NATURE

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Vol. 156, No. 3967 SATURDAY, NOVEMBER 10, 1945 ONE SHILLING & SIXPENCE

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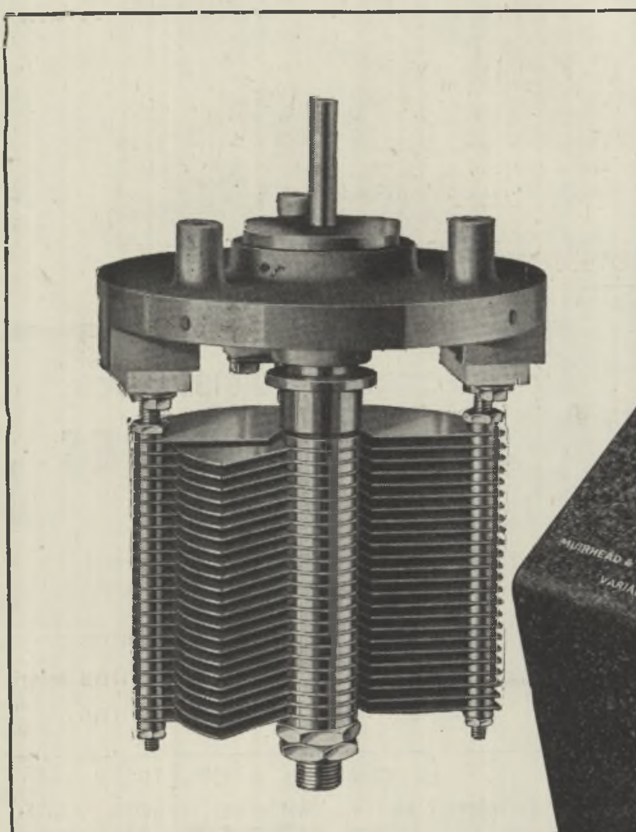

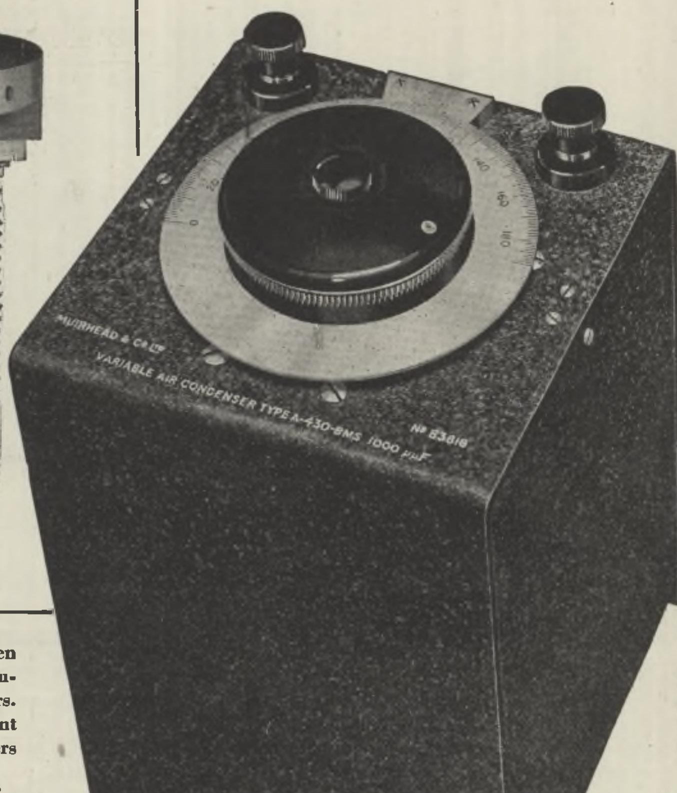

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NATURE

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ATOMIC ENERGY AND ITS UTILIZATION

NO one who has followed the trend of scientific opinion since the end of the War in Europe can mistake the growing emphasis which men of science in every country where the Press is free are placing on the restoration of full freedom of scientific intercourse, and the earliest and fullest possible relaxation of the secrecy imposed by the exigencies of war-time. Earliest in point of time, though not in publication, the Barlow Committee came out so far back as 1943 with strong recommendations regarding the fullest possible removal of secrecy restrictions, and the encouragement of publication and of discussion between scientific workers in different fields, within and without the Government service, above all in fundamental research. No feature of the Government's proposal for a scientific civil service is more welcome than the statement that these recommendations for relaxing secrecy are viewed sympathetically, and that scientific workers in the service of the Government will be encouraged to publish work of their own and to discuss their work with persons outside the service engaged on similar problems.

The report of Dr. Vannevar Bush, "Science : the Endless Frontier", published late in July, shows how scientific opinion in the United States of America has reached similar conclusions, and in one of its most important sections there are outlined concrete proposals for the restoration of scientific communications by international agreement. That report was published before the disclosure of the development of the atomic bomb ; but the visit of Allied men of science to the U.S.S.R. in connexion with the two hundred and fiftieth anniversary of the Academy of Sciences (see *Nature*, August 25, *et seq.*) left no room for doubt that scientific men in the U.S.S.R. are equally anxious for the resumption of contact and communications with their colleagues in other countries. Proposals which have come from Dr. J. Needham indicate that his work with the British Council's Scientific Office in Chungking has provided further evidence of a strong desire for the removal of war-time restraints and for full freedom of intercourse in science (see also p. 558).

This urge for full freedom of communication and the relaxation of the secrecy imposed by war conditions has been greatly strengthened both by the disclosure of the application of atomic energy in the atomic bomb and by the sudden termination of the War in the Far East. Whatever has been done so far to lift the veil on achievements in such fields as radar, 'Pluto', petroleum warfare and the like has in fact fostered, rather than abated, the demand for the full disclosure of the scientific work on which such developments are based. One reason for this may be seen in Sir Robert Watson-Watt's recent article on radar (*Nature*, September 15, p. 319) ; demonstration of the practicability and value of team-work in time of war stresses the importance of team-work for purposes of peace, and team-work is only possible when the exchange of knowledge is free and full.

There is a second reason why the demand for the relaxation of secrecy is growing. Revelations of achievements during the War again and again emphasize the way in which technical advance is bound up with fundamental research, and the extent to which advances in fundamental research proceed simultaneously and on parallel lines in different countries. It is clear from what has already been made known that the original researches in atomic physics from which the atomic bomb was developed were proceeding in various countries, and this knowledge was being freely published. This point is well brought out in the Smythe Report on Atomic Energy, which has now been published, and which looks to the publication, at least in part, of the papers withheld since April 1940. Sir Henry Dale was prompt to emphasize both that the preservation of civilization may depend on the fullest freedom of scientific intercourse and on the abandonment of any national claim to secrecy about scientific discoveries. That, he insisted, is a fundamental condition if international control of the atomic bomb is to be possible; and Sir Henry Dale was one of the first to emphasize that such control, as distinct from control of science or scientific research, is essential if we are to use atomic energy to full effect and avoid the disasters which must attend misuse.

That was the point of view which Mr. L. J. F. Brimble urged in letters to *The Statesman* of Calcutta (August 15 and September 7) during his recent visit to India and which it would seem, from editorial comment and from correspondence, Indian opinion is disposed to accept. Mr. Brimble challenged the practicability of the United States and Britain being able to keep secret the knowledge relating to the production and use of the atomic bomb. Legislation to control scientific research on uranium and other aspects of chemistry or physics related to the development of the atomic bomb would almost certainly be futile. The secret of any branch of research in atomic physics cannot remain the prerogative of any one nation or group of nations. Furthermore, if such control of scientific research were achieved, it would be a deadly blow to scientific progress and the advance of civilization.

Mr. Brimble distinguished clearly between the planning of science within the conception of freedom of the individual, and political control; but these two things are still frequently confused, as subsequent pronouncements in Great Britain and in the United States have shown. This confusion adds further point to Mr. Brimble's contention that our future progress depends both on a complete change of heart among nations and on thorough overhaul of our methods of education, so that every citizen acquires some appreciation of science and some insight into the impact of science on society. These are, in fact, the fundamental conditions for effective collaboration between statesmen and men of affairs, students of the humanities, spiritual leaders, men of science and others.

Further support for the view that it is impossible to maintain secrecy regarding the scientific developments leading to the atomic bomb has been forthcoming from Prof. J. D. Bernal (who, pointing out that secrecy would restrict the free flow of scientific information to the grave detriment of the recovery of international science, urged that rapid progress could only come from the free exchange of information) as well as from others in Great Britain and from various groups of American men of science. The Association of Los Alamos Scientists, for example, comprising some four hundred of those working there on the atomic bomb project, has been formed to promote the use of scientific and technological advances in the best interests of humanity; and recognizes that scientific workers, by virtue of their special knowledge, have, in certain spheres, special political and social responsibilities beyond their obligations as individual citizens. In conformity with this policy of releasing authoritative public statements on scientific questions in their relation to society, the Association issued a statement on October 13 that there could be no keeping the secrets of the atomic bomb from the rest of the world, and that to attempt to do so would lead to war more savage than the last (see also p. 564).

The statement urged that the use of atomic energy must be controlled by a world authority and that such international control is technically feasible, although it may involve the abolition of secrecy in national and international relations and the provision of free access to all laboratories, industries and military installations. It is the hope of the Association of Los Alamos Scientists in developing the bomb that it will be a great force for world co-operation and peace. Lack of decision within even a few months, the statement urges, may lead to unprecedented destruction.

These views have been substantially supported by other organizations, such as the Atomic Scientists of Chicago, who flatly challenged a report issued on October 11 by the Naval Affairs Committee of the House of Representatives as contrary to expert scientific opinion. The Chicago group said that reports which suggest that effective counter-measures have been developed are misleading, and that statements attempting to minimize the importance of the atomic bomb and suggesting that armed forces will soon bring the situation under control would do incalculable harm. The legislation which is being considered by this Military Affairs Committee has been strongly opposed by both these groups of scientific men as likely to retard research and the development of atomic energy rather than stimulate it. It is also feared that the proposed atomic energy control commission will prevent the exchange of information between co-workers in the same laboratory, and that this, in accordance with the views of the Barlow Committee in Great Britain, would drive young men of science from the work, because the transfer of information is vital to research in science.

The Association of Oak Ridge Scientists at Clinton Laboratories, Tenn., composed of more than 90 per cent of the scientific, engineering and technical staffs of the main research and development section of the Plutonium Project, was formed late in September because its members felt they should take a greater responsibility for the consequences of their handiwork. The Association was born out of fear that the wrong course was being taken in regard to at least two aspects of the atomic bomb. The first was the growing false sense of security prevalent when it was thought there was a secret formula for the atomic bomb held exclusively by the United States and Great Britain. The second was apprehension that the atomic bomb was creating a feeling of fear among nations rather than of trust, and it seemed plain that unrestrained developments in this field would only add to such fear. This feeling of apprehension led to the view, held by a large portion of the membership of the Association, that control of atomic power should be on an international rather than national level, for it was felt that control of atomic power on a national level would lead inevitably to the greatest armament race ever known, and to increasing distrust among nations.

The activities of the Association so far have consisted mainly of contributing to informed public thinking in every way possible. Numerous statements have been prepared by scientific workers who have been associated intimately with atomic bomb developments, and the best of these have been endorsed by the Association and used as background material for radio and editorial comments, for Congressional hearings and for personal contacts. If science is to be controlled on a national level, the Association believes that the inevitable armament competition will prevent science, especially 'nucleonics', from ever being free again ; and that scientific freedom as we have known it will not again prevail until a diplomacy of trust and good will is established among nations.

Dr. H. L. Anderson and Dr. Leo Szilard, on the other hand, have criticized the U.S. War Department for publishing the Smyth Report on the development of atomic energy, to which Lord Maugham referred in the House of Lords on October 16. Dr. J. R. Oppenheimer, who has just resigned his post as director of atomic research at Los Alamos, declared before the Senate Committee at Washington on October 17 that the only defence against the bomb is proper international organization, and Dr. H. J. Curtis, representing scientific workers at the atomic laboratories at Oak Ridge, Tenn., told the Committee that the only solution to the secrecy problem is to turn over to an international organization the control of all aspects of atomic power.

International responsibility for the control and development of atomic energy was the theme of the leading article in *Nature* of August 11 immediately following the dropping of the first atomic bomb. This, and the impracticability of secrecy, have been stressed many times since in these columns. But the debate in the House of Lords on October 16 shows how, in Great Britain as well as in the United States, political issues are liable to overlay and confuse the scientific and technical aspects, particularly in relation to the question of secrecy which we are now discussing. Nor was the position made clearer by President Truman's early pronouncements ; and Lord Maugham in the course of his speech did well to bring out the difference between attempting to keep secret the fundamental knowledge in atomic physics with which the development of atomic energy for any purpose starts, and the engineering technique involved in the production of the bomb itself. For the latter, indeed, it would be reasonable to argue for secrecy and the development of some effective means of control ; but for the former, secrecy must be rejected as impracticable, as impolitic, and as contrary to the interests of science or humanity. It is clear from the debate in the House of Lords that there was general agreement as to the impracticability of secrecy in this respect ; further, the Earl of Darnley found little support for his notion that adequate supervision of manufacture or the foreseeing or prevention of use of such weapons were equally impracticable. Rather, the opinion was that such control is difficult, but that it is absolutely imperative for appropriate means to be worked out with the utmost possible speed.

President Truman's address on American foreign policy delivered in New York on October 27 would seem to imply that he has at last arrived at similar conclusions ; for he said : "We must find the answer to the problems created by the release of atomic energy—as we must find the answers to many other problems of peace—in partnership with all the peoples of the United Nations". Discussion of the atomic bomb with Great Britain and Canada will begin in the near future, and later other nations will be brought in. These discussions will look "towards a free exchange of fundamental scientific information" ; but he emphasized that they will not deal with the processes of manufacturing the atomic bomb or other instruments of war. President Truman's pronouncements have met with some keen opposition even in the United States.

The issues were in fact more clearly displayed in the short debate initiated by Capt. Blackburn in the House of Commons on October 30. Capt. Blackburn strongly associated himself with scientific opinion that at the earliest possible moment we should get back to the peace-time exchange of scientific information, and in view of the impossibility of damming the river of knowledge, urged immediate internationalization of research and production in relation to atomic energy, and the calling of a conference of scientific workers as well as statesmen to recommend to the United Nations the best system of international control of atomic energy which can be devised. Sir Arthur Salter, quoting the points made by the American scientific workers already mentioned, and in particular Dr. Urey's declaration that peace-time application of atomic energy was of no importance unless the danger of atomic bombs was banished, stressed the urgency of the situation and pleaded for an immediate offer to place all information in the hands of the Security Council conditionally on an effective system of inspection. That plea for urgency cannot but be reinforced by the Government decision to set up a research and experimental establishment for atomic energy.

What has hitherto been lacking appears to be a convincing statement of the reasons why secrecy regarding the scientific aspects of the development and use of atomic energy should be dismissed forthwith from consideration as practical politics. It is generally recognized that so much is already known to many scientific workers in different countries that secrecy in this respect is a mere pretence. It has also been emphasized that restrictions in this field will only impede the scientific advance upon which the utilization of atomic energy for beneficial purposes depends. That is true, but Lord Addison went nearer to the mark when, in winding up the House of Lords debate, he expressed the opinion that it is not possible to circumscribe the activities of scientific research. The British Government has in fact consistently taken the right line in refusing to treat the atomic bomb as a special case. Mr. Bevin has insisted that it is not merely the atomic bomb but the whole advance of science in the field of war which must be controlled. Similarly, we cannot impose restrictions or secrecy in those branches of science which have contributed to the development of the atomic bomb without regard to the effect of such restrictions on scientific advance generally. We cannot predict from which field of science the next important advance may come, and to impose restrictions anywhere is to impede that interchange of thought, that cross-fertilization of minds and exchange of ideas from which all great advances have come without acquiring in return any solid assurance that investigations, of which we may know nothing, proceeding in other countries will not yield just the startling results that we dread.

Secrecy, therefore, is impracticable and contrary to the advance of science and the interests of humanity. No less important, secrecy in this field of scientific knowledge is impolitic as endangering that very confidence and good will which must be the basis of any organization for international control of the engineering technique of production for war purposes which is so vital and urgent. Nothing makes more powerfully for confidence and co-operation than the effective fellowship of scientific workers across national frontiers, the constant communication of each fresh advance as it is achieved and the interplay of minds engrossed in the search for truth over the problems and difficulties as they emerge. Nothing breeds suspicion and distrust more quickly than the withholding of new knowledge, the refusal to share it with others. It is not merely that scientific effort is wasted in duplication, or that the stimulating clash of minds is interrupted and the general advance of science is delayed. Perhaps even more important at this juncture is that, in place of co-operation and team-work, we have distrust and insecurity and a competition which can only result in disaster.

These are the reasons, therefore, why British men of science welcome the attitude of the British Government on this question of secrecy generally, and its refusal to treat the question of atomic energy as a special case. Mr. Herbert Morrison's statement on October 30 indicates no lack of appreciation on the part of the Government as to the urgency of the political and scientific issues involved, and in asserting the Government's intention to maintain a high standard of fundamental research and to plan most carefully the whole programme of research and development to make the best possible use of our resources, he gave welcome evidence of continued high interest in science and scientific workers. It is clear that much remains to be done to educate public opinion as to the critical importance of this issue, for it forms the starting point of an adequate policy; and unless the implications which follow from this abandonment of a futile attempt at secrecy are realized, we cannot expect the public in Britain or in other countries to support their Governments in making the sacrifices of national sovereignty that are involved in effective international control of the new weapons of war. Lord Cherwell was undoubtedly right in maintaining that we could only hand over all the technique involved in such production to a body which could be trusted to use it in the interests of humanity, and the powers and organization of any such body have yet to be elaborated.

The House of Lords debate gave very little guidance as to the form or nature of any such organization, but both Lord Cherwell and Lord Addison were realistic and attempted to face the difficulties and to find a genuine solution. As explicitly as the Bishop of Chelmsford, Lord Cherwell recognized the need for a moral imperative, the over-riding need of finding means, at no matter what cost and sacrifice, of reaching agreement without resort to force. Lord Addison quoted again the declaration of the Foreign Secretary that "it is the aim of His Majesty's Government that under the world organization we should eliminate the desire to exploit the discoveries of science for the purposes of war, and turn them into channels where they can serve the advancement of humanity and human well-being". Holding that by no apparatus for devising secrecy would humanity be able to safeguard itself against this peril, he urged that our first effort must be directed towards increasing the international machinery which more and more puts a value on co-operation between nations, and which more and more helps to remove the causes of distrust between nations.

That there should be so large a measure of agreement among scientific workers as to the impracticability of secrecy in any field of science, and its untoward effects on the advance of science and on human welfare, is all to the good. Such recognition carries with it the responsibility of seeing that the reasons for that attitude are understood by their fellow citizens. Above all, it must be demonstrated that this is a positive and not a negative attitude; that the abandonment of secrecy involves a fresh effort to build the instruments and institutions for effective control of the agencies of war in any form, and to create a moral imperative, whether in the search for truth or in religious conviction, strong enough to overthrow whatever forces of suspicion, of embedded prejudice or inertia, may stand in the way of the adoption of the means required to deal with the new situation with which these fresh advances in science have confronted mankind. Scientific workers cannot be blind to the fact that there are powerful forces opposing international co-operation and the exchange of scientific information, as the restrictions placed on the entry of British scientific and technical periodicals to parts of Germany and to Japan at the present time indicate. Never perhaps could they take to themselves more appropriately than at this juncture the words of Sir Francis Drake's prayer that in endeavouring such a great matter "it is not the beginning, but the continuing of the same until it is thoroughly finished, which yieldeth the true glory".

POVERTY AND POLITICS IN CENTRAL EUROPE

The Danube Basin and the German Economic Sphere

By Dr. Antonin Basch. (International Library of Sociology and Social Reconstruction.) Pp. xiv+272. (London: Kegan Paul and Co., Ltd., 1944.) 18*s*. net.

Germany and Europe

Political Tendencies from Frederick the Great to Hitler. By Dr. F. Darmstaedter. Pp. vi+226. (London: Methuen and Co., Ltd., 1945.) 12*s*. 6*d*. net.

DR. BASCH surveys in his book the economic problems of the Danubian States and their international repercussions—a subject of major importance for the period of reconstruction that has now begun, and one that has a vital bearing upon the future place of Germany among the nations. The book was written in 1943 and does not, therefore, take into account the important developments of recent months; but it provides a valuable study of the economy of a great region, extending from Czechoslovakia through Austria, Hungary, Yugoslavia, Rumania and Bulgaria, to Greece, and, though it concentrates on the key period of the 'thirties, it glances back to the situation before 1914 and makes some constructive suggestions for the future.

