ref. A.502), and ASSISTANTS III (Ref. A.503)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting appropriate Ref. number).

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge during the Academical Year 1938–1939. (Published by Authority.) Pp. 162. (Cambridge: Printed at the University Press.) [94

Reports of the Progress of Applied Chemistry. (Issued by the Society of Chemical Industry.) Vol. 24, 1939. Pp. 756. (London: Society of Chemical Industry.) [94

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 22: The Requirements of the Pig for Vitamins A and D. By Brendan J. Senior. Pp. 229–236+plate 6. 1*s*. Vol. 22 (N.S.), No. 23: The Chemical Constituents of the Lichen *Parmelia latissima* Fée. Dr. T. J. Nolan, Dr. J. Keane and V. E. Davidson. Pp. 237–240. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [94

Publications of the International Tin Research and Development Council. No. 96: The Determination of Tellurium in Tin-Rich Alloys. By Dr. W. T. Pell-Walpole. Pp. 4. (Greenford: International Tin Research and Development Council.) Free. [104

Imperial Forestry Institute: University of Oxford. Fifteenth Annual Report, 1938–39. Pp. 38. (Oxford: Imperial Forestry Institute.) [104

Other Countries

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 780: Geology and Ground-Water Hydrology of the Mokelumne Area, California. By A. M. Piper, H. S. Gale, H. E. Thomas and T. W. Robinson. Pp. vii+230+22 plates. 2.25 dollars, Water-Supply Paper 821: Surface Water Supply of the United States, 1937. Part 1: North Atlantic Slope Basins. Pp. viii+441+1 plate. 50 cents. Water-Supply Paper 850: Summary of Records of Surface Waters, 1898–1937. By C. E. Ellsworth. Pp. vi+154. 20 cents. (Washington, D.C.: Government Printing Office.) [84

South Australia. Annual Report of the Director of Mines and Government Geologist for 1938. Pp. 8. (Adelaide: Government Printer.) [84

University of Illinois: Engineering Experiment Station. Bulletin No. 318: Investigation of Oil-Fired Forced-Air Furnace Systems in the Research Residence. By Prof. Alonzo P. Kratz and Prof. Seichi Konzo. Pp. 88. 90 cents. Bulletin No. 319: Laminar Flow of Sludges in Pipes with Special Reference to Sewage Sludge. By Prof. Harold E. Babbitt and David H. Caldwell. Pp. 58. 70 cents. Bulletin No. 320: The Hardenability of Carburizing Steels. By Prof. Walter H. Bruckner. Pp. 62. 70 cents. Circular No. 40: German-English Glossary for Civil Engineering. By Alphonse A. Brielmaier. Pp. 38. 45 cents. (Urbana, Ill.: University of Illinois Engineering Experiment Station.) [84

Annuaire de l'Académie Royale de Belgique, 1940. (Cent-sixième année.) Pp. 170+45+2 plates. (Bruxelles: Académie Royale de Belgique.) [84

Publications of the Dominion Astrophysical Observatory. Vol. 7 No. 9: The Mass Ratio of the Lithium Isotopes from the Red Bands of Li_2. By Andrew McKellar and F. A. Jenkins. Pp. 155–188. (Victoria, B.C.: Dominion Astrophysical Observatory.) [84

Memoirs of the India Meteorological Department. Vol. 27, Part 1: A Study of the Duststorms of Agra. By B. N. Sreenivasaiah and N. K. Sur. Pp. 30+10 plates. (Delhi: Manager of Publications.) 1.12 rupees; 2*s*. 6*d*. [84

Ministry of Public Health, Egypt: The Research Institute and the Endemic Diseases Hospital. Sixth Annual Report, 1936. Pp. vii+63+12 plates. (Cairo: Government Press.) [84

The Engineering Foundation. Twenty-five Years of Service, 1914–1939. Pp. 86. (New York: The Engineering Foundation.) [84

Department of Science and Agriculture, Jamaica. Bulletin No. 18: Reprints of Miscellaneous Articles, 1937. Pp. 56. 6*d*. Bulletin No. 20: Field Experiments on Sugar Cane in Jamaica, 1936–39. Report by H. H. Croucher and M. S. Goodman. Pp. 20. 6*d*. Bulletin No. 21: Forestry and Erosion in Haiti and Puerto Rico. By C. Swabey. Pp. 12+9 plates. 6*d*. (Kingston: Government Printing Office.) [84

Indian Forest Records (New Series). Silviculture, Vol. 4, No. 2: An Investigation into the Relative Merits and Costs of Five Different Weeding Methods in the Formation of Teak (*Tectona grandis*) Plantations in areas having a West Coast Type of Climate. By A. L. Griffith. Pp. v+97–132+2 plates. (Delhi: Manager of Publications.) 1.10 rupees; 2*s*. 6*d*. [114

Catalogues

Annotated Catalogue of Works on Exact Science. (Sotheran's Price Current of Literature, No. 864.) Pp. 160. (London: Henry Sotheran, Ltd.)