The work is authoritative, for Dr. Basch himself played an active part in many of the developments he describes. As a leading Czech economist he combined for some years a teaching post at the University of Prague with economic research for the National Bank of the Republic: later he became head of the Czech chemical industry and a member of the Economic Board of the Little Entente. He is mainly concerned with the political and economic opportunities that were missed in 1919 and subsequent years, and with the need for a better understanding of the Danube region's role in international affairs, for he is able to show only too clearly how the indifference of Britain and France to the economic problems of the region played into Germany's hands. But underlying all that he says of the economic activities of the seven countries, with their total population of nearly eighty millions, is an awareness of the human tragedy of economic backwardness which the Nazis exploited for their own ends. The consumption of food, and especially of protective foods, Dr. Basch points out, was "extremely low" throughout most of the region: only about one seventh of the agricultural area was devoted to protective foods, as against one third in western Europe. Yet foodstuffs and other agricultural produce had to be exported in order to buy essential raw materials and manufactured goods.

It was this situation, aggravated by the world slump in agricultural prices, by German agricultural protection, and by the indifference of the Western Powers (thus Britain, which before 1914 had bought Greek tobacco every year up to the value of £9,000,000, took only £20,000 worth in 1937), which gave Germany from 1934 the opportunity of using her purchasing power, through bulk buying, to turn the Danubian area into a dependent colonial, or semi-colonial, region, bound ever more closely to the Nazi military machine. German propagandists maintained that south-eastern Europe was the 'natural' sphere of German economic development and that the peoples in it would gain from their association with the Reich. In truth, German interest was rather in the military and strategic possibilities of economic control, as was made clear in 1941. Dr. Basch is able to show how heavily the bargain weighed against the Danubian peoples—and how little Germany gained, relatively, by her economic control. The conclusion is overwhelming that international, national and personal problems are indissoluble; that Europe cannot again run the risk of leaving the Danube area an agricultural slum. Peasant poverty and German hegemony are the same issues seen from different angles. The solution must lie in improved agriculture, with co-operative farming, in capital investment from abroad, in industrial development, and in the planned exploitation of natural resources. "An ultimate change in the economic and social status of this neglected region will provide a new and safer balance for Europe as a whole."

The nature of the German domination which turned peasant difficulties to its own ends is examined in Dr. Darmstaedter's book. He surveys the development of the German Power-State from the time of Frederick the Great, and sees it arising as the result of the weaknesses and divisions of German political life. Now National-Socialism has failed to give the German people the unity they have long sought, and a final solution of their problems can only be reached in a "European Commonwealth" in which Germany has an equal place. The argument is sound, if not always too clearly expressed: the conclusion would seem at the moment rather remote.

MAURICE BRUCE.

DEFICIENCY DISEASES IN BELGIUM

Les états de carence en Belgique pendant l'occupation Allemande 1940–1944

Par Lucien Brull, G. Barac, T. Brakier-Zelkowiecz, P. Clemens, R. Crismer, J. Deltombe, A. Divry, L. Dubois, L. Dumont, L. Dumont-Ruyters, A. Lambrechts, R. Neuprez, A. Nizet, M.-J. Op de Beeck, J. Piersotte et A. Thomas. (Institut de Clinique et de Policlinique médicales: Université de Liége.) Pp. 286. (Liége: Éditions Soledi; Paris: Hermann et Cie., 1945.) n.p.

THIS volume contains sixteen papers by different authors dealing with various aspects of dietetic deficiency as studied in Belgium during the years of German occupation.

Protein deficiency appears to have been the most important factor in the production of disease in war-time, and several papers are concerned with the effects of this deficiency on serum protein levels, œdema, etc.

Diseases due to vitamin deficiencies were little in evidence and the authors do not agree with the well-meaning theorists who advocated vitamin tablets where a square meal was wanted. Iron-deficiency anæmia and osteomalacia were likewise rare. The necessary vitamins, iron, etc., were obtained from whole bread and vegetables, and from milk and cheese, which were available for several months of the year.

Severe cases of Graves's disease were uncommon, and it is suggested that under-nourishment was responsible for this and outbalanced the opposite effects of increased emotional disturbance caused by the occupation.

Peptic ulcer was increased in incidence, largely due to emotional stress ; but partly perhaps by the low fat-content of the diet. Other diseases of the gastro-intestinal tract were little affected in war-time except in that constipation was less frequent because of the diet comparatively high in carbohydrate and residue.

The last article would have been better omitted. On totally inadequate evidence the author cites infected scabies as the causal factor in a few cases of acute and subacute nephritis. Scabies has been so common all over occupied (and unoccupied) Europe that its presence in the cases described was almost certain to have been coincidental.

Belgium appears, on the whole, to have suffered less dietetic deprivation under the Germans than most of the other occupied countries ; but, as Prof. Brull points out in his introduction, the conditions under which some of the authors had to work were iniquitous.

This interesting preliminary survey can only be recommended to those who read French, as the summaries in English which follow the articles are so condensed that they fail to convey the proper sense.

J. Marshall.

NATURAL ORGANIC COLOURING MATTERS

The Chemistry of Natural Colouring Matters

The Constitutions, Properties and Biological Relations of the Important Natural Pigments. By Dr. Fritz Mayer. Translated and revised by Dr. A. H. Cook. (American Chemical Society, Monograph Series No. 89.) Pp. 354. (New York: Reinhold Publishing Corporation, 1943.) 10 dollars.

THIS book will be warmly welcomed by all organic chemists who are interested in natural products. The colouring matters described are either of vegetable or animal origin, with the one exception of the organic mineral graebeite, a derivative of a polyhydroxyanthraquinone. The word 'Organic' would find an appropriate place in the main title of the book, and the subtitle would more accurately read "the Properties, Constitutions, and Syntheses of the Important Natural Pigments". There is naturally little discussion in the book on the biological relations of the colouring matters or of their mode of synthesis in Nature, as these are topics about which we possess extremely little knowledge.

The need for an up-to-date book dealing with this subject has been widely felt for many years, and it is natural to compare the present volume with A. G. Perkin and A. E. Everest's "The Natural Organic Colouring Matters", published in 1918. The advances revealed are most outstanding in our knowledge of the structures of the complex pigments of the carotenoid and porphyrin groups ; in the carbocyclic and oxygen-heterocyclic series the advances are chiefly in the large number of new pigments which have been isolated since 1918.

In the foreword written by Dr. Mayer in 1939, the work is described as a completely revised text based on the second volume of the third edition of his "Chemie der organischen Farbstoffe", translated by Dr. A. H. Cook. The untimely death of Dr. Mayer in 1940 and war-time difficulties delayed the publication of the volume, and the opportunity was taken by Dr. Cook to revise the text to include papers published up to the summer of 1941.

Chapter 1 contains a comprehensive account (85 pages) of the carotenoids, and this is one of the most valuable sections of the book. Chapter 2 describes curcumin, the sole representative of the dicinnamoylmethane class. In Chapter 3 (60 pages) are described the carbocyclic colouring matters, which are nearly all derivatives of *p*-benzoquinone, naphthoquinone or anthraquinone. The account of the many compounds containing a heterocyclic oxygen atom is given in Chapter 4 (108 pages). Compounds containing heterocyclic nitrogen atoms are described in Chapter 5 (71 pages) ; these include the pterins isolated from butterflies' wings, a long account of the porphyrins, and shorter accounts of the derivatives of indigo and pyrazine, the latter including riboflavine. Where there are many pigments of the same type, general descriptions are given of the properties and methods of synthesis of members of the group, followed by brief descriptions of the individual members. The book contains more than two thousand references to the original literature, and has an author and a full subject index.

It may be doubted if it is wise to adhere too rigidly to the division of natural organic compounds into those which possess, and those which do not possess, colour visible to the human eye. Such a distinction is very artificial and has not been strictly followed in the volume under review. For example, Chapter 4 includes descriptions of the colourless substances flavone, catechin, cyanomaclurin and several others, presumably because of their similarity to related coloured compounds ; but the same liberality is not shown in the coumarin series, of which the sole representative is daphnetin. Many naturally occurring coumarins are known, but they are largely of the phenol ether type and are colourless ; had they happened to exist as free phenols, many would have been coloured and would have received mention.

To the organic chemist this book is a well-stocked herbaceous border showing every variety of colour, and a few welcome colourless blooms. It would be too much to expect to find no weeds among such profusion ; but it is surely time that pentacovalent nitrogen atoms and tetracovalent oxygen atoms should be rooted out. Close inspection reveals a moderate crop of accidental weeds, among which may be mentioned a number of errors on pages 242 and 243, where the main reactions of brazilin are shown ; vanillic acid (p. 229) is shown as *iso*vanillic acid ; hydroxyl groups are missing from formulæ on pages 167, 201 and 205 ; flavane (p. 162) lacks a phenyl group ; purpurogallin (p. 103) is named as its glycoside dryophantin. It is unfortunate that the most important method for the synthesis of flavones and flavonols, the fusion of an *o*-hydroxyketone with the anhydride and the sodium salt of an aromatic acid (Allan-Robinson), should have received mention only as an 'also ran'.

This is a valuable book, and it is to be hoped that it will be kept up to date by frequent further editions.

W. Baker.

A UNITED NATIONS EDUCATIONAL AND CULTURAL ORGANISATION

INTRODUCTION

By Dr. E. F. ARMSTRONG, F.R.S.
Adviser to Delegates of H.M. Government

THE United Nations Educational and Cultural Conference that opened in London on November 1 has been called to prepare the establishment of a United Nations Organisation for promoting educational and cultural co-operation.

It is natural that a new effort towards world co-operation in the cultural field should occur after the devastations of the Second World War. We wish to repair the damage to our friends and ourselves as quickly as possible.

This is particularly serious in the cultural field. The damage that the enemy has done to things of the mind is even more appalling than the terrible material destruction for which he is responsible. Vile ideas have been instilled into the young, and the best traditions of research and learning have been debased.

The chief way by which the victims can be restored to civilization is by education and rehabilitation. It is, however, impossible to teach and to train the mind in research and rational inquiry without schools, and apparatus and laboratories.

One of the main aims of the Conference will be to create an Organisation that will help to achieve this restoration.

A second matter of equal importance is the promotion of educational, scientific and cultural co-operation in the future. Men of science will expect that due weight should be given to science in the conceptions and machinery of the new Organisation.

The place of science in the structure and outlook of modern civilization has been growing steadily for generations. Almost every aspect of production, transport, nutrition, health and the primary needs of life are dependent on it. The influence on modes of thought in research and learning, and spiritual attitudes, is equally great. The application of the scientific mode of thought to the problems of man and society is perhaps our chief hope for the future. But we cannot utilize it if we do not know what it is. We want to see the restoration and improvement of education, with appropriate weight given to science, in view of its contemporary importance.

The latest developments of atomic energy make the need for the understanding and use of science yet a thousandfold greater.

Thus it is profoundly necessary that science should have due place both in the conceptions and aims of the new Organisation, and in its machinery.

The most perfect plan and organization will not work, however, without finance and public support, and these must be based on public approval.

Another point of equal importance is the question of priorities. It is essential that the Organisation should be able to secure the needed equipment, after it has acquired the adequate finance. Teaching and research cannot be done without apparatus, scientific literature, and communications.

Men of science throughout the world hope that the Conference will have every success, and that, as a result of the discussions, a new Organisation will be established which will strengthen existing scientific collaboration and create new links where they are needed.

SCIENCE AND THE UNITED NATIONS

By Dr. JULIAN HUXLEY, F.R.S.

THE proposals for the new United Nations Educational and Cultural Organisation were first put forward by the Conference of Allied Ministers of Education, which has sat in London since 1941, and in some of its later work was assisted by a delegation from the United Nations. This body was originally concerned with the immediate and essentially short-term task of securing the educational and cultural reconstruction of those parts of Europe and Asia which had suffered cultural distortion or destruction at the hands of the Axis Powers; and in April 1944 it formulated proposals designed to meet these needs. At San Francisco, however, this aim was extended and generalized, and it was proposed that a permanent special agency of the United Nations, devoted to educational and cultural tasks, should be established. The present Conference is engaged on the problems of giving final form to the draft charter of the Organisation put forward by the Allied Education Ministers, and broadly outlining its main aims and functions and of delimiting its field of action; after which it will set up an interim commission to work out details and to prepare the ground for the first full Conference to be held about a year hence.

Another historical point is also relevant. Since the original sponsoring body was a Conference of Education Ministers, the present Conference is one of delegations appointed by the Ministries of Education of the United Nations, convened by the British Ministry of Education, and presided over by the British Education Minister. Further, the emphasis in the original proposals was largely upon education. Some stress was later laid on culture, and the word 'Cultural' was included in the proposed title; but in spite of the fact that the Allied Education Ministers had a sub-committee to deal with scientific questions, science received less consideration, and proposals to include the word 'Scientific' in the title were at first rejected.

The Ministry of Education has now invited comments from a large number of bodies concerned with the educational, cultural and scientific life of Britain, and undoubtedly the replies of the scientific bodies will have ensured that the fullest consideration will be given by the British Delegation, and may we assume by the Conference as a whole, to the claims of science. However, there is no harm in rehearsing here some of the considerations which occur to most men of science who have given thought to this important subject.

In the first place, they consider it essential that the word 'Science' or 'Scientific' should occur in the title of the Organisation—that, in transatlantic phrase, the Conference should put the S in UNESCO. Opposition to this appears to come from two quarters

—from certain educational circles who fear that the educational side of the new Organisation might come to be overshadowed by the scientific side; and from certain scientific quarters who dislike the idea that science is not 'cultural'. However, although of course 'culture' is a term of such loose definition that it may be stretched to include the totality of man's social activities, it *is* customarily used to include the humanities, literature and the arts, and in contradistinction to science. Further, even if culture in a partially restricted sense can be taken to include pure science, it is difficult for most people to envisage applied science and technology as falling within its sphere. Finally, if culture be enlarged to include science, it should, by the same token, include education as well. Thus, on every ground it would appear right to call the new Organisation either simply 'Cultural', or else 'Educational, Scientific and Cultural'.

However, the question of organization is more important than that of nomenclature. Here, too, most men of science are agreed that it is essential that a separate and relatively autonomous division devoted to the sciences and their application should be set up within the Organisation. There would presumably be other equivalent divisions dealing with education and with culture in the sense previously mentioned; in addition, a further division has been suggested in some quarters to deal with the "General Dissemination of Ideas", that is, the international aspects of the press, radio, cinema and the like, and laws concerning freedom of conscience, speech and assembly.

Each division should then have its own assistant director-general, its own secretariat, its own share of the general budget, and its own representation on the Council or other executive body of the entire Organisation. Such a council, with the director-general of the United Nations Educational and Cultural Organisation as its chairman, and again its own share of the secretariat, would consider questions of general policy and the co-ordination of work between the separate divisions; but most of the actual work of the United Nations Educational and Cultural Organisation would be carried out by the separate divisions.

A subsidiary question remains. Should there be two scientific divisions, dealing with the natural and social sciences respectively; or only one, dealing with both? There is a good deal to be said on both sides. But there is one consideration which is perhaps of an over-riding nature. The time appears to be ripe for extending scientific methods into many fields of social and economic life, both in respect to their study and to their practical direction and control, and for associating workers in the natural sciences with social and economic policy (witness the success of the application of scientific method in so-called 'operational research', in the social activity we call 'war'). If this be accepted, then it would seem important to make the attempt to unite the social and natural sciences and their applications within a single division: if this should prove impracticable, it would be easier to split a single division into two than to combine two separate divisions, each with its own outlook and traditions, its own *amour propre*, its own staff, into one.

There will clearly need to be considerable liaison between the separate divisions of the United Nations Educational and Cultural Organisation (a liaison which will presumably need to be co-ordinated from above by the executive board, and to be effected horizontally between the divisions). Thus the scientific division will be deeply concerned about the place allotted to science at all levels of education, and about the methods of scientific teaching, as well as with the popularization of science by press, radio, etc.; and in so far as the cultural division deals with philosophy and history, it will be concerned about the application of methodology of science to these and similar subjects.

In another article Mr. Crowther deals with some of the specific projects which the scientific division might undertake. Here let me merely sketch its main possible functions. In the first place, it should assist, stimulate, and co-ordinate the activities of existing international bodies in science—such as the international scientific unions, the international work in locust control, etc. Secondly, where some field is inadequately covered, or not at all, by existing international agencies, it should either promote such an agency or itself initiate and carry out the necessary survey and research. Thirdly, it should assist and promote the speediest possible diffusion of new scientific knowledge and ideas—by exchange of books, periodicals and reports; by promoting rapid publication; by improved facilities for translation, abstracting, and providing reviews; by promoting special meetings of scientific workers to discuss pure scientific problems (notably perhaps in rapidly growing 'borderline' fields) and urgent practical applications of science; and in other ways. Fourthly, it should assist and promote the exchange of scientific personnel at every level—students, especially research students; teachers, both in schools and universities; mature research workers; etc. Fifthly, it should promote world science by assisting the growth of science in countries in which it is quantitatively or qualitatively under-developed—by helping in the provision of books and periodicals and apparatus, by travelling scholarships, research studentships and professorships in both directions, and above all by helping scientific workers in these countries to have speedy access to new scientific methods and results in the rest of the world. The success of the British Scientific Mission to China shows what can be done in this field by bilateral action: this would be multiplied many-fold by proper international organization.

So much for a United Nations Educational and Cultural Organisation. But it must be emphasized that, however satisfactory the place of science in this Organisation, there will remain other important functions for science to perform in the international sphere.

Let us recall the general organization proposed for the United Nations. In addition to the General Assembly, corresponding to the Assembly of the League of Nations, there are three Councils directing policy at the highest level. The Security Council will operate in the political and military field, with special reference to the preservation of peace. The Trusteeship Council will deal with what were called Mandated Territories under the League, and other similar problems. And the Economic and Social Advisory Council, as its name implies, will be concerned with all other fields in which it is hoped to secure international co-operation.

In this section of international affairs, a number of "Specialized Agencies", to quote the United Nations Charter, have been or will be set up to deal with particular fields. The United Nations Educational and Cultural Organisation is one of these; there are also in existence the International

Bank and the International Monetary Fund, dealing with long-term and short-term problems respectively in the financial field, and the United Nations Food and Agriculture Organisation; it is proposed to set up a United Nations Health Organisation in the near future; and the International Labour Office has just decided to divest itself formally of its original connexion with the League and to seek to enter into relation with the United Nations Organisation. It is proposed that all the United Nations agencies of this type should be "brought into relationship" with the Social and Economic Advisory Council; and many people hope that it may be possible to do the same with the International Labour Office.

The precise relationship between the special agencies and the Economic and Social Advisory Council remains to be determined. While there is no suggestion that they shall be mere organs of the Council, it seems clear that they must be subordinate in the sense that they will be on a lower hierarchical level of the General United Nations Organisation; further (with the exception of the International Bank and Monetary Fund, which will be self-supporting) they might perhaps with advantage be directly financed by it through a block grant from the general funds of the United Nations*.

With this proposed set-up in mind, it becomes clear that the United Nations Educational and Cultural Organisation, however important and adequate a role is assigned in it to science, cannot cover all the scientific functions which the United Nations Organisation should exert. In the first place, since a United Nations Educational and Cultural Organisation will be in relationship with the Economic and Social Advisory Council, it cannot be expected to play any, or any considerable, part in relation to the Security and Trusteeship Councils. Secondly, since other special organizations operating in relationship with the Economic and Social Advisory Council have scientific aspects, notably the Food and Agriculture Organisation and the Health Organisation, some machinery is required for co-ordinating scientific policy and for allotting scientific functions as between the different special organizations; and this can only be done at the level of the Economic and Social Advisory Council. And thirdly, the Economic and Social Advisory Council, the Security Council, and the Trusteeship Council will themselves undoubtedly require scientific advice on policy.

Thus while scientific work of an *extensive* type, involving either the co-ordination and assistance or the actual promotion of many detailed and concrete schemes, will fall to the share of the United Nations Educational and Cultural Organisation, and special applications of science to that of the Food and Health and the Agricultural Organisations (and perhaps of the International Labour Office also), *intensive* scientific work, involving advice on and guidance of policy, will be required at the higher or Council level.

This, it may be suggested, would best be achieved by the formation of special scientific committees of the three Councils, which would combine advisory with policy-making functions. In order to obtain the services of the highest-ranking men of science, these Committees should not be drawn from the permanent staff of the United Nations, but should meet at intervals of a few months, presumably in relation to the regular meetings of the Economic and Social Advisory Council and the Trusteeship Council; and for the Security Council, which will be in permanent session, at such times as are proved convenient. An amount of preparatory work on scientific subjects might also be required, which could of course be carried out by a few members of the permanent secretariats of the Councils.

As regards the composition of the scientific committees, the case of the Security Council is the simpler, since the scientific problems with which it is or ought to be concerned are less varied. One may suggest that a committee of 10–15 members would suffice. Owing to the technical and often secret nature of the scientific problems involved, the members would presumably have to be drawn from the permanent scientific advisers of the Armed Services of the eleven nations composing the Council, or from independent men of science who had been closely associated with scientific advisory work for their Service Departments.

It may further be suggested, in view of the overwhelming importance of science in various questions with which the Security Council will inevitably be concerned (such as the control of atomic weapons and the regulation or inspection of pure scientific work in atomic physics), that a proportion of the members of its scientific committee who by virtue of their training are able to understand both the immediate and the long-range implications of scientific ideas and applications, should actually sit at the meetings of the Council itself, as observers taking part in its discussions.

In the case of the Economic and Social Advisory Council, the scientific committee will in the first place require to be more numerous, in view of the numbers of fields of science to be covered—say 15–25 members; normally much of its work might perhaps be best carried out by sub-committees. Secondly, it will not be so imperative that its members should be drawn from among the permanent scientific staff of member nations; a considerable proportion at least could more profitably be selected from independent men of science in universities or research institutes. Among the separate subjects on which their advice would be sought would be the place of science in education, the encouragement of scientific research in general, the application of science to health, agriculture, housing, generation of power, population policy, etc.; but their most important function would be to make the Economic and Social Advisory Council aware of the broader implications of scientific advance for social and economic welfare.

The scientific committee of the Trusteeship Council will presumably have to cover fields such as anthropology, tropical agriculture and medicine, soil erosion, etc., and might include 12–20 members.

The assumption of such important roles by science in the international sphere has certain implications for its future role in national affairs. In Britain, the most obvious need would seem to be the strengthening of the Scientific Advisory Committee to the Cabinet, and the provision of a national scientific secretariat in the Cabinet Office. In addition, the internal apparatus of scientific research councils needs to be

* The converse procedure, by which the special organizations would be independently financed, by separate grants from separate member nations, was adopted for the special organizations of the League, namely, the Institute of Intellectual Co-operation and the International Labour Office. It is not, however, in principle satisfactory, as it does not guarantee that all member nations will take part in the work of the special organizations, there is less guarantee of nations being in arrears with special contributions than with a general contribution to the United Nations, and it may lead to nations attempting to attach conditions to their contributions.

reviewed, to see whether there are not any gaps to be filled in it; some men of science, for example, consider that the existing Research Councils (including, of course, the Department for Scientific and Industrial Research) might profitably be supplemented by the creation of a Biological Research Council, which, in addition to covering a wide field of research which is not at present adequately covered by the existing Councils, could take over under unified control some of the biological projects now dispersed among the others.

To return to the international sphere, it is of great importance that men of science should realize the need for 'high-level' representation of science in the United Nations Organisation, in direct relation to the three Councils. This is all the more urgent since not only is such a function of science in no way covered by the United Nations Educational and Cultural Organisation, still less by the other special agencies, but it has not yet been envisaged by the Preparatory Commission of the United Nations Organisation (see the recently published Report of its Executive Committee)—in spite of the fact that the first session of the General Assembly of the United Nations is to meet in London in January.

WORLD CO-OPERATION IN SCIENCE

By J. G. CROWTHER

THE present Conference and proposals for educational, scientific and cultural co-operation have arisen, in the first instance, through the devastation of war. When countries were invaded, millions of men and women retreated before the enemy, and hundreds of thousands came to the United Kingdom. The children and the young needed succour and education, and through this, the Ministers of Education of the occupied countries met to organize assistance. From immediate help for refugees, they passed to plans for assisting the cultural life of their countries after liberation, and then to the promotion of cultural co-operation on a new world scale. There were the three stages of relief, rehabilitation, and the advancement of civilization.

Each of these stages has its special problems. In the educational field, books and elementary teaching equipment are the most important mass need. The urgency of the provision of text-books, pencils, desks, paper, and the other elementary things is extreme. In principle, it does not seem to be a very difficult problem. The great difficulties that arise in practice are shortage of raw materials, labour, machinery and the organization of production. Their solution would be straightforward, if economic conditions were easy.

In the field of rehabilitation concerned with more advanced institutions, the problems are much less clear. How should a restored physics research laboratory be equipped? Should its old equipment be looked for, and put back; or should modern up-to-date equipment be installed? Should the balance of selection of new equipment be the same as the old?

It is evident that rehabilitation of advanced and university laboratories is a complex and highly technical job. A pooling of world information on equipment and a pooling of world opinion on methods of equipping scientific institutions are required.

The Conference of Allied Ministers of Education, which gave rise to the present Conference, has already done a considerable amount of work on the compilation of inventories of equipment for a wide range of teaching and academic laboratories. The various inventories for chemical, physical, agricultural, medical and engineering laboratories have been compiled by committees of men of science of various nationalities.

It is possible that their labours contain the germ of the rationalization of scientific equipment. The new organization should extend this work.

A second needed activity is the survey of the world needs of scientific equipment. In the process of its work, the Science Commission of the Conference of Allied Ministers of Education had occasion to estimate the value of scientific equipment that existed in nine occupied European countries. They found that it was of the order of £100,000,000. There is a striking lack of economic data of this kind. No one ever seems to have asked before exactly what the world needs of scientific equipment might be. It is evident that such data are essential for the planning of the mass-production of scientific equipment at low prices. For example, steam-engines of various kinds are needed for engineering laboratories. Their price varies greatly according to whether they are needed in lots of five or five hundred. The cost of scientific rehabilitation could be greatly reduced if the world manufacture of scientific equipment could be to some extent rationalized.

The world Organisation could promote similar action with regard to scientific and engineering text-books. For example, a uniform system of units might be introduced. A common denominator for the decimal and the foot-pound systems would enable men of science and engineers to refer to books in any language, without the confusion of incommensurable sizes and units.

Another direction in which there is need for positive innovation is in the types of research fellowship. Something in the nature of 'research visitors' should be invented. There is a great need for the provision of small sums to enable research workers to make short visits for periods of a week to three months, to demonstrate or learn a new technique, or to travel to a laboratory where there is unique apparatus, in order to make a special experiment. There is very much less resource for this kind of journey than for studentships and fellowships of one year's minimum duration. The promotion of contact between men of science should be much more flexible and varied. The new Organisation should compare what various countries are doing in this way, make a list of world resources for means for travel, and direct the attention of particularly good systems that exist in one country to the notice of others.

There is general agreement that the small scientific conference of specialists should be encouraged. Allied to this development is the provision of accommodation for scientific workers and men of learning travelling about the world. A chain of houses in the leading cities and centres of the world should be developed, so that a man of science going from one country to another can be sure of a comfortable, informed and inexpensive reception everywhere. A pooling of the ideas of the nations on this topic might lead to interesting innovations.

Yet another direction for development is in the encouragement of new contacts between different branches of science. An efficient world Organisation would have unequalled opportunities for bringing together fertile new personalities and ideas, lying outside the old classifications and organizations. The most obvious ground for development is in the region between the natural and the social sciences.

While new subjects should be stimulated and fertilized, similar attention should be paid to new places. Modern means of transport and communication have brought cities hitherto quite isolated from the cultural current of the world within a few hours' journey of the main centres. A few years ago, the acceptance of a scientific post in an institute in a distant country usually meant cultural exile. With a world Organisation to assist in communications, such an outpost may offer more interesting opportunities to the research worker than he may find in the more crowded and conventional places at home.

A world Organisation for educational, scientific and cultural co-operation, conducted with a positive constructive spirit, can perform great and necessary services in the extension of existing international scientific co-operation, and the creation of new activities to meet the needs of the times.

A PERMANENT INTERNATIONAL SCIENTIFIC COMMISSION

By Prof. J. D. BERNAL, F.R.S.
Birkbeck College

IT is sincerely to be hoped that the United Nations Conference for the Establishment of an Educational and Cultural Organisation will, as one result of its deliberations, set up some form of international scientific commission. Such a body has long been needed and never more than in the present period of rehabilitation and reconstruction. The experiences of the War have shown, not only in industrial countries but also in the agricultural and other undeveloped regions, that the rational application of scientific knowledge and the initiation and carrying out of research and development in relation to current problems is an absolute necessity for progress. The War has also shown that the gap which has long existed between scientific research and practical results can, with suitable organization, be drastically narrowed. This experience bears with it the responsibility for seeing that methods at least as efficient shall be put into operation with the minimum of delay for the purposes of peace.

One of the main lessons of war science was its transcendence of national boundaries. In most fields of science there was a complete pooling of British Commonwealth and United States of America scientific resources. In some fields of science, notably medical, the pooling also included, within limits of difficulties of communication, the Soviet Union and China. But the actual geographical extent of scientific collaboration was still wider; it ranged over the whole of the fields of operation of allied armies and supply services, that is, over practically all but enemy-occupied territory. The work was planned and co-ordinated in regard to problems and needs rather than to individual and national contributions. The British Commonwealth Scientific Office in Washington was a focus of common scientific planning and information such as has never existed in the world before and one well justified by its results. There could be correlated, for example, work on insecticides such as D.D.T. being applied all the way from New Guinea to West Africa, and this was not the only centre. Men of science attached to the Middle East Supply Centre at Cairo were examining all the related problems of the region—of agriculture, industry and health—from Morocco to Baluchistan. The advantages to be got from scientific collaboration on a regional basis are now proved; but to safeguard them requires a permanent form of organization which only the United Nations can provide.

Another lesson of equal importance was that the distinction between the different sciences tended to disappear in practice in this type of organization. In fact one of the main lessons of the War was that mixed research teams, ranging from mathematicians and physicists to economists and psychologists, were needed to cope with regional problems in their entirety. Even in highly industrialized countries we are beginning to find out that the physical scientists and the technicians cannot get to work effectively unless they can see their problems in a framework which only social scientists can grasp and which only statisticians can convert into figures on which quantitative action can be taken. This was effectively what was done in the building up of "operational research" during the War, and already the techniques of operational research are being applied to the building and export industries in Britain. The need for them on an international scale will be far greater.

The world of science after the War is ripe for great changes. In the United States and Great Britain science has been relatively undamaged and much increased in scope and effective organization. In the Soviet Union, in spite of the almost total devastation of the western areas, science has not only been maintained but has grown. By contrast, in the majority of the occupied countries, science has barely survived destruction and persecution, while both there and in the countries of Asia and Africa there is an increasingly conscious demand for more science. The devastated countries need immediate help, but it will not be sufficient, or, indeed, desirable, simply to return to pre-war conditions. The smaller countries already feel the need for larger units of scientific intercommunication. In a sense, German science provided this before the War, and the filling of the vacuum left by the perversion and destruction of German science is a task which can only be carried out by organized international action. It should be possible to get away from the conception which had grown up before the War, of scientific circles confined to a large extent by the circulation of journals in the same language, towards one of a world scientific commonwealth. This implies, however, a serious effort to recast the whole system of scientific publication and personal communication.

Such a task is eminently one for the new United Nations Organisation. What is a reconstitution of science in some of the European countries is, for many of the backward countries of the world, a first creation of science. The history of the Soviet Republics of Central Asia shows how rapidly science can be built up and how eagerly it is seized on by a population starting from a medieval standard of culture. During the war years we have seen another example in the extraordinary effort to expand and apply science which has been carried out under the most adverse conditions in China. The part that Dr. Joseph Needham's Sino-British Mission has taken in this effort is an extremely good example of both the needs and opportunities for international collaboration. As a result of this experience, Dr. Needham is convinced that similar international collaboration would be just as much needed and appreciated in all relatively undeveloped countries.

The men of science of this and most other industrial countries have been occupied in the last six years largely with the important tasks of war, and have engaged in international collaboration for that purpose. In this they have learned both of the unity of the natural and social sciences and that of all peoples of the world. The problems of peace can start from this experience, but there is no question of applying it in a mechanical way. Much research and discussion must take place before a complete and effective system of united world scientific collaboration can be built up. This is now of particular importance in the light of the Soviet Government's expressed view that the full organization of cultural and scientific activities should await the setting up of the United Nations Economic and Social Council. It is to be hoped that in a few months time this will have occurred and that both the natural and social sciences will find their place in an all-inclusive international organization.

THE PLACE OF SCIENCE AND INTERNATIONAL SCIENTIFIC CO-OPERATION IN POST-WAR WORLD ORGANIZATION

By Dr. JOSEPH NEEDHAM, F.R.S.

MY experience during the past two years in China in organizing and directing scientific and technical co-operation between China and the United Kingdom has led me to devote much thought to post-war international scientific co-operation. The present memorandum, sketched out in Chicago and Washington in March 1945 and completed in Chungking in May 1945, does not necessarily represent the views of any organization, but are my own views.

In the past, in times of peace, men of science themselves organized periodical international congresses for each science; and for certain branches of science (though not for all) there were successful international unions, or permanent bureaux, able to deal with day-to-day co-operation. These unions were federalized in an International Council of Scientific Unions, which, however, was not as successful as it might have been, due to the lack of an adequate secretariat. The International Council was associated with the League's International Institute of Intellectual Co-operation, but this itself was imperfect.

In war-time all these international agencies have gone into a state of suspended animation. Under the exigencies of war, the United Nations set up in each others' capitals science co-operation offices to deal with the emergency exchange of scientific and technical information bearing on military affairs. Most of these offices, such as the British Commonwealth Scientific Office in Washington; the United States Scientific Mission in London (under the Office of Scientific Research and Development); the French Scientific Missions in London and Montreal, in general much more efficiently run than anything known to international science in peace-time, deal to the extent of some 85 per cent with war science. But in one case (the British Scientific Office in Chungking) a condition more similar to what might pertain in peace-time is found. These science co-operation offices differ from pre-war international scientific co-operation mainly in that they have adequate funds, secretariat and mechanical aids; and are not confined to any one science, but have to promote general scientific co-operation between the countries which they link. They are, therefore, rather a new departure; and point the way for the future.

The pre-war international scientific unions were thus limited as to subject-matter; the bilateral science co-operation offices are limited as to national scope. What we need to-day is fundamentally an attempt to combine the methods which science has spontaneously worked out for itself in terms of peace, with those which the nations have had to work out under the stress of war. None of the machinery ought to be scrapped. The problem is to weld it into a satisfactory functioning system.

In the future, there are two other types of international scientific intercourse which may grow up. One is the further extension into the scientific field of the bilateral cultural goodwill organizations (such as the British Council, Cultural Division of the State Department, etc.). The other is the appointment of scientific attachés in the principal embassies, a measure which the continuing interchange of information on war science will almost certainly necessitate. While there is much to be said for both these methods, I feel that these methods are not fitted to play the major part, though they may well play a valuable minor part, in the international exchange of so basically international an activity as science. Now is the time to attempt the establishment of an International Science Co-operation Service in which a supra-national loyalty would be possible, as it was in the case of the most successful League agencies.

In general, it may be said that there is a universal desire among men of science to see better international scientific contacts after the War. The dependence of all modern world civilization on applied science must find its expression in the sphere of international relations. This desire is more strongly expressed, however, the further one goes away from the great scientific and industrial centres of Europe and the United States. The picture of world science looks very different when seen from Rumania, Peru, Java, Siam or China.

It is often thought that in science everyone knows everyone else, and can, therefore, easily get in touch when any problem arises which calls for it. But this is not the case in the greater part of the world. A Venezuelan economic entomologist may have a problem very similar to that of a Chinese economic entomologist; but the difficulties of their coming into touch are enormous. A Rumanian organic chemist may need a few grams of a substance only being produced in India or Canada; but if he only knows his own language it will not be so easy to get it. The Australian workers on alunite needed for years the publications of the Chinese National Academy on the same subject; but were never able to get them until an exchange was arranged through the British Scientific Office in Chungking.

Allied to what may be called this 'periphery principle' of concentrating the help of an International Science Co-operation Service where it is most needed, that is, to the scientific men isolated around the periphery of the 'bright zone', is the complementary principle of not interfering too much within the 'bright zone'. It would obviously be absurd for any international funds to be spent in communicating between people in the United Kingdom and the United States, for example, who are quite well able to communicate with each other. The International Science Co-operation Service should be directed, and indeed limited, to doing those things in international scientific co-operation which are not being done, and cannot be done, by any other channels.

The problem before an International Science Co-operation Service (or, what we are now coming to, a scientific section of a United Nations Educational and Cultural Organisation) is to steer clear of two extremes. The spontaneously arising scientific organizations before the War too often made the mistake of thinking that the battle was won when the organization was once written down on paper, and eminent men of science in different countries had accepted high positions in it. On the other hand, if care is not taken to select the right personnel, the other extreme of undue bureaucratism will kill the organization. The former danger may be avoided if adequate office management is assured, and the latter will not arise if men of science themselves fully participate.

The United Nations Educational and Cultural Organisation

While these discussions about an International Science Co-operation Service had been proceeding in the scientific world, planning had been going on for the establishment of a United Nations Educational and Cultural Organisation. Draft proposals for such an organization have been published by H.M. Stationery Office for the Conference of Allied Ministers of Education, and are being discussed by the United Nations Educational and Cultural Conference at present being held in London.

In my opinion it is desirable that the word 'science' appears in the actual title of the Organisation. This is essential, since the co-operation of men of science throughout the world is necessary. Many of them are not much concerned with teaching, since they may be in governmental or industrial laboratories; and the word 'culture' does not have in all countries the wide connotation that it has in the United States. Men of science in many countries would be likely to feel that an organization entitled only 'educational and cultural' had little to do with them. Hence I suggest that the full title of the Organisation should be United Nations Educational, Scientific and Cultural Organisation. The word 'cultural' could be assumed to take sufficient care of the humanities and the arts.

I am deeply convinced of the importance of the Organisation's name. I feel that from the psychological point of view, the avoidance of prejudice, etc., names matter enormously. The League's International Institute of Intellectual Co-operation was hindered by the lack of a good 'selling' name, and also lack of any arts of modern publicity to put it across to the intellectual world.

'Applied science' as well as 'pure science' should be written in the Organisation's constitution. If this is not done there might conceivably be a tendency later on to confine the work of the United Nations Educational and Cultural Organisation to matters of pure science without any technological aspect or bearings on the life and needs of the peoples. But pure and applied science can never be separated.

The scientific division of the Organisation should be to:

(1) Promote international scientific co-operation in all its aspects.

This general aim covers all the rest. The United Nations Educational and Cultural Organisation would not be restricted to any one group of sciences. It should also be thought of in connexion with the 'periphery principle' already mentioned.

(2) Organize and assist the better exchange of scientific information and research services between men of science and their organizations in the different countries.

While in the future there may be many opportunities for the exchange of confidential technical information between various countries, there is an enormous field of work to be done in seeing that the information actually published by government scientific organizations reaches those who need it both near and far. Moreover, the availability of scientific journals, especially the more specialized ones, throughout the world, is very restricted, and there is great need for an agency which could help isolated scientific workers with microfilmed or double-contact-printed excerpts from the literature.

Then the system of exchanging reprints, universally used among men of science and most valuable in itself, is very incomplete and unsatisfactory. It needs to be supplemented by other means, especially microfilms, double-contact prints, photostats, etc. If there were, under International Science Co-operation Service, some central stockpile where reprints could accumulate, the work of scientific workers throughout the world would be considerably assisted and much time saved.

In the field of research services, great help could be rendered by arranging for the wider use of special apparatus only available at certain places. It will be a long time before every centre has an electron microscope, a cyclotron, equipment for cutting thin rock-sections, or an ultracentrifuge. In all such work, very often the International Science Co-operation Service of the United Nations Educational and Cultural Organisation would only need to put men of science in different countries in touch with each other.

(3) Work out a plan for the restoration of scientific facilities in the liberated countries.

(4) Work out a plan for the provision of German and Japanese reparations in the form of scientific apparatus and research chemicals.

(5) Work out a plan for the utilization of such surplus war material and equipment as would be suitable for use in scientific research, and its transfer to the more scientifically backward countries.

(6) Assist in maintaining contact between government organizations concerned with science, pure and applied, when necessary; and advise governmental and diplomatic personnel on scientific matters, when desired.

It is probable that government organizations concerned with science in the major countries can communicate with each other quite satisfactorily without the good offices of any new international organization. But is this equally the case between the forestry service of a Balkan country, let us say, and the economic entomology bureau of one of the smaller States in South America? The diplomatic representation of the smaller Powers abroad can never be expected to be elaborate enough to handle all such technical inquiries. There is thus a large scope for an International Science Co-operation Service which would know no limitations of language or geography.

Again, if scientific attachés are appointed in the embassies of the larger Powers, competent advisers will be available to the diplomatic staffs. That this is most desirable would be readily admitted by all of them. But the smaller Powers can scarcely be expected to appoint such advisers, owing to lack of sufficient personnel. There is much, therefore, for the International Science Co-operation Service to do in this direction, and its supra-national character would render it all the better qualified to do it.

(7) Assist the free flow of essential research apparatus, chemicals and equipment across national boundaries.

A helping hand might be very useful, especially in the matter of customs duties and procedures. The International Science Co-operation Service could press, for example, for increased facilities for movements of apparatus, at least in the medical sciences. It would also do everything possible to encourage the production of scientific apparatus by local initiative from materials locally available. The Committee on Scientific Equipment of the Conference of Allied Ministers of Education has already emphasized these points.

(8) Assist the free flow of scientific books, periodicals, microfilms, manuscripts for publication, translations, abstracts, etc., across national boundaries, and especially between world regions of widely different linguistic pattern, for example, those of the ideographic and alphabetic languages.