Books, Prints and Autographs on the Theatre, including the Circus, Pantomimes, Exhibitions, Showmanship and Pleasure Gardens. (Catalogue No. 648.) Pp. 46. (London: Francis Edwards, Ltd.)

Bromethol B.D.H.: a British Basal Anæsthetic for use by Rectal Injection. Pp. 2. (London: The British Drug Houses, Ltd.)

Diet, Nutrition and Therapeutics. Pp. 12+2 plates. (London: Vitamins, Ltd.)

"Technico" Laboratory Protective Paints, etc. (Publication No. 362.) Pp. 4. (London: A. Gallenkamp and Co., Ltd.)

Kodak D-19b X-Ray Developer. Pp. 4. (London: Kodak, Ltd.)

OFFICIAL ANNOUNCEMENTS

BRIGHTON SUMMER SCHOOL IN ANIMAL BIOLOGY

AUGUST 2 to 15, 1940

The course is intended as an introduction to Biology and as a refresher course for teachers of the subject. Laboratory and field work. Director: Prof. L. E. S. Eastham, M.A., M.Sc., Professor of Zoology in the University of Sheffield, assisted by specialists. Prospectus of F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

THE UNIVERSITY OF MANCHESTER

GRISEDALE BIOLOGICAL RESEARCH SCHOLARSHIPS

A scholarship of the value of £200 in either Botany or Zoology offered to Graduates who have already had training in research. In the present year a preference will be given to candidates with qualifications in Botany. Applications should state clearly the candidate's qualifications and previous experience and should be accompanied by one or more testimonials. Further particulars may be obtained from the Registrar, the University, Manchester 13. Applications must reach him not later than *June 1*.

Junior British Scholarship, 1940-41, offered by

British Federation of University Women, Ltd. Value £100, for women not over 25 years of age, who are graduates of a British University, for study at home or abroad.—Details from Research Applications, B.F.U.W. Ltd., 16 King Street, Reading, Berks. Applications by May 25.

AIR MINISTRY

A number of ASSISTANTS, I, II and III, are required at the Royal Aircraft Establishment, South Farnborough, Hants.

SALARY:

Ref. A.501, ASSISTANTS I, £400 a year (£325 a year women);
Ref. A.502, ASSISTANTS II, £315 a year (£265 a year women);
Ref. A.503, ASSISTANTS III, Salary up to £260 a year, according to qualifications and experience.

Candidates should have had good technical education and practical works, or laboratory experience, and experience in one or more of the following categories:

(*a*) Design and development of small mechanical and electrical devices;
(*b*) Strength investigation in connection with Aircraft structures and equipment, or similar types of work;
(*c*) General Aerodynamics, including, if possible, wind tunnel, tank, or full-scale observing experience. For some posts general engineering training and experience would be suitable qualifications;
(*d*) Metallography and analysis of ferrous and non-ferrous materials used in aircraft;
(*e*) General aircraft instruments and allied equipment;
(*f*) Radio or communication engineering, preferably with knowledge of design of small radio equipment;
(*g*) Design and development work in light engineering;
(*h*) Ballistic calculation and statistical work;
(*i*) Experimental work on I.C. engines and associated equipment;
(*j*) Electrical and ignition equipment for aircraft;
(*k*) Research work on chemical problems related to aeronautics, including aircraft fuels, lubricants, paints, fabrics and plastics;
(*l*) Mechanical testing of materials and structures;
(*m*) Compilation of instructional handbooks and technical descriptive matter on aircraft, aero engines and associated equipment.

Requests for the necessary application form should be made by postcard, addressed to the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

AIR MINISTRY

A number of TECHNICAL OFFICERS are required at the Royal Aircraft Establishment, South Farnborough, Hants.

Commencing salary up to £455 a year, men (£347 women), according to qualifications and experience.

Candidates should possess a University Degree or evidence of equivalent technical standing, in a subject appropriate to the requirements specified below, and suitable practical experience.