(9) Assist the free flow of men of science coming and going across national boundaries, whether for periods of study or research, or for congresses, conferences and the like.

Here the International Science Co-operation Service would have to work in close contact with the continuation committees of the great international congresses, for example, those of physics, zoology and geology, usually triennial, and the smaller special conferences which have grown up in special subjects, for example, the Annual Conference on Differentiation and Growth. The more complete the return to normal after the War in matters of travel, passports, and the like, the less need there will be for an International Science Co-operation Service of the United Nations Educational and Cultural Organisation to exert any special influence in the direction of assisting the movements of men of science. But even if this return successfully takes place, there will be room for a long time to come for financial and other assistance to competent men of science to travel.

Allied to this is the helping hand which International Science Co-operation Service could give in the preparation of all kinds of scientific expeditions in zoology, astronomy, etc.

Then again, there are particularly interesting parts of the world which are unable themselves to finance the investigation of their natural products. The International Science Co-operation Service could help, either by financing the necessary investigations or by bringing the need to the notice of the existing world financing foundations.

An interesting proposal has been made by Dr. F. W. Went of the organization of temporary research groups in specific topics. Some of the more important investigators of a certain controversial subject would be brought together for a period of some months in one laboratory, during which time each would demonstrate the experiments on which he bases his own conclusions, and also work with the methods and materials of some of his opponents. As examples, twelve investigators hold fourteen different theories of bud inhibition, each man concentrating on a different aspect and using a different experimental plant; and there are no less than ten mutually contradictory theories of translocation of carbohydrates in plants. The expenses of such research gatherings, and the arrangements for them, could properly be undertaken by United Nations Educational and Cultural Organisation.

(10) Promote plans of international collaboration in research.

This, of course, overlaps with the last heading. It would require close contact with the international scientific unions, which in the case of such sciences as astronomy, geophysics, geodesy and radio physics have been in the past, and no doubt will again be in the future, outstandingly successful. The United Nations Educational and Cultural Organisation would also encourage the setting up of such unions in sciences which have not previously had them. It would also encourage the activities of such essential organizations as the International Committee on Zoological Nomenclature.

(11) Support all international activities of the various national academies of science.

This simply emphasizes the desirability of working in close co-operation with such bodies as the Royal Society, the Paris Academy of Sciences, the U.S. National Academy of Sciences, the Academy of Sciences of Moscow, etc.

(12) Assist the work of other international organizations, such as the United Nations Food and Agriculture Organisation, the International Labour Office, the International Health Organisation, the United Nations Relief and Rehabilitation Administration, etc., in scientific questions.

At first sight this seems to need no comment since the means of mutual assistance would grow up naturally between these bodies. But mention may be made here of certain bodies which may play a very important part in world science without being international in the widest sense. Thus the British Commonwealth, now the War is practically over, will almost certainly possess a science co-operation service of its own, with a central secretariat in London and permanent offices in all the other capitals, for example, Delhi, Canberra, Ottawa, etc. This would be a federation within a federation, and its existence would enormously lighten the work of scientific co-operation since the British Commonwealth could be treated as one unit. The United States and U.S.S.R. do not present such problems on account of their territorial contiguity and unity.

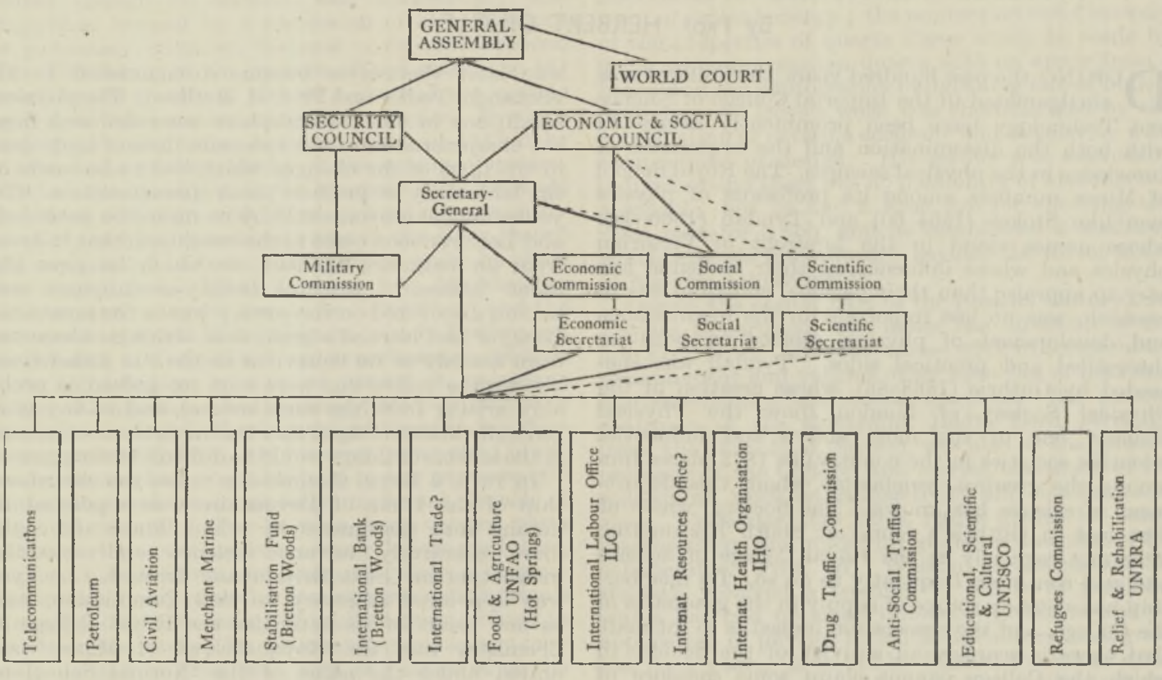
In the field of agriculture, what is essentially a British Commonwealth science co-operation service has led an extremely successful existence since 1929, under the name of the Imperial Agricultural Bureaux.

(13) Combine into branches of one organization, if feasible, the smaller international scientific bodies already existing.

A Scientific Commission and Secretariat

In all the foregoing discussion, it has been assumed that the principal place for science in the international scheme would be the United Nations Educational and Cultural Organisation. But although this body has seemed the obvious home for an International Science Co-operation

UNITED NATIONS WORLD ORGANISATION



Service, it must be remembered that a considerable number of men of science will be working with the other functional organizations, such as the envisaged Radio Communications Organisation, the Civil Aviation Board, the Food and Agriculture Organisation, the Petroleum Board, the International Health Organisation and the Drug Traffic Commission.

Another proposal, of great importance, therefore deserves discussion. The services which science could render to world organization are so substantial, and at the same time so unpredictable, that it might be desirable to introduce a scientific body at a higher level than any one of the functional organizations.

Let us look for a moment at the Dumbarton Oaks proposals (see accompanying diagram). From the General Assembly there will stem on one hand the Security Council for military and political matters (five great Powers *ex officio* and six elected governments). This will not immediately concern us further. On the other hand, there will stem the Economic and Social Advisory Council (eighteen governments elected freely by the Assembly). This Council is to have an Economic Commission and a Social Commission with their respective secretariats "and such other Commissions as may be necessary". Why should it not also have a Scientific Commission and a Scientific Secretariat ?

A World Conference of Science

There can be no doubt that among those concerned with government and international relations there is a general desire to see science well represented, and in a manner satisfactory to its representatives. The various proposals in this memorandum are brought forward as an aid to discussion. Others have been, and will be, forthcoming. There is available much carefully thought-out material embodying useful experience in crystallizing the structure of international organizations. But nothing authoritative can be obtained without a world conference of science, organized along the same lines as Bretton Woods, Hot Springs and Dumbarton Oaks. This should be called together as soon as possible. Only in this way can the voice of world science clearly indicate its wishes and aspirations with regard to the organization of the International Science Co-operation Service and the United Nations Educational and Cultural Organisation.

Summary

(1) An International Science Co-operation Service has been proposed. It is shown that there are immense tasks to be undertaken for the benefit of humanity through the rapid expansion and dissemination of knowledge, by such an organization.

(2) The United Nations Educational and Cultural Organisation now being planned could embody the machinery proposed above, subject to certain conditions being met. A formulation of the tasks before any science division of the United Nations Educational and Cultural Organisation is given.

(3) Science has so much to offer to world organization that it would be highly desirable if it were represented at the higher, or conciliar, level, as well as at the lower, or functional organization, level. A proposal is made for a Scientific Commission to take its place, with its corresponding secretariat, side by side with the Economic and Social Commissions and their secretariats, in assisting the work of the Economic and Social Advisory Council. This arrangement would provide a means for correlating the entire scientific work of the whole world organization, and affording means of contact between the men of science in the various functional organizations.

(4) In order to ensure that all arrangements made shall be to the greatest benefit of world science, and hence to the welfare of the peoples, it is necessary that a world conference of men of science and their organizations should be called to assemble at some convenient place as soon as possible.

PHYSICS AND ASTROPHYSICS AT THE IMPERIAL COLLEGE

By Prof. HERBERT DINGLE

DURING the past hundred years, the Colleges now amalgamated in the Imperial College of Science and Technology have been prominently associated with both the dissemination and the acquisition of knowledge in the physical sciences. The Royal School of Mines numbers among its professors of physics men like Stokes (1854–60) and Tyndall (1860–68), whose names stand in the forefront of Victorian physics and whose influence on their students, less easy to appraise than their personal contributions to research, was no less important in the maintenance and development of physical science on both its theoretical and practical sides. Tyndall was succeeded by Guthrie (1868–86), whose creation of the Physical Society of London (now the Physical Society, one of the most active and influential scientific societies in the country) in 1873 places him among the greatest benefactors whom this department of science has known. The Society, which at first met in Guthrie's rooms at South Kensington, later met regularly at the Royal College of Science and still continues frequently to do so. Its membership has a steady source of supply in the graduates of the College, and the association indeed is so intimate that there is scarcely an activity of the Society in which the College cannot claim some measure of participation.

A comparable influence is that of Mr. (later Sir) Norman Lockyer who, by his founding of *Nature* in 1869, provided a much-needed medium through which men of science could communicate to one another and to the world generally the results of their researches. After fifty years of continuous service, Lockyer passed on the office of editor to his former pupil Gregory (now Sir Richard Gregory, Bart.) who received his early training, and later assisted with the teaching, at the Royal College of Science. Gregory edited *Nature* for twenty years, so that for seventy of the last hundred years it may be said in this place without lack of modesty that the leading scientific journal of the world was established and guided by men whose scientific activities are part of the history of the Royal College of Science.

When, in 1868, Lockyer sprang overnight into fame by the dramatic circumstances of his discovery of the nature of solar prominences and the consequent birth of the science of solar physics, he was not a member of the College staff but a clerk in the War Office. He immediately established relations, however, with the College which he was later to adorn by entering into collaboration with Frankland, then professor at the College of Chemistry in Oxford Street, the foundation of which in 1845 makes the present year the centenary year of the Imperial College*. Lockyer had observed in the spectrum of the solar prominences and of the chromosphere, which he discovered and named, the lines of hydrogen and also an unknown yellow line which he was anxious to identify. He realized at once that thenceforth astronomical and laboratory observation must go hand in hand, and with Frankland's assistance he inaugurated a programme of research of the type which is now universally recognized as indispensable to the successful study of astrophysics. They worked in the evenings —the only time during which Lockyer was free—with the assistance of two young men, Pedler and McCleod, who later themselves became distinguished as Sir Alexander Pedler and Prof. H. McCleod. The physical conditions in the chromosphere were deduced from the characteristics of the spectrum lines of hydrogen, in the light of the changes which had to be made in the laboratory to produce those characteristics. The yellow line, however, could by no means be produced, and Lockyer soon came to the conclusion that it arose from an unknown element, to which he gave the name 'helium'. Not for twenty-seven years was helium discovered on the earth; but in the meantime Lockyer had learned a great deal about its character from a study of its behaviour in the sun (other lines besides the yellow one were soon recognized as probably arising from the same source), and to-day it is generally acknowledged that the importance of helium in the scheme of things would be difficult to exaggerate.

* See also *Nature* of Nov. 3, pp. 518–527.

In 1870, a Royal Commission under the chairmanship of the Duke of Devonshire was appointed to inquire into the means by which State aid could more effectively advance science and scientific instruction in Great Britain and Ireland. Lockyer was appointed secretary to this Commission, and as one result of its activities the Royal College of Chemistry and the Royal School of Mines were united under the name of the 'Normal School of Science' (later changed to 'Royal College of Science') and established at South Kensington. The Commission sat for five years, and in its final report it expressed the hope that "some arrangement may be made by which the services of Mr. Lockyer in the promotion of science may be secured to the country". The ultimate result of this recommendation was that the Solar Physics Observatory (now transferred to Cambridge) was created under Lockyer's direction at South Kensington, and he was appointed in 1881 as lecturer, and in 1887 as professor, in astronomy at the Normal School of Science. From that time until his retirement from the College in 1901, the activities of the Observatory and of the College were closely connected.

During this period the work at South Kensington stood in the forefront of astronomical physics. Of Lockyer's two outstanding ideas, that of the 'meteoritic hypothesis'—the theory that the heavenly bodies originated in meteors the gradual aggregation and subsequent development of which constitute the evolution of the physical universe—has not stood the test of time; though in some respects—such as the deduction that stars, starting as cool bodies, become hotter and pass through a maximum temperature to a cool state again—it later received on independent grounds a degree of approval for which Lockyer fought vainly in earlier years. The other idea, however—that of 'dissociation'—was truly prophetic. On spectroscopic evidence Lockyer argued, with complete justification, that we must recognize that atoms and molecules are not eternally unchangeable entities, but that they can be and are broken up into simpler forms which yield different spectra. The character of the dissociation it was scarcely possible to conceive in the absence of any theory of atomic structure; but on the main point, Lockyer, though he stood almost alone, was perfectly correct.

From 1885 onwards Lockyer had as his assistant Alfred Fowler, a young student of great ability in astronomical and spectroscopic work. Fowler succeeded Lockyer in the conduct of the work at the Royal College of Science, and immediately distinguished himself by a succession of identifications of previously unknown features of celestial spectra. The TiO bands in the spectra of red stars, the CO bands in the spectra of comets' tails, and the 'cosmic hydrogen' lines are outstanding examples. Fowler's real opportunity came, however, when in 1913 Bohr initiated the modern theory of the origin of spectra. Fowler's familiarity with the spectra of the elements and their variation with physical conditions was unrivalled, and he immediately saw in the Bohr theory the explanation of facts with many of which he alone was acquainted. What Lockyer had described as 'dissociation' was now seen to be 'ionization', and the successive spectra of an element which Fowler had sorted out and classified on experimental grounds were identified as spectra of atoms at successive stages of ionization. As the theoretical possibilities of analysis developed, Fowler applied them to his store of experimental data, and for some years the College made outstanding contributions to the most rapidly developing and fundamentally important branch of physical research. Pupils came from various parts of the world, as well as from among College graduates, and, to mention but two examples, Saha's thermodynamical theory of stellar atmospheres and Catalan's discovery of the existence of multiplets originated in Fowler's laboratory. Experimental spectroscopy may truly be said to have been born and matured at the Royal College of Science. Fowler himself, after his appointment as one of the first Yarrow research professors of the Royal Society, continued to work and direct research there.

Another branch of study in which the College has figured prominently is that of colour physics. This was begun as early as 1877, when Captain (later Sir William) Abney set up his laboratory in one of the temporary buildings at South Kensington which at that time were the only accommodation available to the Normal School of Science. The work has continued until the present time, and now forms an important part of the College's contribution to physical research. Abney's colour-patch apparatus was a pioneering effort in experimental research in this field, and it was applied not only to fundamental investigations but also to the testing of the colour vision of recruits for the Royal Navy and other services in which this physical characteristic is of importance. In photographic work also, particularly in the infra-red, Abney was a pioneer, and his emulsions for this region of the spectrum still defy reproduction. If the story that he photographed a kettle of boiling water in the dark by means of its temperature radiation is authentic, it was at the College that the work was done. In more recent years the Abney apparatus has been superseded by the Wright colorimeter, also a product of the College, and active research is carried on not only into the peculiarities of various types of colour vision, in which valuable assistance is given by the Medical Research Council, but also into many aspects of colour which affect problems of illumination and the dyeing and other industries.

For twenty-one years, from 1876 until 1897, the College was the scene of activity of one of the great experimenters of the time—Mr. (later Sir) C. V. Boys. Of his numerous achievements, all bearing the stamp of great ingenuity and experimental skill, it will be sufficient to recall his determination of the constant of gravitation with a small laboratory apparatus; his invention of the radio-micrometer, the most sensitive instrument yet devised for the detection and measurement of radiant energy; the production and discovery of the properties of quartz fibres which he made by firing white-hot molten quartz with an arrow from a bow; and the photography of lightning and of bullets in flight. All Boys's work was characterized by the combination of extreme accuracy and sensitivity with compactness of design. His genius was essentially individual and there was no possibility of his founding a school; but he had a keen eye for choosing the right man for a job, and he established a tradition which extends his influence beyond the direct effect of his own achievements.

During the earlier part of the present century, the Physics Department was under the direction of the late Prof. H. L. Callendar, whose work in temperature measurement and various other branches of heat and thermodynamics has become classical. The present chairman of the Governing Body, Lord Rayleigh (then the Hon. R. J. Strutt), was also at that time a professor of the College, and carried out much of his well-known work on radioactivity and discharges in gases. Callendar, like Boys, had a genius for exact measurement, and under his guidance and that of his collaborator, Prof. W. Watson, a succession of students received a training in habits of precision which has had no small influence on the successful application of physics to industrial affairs during the last forty years. It would be difficult to estimate, for example, how much Callendar's example and influence have contributed to the achievements of the National Physical Laboratory since its establishment. Some of the most outstanding members of the staff of that institution owe their physical knowledge and methods of research to his training.

During Callendar's professorship, the practice was begun of establishing sub-departments of the Physics Department for the advancement of certain specialized subjects. Astrophysics, already mentioned, became after Lockyer's retirement one such department which is still very active, and a Technical Optics Section was later added. This Section originated during the War of 1914–18 as a separate department, intended to be a source of production of optical designers, the lack of whom in the country during the War was felt as a serious disability. It was later brought under the general control of the head of the Physics Department, and it now covers a wide field of research and training in various aspects of optical work. An associated sub-department of Instrument Design has performed a useful function, and its reorganization as an independent department is now under consideration. Meteorology has pursued the opposite course to technical optics. Beginning in 1920 as a branch of physics, with a part-time chair, which has had such distinguished occupants as the late Sir Napier Shaw and Sir Gilbert Walker, it became a separate department in 1934 with a full-time professorship. Courses are given to students who have graduated in physics at the College or have had an adequate training elsewhere, and research into various problems of climate and weather is carried on. The most recently established sub-department is that of Geophysics, where, in the only postgraduate school of its kind in the country, students are trained in the principles of prospecting and other geophysical work.

Under the present head of the Department of Physics, Sir George Thomson, research in electron diffraction and nuclear physics is conducted. This is so much a matter of common and vital interest at the present time that it needs no emphasis here. The work of the College was specifically mentioned in Mr. Churchill's original statement on the atomic bomb, when for the first time the leading part played in the matter by Sir George Thomson's Committee was made known. Physics at the Imperial College begins its second century in most auspicious circumstances, and, granted the support to which its record entitles it, the future should witness no abatement of its influence both in pure research and in the application of physical knowledge in the widest possible field.

NEWS and VIEWS

Atomic Energy and Scientific Freedom

SINCE the opinions on atomic energy expressed in the leading article beginning on p. 547 were written, several important pronouncements in this connexion have been made. In the past, statements have been published from many sources and some of these, especially those attributed to Mr. Truman, have not only misled the general public, but have also caused irritation to many men of science in general and those who have kept in touch with research in atomic physics, especially since 1934, in particular. M. Molotov's claim in his speech in Moscow, on November 6, that the Soviet Union will soon "have atomic energy and many other things" will come as no surprise to men of science. On the other hand, it will probably stimulate second thoughts in others (and there are many) who have been inspired to believe that while the so-called 'secrets' of the atomic bomb remain vested in Britain, the United States and Canada, the world is safe.

Prof. M. L. Oliphant's vigorous speech at Birmingham on November 3 was also timely. As he stated, it is not possible to "deal with this job by a secret meeting between Mr. Attlee and President Truman. This is so big, so important, and so vital to the world, that it has to be done in the open". The recent statement from the Soviet Union confirms Prof. Oliphant's view that the value of the 'secret' held by the Allies is about six months effort on the part of any industrial country. A more vigorous and concerted effort on the part of all men of science to keep science free and intercourse between men of science open and world-wide is essential if the science of atomic energy, and most probably other branches of science eventually, are not to sink into the slough of international political intrigue. Science must not be allowed to become a tool in the hands of anyone, certainly not a part of any nation's foreign policy, for if ever it does then the consequences may prove to be the most serious in the history of science, indeed of the world.