(*a*) Design and development of small mechanical and electrical devices;
(*b*) Work in the performance, wind tunnel, and model testing tank, sections of the Aerodynamics Department;
(*c*) General metallurgy, of ferrous and non-ferrous metals;
(*d*) Development work on high-speed internal combustion engines, components, and fuels;
(*e*) Radio or communication engineering, with specialist knowledge of small transmitters, or receivers, or direction finding equipment;
(*f*) Design, development, testing and installation of aircraft instruments, or similar equipment;
(*g*) Design and development of armament, armament mountings, and similar light engineering work;
(*h*) Design and development of electrical and ignition equipment for aircraft.

Requests for the necessary application form should be made by postcard (quoting Ref. A.500), addressed to the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

AGRICULTURAL RESEARCH SCHOLARSHIPS, STUDENTSHIPS FOR RESEARCH IN ANIMAL HEALTH AND VETERINARY SCHOLARSHIPS

Acting in consultation with the Agricultural Research Council, the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland invite applications for the following scholarships and studentships, tenable as from October 1, 1940:

(i) Not more than three Agricultural Research Scholarships, each of the value of £200 per annum, with an allowance not exceeding £50 per annum for fees and expenses and tenable for a period not exceeding three years.

(ii) *Either* (*a*) not more than one Studentship for Research in Animal Health, of an inclusive value of £300 per annum and tenable for a period not exceeding three years, after the first year of which the appointment will be reviewed;

or (*b*) not more than one Veterinary Scholarship, of the value of £200 per annum, with an allowance not exceeding £50 per annum for fees and expenses and tenable for a period not exceeding four years. This scholarship is intended to enable a graduate with Honours in Science to obtain a veterinary professional qualification with a view to undertaking research in animal health.

Applications must be received not later than May 31, 1940. Nomination forms and further particulars may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 83 Baker Street, London, W.1, in the case of candidates resident in England or Wales, or from the Secretary, Department of Agriculture for Scotland, St. Andrew's House, Edinburgh, 1, in the case of candidates resident in Scotland.

KING'S COLLEGE, NEWCASTLE-UPON-TYNE

IN THE UNIVERSITY OF DURHAM

Applications are invited for the post of Lecturer in Civil Engineering. Salary £600 to £700 per annum according to qualifications and experience. Duties to commence October 1, 1940. Twelve copies of applications together with twelve copies of not more than three testimonials, or alternatively, the names of three referees, must be lodged not later than May 31 with the undersigned from whom further particulars may be obtained.

W. G. B. OLIVER,
Registrar of King's College.

THE UNIVERSITY OF SHEFFIELD

Applications are invited from **Physicists or Physical Chemists** to investigate factors affecting the **formation and stability of dust clouds** with special reference to dust in Coal Mines.

The appointment will be made as the result of a bequest from the late Mrs. Habershon.

Subject to satisfactory service, its duration will be three years at a salary of £300 per annum and the work will be done in the Department of Mining of the University. Experience in similar work will be an advantage.

For full particulars apply, The Registrar, The University, Sheffield.

SWANLEY HORTICULTURAL COLLEGE FOR WOMEN, SWANLEY, KENT

Required in September, a Lecturer in Plant Pathology and Zoology who can teach these subjects to students taking the course leading to the University of London Degree of B.Sc. Horticulture (Zoology to Intermediate stage only), and students reading for the College Diploma and Certificate.

Full particulars may be obtained from the Principal, to whom applications should be submitted before May 31, 1940.

THE QUEEN'S UNIVERSITY OF BELFAST

MUSGRAVE STUDENTSHIPS

Applications are invited for five Musgrave Studentships, each of a value of £200 per annum, in Pathology, Biology, Chemistry, Physics and Physiology.

The appointments will date from OCTOBER 1, 1940, and will be tenable for one year each, but are renewable for a further period.

Applications must be lodged with the Secretary before JUNE 1, 1940, on forms which may be had on application to the undersigned:

Queen's University, BELFAST. RICHARD H. HUNTER, *Secretary*.

FRESHWATER BIOLOGICAL ASSOCIATION

ASSISTANT IN BACTERIOLOGY LABORATORY AT WRAY CASTLE

Qualifications: Experience in preparation of bacteriological media and in routine bacteriological and chemical examination of water.

Wages: Up to £3 per week, according to experience, together with free living-room at Wray Castle.

Applications if possible by May 14 to The Director, Wray Castle, Ambleside, Westmorland.

Information

The address of the Editorial and Publishing Offices of "NATURE" is

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All editorial communications, books for review, etc., should be addressed to the Editors, at the above address.

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