At a joint conference of the World Unity Movement and the Council for World Airways (both organizations with offices at 20 Buckingham Street, London, W.C.2) held at the City Literary Institute, London, on November 2, Sir Leonard Hill, Prof. Lancelot Hogben, Dr. Kathleen Lonsdale, Prof. Lionel Penrose and Mr. Ritchie Calder, among others, spoke on the implications of the recent developments of atomic energy in relation to international affairs and the freedom of science. The following resolution, moved by Mr. Caradog Jones, was passed by the meeting: "Believing that no scientific knowledge should or can willingly be kept secret this Conference urges that the development of atomic energy be made subject without delay to international control and that the advice and co-operation of scientists be sought in order to devise the best means to exploit its use under a world authority solely and fully in the interest of the world community".

Nobel Laureates in Medicine

MEN of science will welcome the announcement that the Nobel Prize for Medicine for 1945 has been awarded jointly to Sir Alexander Fleming, Sir Howard Florey and Dr. E. Chain. Sir Alexander Fleming is now professor of bacteriology in St. Mary's Hospital Medical School, London. During the First World War, when he was working upon the bacteriology of septic wounds, Fleming became convinced that the chemical antiseptics then in use were often very harmful to the leucocytes which attack bacteria, and he discovered, in 1922, lysozyme, an antibacterial ferment which occurs in many animal tissues and secretions. In 1924 he showed that, if the antileucocytic power of an antiseptic is greater than its antibacterial power, it is not likely to be therapeutically valuable. When, therefore, he published in 1929, six years before the announcement by Domagk of the discovery of the sulphonamides, the discovery of penicillin and an account of his early trials of its antibacterial action, it was evident that he had provided us with an antibacterial agent which was not only powerfully antibacterial against some of the most pathogenic of organisms, but was also not toxic to the all-important antibacterial leucocytes and also not toxic to the animal infected with them. Attempts made at that time, however, to extract a form of penicillin which could be used therapeutically were not successful, and it seemed that this remarkable antibacterial agent would be denied to man.

The stage had, nevertheless, been set for the later work at Oxford of Sir Howard Florey and Dr. E. Chain, and it is interesting to note that the earlier work of these two investigators, like that of Sir Alexander Fleming, had predisposed them to make the particular and all-important contribution to the main problem which they made. Sir Howard Florey is now professor of pathology in the University of Oxford. Since the 1920's he has been interested in problems of bacterial inhibition and he has studied Fleming's lysozyme. The original discovery that some organisms produce substances which inhibit or prevent the growth and multiplication of other organisms was made by Pasteur and Joubert in 1877, and in 1899 Emmerich and Loew had extracted pyocyanase from *B. pyocyaneus*. When the Oxford work on antibiotics began in 1938, pyocyanase and penicillin were selected for study. Florey now had at hand the assistance of Dr. E. Chain, University demonstrator in chemical pathology at the Sir William Dunn School of Pathology, a man whose studies of enzymes and of the isolation from natural sources of substances which are physiologically active has earned him distinction. Dr. Chain (though of Russian extraction) was born in Berlin and received his early training at the University there. He came to Britain in 1933 and was appointed to the staff of the Sir William Dunn School of Pathology in 1935.

The success of this collaboration is now well known.

[None of the vacancies in these columns relates to a Man between the ages of 18 and 50 inclusive or a Woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.]

THE EXECUTIVE COUNCIL OF THE IMPERIAL AGRICULTURAL BUREAUX

The Council is an official body financed jointly by the Governments of the British Empire and Commonwealth and composed of nominees of those Governments. It administers those schemes in connection with agriculture, livestock and forestry which those governments jointly remit to it. At present these comprise centres of information in 12 branches of science, and two research schemes. The chief administrative post under the Council, that of SECRETARY, will fall vacant in 1946.

Applications are invited.

Requirements: Senior administrative experience in or with government departments connected with science, agriculture or forestry; scientific background or training; overseas experience or experience in inter-imperial relations. Fluency in some foreign language is an additional qualification.

Age preferably about 45–55. Salary in the range of £1,300 to £1,500, plus War Bonus and Superannuation Allowance.

Applications with a full record of past experience and names of two referees should reach the Secretary, The Executive Council of the Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, Dartmouth Street, London, S.W.1, by April 7, 1946.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the post of ASSISTANT LECTURER in MATHEMATICS. The person appointed must be prepared to lecture to classes of all grades of students, including undergraduate students of Engineering. Preference will be given to an applicant specially interested in Applied Mathematics. Salary £350 per annum, with Superannuation provision under the Federated Superannuation Scheme for Universities and war-time marriage and children allowance. Applications (three copies) including the names and addresses of three referees, and if possible, copies of two testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than December 31, 1945.

A. W. CHAPMAN,
Registrar.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the post of LECTURER in PHYSICAL CHEMISTRY. Salary approximately £700 per annum, with Superannuation provision under the Federated Superannuation Scheme for Universities and war-time marriage and children allowance. The successful candidate will be required to begin duties as early in 1946 as possible. Applications (six copies) including the names and addresses of three referees, and if possible, copies of two recent testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than December 31, 1945.

A. W. CHAPMAN,
Registrar.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the post of ASSISTANT LECTURER in CHEMISTRY. The person appointed must be prepared to lecture and demonstrate to classes of all grades of undergraduate students. Salary £350–£400 per annum, in the first year, according to qualifications and experience, with Superannuation provision under the Federated Superannuation Scheme for Universities and war-time marriage and children allowance. A somewhat higher salary might be offered in exceptional circumstances. The successful candidate will be required to begin duties early in 1946. Applications (three copies) including the names and addresses of three referees, and if possible, copies of two testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than December 31, 1945.

A. W. CHAPMAN,
Registrar.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of LECTURER in GEOGRAPHY. Stipend £400 per annum, rising according to scale. Duties to commence at beginning of Lent Term, 1946, or as early as possible thereafter. Applications should be sent not later than November 25, 1945, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

UNIVERSITY OF DURHAM
KING'S COLLEGE, NEWCASTLE UPON TYNE

Applications are invited for the post of Temporary Demonstrator in Physiology in the Medical School of King's College. Salary £300/£400 per annum according to qualifications and experience. Duties to commence on January 7, 1946, or, if the successful applicant is now serving in H.M. Forces or on other national service, on release. Ten copies of applications, with the names of not more than three persons to whom reference may be made, should be sent not later than November 30, 1945, to the undersigned from whom further particulars may be obtained.

G. R. HANSON,
Registrar of King's College.

UNIVERSITY OF DURHAM
KING'S COLLEGE, NEWCASTLE UPON TYNE

Applications are invited from graduates in Science for the post of Lecturer in the Department of Bacteriology. Salary will be in accordance with the qualifications and experience of the candidate appointed, but, in any case, will not be less than £400 per annum. Duties to commence on January 7, 1946, or, if the successful applicant is now serving in H.M. Forces or on other national service, on release. Ten copies of applications, with the names of not more than three persons to whom reference may be made, should be sent not later than November 30, 1945, to the undersigned from whom further particulars may be obtained.

G. R. HANSON,
Registrar of King's College.

UNIVERSITY OF EDINBURGH
LECTURESHIP IN GEOGRAPHY

The University Court invite applications for the post of Lecturer in Geography. The Lecturer will be charged especially with the teaching relative to the physical aspects of Geography. He will be expected to begin work on January 8, 1946; but applications will be considered from men now serving in H.M. Forces who may not be released by that date. The initial salary will be £475, and the Lecturer will be required to join the Federated Superannuation Scheme for Universities. Applications, giving evidence of qualifications and the names of at least three referees, should reach the undersigned not later than November 30.

R. JARDINE BROWN,
Secretary to the University.

MIDLAND AGRICULTURAL COLLEGE
SUTTON BONINGTON, LOUGHBOROUGH

(in conjunction with Nottingham University College). Applications are invited for the post of PROVINCIAL AGRICULTURAL ECONOMIST at a salary in the range of £400 to £680 per annum, plus War Bonus and Superannuation. Candidates should have had previous experience of the work in a department of agricultural economics and must possess a University degree in Agriculture or Economics. Applications with the names of two referees must be sent to the Principal, not later than November 19, 1945.

CIVIL SERVICE COMMISSION

Applications are invited for competitions by interview to fill vacancies on the scientific staffs of Government Departments.

(a) SCIENTIFIC OFFICERS and SENIOR SCIENTIFIC OFFICERS (age 21–30), 300–500 vacancies; candidates must possess a university degree in a scientific subject or in Mathematics with first or second class honours or an equivalent qualification.

(b) ASSISTANT EXPERIMENTAL OFFICERS and EXPERIMENTAL OFFICERS (age 18½–30), 750–1,000 vacancies; candidates must possess a university degree in a scientific subject or in Mathematics, or a Higher School Certificate with Mathematics or a scientific subject as a principal subject, or an equivalent qualification.

Salary of Scientific Officers, £275–£500 (men), or £275–£430 (women), and of Assistant Experimental Officers, £150–£350 (men) or £150–£280 (women); there is a war bonus in addition.

Full particulars are contained in the detailed Regulations which, together with the appropriate Application Form, can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1.

UNIVERSITY OF READING
FACULTY OF AGRICULTURE AND HORTICULTURE

The Council of the University will shortly appoint an Assistant Advisory Mycologist, salary £300–£400 per annum, plus war bonus, according to experience. Further details may be obtained from the Dean of the Faculty of Agriculture and Horticulture.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE
(University of London)
CAMPDEN HILL ROAD, LONDON, W.8.

The College Council invites applications for the appointment of PRINCIPAL, to take office in October, 1946.

Further particulars may be obtained from the Secretary, King's College of Household and Social Science, c/o University College, Leicester.

Completed applications should be received on or before January 1, 1946.

NORTHAMPTON POLYTECHNIC
ST. JOHN STREET, LONDON, E.C.1.

Applications are invited for the post of Full-time LECTURER in the MATHEMATICS Department.

Salary in accordance with the revised London Burnham Scale for Teachers in Technical Institutions.

Conditions of appointment and form of application on request to the Secretary.

S. C. LAWS, O.B.E., M.A., M.Sc.,
Principal.

EAST MALLING RESEARCH STATION

A vacancy for Assistant Mycologist and Bacteriologist in Plant Pathology Section. Research experience in one or both subjects essential. Salary, according to qualifications and experience, as Scientific Assistant or Scientific Officer on Ministry of Agriculture Scale. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent, returnable by December 15, 1945. Applications from members of the Services will be given consideration.

EAST MALLING RESEARCH STATION

A Research Worker is required in the Pomology Section for field experiments. Honours Botany or similar qualifications. Salary, according to qualifications, as Scientific Assistant or Scientific Officer on Ministry of Agriculture Scale. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent, returnable by December 15, 1945. Applications from members of the Services will be given consideration.

THE ROYAL SOCIETY
GOVERNMENT GRANT FOR SCIENTIFIC INVESTIGATIONS

Applications for grants from the third allotment of the Government Grant for Scientific Investigations for the year 1945 should be made as soon as possible in the manner specified in regulations to be obtained from the Assistant Secretary of the Royal Society, Burlington House, London, W.1. No application can be considered which is received later than November 30, 1945.

Applicants must be of British nationality. Grants can be made for the promotion and support of scientific research and for the assistance of scientific expeditions and collections, but not in aid of publications.

UNIVERSITY OF MELBOURNE
DEPARTMENT OF SOCIAL STUDIES

Applications are invited from experienced social workers, preferably with degrees in Social Science, to act as field work supervisors in the course for the Diploma of Social Studies. Supervisors, while working under the direction of the University, would be attached to social agencies and carry a case load sufficient for teaching purposes. Salary £350–£400 (Australian). Appointment for three years to commence February, 1946. Return fares will be paid. Applications (in duplicate) together with copies of testimonials and the names of two referees should reach The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1, not later than December 10, 1945.

NEWCASTLE-UPON-TYNE EDUCATION COMMITTEE
RUTHERFORD COLLEGE OF TECHNOLOGY

Wanted a Graduate Lecturer in Zoology, Botany and Chemistry, to take Biological Subjects to Inter. B.Sc. standard and Chemistry from Matriculation upwards. Burnham scale. Prescribed form to be returned to the undersigned by November 19, 1945.

THOS. WALLING,
Director of Education.
City Education Office,
Northumberland Road,
Newcastle-upon-Tyne, 1.

Scientific Consultant Service, 68 Victoria Street, S.W.1. Technical Investigations.

BEDFORD COLLEGE FOR WOMEN
(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1.

The Council of Bedford College invites applications or the following vacancy: DEPARTMENT OF ZOOLOGY. Junior research worker and part-time Demonstrator; salary £160 p.a. Applications to the Secretary.

BEDFORD COLLEGE FOR WOMEN
(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1.

The Council of Bedford College invites applications or the post of Demonstrator in the Department of Geology, vacant immediately, open to men and women equally. Candidates must hold a Special Degree in Geology. Salary £320–£400 p.a. For further particulars apply the Secretary.

University of Durham. Applications are invited for the APPOINTMENT of READER in ZOOLOGY and HEAD of the DEPARTMENT of ZOOLOGY in the DURHAM COLLEGES. Salary £800 a year with superannuation (F.S.S.U.). The successful applicant will be expected to take up appointment early in 1946, unless release from National service necessitates postponement. Twelve copies of applications, with the names of not more than three persons to whom reference may be made, should be lodged by December 31, 1945, with the undersigned, from whom further particulars may be obtained.

W. S. ANGUS,
University Office, Registrar.
46 North Bailey, Durham.

Applications are invited from men qualified to fill the position of EDUCATION OFFICER to the INTERNATIONAL WOOL SECRETARIAT, preferably from graduates who are competent lecturers, informed on the British educational system, keen and possessed of initiative; previous knowledge of the wool industry is not essential, though desirable.

An excellent opportunity will be offered to a man capable of expanding and developing an important section of the work of the Secretariat. A liberal insurance-superannuation scheme applies to the position. Applications, giving full personal details and names of referees, from whom further information may be obtained, and stating also the initial salary required, should be made now to The Chairman, The International Wool Secretariat, Grand Buildings, Trafalgar Square, London, W.C.2.

Senior Physicist required by British Leather Manufacturers Association to organise and collate investigations on physical properties of leather. Man or woman, British nationality, aged 30-45. Candidates should have honours degree or equivalent in physics with sound knowledge of chemistry. An appreciation of significance of biological structure in relation to physical qualities, or knowledge of physics of fibres and fibre weave, an advantage. Salary £500 to £750 according to qualifications and experience and post carries benefits under F.S.S.U.

Write quoting A.1141XA to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by November 24, 1945.

Full-length MSS. wanted on all branches of Science. Submit to the Scientific Book Club, 121, Charing Cross Road, London, W.C.2.

Physicist or applied mathematician, with research experience, required by British Cotton Industry Research Association, to carry out theoretical and experimental studies of vibrations in machines. Salary £400 to £600 according to experience plus £60 per annum war bonus. Permanent post included in F.S.S.U.

Write quoting A.1149X to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by November 30, 1945.

The British Oxygen Company is planning an expanding programme of research and development, and has openings for research chemists, physicists and engineers for technical planning, and for laboratory and semi-technical experimental work. Previous industrial experience welcomed but not essential, sound theoretical background indispensable. Applications (detailing age, qualifications and experience), which will be treated in confidence, should be made to the Director of Research and Development, The British Oxygen Co., Ltd., Grosvenor House, 6th Floor, Park Lane, London, W.1.

Queen Mary College (University of London), Mile End Road, E.1. Applications are invited for the post of Assistant Lecturer in Inorganic and Physical Chemistry, to commence January 1, 1946. Facilities for research. Salary £350 p.a. with F.S.S.U. participation. Applications (6 copies naming two referees) should reach the Acting Registrar by November 30.

Senior Laboratory Steward, age not more than 35, wanted for Department of Organic Chemistry. Laboratory experience and some knowledge of Chemistry essential. Must be capable and hard-working. Salary according to qualifications. Apply, giving full particulars of education, training and experience, with names of three referees to the Registrar, University, Liverpool.

A secretary with some knowledge of medical sciences is wanted in the Department of Pharmacology, Oxford. Main work would be preparation of abstracts of medical literature. There would be opportunity for doing biological work, either learning methods or research. Post might suit someone wishing to become a medical journalist. Salary according to experience. Maximum £500 p.a. Applications should be made to the Head of the Department.

Assistant Research Chemist required in textile works in Northern Ireland. Organic, physical or biochemistry desirable as main qualification. Knowledge of plant products an advantage but not essential. The appointment will be for a minimum of three years in the first instance. Applicants should give details of age, education and experience and should state when free to take up the appointment. Box 430, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The Institution of Automobile Engineers, Research Department, Great West Road, Brentford, Middlesex, invites applications for the post of Library Assistant. Candidates should hold a recognized qualification in Librarianship and have had experience in classification and cataloguing, preferably in a technical library. Initial salary £250–£300 per annum, according to qualifications. Superannuation System for Universities.

Metallurgist required for well-known Engineering Works in South-West. Must have degree or equivalent and possess sound experience in heat-treatment, testing and metallography. Salary according to qualifications and experience but will not exceed £600 p.a. "By permission of the Ministry of Labour and National Service under the Control of Engagement Order, 1945." Forward full particulars to Box No. 431, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Assistant Research Chemists and Biochemists required for research on Penicillin and related Antibiotics. Minimum standard, First Class Honours. Salary according to qualifications and experience. Applications, with full details of career, experience, etc., to Box 429, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Assistant Bacteriologist required for research on Antibiotics in London area. Minimum standard, honours degree. Salary according to qualifications and experience. Applications, with full details of career, experience, etc., to Box 428, T. G. Scott & Son, Ltd., 9 Arundel street, London, W.C.2.

Chemist (32), B.Sc. (1st class Hons.), Ph.D., requires permanent position. Teaching and research experience in Physical, Bio- and Agric. Chem. Box P.151, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: A Laboratory Assistant (female) of Inter.Sci. standard for work in a Biological Laboratory. Apply Pharmacological Department, Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1.

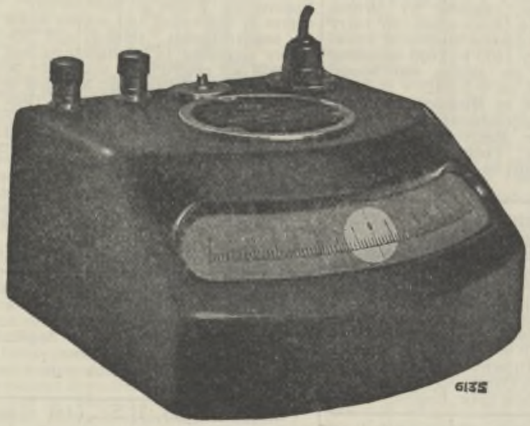
Senior Laboratory Assistant required in January for the Laboratories, Radley College. Previous experience essential. Salary from £150, according to qualifications. Live in or out. Apply in writing to W. S. Porter, Radley College, Abingdon.

Laboratory Assistant Wanted for adjusting and testing scientific instruments. Apply stating age and full details of experience to: The Controller of Production, Adam Hilger Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1.

Royal Anthropological Institute, 21 Bedford Square, W.C.1—Required, a secretarial assistant in Secretary's office. Write, giving details of experience, salary required, etc., to Assistant Secretary.

We wish to purchase always complete sets, and long or short runs of all SCIENTIFIC JOURNALS, PERIODICALS, and LEARNED SOCIETY PUBLICATIONS which libraries or private individuals may have for disposal. At the present time, however, we particularly require offers on Mathematics; Physics; Chemistry; Aeronautics (all branches); Fuel and Rubber Technology; Plastics, Engineering (Electrical, Chemical and Mechanical); Geology and Metallurgy. Also good standard reference works for library use. Please send particulars (or 'phone) to: THE MUSEUM BOOK STORE, LTD., 45 Museum Street, London, W.C.1. (Chancery 8947; Holborn 0400). Established 1901.

Microscopes, of all descriptions, only a few available, second-hand, perfect condition. Send details of your requirements, enclosing 8d. stamp.—Telephone or correspondence only. Chards. Forest Hill, S.E.23 (Spring Park 1628).



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Less well known—outside scientific circles, at any rate—is the full story of the remarkable work of the team of experts which was afterwards formed at Oxford for the study of the production, therapeutic use and mode of action of penicillin. Some day perhaps we shall have the human, as well as the scientific, story of this work and we shall then realize to the full the achievement of the many men and women who, working under the three leaders whom the Nobel Prize so deservedly honours, have given to mankind, not only penicillin, but also the whole volume of the later work on antibiotics which has opened a new chapter in the history of the fight against disease. To these others their leaders have often acknowledged their debt.

United Nations Educational and Cultural Organisation : Scientific Delegates

AMONG the delegates to the United Nations Conference now meeting in London to discuss the establishment of an Educational and Cultural Organisation (see pp. 553–561) are the following men of science : *United Kingdom*, Dr. E. F. Armstrong, adviser to the delegates of H.M. Government ; *Canada*, Dr. R. C. Wallace, principal of Queen's University, Kingston, formerly professor of geology and mineralogy in the University of Manitoba, and Dr. J. G. Malloch, chief scientific liaison officer (London) of the National Research Board of Canada ; *United States*, Dr. Harlow Shapley, director of Harvard Observatory (due to arrive shortly), and Dr. George Stoddard, the child psychologist and commissioner of education for the State of New York ; *France*, Prof. Joliot-Curie and Prof. Auger, both professors of physics in the Sorbonne ; Prof. H. Laugier, professor of physiology in the Sorbonne, and Prof. Wallon, professor of psychology in the Collège de France ; *China*, Mr. Li Shu-Hua, physicist in the Research Institute of Peiping, and Mr. Wang Ging-Shi, director of the Chinese Institute of Psychology, (the head of the Chinese delegation, the geologist Mr. Chu Chia-Hua, is not likely to arrive in time) ; *Netherlands*, Prof. H. R. Kruyt, professor of physical chemistry in the University of Utrecht ; *Belgium*, Prof. G. Magnel, professor of civil engineering in the University of Ghent ; *Norway*, Dr. Olaf Devik, physicist, and Dr. Ellen Gladitsch, chemist ; *Poland*, Prof. Mikolaj Olekiewicz, professor of biological and mathematical statistics in the University of Lublin ; *Turkey*, Prof. Omer C. Sarc, professor of economics in the University of Istanbul, and Prof. Ratip Berker, professor of mechanical engineering in the University of Istanbul.

New Television System

ON October 31, Messrs. Pye, Ltd., gave a demonstration at Cambridge of a new television system recently developed by a research team under Mr. D. I. Lawson. The novel feature in this system is the utilization of the 'fly-back' times in the scanning sequence, during which the transmitter would otherwise be idle, to accommodate short pulses the duration of which can be modulated by the sound accompaniment of the television programme. At the receiving end, these width-modulated pulses are filtered out of the total transmission by an amplitude-selection process. Thus a single frequency channel is made capable of conveying both the vision and sound simultaneously ; hence the name 'Videosonic' which has been given to the system.

With the standard type of 405-line scanning in use in Britain before the War, the fly-back time is 10 microseconds, occurring 10,125 times a second. This pulse-repetition frequency limits the audio-frequency range to something less than a high-fidelity standard, but a subsidiary demonstration showed that a 1,000-line system would enable a very satisfactory audio-frequency range to be transmitted. The use of a single channel has obvious advantages in view of the demand for space in the radio spectrum, but from the commercial point of view the chief potential advantage of the 'Videosonic' system is the cheapening of television receivers. The system also offers some interesting possibilities for future development ; in particular the location of twin pulses in the fly-back space could be used for stereophonic sound, and the superposition of a sequence of amplitude changes on the width-modulated pulses might be used as a means of controlling a triple-scanning sequence for television in colour.

Danish Research Expedition

ON November 1, the Danish research vessel *Atlantide* left Plymouth en route for the coast of West Africa. The ship left Copenhagen on October 3 and, after being held up by bad weather, reached Plymouth on October 30. The vessel, a three-masted schooner which once sailed under the well-known name of *Shenandoah*, is owned by the Danish sculptor, Mr. Viggo Jarl, who has lent her to the Danish Government for marine research and is paying all expenses. Dr. Anton Fr. Bruun of the Copenhagen University Museum, who has made many cruises in the *Dana*, is leading the expedition ; he has with him two young Danish zoologists, Jorgen Knudsen of the Royal Danish Veterinary College, and Torben Wolff. The British Museum (Natural History) is represented by Dr. F. C. Fraser, and the vessel will pick up Dr. G. R. Howat, Government chemist, at Accra. The route to be followed covers the whole of the coast of West Africa to the Cape, and includes the Ascension Islands and St. Helena. The expedition is intended primarily to make a zoogeographical survey along that coast. Sections will be made outwards from the coast to deep water at intervals, the main region of interest lying between the Congo and Walfisch Bay, an area from which little collecting has been done. The vessel is equipped for collecting with Petersen and Feen grabs, shrimp trawls and plankton nets of various sizes ; she also carries a small harpoon gun. The voyage is expected to last about eight months, and it is hoped that much valuable material will be collected for the Danish and British Museums. This is the first marine expedition to leave the coasts of Europe since the War ended, and the Danes are to be congratulated on acting so promptly in starting the exploration of the sea once more.

Queen Victoria Memorial, Salisbury, Southern Rhodesia

THE annual report, for the year ended March 31, 1945, of the Queen Victoria Memorial, Salisbury, Southern Rhodesia, indicates that owing to the difficult conditions with which publishers in Great Britain are faced, the limitation of the number o copies of books, and the irregular arrival of mails from overseas, the supply of books for the library continues to decrease. In the meantime, the demand for certain cultural and technical literature is being met so far as is possible, but no improvement in the position is expected for some considerable time to come. Of the Salisbury Museum, the Committee reports that in spite of difficulties relative to exhibition and working space, specialization in certain branches of science continues.

Summer School in X-Ray Crystallography at Cambridge

For the third year in succession, members of the Department of Mineralogy and Petrology and the Cavendish Laboratory at Cambridge were able, through the courtesy of Prof. C. E. Tilley and Sir Lawrence Bragg, to conduct a summer school in X-ray crystallography; the administration was under the control of the Board of Extra-Mural Studies. The first part of the course, which was attended by everyone, dealt with crystal symmetry and the use of stereographic and gnomonic projections. Then followed fundamental theory and practice in the interpretation of the various types of X-ray photographs, the production and properties of X-rays and the measurement of intensities of X-ray reflexions. The methods of taking, interpreting and using powder photographs were dealt with in some detail. The school differed from those previously held in that during the last two days it was divided into two groups (as it happened, into almost equal numbers), one of which studied further theory and practice in the elucidation of fundamental crystal structure, such as the theory of space groups, structure factors, use of absent spectra to determine space groups and parameter determination; the second group studied powder photographs in relation to metallurgical problems such as the determination of grain size, stress and the orientation of crystals in drawn wires and rolled sheets. Throughout the course the labour of computation was greatly reduced by the use of graphical methods and the provision of tables in which many of the factors in formulæ had already been worked out. Of the thirty-one who attended the course, eight were from universities, two from research institutes, one from a technical college, two from research associations, three from Government laboratories and fifteen from industry. The opportunity for interchange of ideas afforded (especially at tea served in the laboratory after the day's work) was one of the most valuable aspects of the course. The success of these schools at Cambridge should encourage other authorities to develop this aspect of university education.

Institute for the Study of Animal Behaviour

At a meeting of the Council of the Institute for the Study of Animal Behaviour on October 16, at the Zoological Society of London, Dr. E. Hindle, scientific director of the Zoological Society, was elected president in succession to Dr. E. S. Russell, who had resigned and who was made an honorary member and re-elected a member of Council. The following were also re-elected members of Council: Mr. R. J. Bartlett, Dr. J. T. Edwards, Mr. J. W. B. Douglas (*Hon. Asst. Editor*), Mr. J. M. McC. Fisher, Dr. J. Hammond, Dr. E. Hindle, Dr. J. Huxley, Dr. G. Lapage, Dr. W. H. Thorpe, Dr. A. Walton, Prof. A. N. Worden (*Hon. Secretary-Treasurer*), Prof. S. Zuckerman (*Hon. Editor*). Dr. A. Landsborough Thomson, Prof. James Gray, Dr. B. W. Tucker and Mr. David Lack were invited to attend to discuss Dr. W. H. Thorpe's proposal that a small field station for work on bird behaviour be initiated under the direction of the Institute. This proposal was welcomed, and Dr. Thorpe was entrusted with the preparation of working details of his scheme. The future of publication in Europe of matter relating to animal behaviour was discussed also in the light of a communication from Dr. N. Tinbergen, of the Zoological Laboratory of the University of Leyden. The Council agreed to support any claims for the financing of work on behaviour among domestic animals, for example, on grazing behaviour in ruminants and on sexual behaviour in bulls. It was agreed to hold the next scientific meeting of the Institute early in 1946.

University of London

Dr. G. A. H. Buttle has been appointed to the University chair of pharmacology tenable at the College of the Pharmaceutical Society of Great Britain as from October 1.

The following titles have been conferred: professor of electrical engineering on Dr. H. E. M. Barlow, who has been reader in electrical engineering at University College since 1938; reader in analytical chemistry in the University on Mr. L. S. Theobald, in respect of the post now held by him at Imperial College of Science and Technology; reader in nutritional science in the University on Dr. Gladys A. Hartwell, in respect of the post now held by her at King's College of Household and Social Science.

Announcements

Dr. A. B. Stewart, deputy director of the Macaulay Institute for Soil Research, Aberdeen, has been granted leave of absence for six or seven months to advise the Government of India upon the organization and conduct of research and field experimentation upon problems of soil fertility and crop production. Dr. Stewart has in recent years devoted much time to problems of soil fertility in relation to both plants and animals.

The Medical Research Council has appointed the following to be members of its Industrial Health Research Board until August 31, 1948: Prof. F. C. Bartlett (*chairman*), Dr. A. N. Drury, Prof. T. Ferguson, Lord Forrester, Prof. A. Bradford Hill, Dr. D. Hunter, Prof. Esther M. Killick, Prof. R. E. Lane, Prof. J. M. Mackintosh, Dr. E. R. A. Merewether, Prof. J. A. Ryle and Mr. J. L. Smyth. (Dr. R. S. F. Schilling, seconded to the Council's headquarters staff from the Factory Department of the Ministry of Labour and National Service, continues to be secretary of the Board.)

The directors of Messrs. H. K. Lewis and Co., Ltd. (Medical Publishers, 136 Gower Street, London, W.C.1), are considering adding foreign medical and scientific books to their lending library. In order to assess the possible demands for such books, a questionnaire is being circulated to men of science and medical men. Copies of this can be obtained from Messrs. Lewis at the above address.

A Conference on "The Training, Qualifications and Function of Dietitians" will be held by the Nutrition Society on November 17, beginning at 11 a.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. Non-members desiring to attend this meeting should apply to a member of the Society for a ticket of admission. Further details of the Nutrition Society can be obtained from the Hon. Secretary, Dr. Leslie J. Harris, Nutritional Laboratory, Milton Road, Cambridge.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

The Raman Effect in Rocksalt

THE theory of the Raman effect in crystals, as found in the literature, is rather unsatisfactory. Apart from some general symmetry considerations, the only attempt known to us of establishing definite formulæ is that by Fermi and Rasetti[1] who gave the correct expressions in a general way for explaining the observations on rocksalt. These observations made by Rasetti[2] show clearly a continuous spectrum with small superimposed peaks. The theory mentioned explains this general aspect satisfactorily; but Fermi and Rasetti find the formulæ too complicated for quantitative discussion.

We have taken up the same problem again because these same observations have been used by Raman and his pupils as an argument against lattice dynamics and in favour of their own theory of lattice vibrations. The latter contends that a crystal lattice has a vibration spectrum of a small number of frequencies, in contradiction to elementary laws of classical or quantum mechanics, according to which the number of vibrations of a system of N particles is $3N$, hence quasi-continuous for a crystal of finite dimensions (N large).

Krishnan[3] interprets Rasetti's published reproduction of the Raman spectrum as a line spectrum of nine Stokes lines (and nine anti-Stokes lines), neglecting the very strong background effect. This is rather strange, since the publication of the Italian authors also contains a photomicrograph of the density distribution, which shows that the continuous background is an essential feature. The original picture is reproduced herewith (Fig. 1).

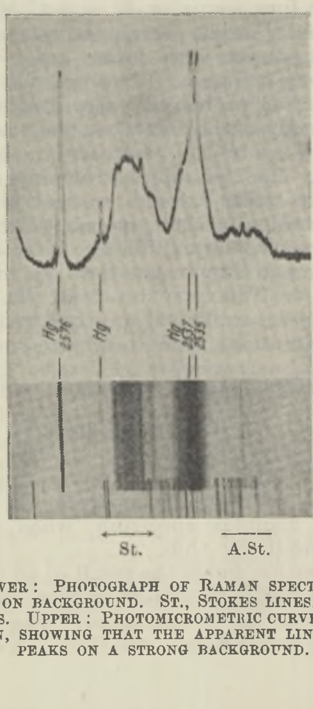

Fig. 1. LOWER: PHOTOGRAPH OF RAMAN SPECTRUM SHOWING FAINT LINES ON BACKGROUND. ST., STOKES LINES. A.ST., ANTI-STOKES LINES. UPPER: PHOTOMICROMETRIC CURVE OF INTENSITY DISTRIBUTION, SHOWING THAT THE APPARENT LINES ARE SMALL PEAKS ON A STRONG BACKGROUND.

Krishnan further states that the number of lines (nine) is in agreement with Raman's theory; but he makes no attempt to compute the frequencies and intensities of these nine 'lines'.

In these circumstances we thought it necessary to work out the complete theory of the Raman effect in crystals and apply it to the case of rocksalt. This substance is particularly suitable, as Kellermann[4] has worked out the vibration spectrum in detail. His numerical results are independent of any arbitrary constants and are based only on the measured values of the lattice constant and compressibility. Using these results, we have derived the Raman spectrum,

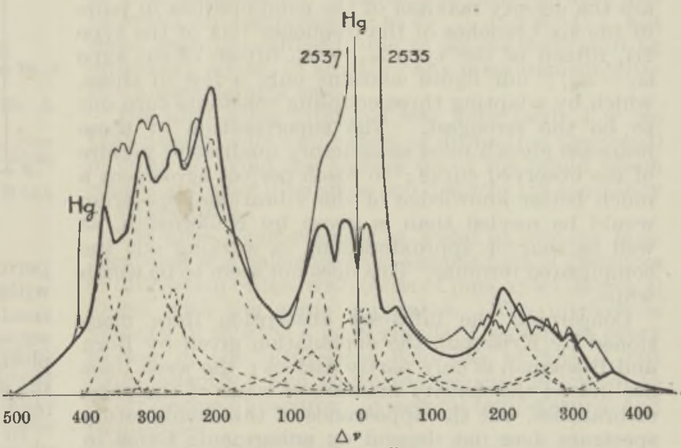

Fig. 2. FINE LINE REPRESENTS FERMI-RASETTI PHOTOMICROGRAPH (FIG. 1). BROKEN LINES ARE APPROXIMATE THEORETICAL CONTRIBUTIONS FROM PAIRS OF FREQUENCY BRANCHES. THICK LINE IS THEORETICAL CURVE FOUND BY SUPERPOSITION OF THESE.

which is in this case a second-order effect with respect to the amplitudes of vibration, and we present the results in Fig. 2.

It shows that the general features of the observations (continuous background with small peaks) come out very well from the theory. The range of the continuum and the positions of the maxima are obtained without any arbitrary assumptions, while the intensities are fitted to the experiment by adjusting some coupling constants. The formulæ for the intensities are so involved that we have picked out only the main terms. It is quite possible that further careful study would improve the agreement.

The Indian physicists have published new and valuable observations of a similar kind (on Raman effect and other optical phenomena in crystals) and have interpreted them as evidence for their theory. We are convinced that ordinary lattice dynamics will be able to explain these facts in a satisfactory way, though the calculations may be involved.

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Aug. 26.

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The Editors, on receiving our communication, sent us the proofs of a new note by Prof. Krishnan on the same subject published in *Nature* of September 1.

It contains a reproduction and description of a new photograph which is certainly a considerable improvement on Rasetti's work. Krishnan interprets it in the same way as before, that is, as a line spectrum, because the little peaks, already visible in Rasetti's photomicrograph, have come out more clearly; but he again neglects the continuous background.

We have nothing to change in our opinion and only wish to add a few remarks. In the new photograph Krishnan finds six stronger and two weaker peaks; he seems to have given up the claim that the observations confirm the prediction from Raman's theory of exactly nine lines. In our theory the 'lines' are the density maxima of the combinations in pairs of the six branches of the frequency (six of the type 2ω, fifteen of the type $\omega_1 + \omega_2$, fifteen of the type $\omega_1 - \omega_2$); our figure contains only a few of these, which by adapting three coupling constants turn out to be the strongest. The superposition of these branches gives a most satisfactory qualitative picture of the observed curve; to reach perfect agreement a much better knowledge of the vibrational spectrum would be needed than is given by Kellermann, as well as sharper approximations in working out the complicated formulæ. This does not seem to be worth while.

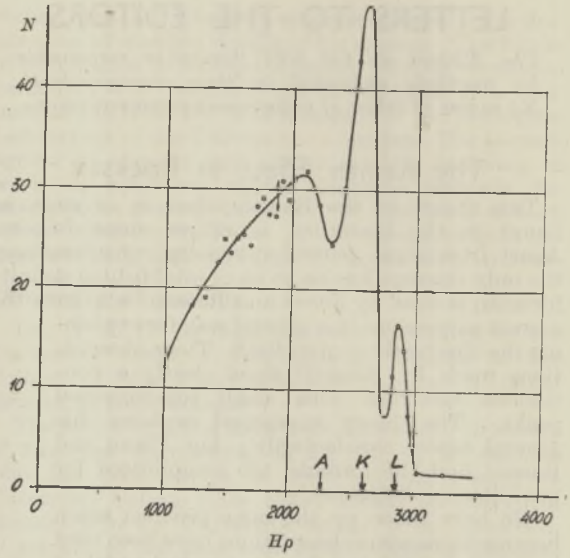
Concerning the infra-red absorption lines mentioned by Krishnan, the explanation given by Born and Blackman is only partly correct; the weak lines are indeed the density maxima of some of the pairs of branches, but the appearance of this combination spectrum does not depend on anharmonic terms in the equation of motion, but follows directly from the deformability of the ions, in the same way as the second-order Raman effect.

M. B., M. B.

Radioactivity of Active Nitrogen

INVESTIGATIONS of the radiations from the artificially active elements have been made with the help of the lens β-spectrograph, previously described[1]. It is of special interest to examine the β-spectra from the light elements, which, on account of their positions in the Sargent diagram, are due to permitted transitions. Among those elements there are only two, which, considering the short half-lives we have to deal with here, can be investigated with such an accuracy as to permit any conclusion, namely, carbon C^{11} and nitrogen N^{13}. Of these elements C^{11} has already been the subject of an investigation with the lens-spectrograph[2]. Nitrogen[3] is of special interest because of the fact that several authors[4] have found that the positron radiation is accompanied by a γ-radiation, caused by a complexity in the β_+-spectrum. On the other hand, some investigators[5] have not been able to detect this γ-radiation.

In order to study N^{13}, graphite was bombarded with deuterons (5 MeV.) in the Stockholm cyclotron. The half-value period for the active nitrogen was determined as $10 \cdot 13 \pm 0 \cdot 10$ m. by means of a Geiger-Müller counter plus a scale of eight, and also by an ionization chamber plus electrometer, the results obtained by the two methods showing good agreement. With the help of a special lock-device, the rather short-lived sample could quickly be brought into the β-spectrograph. To get a correct form of the energy distribution curve, it is important to avoid secondary radiation so far as possible. The window in front of the Geiger-Müller counter was less than $0 \cdot 5\,\mu$, which



permitted an almost true reproduction of the spectra, without any corrections for absorption even at very small energies. The result from eleven different series of measurements of the positron spectrum was plotted in a diagram. A separate investigation of the upper limit was also made. This limit was determined as $1 \cdot 24 \pm 0 \cdot 02$ Mev.

In the Fermi formula for the energy distribution of the β-spectrum, there is a function $F\,(ZW)$, which accounts for the influence of the Coulomb field of the nucleus upon the disintegration. It may be shown that this function for light nuclei is approximated with good accuracy by $(1 - 1 \cdot 65\Delta^2)\, e^{\pi\Delta}$, where $\Delta = \alpha\, Z\, \frac{W}{p}$, α is 1/137, W is energy, p is momentum, Z is atomic number (with negative sign for positron emission). The Fermi diagram cuts the abscissa at $W_{\text{max.}} = 1 \cdot 24$ Mev., in good agreement with the direct determination. The departure from the straight line occurs at $W = 0 \cdot 47$ Mev., a point which evidently might correspond to the upper limit of the component with lower energy if the β_+-spectrum were complex. If we make a computation of the transition probability according to the actual β-theory based on the fact that the lowest state of N^{13} and of C^{11} is a $^2P_{1/2,\,3/2}$-state we find, however, that the intensity for the supposed component of lower energy, if it exists, would amount to an almost negligible fraction of the component with the higher energy, due to the large difference between the upper limits for the two components that our measurements would require. The departure from the straight line might in fact be explained mostly by the inevitable secondary radiation, which originates in the sample itself. If we plot $\left(\frac{N}{pW}\right)^{1/2}$ against $\sqrt{1 + p^2}$, we get, however, an absolutely straight line, which furthermore cuts the abscissa at the same point $W_{\text{max.}} = 1 \cdot 24$ Mev. Such a diagram might possibly be of use in attempts to separate the components in a really complex spectrum, when the samples are not exceedingly thin.

The illustration shows the result of an investigation of the photo- and Compton-effect with lead as secondary radiator in the spectrometer. The curve shows from the left to the right: the Compton effect for the annihilation radiation, the *K*- and *L*- photo-lines from the same radiation. The energy for the annihilation radiation obtained from the curve is $0 \cdot 515 \pm 0 \cdot 010$ Mev., in good agreement with the value, which can be computed from mc^2, namely, 0·511 Mev. No γ-ray of the previously[4] reported energy of 280 kev. has been found by us, and according to our investigation the only γ-ray which accompanies the disintegration is due to the annihilation radiation.

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Temperature Effect on Ultra-sonic Velocity in Water

VERY few systematic data exist so far relating to the effect of temperature on ultrasonic velocity in liquids, especially water. Loomis and Hubbard's results[1] for the change of ultra-sonic velocity in water and other liquids with rising temperature may be cited as perhaps the only systematic investigations, because earlier experiments[2] were carried out under rather unstandard conditions and in a very low region of sonic frequencies and therefore are not reliable. Even Hubbard's data for water are reported for a very limited range of temperature, 0°–40° C., using a sonic interferometer at a frequency of 500 kc. only. The present work extends the knowledge of ultra-sonic velocity in water up to a temperature of 70° C., using the method of diffraction of light by ultra-sonics at a frequency of 5·7 mc./sec.

In this investigation the ultra-sonics were produced by a quartz crystal (diam. 22 mm., fundamental frequency 1·91 mc./sec.) which was cut and ground in this laboratory by me. The crystal was excited to its third harmonic at a frequency of 5·7 mc./sec. by applying the output from a one-valve oscillator (Hartley circuit), adjusted to the same frequency, to the two opposite faces of the crystal. For the production of ultra-sonics in water under investigation, the crystal was not directly immersed in water because of short-circuiting. The crystal was mounted in a small metallic cell containing xylol and having a small leak-tight mica window in one face to let ultra-sonics pass through it. The cell containing the quartz crystal and xylol, and thus serving as a sort of source of ultra-sonic waves, was placed along one of the walls of a rectangular plate-glass vessel containing distilled and degassed water.

The plate-glass vessel with its contents was surrounded by a water-bath the temperature of which could be controlled and kept constant within 0·1° C. by a simple thermostat and relay; the water-bath was constantly agitated by stirrers, and the whole bath was enclosed in a double-walled wooden box loosely packed with sawdust. The temperature was read directly by a sensitive thermometer dipped in the plate-glass vessel.

The bath with its outer wooden enclosure had glass windows on two opposite faces which allowed parallel monochromatic light (green line $\lambda = 5461$ A. from a mercury arc) to pass at an incidence perpendicular to the direction of ultra-sonics generated in the vessel. A long focal length lens ($f = 110$ cm.) placed on the other side focused the emergent beam on a photographic plate which recorded the diffraction pattern for various temperatures of the water. Corresponding to each temperature from about 31° C. to 70° C. at intervals of 5° C., six independent photographic exposures were taken, and a mean of these six readings was used for calculation of the velocity at that temperature. Diffraction patterns were also recorded for temperatures at 75° C. and 80° C.; but these were too diffused, due to the constant shifting of density layers, to admit of any measurement without a considerable error.

The ultra-sonic intensity was kept fairly low (so that usually only two orders of diffraction appeared) in order to avoid the heating up of the liquid which results at higher intensities and disturbs the constancy of temperature.

The ultra-sonic velocity in water at various temperatures was calculated by comparing the distances of diffraction orders with those of pure xylol (Merck's) found with the same apparatus. The ultra-sonic velocity in xylol is a good standard, as almost every worker in the ultra-sonic field has worked it out independently; and hence the velocity is known to a fair degree of accuracy at several temperatures and frequencies.

The velocity in water at the various temperatures was found to be as follows:

ULTRA-SONIC VELOCITY IN WATER (FREQ. 5·7 MC./SEC.)

No.	Temperature ° C.	Ultra-sonic vel. (author) m./sec.	Ultra-sonic vel. (Hubbard) m./sec.
1	31·5	1510	1509·0 (at 30° C.)
2	35·1	1521	1520·6 (at 35° C.)
3	40·1	1531	1530·3 (at 40° C.)
4	45·4	1538	—
5	50·5	1545	—
6	55·4	1552	—
7	60·3	1553	—
8	65·3	1555	—
9	70·3	1557	—

My thanks are due to Prof. P. K. Kichlu for his interest in the work.

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[1] Loomis and Hubbard, *Phil. Mag.*, (7), **5**, 1177 (1928).
[2] Buss, *Ann. Phys.*, **75**, 657 (1924). Dörsing, *Ann. Phys.*, **25**, 227 (1908).

Near Ultra-Violet Emission Bands of Benzene

THE ultra-violet emission spectrum in the region 3000–2475 A., obtained by Asundi and Padhye by high-frequency electrical discharge through benzene vapour[1], is probably more closely similar than the authors have realized to the fluorescence spectrum excited by Hg 2537 A. in benzene vapour at pressures which are not too low[2].

The authors point to a supposed difference of relative intensity in the various progressions labelled

A-*F*, giving the order *B*, *F*, *D*, *A*, *C* for the electrical, and *C*, *A*, *B*, *E*, *D* for the optical, method of excitation. Some confusion has, however, arisen, and it may be due to the fact that, when Sponer, Nordheim, Sklar and Teller[3] suggested their new basis for assignments in the ultra-violet spectra of benzene, they very properly changed Ingold and Wilson's labels. In any event, there appears to be no difference in the order of the intensities, which in both spectra agrees with the Boltzmann factors associated with the progressions.

The other supposed difference relates to the apparently shorter sequences in 160 cm.$^{-1}$ which appear in the electrically excited spectrum. However, the recognition of the nature and classification of the upper electronic state permits an assignment of fluorescence bands which avoids the assumed long sequences in 160 cm.$^{-1}$; and it now appears that with either type of excitation the upper electronic state is able to settle to something like a true Boltzmann distribution with respect to vibration and rotation. These and related matters will be discussed *in extenso* elsewhere.

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Sept. 30.

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[3] *J. Chem. Physics*, **7**, 207 (1939).

Spectra of Diatomic Oxides by the Method of Exploded Wire

During recent years we have developed the method of the exploded wire with the view of its application to the study of molecular spectra, but the circumstances of the German occupation have prevented us from publishing the results. A full account of our investigations by this method (as well as by the method of the aureole of an arc) of FeO, NiO, CoO, CuO and CaO spectra will be given later in the *Bull. Soc. Roy. Sci. Liége*.

FeO. We studied the spectrum of FeO in the yellow during 1940 in collaboration with A. Delsemme, and extended our investigation to the blue and the photographic infra-red during 1942 with L. Malet. Four systems can be represented by:

$$\nu = \left\{\begin{matrix}17908\\17808\end{matrix}\right\} - 875\,v'' + 5\,v''^2 + \left\{\begin{matrix}667\\660\end{matrix}\right\} v' \quad \text{(System } A\text{)}$$
$$\nu = 17267 - 875\,v'' + 5\,v''^2 + 825\,v' \quad \text{(System } B\text{)}$$
$$\nu = 22326 - 875\,v'' + 5\,v''^2 + 540\,v' \quad \text{(System } C\text{)}$$
$$\nu = 12900 - 955\,v'' + 670\,v' \quad \text{(System } D\text{)}$$

Two short isolated band series ending on the same lower level as the *A*, *B* and *C* bands indicate the existence of FeO electronic terms at 12,150 and 14,650 cm.$^{-1}$ above this level, which is probably the ground-level of FeO. The classification of the yellow doublets is the same as that proposed by Gaydon and Pearse[1].

NiO. We studied the spectra of NiO and CoO with L. Malet in 1942. For NiO nearly all the bands observed between 9,070 and 4,145 A. can be fitted into six systems. The constants are given in Table 1.

Table 1.

	ν_0	ω''	ω'
System I	12655	615	475
System II	13638	590	460
System III	16420	615	560
System IV	19314	825	590
System V	19602	820	590
System VI	21135	825	570

The state with $\omega'' = 615$ cm.$^{-1}$ is probably the ground-state of the molecule. The systems II, IV and V are established with less certainty than the others.

CoO. Bands are observed between 5,000 and 10,000 A. The only characteristic frequency $\omega'' = 840$ cm.$^{-1}$ can be attributed with great probability to the ground-state of the molecule.

CuO. The spectrum of CuO was investigated during 1942 in collaboration with J. M. Lejeune. The vibrational analysis of the red CuO bands showed that they can be represented by:

$$\nu = 16222 - 625\,v'' + 3\,v''^2 + 274\,v' \quad \text{(System I)}$$

The green and blue bands observed previously by Hertenstein[2] can be represented by:

$$\nu = 21570 - 625\,v'' + 3\,v''^2 \quad \text{(System II)}$$
$$\nu = 21324 - 625\,v'' + 3\,v''^2 + 510\,v' \quad \text{(System III)}$$

The lower state with $\omega'' = 625$ cm.$^{-1}$ is very probably the ground-state of the molecule.

CaO. This spectrum has been studied during 1942 and 1944 in collaboration with J. M. Lejeune. The main results are summarized in Table 2, which includes also the revised results of previous investigations on this spectrum.

Table 2.

	System α (Meggers I)	System β (Meggers II)	System γ (Orange bands)	System δ (Green bands)	System ε	System σ	System η
ν_0	9491	13679	15947	18260	25191	28054	29330
ω''	637	711	640	780	711	711	
ω'	674	694	711	670	575	550	825
$x''\omega''$	~7	~3·5	~5		~4	~4	
$x'\omega'$	~5	~5	~5				

The state with $\omega'' = 640$ cm.$^{-1}$ is probably the ground-state of the CaO molecule.

All the proposed ω''-values for the ground-states of the molecules studied are in accordance with the empirical laws governing the ω''-values of diatomic oxides.

The results of our investigation on the AlO spectrum by the method of exploded wires, which enabled us to establish several new systems of AlO and to study in some detail the predissociation phenomenon in emission spectra, have already been published[3,4].

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Chromatography of Two Solutes

We regret that we cannot agree with the conclusions arrived at by Dr. Glückauf[1] and that even in the case of the Langmuir isotherm they seem scarcely plausible in the general case.

Our equations can be applied to any suitable adsorption isotherm. In the case of a single solute, the concentration in the developed band is given by our equation:

$$f'(c) = \frac{v}{x} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The corresponding equation for two solutes is:

$$\begin{vmatrix} f'_{c_1} - \dfrac{v}{x} & f'_{c_2} \\ g'_{c_1} & g'_{c_2} - \dfrac{v}{x} \end{vmatrix} = 0 \quad . \quad . \quad (2)$$

from which the equation (3) of our note may be deduced. (The plus sign in front of the square root of equation (3) of our communication should be replaced by a minus sign.)

There is a second equation connecting c_1, c_2 in the developed band. This is equation (2) of our previous paper and it can be employed to find the level at which the equation (2) given above begins to hold, that is, the point where c_2 is zero. Now according to Glückauf, at this point dc_2/dc_1 is discontinuous. It follows from our theory that it is, in general, continuous and has the value zero. This we feel is physically more reasonable than the hypothesis of Dr. Glückauf. From this it follows that $(g'_{c_2})_{c_2=0} = (f'_{c_1})_{c_2=0}$ and the complete theory as given in our previous communication.

Under some special conditions and if some of the original undeveloped band is still present, it may be possible that $\left(\frac{dc_2}{dc_1}\right)_{c_2=0} > 0$. This would seem to be the case discussed by Dr. Glückauf. However, there are other points in which our theory differs from his even for this case, and we find ourselves unable to agree with his main conclusions.

A full discussion will be given in our forthcoming publication.

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[1] See *Nature*, 155, 725 and 156, 205 (1945).

By changing the sign in front of the square root of their equation (3), Prof. Offord and Dr. Weiss have made this equation in substance identical with my proposed equation (1.1), though the complexity of the differential functions tends to hide this fact from the eye of the reader. As regards the "scarcely plausible" discontinuity at the rear of the mixed band, which is quite plausible to de Vault (1943), I have convincing experimental evidence which will be published in due course.

The implied suggestion that the tail end of the mixed band can be influenced by the state of the front boundary (whether developed, undeveloped or eluted) must be strongly repudiated both on theoretical and experimental grounds. The conditions of the diffuse back boundary depend on the initial concentrations independently of whether these are still present in the chromatogram or not.

A correct general solution must contain the correct solution of any special isotherm. Offord and Weiss's equations (6 and 7) when applied to the Langmuir isotherm (using the notation of my earlier letter) lead to

$$V = b_1 m_1/\delta^2 \quad \text{(Offord and Weiss 7, Langm.).}$$

My corresponding equation, obtained by direct integration of the common equation (Offord and Weiss 2 or Glückauf 1) is

$$V = b_1 m_1(1 + \lambda)/\delta^2. \qquad \text{(Glückauf 9).}$$

Thus, one of the two theories is wrong.

The apparently slight difference is of the greatest practical importance. Contrary to equation (Glückauf 9), equation (Offord and Weiss 7, Langm.) would mean that the volume of developing solvent required for complete separation is independent of the concentration of the solutes in the developing solvent. No practical chromatographer will agree to that, especially for substances difficult to separate. Equation (Offord and Weiss 7, Langm.) would also require that V is independent of the quantity m_2. I have experimental proof that this is not so. Moreover, in the case of comparatively low adsorption intensities, ($b_1 c^0_1 \lll \delta$), the Langmuir isotherm must revert to the ideal case where Wilson's equation, $V = v^0/\delta$, is valid. As shown in my first letter, my equation (9) fulfils this demand, while equation (Offord and Weiss 7, Langm.) does not.

Finally, the laborious though not difficult graphical integration of $df/dc_1 = dg/dc_2$ has been carried out for several types of isotherms, using numerical constants. The results for the Langmuir isotherm are identical with those of my theory. All integrations show that Offord and Weiss's conclusions (reiterated in their second communication) are in complete disagreement with this fundamental equation from which their results are supposed to be derived.

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Determination of β-Carotene in Dried Grass

At the time when the tentative official method for the estimation of carotene in dried grass[1] was drawn up, it was recognized that it gave results which included one or more pigments other than β-carotene[2,3]. However, at that time there seemed little chance of working out a satisfactory process for β-carotene on account of difficulties in obtaining a suitable adsorbent; and in accordance with the usual custom it was decided to return the whole of the petrol-soluble phase as 'carotene'. Although it has been shown that β-carotene predominates, yet this may account for only 70 per cent or even less of the 'crude carotene'.

Mann[4] has proposed the use of the name neo-β-carotene for the major pigment of the remainder, in deference to Beadle and Zscheile[5], who propose this name instead of pseudo-α-carotene referred to by Carter and Gillam[6].

Mann had pointed out that this second major pigment of grass is not the pseudo-α-carotene of Carter and Gillam, and shortly after, Zechmeister[7] published data on the isomerization of the carotenoids in which he sets forth a method of nomenclature in which pseudo-α-carotene will fall into the category of neo-β-carotenes. Zechmeister shows these neo-β-carotenes to be true isomers of β-carotene entering into *cis-trans* isomerization by heat, by iodine catalysis, by acid catalysis and by the action of light.

Other workers[8,9] have found that such neo-β-carotenes have biological activity; these findings we believe reasonable to adopt in view of the fact that the neo-β-carotenes which they investigated were part of the β-carotene isomerization complex.

To avoid confusion in the literature and to conform to Zechmeister's new nomenclature, which regards neo-β-carotene as the name of a group of isomers, we propose that the previously mentioned other petrol-soluble 'carotene' pigments of dried grass should be termed 'spurious carotenes', and that the use of the name neo-β-carotene for the major component of those pigments should be discontinued. In support of this suggestion, it is to be noted that other workers[2,4,9,10] have encountered such petrol-soluble pigments which have shown negligible or no biological activity.

As both Mann and Zechmeister show that solutions of β-carotene tend to isomerize with heat or standing, and upon isomerization have a lowered molecular extinction coefficient with altered absorption maxima, we would direct the attention of workers to the necessity for the use of as little heat as possible in preparing β-carotene extracts of dried grass, and the further necessity for as rapid estimation as possible of the β-carotene in the solution.

Both of us have suggested the use of chromatographic methods for the separation of β-carotene from all other pigments occurring in dried grass[3,4], and we propose to communicate with other workers interested in this subject in order to promote examination of methods which may produce more concordant results than are obtained at present.

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Preparation of Silicic Acid Jellies for Bacteriological Purposes

For the preparation of jellies intended for the cultivation of micro-organisms, agar-agar is generally used. For some purposes, however, it is desirable to have an opportunity of obtaining cultures of bacteria or fungi on inorganic gels to which only known substances are added. Agar-agar is an organic substance varying in composition and containing other organic substances, which may influence the cultivation of bacteria. Attempts have been made to prepare gels, for example, of silicic acid; sodium silicate and hydrochloric acid were used for the purpose[1,2,3,4]. But this method entails certain difficulties. Instead we have tried to make silica gels for bacteriological purposes from *ortho*-silicic acid tetramethyl ester, $Si(OCH_3)_4$. When water is added to this silico-compound, silicic acid and methanol are formed, and the solution is transformed into a firm coherent gel as clear as glass. This gel formation was observed by Grimaux[5].

The simplest method for the preparation of these gels is to autoclave a mixture of the silico-ester and a suitable nutrient solution in the usual way in a test-tube, in which the gel is formed, the tube being sterilized simultaneously. After the sterilization, the tube must not be cooled too fast as the gel is then apt to crack. The best way of avoiding bubbles and cracks during sterilization of the gel is to employ boiled water or boiled nutrient solution.

During the hydrolysis, however, methanol is formed, which does not completely disappear on autoclaving and prevents more delicate bacteria from growing. In order to enable such bacteria to grow, it is necessary to remove the methanol entirely and to this end a more complicated method must be employed. We therefore propose the following method. 1 ml. $Si(OCH_3)_4$ is mixed with 10–20 ml. water, when there appears a slight turbidity. The solution is centrifuged until it becomes clear and then poured into tubes or other suitable vessels. The solution becomes a clear gel when the vessels have been left standing at room temperature for some days or are kept warm in an autoclave in the usual way. Water is poured over the gel, and the methanol diffuses into the water and is thus removed. The water is replaced by a suitable nutrient solution to which buffer substances may be added to give the gel a suitable *p*H. The tubes must be kept at a temperature high enough to prevent the growth of bacteria. When the gel has absorbed the nutrient substances for some time, the liquid above the surface of the gel is poured out, the tubes are autoclaved in the usual way, and are then ready for use.

The silica gels are more apt to dry up than agar-agar, so they ought to be kept in moist air, for example, in a closed jar with some water in the bottom.

The gels have been tested by cultivation of *Bac. vulgatus*, *Leuconostoc mesenteroides* and *Schizosaccharomyces* Pombe, and in all cases the results were positive. Investigations concerning the applicability for bacteriological purposes of silicic acid gels from the methyl ester will be continued by Dr. H. Laurell.

We wish to thank Profs. The Svedberg and Arne Tiselius for the provision of laboratory facilities, as well as Dr. H. Laurell for advice. The silico-ester was kindly placed at our disposal by the Uddeholm Company (Skoghallsverken), Sweden.

Björn Ingelman.
Ingvar Jullander.

Institute of Physical Chemistry,
University of Uppsala.
July 4.

[1] Müller, D., and Holm, F., *Zentralbl. Bakt.*, ii, **105**, 131 (1942).
[2] Bojanovsky, R., *Zentralbl. Bakt.*, ii, **64**, 222 (1925).
[3] Hjorth-Hansen, S., *C.R. Carlsberg*, Sér. physiol., **22**, 417 (1940).
[4] Hanks, J., and Weintraub, R., *J. Bact.*, **32**, 639 (1936).
[5] Grimaux, E., *C.R. Acad. Sci.*, **98**, 1434 (1884).

Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the Ferret

A form of parodontal disease has been previously described, in which the initial lesion of the gum was caused by the impingement and eventual penetration of salivary calculus[1,2]. Both tartar deposition and gingival disease were prevented by including in the diet short lengths of bone with small amounts of muscle, tendon and periosteum left *in situ*. The latter attachments fed separately had no prophylactic influence, and their importance lay in their providing the main inducement to gnawing of the bone by the animals. The tartar-preventing action of bone-gnawing was largely due to the mechanical friction of the hard bone against the tooth surfaces, and its curative effect on established parodontal lesions was also demonstrated.

While the precise cause of these calcareous accretions is still undetermined, a series of recent observations has led me to believe that the enamel cuticle

(Nasmyth's membrane) plays an important part in tartar formation. First, in the relatively young ferret this cuticle covers the whole part of the tooth exposed to the mouth. As the animal grows older, an increasing amount of the cuticle becomes worn off during mastication, the parts of the teeth first and most affected being those which occlude on biting. The more sheltered areas, such as the upper buccal or lower lingual grooves between the carnassial tooth cusps, remain comparatively free from masticatory friction in the absence of access to dietary bone. Even when pieces of bone (plus attachments) do form part of the ferret's diet, the cuticle in these intercuspal grooves may retain much of its original thickness for some considerable time. It follows, then, that at any given time subsequent to complete eruption and full function of the teeth, the amount of enamel cuticle on any given area of a tooth depends not only upon the degree of friction exerted by occlusal and masticating stresses, but also upon the anatomical form of the tooth crown. In the ferret the number of sheltered intercuspal grooves is greatest in the molar and upper fourth premolar and least in the incisor teeth, so that, given the same masticatory friction, the latter lose their enamel cuticle at a proportionately faster rate; the difference is, however, to some extent reduced by the fact that the carnassial teeth bear the brunt of mastication, especially when bone is gnawed.

Secondly, as described previously, dental calculus first appears in the upper jaw of the ferret in the groove between the buccal cusps of the fourth premolar adjacent to the opening of the parotid duct, and in the occlusal depressions of the somewhat rudimentary first molar near the opening of the infraorbital salivary duct. In the lower jaw, calculus is first laid down in the lingual groove between the first molar cusps adjacent to the orifice of the retrolingual gland; in the ferret the latter takes the place of submaxillary and sublingual glands. In other words, the mouths of the salivary ducts are close to those particular areas of the denture in which the enamel cuticle is relatively persistent and which in turn show the first and heaviest accretions of tartar.

Thirdly, microscopic preparations of teeth and parodontal tissues clearly demonstrate the very firm adherence of the organic constituents of tartar to the enamel cuticle, even after such drastic treatment as decalcification in 2 per cent nitric or hydrochloric acid, dehydration in alcohol and ether, celloidin and/or paraffin impregnation, and sectioning on the microtome. The implication is that some association exists between the organic constituents of tartar and enamel cuticle. Moreover, there is evidence to indicate that, in ferrets given bone to gnaw, not only are they free from tartar and parodontal disease, but also *in time* the enamel cuticle is itself largely removed by friction and, on subsequent withdrawal of the dietary bone, the teeth still remain free from all but a trace of tartar in the most sheltered grooves distant from the gum margin.

Finally, under certain conditions, calcium-containing material is laid down *in vitro* on pieces of enamel cuticle, removed by acid from ferret or human teeth, on incubation in human saliva.

It seemed possible that the foregoing findings might be something more than coincidental and, indeed, that presence of the enamel cuticle might be a prerequisite for the deposition of dental calculus. With the purpose of determining whether or not the cuticle is indispensable to the initial formation of tartar in ferrets, a series of experiments is now in progress in which the teeth of animals fed on bone-free diets are being submitted to various procedures designed to remove or destroy the enamel cuticle.

The results will be reported in due course, but already some evidence has been obtained in support of this new approach to an old problem.

J. D. King.
(Medical Research Council.)
Nutrition Building,
National Institute for Medical Research,
Mill Hill, N.W.7. July 25.

[1] King, J. D., *Brit. Dent. J.*, 77, 221, 245 (1944).
[2] King, J. D., and Glover, R. E., *J. Path. and Bact.*, 57, 353 (1945).

Conditioned Excitors and Human Sense Organs

About ten years ago, Alexey Bogoslavsky and Krikor Kekcheyev in Moscow and Alexander Dolin in Leningrad, working independently, demonstrated experimentally that the sensitivity of the human sense organs may be considerably modified under the influence of an indifferent factor, for example, the weak beat of a metronome, if it is accompanied several times by the influence of an active excitor. It was found that the latter, acting on an appropriate sense organ (for example, a sweet substance on the taste organ, or an odorous substance on the sense of smell), simultaneously changed the sensitivity of the entire sensory sphere of the brain. As in other conditioned reflexes, already studied, in which the excited organs were the salivary glands or definite groups of muscles, so in the case of our sensory conditioned reflexes, one rule must be observed: the formerly indifferent, or, as Pavlov called it, the conditioned excitor must be 'reinforced' several days in succession by the action of an excitor which by itself always produces the desired effect (unconditioned excitor).

The Institute of Psychology in Moscow has in recent months conducted a series of experiments in which the conditioned excitor was not a physical agent, but a phrase or sentence, the meaning of which bore no relation to the experiment itself. A passage is read aloud to the subject and when a given phrase is reached his face is rubbed with a cold wet towel. This was done several days in succession, after which measurements of the sensitivity of the eye, or more exactly, of its powers of night vision, revealed a marked enhancement of sensitivity after the phrase constituting the 'conditioned excitor'—and only after that particular phrase—had been read (Dubinskaya). This demonstrated that conditioned sensory reflexes may be formed not only by physical or chemical excitors (Pavlov's first signal system), but also by words and sequences of words (Pavlov's secondary signal system).

In another series of experiments, which is inherently connected with the one just described, the sensitivity of sight and hearing was modified not by the influence of physical excitors themselves (light, sound, cold, mechanical action, etc.), but only by the idea of the corresponding sensations. The changes in one direction or the other were well marked and lasted for about half an hour. The idea of the bright light of automobile headlights invariably enhanced sensitivity of hearing (this effect was also produced by the direct action of light on the eye), and the idea of the noise of a motor, just as the noise itself, always resulted in a marked diminution of sensitivity of night vision. Similar effects are produced by the ideas of sweet and bitter. The idea of the sensation always produced a change, and invariably in the direction which would have resulted from the action of the excitor itself. Emotionally pleasant ideas invariably enhanced the sensitivity of all the sense organs. The idea of weak excitors produced the same effect as the weak excitors themselves. The opposite effect was produced by the idea of strong excitors, for example, of very sour substances or of uncomfortably hot water.

It has been demonstrated in my laboratory that sensitivity to red light increases after action on the eye of its complement green light, and vice versa, although in a lesser degree. This is likewise true of yellow light and its complement, blue light (Schwarz). We now find that the idea of red or yellow light increases the sensitivity of the eye to its complement (green or yellow light), but that the idea of the latter does not have the same effect.

The researches here briefly described transcend the bounds of physiological optics and are of great value for our understanding and quantitative evaluation of certain aspects of the influence of the mind on the physical state in man, and, in particular, on the functional state of the sense organs.

KRIKOR KEKCHEYEV.

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Moscow.

Demonstration of Mitosis in Animal Cells

IN a recent communication, Lloyd[1] raises the subject of the teaching of mitosis to zoology students. The materials which he recommends are the developing eggs of various species of nematode worms, and his method is a smear technique.

Slides of maturing and cleaving nematode eggs are also used extensively in the United States and in Canada for teaching mitosis to zoology students; and indeed nowadays it is probably correct to say that the practice is general, except in so far as it has been superseded by the use of slides of cleaving teleost eggs. The nematode used is *Ascaris equorum* Goeze (*A. megalocephala* Cloquet), the horse-worm, which is always readily available and has the advantage of possessing only a small number of chromosomes. The slides are prepared not by a smear technique, which might prove to be considerably easier, but by sectioning the uterus after the fixation of that organ, or of the whole worm, by one of the drastic methods normal for nematodes. Before embedding, the uterus is sometimes bent backwards and forwards upon itself so that each final slide contains numerous sections from several different levels and shows many different stages of mitosis. For a zoologist, these sections of *Ascaris* are in every way superior to those of root tips, and they are as suitable for first-year classes as for advanced students.

However, as an alternative which is considered by some to be even better, whitefish eggs in early stages of cleavage are now being used increasingly (whitefish is a salmonid species, *Coregonus clupeiformis* Mitchill, common in the Great Lakes). Although these eggs are not so readily available, they are easy to prepare in that fixation is simple and sectioning is unnecessary; slides are being marketed in increasing numbers by the large American biological supply houses which had previously concentrated almost exclusively on the eggs of *Ascaris*.

W. S. BULLOUGH.

Department of Zoology,
McGill University, Montreal.
July 4.

[1] Lloyd, Ll., *Nature*, **155**, 636 (1945).

Late Flowering of Horse-Chestnut

WHILE passing through Paris recently en route to and from Switzerland, I noticed that a number of horse-chestnuts in the streets were still in flower—quite a number on September 11, and a few still on October 4.

On these dates, perhaps a third of the trees showed foliage normal for the time of year. On the remainder, all or most of the leaves were already withered and brown. I understand that this was due to a severe frost, followed by very dry weather in the spring. Of these prematurely withered trees, a considerable proportion showed a few branches or shoots with normal leaves—indeed, greener than those on the trees which had not been damaged by the frost; and a fair number of these green shoots carried flowers. The same phenomenon, but to a lesser extent, was noted among horse-chestnut trees in western Switzerland in late September.

It would seem that the premature damage to the foliage had stimulated the production of new shoots from buds that would normally have developed next spring, some of which managed to flower as well as to produce new leaves. The phenomenon would thus appear to be very similar to the new growth of leaves and sometimes of flowers observed in various trees in London after being wholly or largely defoliated by bomb-blast[1]. However, the lateness of blossom must, I think, be exceptional.

JULIAN HUXLEY.

16 Queen Anne's Gate,
London, S.W.1.
Oct. 9.

[1] *Daily Sketch*, Aug. 16, 1944.

Lantern Slides of Line Drawings

THE following simple method of making lantern slides of line drawings may be of interest. Where the diagrams are not already available in printed form, they are drawn in white chalk on a blackboard and photographed directly. The photographic negative so obtained is mounted and bound as a lantern slide, the resulting projection on a screen being a black line drawing on a white background.

As compared with the more usual method of drawing the diagram in Indian ink, photographing it, and finally printing the slide from the negative, the saving in time and materials is considerable.

In order to produce the best results by our method, the blackboard should be well cleaned, a chisel-end cut on the chalk, and the negative should be slightly under-exposed to minimize traces of background. We have found the method suitable for reproducing diagrams of apparatus and mathematical formulæ. It should be equally suitable for biological drawings.

G. D. YARNOLD.
L. HEATH.

University College,
Nottingham.

U.S. NATIONAL ACADEMY OF SCIENCES

ELECTIONS AND MEDAL AWARDS

Elections to Membership:

Alfred Blalock, professor of surgery, Johns Hopkins Medical School, Baltimore, Maryland.

Vice-Admiral Edward Lull Cochrane, Bureau of Ships, Navy Department, Washington, D.C.

Henry Eyring, professor of physical chemistry, Princeton University, Princeton, New Jersey.

Enrico Fermi, professor of physics, Columbia University, New York.

James L. Gamble, professor of physiology, Harvard Medical School, Boston, Massachusetts.

Henry Gilman, professor of chemistry, Iowa State College, Ames, Iowa.

Beno Gutenberg, professor of geophysics and meteorology, California Institute of Technology, Pasadena, California.

Harold Hibbert, New Haven, Connecticut (deceased).

Mervin J. Kelly, research physicist, Bell Telephone Laboratories, New York.

Victor K. LaMer, professor of chemistry, Columbia University, New York.

George W. Lewis, National Advisory Committee for Aeronautics, Washington, D.C.

Ralph Linton, professor of anthropology, Columbia University, New York.

Clarence Cook Little, geneticist, director of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

Paul C. Mangelsdorf, professor of botany, Harvard University, Cambridge, Massachusetts.

John Howard Mueller, professor of bacteriology and immunology, Harvard Medical School, Boston, Massachusetts.

John R. Paul, professor of preventive medicine, Yale University Medical School, New Haven, Connecticut.

John B. Reeside, U.S. Geological Survey, Washington, D.C.

Francis W. Reichelderfer, United States Weather Bureau, Washington, D.C.

William W. Rubey, U.S. Geological Survey, Washington, D.C.

Homer W. Smith, director of the Physiological Laboratory, New York University College of Medicine, New York.

William C. Stadie, professor of medicine, School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

Otto Stern, research professor in the Physics Department, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

Harald U. Sverdrup, director of the Scripps Institution of Oceanography, La Jolla, California.

Cornelis B. van Niel, professor of microbiology, Hopkins Marine Station (Stanford University), Pacific Grove, California.

John C. Walker, professor of plant pathology, University of Wisconsin, Madison, Wisconsin.

Alexander Wetmore, ornithologist, secretary of the Smithsonian Institution, Washington, D.C.

Hassler Whitney, associate professor of mathematics, Harvard University, Cambridge, Massachusetts.

Eugene P. Wigner, Thomas D. Jones professor of physics, Princeton University, Princeton, New Jersey.

Robert R. Williams, chemical director, Bell Telephone Laboratories, New York.

Benjamin H. Willier, professor of biology, Johns Hopkins University, Baltimore, Maryland.

Foreign Associates:

Sir Lawrence Bragg, Cavendish professor of experimental physics, University of Cambridge.

Dr. Harold Jeffreys, reader in geophysics, University of Cambridge.

Paul Karrer, professor of experimental chemistry, University of Zurich.

Prof. The Svedberg, professor of physical chemistry, University of Uppsala.

Sir Geoffrey Taylor, Yarrow research professor of the Royal Society.

Medal Awards:

Henry Draper Medal for 1945 to Paul W. Merrill, astronomer, Mt. Wilson Observatory (Carnegie Institution), Pasadena, California, for his many important contributions to astronomical physics, in particular those relating to his researches in stellar spectroscopy.

J. Lawrence Smith Medal (No. 3) to Stuart H. Perry, Adrian, Michigan, for his original investigations of meteoric bodies.

Marcellus Hartley (Public Welfare) Medal to Vannevar Bush in recognition of his outstanding service in bringing to bear the scientific and engineering talent of the United States upon problems of research connected with the war effort.

Daniel Giraud Elliot Medals:

1941. Th. Dobzhansky, for "Genetics and the Origin of Species" (second edition).

1942. Sir D'Arcy Thompson (The University, St. Andrews, Scotland), for "On Growth and Form" (revised and enlarged, 1942).

1943. Karl Spencer Lashley, for "Studies of Cerebral Function in Learning" (*J. Comp. Neurol.*, **79**, 431; 1943).

Mary Clark Thompson Medal to Thomas Wayland Vaughan, in recognition of his outstanding achievement in his ingenious co-ordination of observations and generalizations made in, and bearing on, the fields of stratigraphic geology and palæontology.

The fifth John J. Carty Medal and Award was presented to William Frederick Durand, "in his profession a versatile and creative Engineer; among his colleagues a wise and friendly Counselor; before his students a kindly and inspiring Teacher; to the Nation an able and devoted Servant".

Awards to the National Academy of Sciences and National Research Council:

The American Pharmaceutical Manufacturers' Association Award of Distinction was presented to the National Research Council in recognition of its fundamental contributions to public health in the field of the medical sciences and also in recognition of its essential services to the United States during the First and Second World Wars.

Lord and Taylor Annual American Design Award for 1945 to the National Academy of Sciences in recognition of the outstanding achievements of the men of science in the prosecution of the War and for the furtherance of research for national security.

RECENT INVESTIGATIONS ON THE GROWTH OF BONE

By Prof. P. LACROIX
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Any condition in which bone grows or disappears seems bound to involve some of the mechanisms of normal bone growth. Therefore it was felt that, in the long run, the best way to approach some of the problems of surgical bone pathology would be to deal first with normal development, and to submit the whole question to a new inquiry in the light of recent embryological advances.

The first results of this study are now being published[1] and will be briefly summarized here.

(1) In rabbits, the distal growth cartilage of the radius and the growth cartilage of the rib were cut off by two transverse and parallel sections. Their peripheral region was then entirely taken away by four sections at right angles. The disk-shaped growth zone was thus reduced to a small cube consisting exclusively of cartilaginous tissue without any remnant of the ossification groove (Ranvier's "encoche d'ossification"). This piece was grafted into the brain or under the kidney capsule or into the medullary cavity of the tibia in other rabbits. When recovered, it was found to have produced a large quantity of endochondral trabeculæ which were being resorbed and replaced by hæmopoietic marrow. All around the cartilage, cells which seemed to be ordinary fibroblasts had gathered. Some of these cells had taken part in the formation of a thin bony lamella surrounding and flanking the growing cartilage. The formation of this bony ring is a typical example of an induction phenomenon.

Now this observation led to the reconsideration of the structure of the growing long bones, and it was found—however surprising it may seem that such an obvious detail could have been overlooked thus far—that the ossification groove contains a perichondrial ring identical with that of the grafting experiments. The formation of this ring was traced back as follows : in its earliest stage the diaphysis is a continuous bony tube, but after a while its extremity is cut off from the rest of the bone by osteoclasts and becomes the perichondrial ring of the ossification groove ; this change of structure is brought about by the endochondrial tabeculæ beginning to take part in the constitution of the diaphyseal extremities.

From these facts it was inferred that the formation of the normal perichondrial ring and of the earliest form of the diaphysis is the result of inductive activity depending directly or indirectly on the growing cartilage.

(2) Yet another instance of an induction phenomenon in bone growth is provided by the following experiments. A rod of hyaline cartilage was taken from the rib of a rabbit and put into the upper extremity of the tibia of another young rabbit in such a manner that it pierced the centre of its proximal growth cartilage. The latter, in spite of its having been wounded, went on proliferating and a close contact was established between the grafted cartilage and the growth cartilage. After a few weeks the grafted cartilage was the seat of a typical endochondrial ossification. Since the serial sections proved that no cells of the host cartilage had invaded the graft, the phenomenon was to be considered as one of assimilatory induction.

(3) The two previous groups of experiments are clear-cut evidence of the part played by induction at a much later stage than one would ever have thought. They point strongly toward the existence in the growing cartilage of an organizer. The question has been pushed another step forward by the following crucial experiments.

An alcoholic extract has been prepared from the cartilaginous epiphyses of the long bones of newly born rabbits and injected into the thigh muscles of other rabbits. Forty-one days afterwards, a large osteoma was found in the thigh. Its histological examination revealed the presence of all the structures which may be analysed in a growing long bone : growth cartilage with its characteristic row arrangement and partially surrounded by a perichondrial ring of the ossification groove, circular or triangular diaphysis enveloped by a periosteum and containing a functional hæmopoietic marrow.

Thus not only the endochondrial ossification but even the organization of the diaphysis seem to be under the influence of a substance or a group of substances which I suggest calling *osteogenin*.

According to the view put forward at the beginning of this article, evidence should now be sought of the intervention of such a factor in various pathological and surgical conditions (periosteal and medullary osteogenesis, formation of a fracture callus, evolution of a bone graft, etc.). Further research will then have to show whether the possibility of promoting osteogenesis at will is really within easy reach.

[1] *Mém. Acad. Roy. Méd. Belg.*, **2**, Fasc. 2 (1943). *Acta biol. belg.*, **3**, 93 (1943). *ibid.*, **3**, 124 (1943). *ibid.*, **3**, 125 (1943). *ibid.*, 25 mars 1944 (in the press). *Arch. Biol.*, **56**, 185 (1945). *Anat. Rec.*, 1945 (in the press). *Arch. Biol.* Fasc. 3, 1945 (in the press).

SCIENTIFIC AFFAIRS IN EUROPE

From time to time news is being received of scientific men and institutions on the Continent of Europe, who have been cut off from Great Britain for some five years. A note referring to some Belgian biologists and Belgian biological publications, based on material provided by Dr. Julian Huxley, appeared in *Nature* of August 11, p. 166. Dr. John W. Wells contributed an article on French and German geographical and geological institutes to *Nature* of August 25, p. 243. Dr. F. W. Sansome has referred to correspondence with some Danish men of science (*Nature*, September 1, p. 263). Now Dr. Huxley has put at our disposal two letters received by him from Dr. N. Tinbergen, of Leyden, and Dr. A. Buzzati-Traverso, of Verbania, Pallanza, Italy, the substance of which is printed below.

Throughout all these communications, the intense desire to re-open relations with scientific men in Great Britain is apparent, and it is to be hoped that British men of science will, as soon as conditions permit, get into touch with correspondents in the liberated countries and exchange reprints with them, in the interests of international relations.

From Dr. Tinbergen :

The situation in the Netherlands is still more or less chaotic. We have great admiration for the swift and efficient help by the 'food flying squads' that have brought immediate relief to our people at an instant when thousands were dying of starvation. We owe an enormous debt of gratitude to the instigators and organizers of that huge enterprise. Real hunger is over now, but the after-effect, bodily and moral and spiritual, of the German terror and hunger combined is still evident. . . .

Scientific work, which was little affected in the first year of occupation, has practically come to a standstill in the last year. In 1942 we had a great clash with the Germans, who wanted to nazify the University of Leyden; we did not 'surrender' and took our leave; as a reprisal we were put into an internment camp as hostages, and spent two years there. They did not shoot us, however, and all but one of us have safely returned. That one was Prof. Telders, who died in a German concentration camp. In Utrecht, Jordan has died.

I want to renew and intensify the contact and co-operation with British students of behaviour, and I am sure most of my Dutch colleagues in the field of animal psychology are of the same opinion: we all have a great longing for international interchange of ideas. I do not intend to cut off all relations with German scientific men. But first I must not see them for a long time, so as to overcome the psychological aversion resulting from the incredible German terror we underwent; and secondly I want only to renew contact, eventually, with those investigators that I personally know as honest and reliable men, such as Rensch, von Frisch, Stresemann, Lorenz and (I hope) Laven.

As soon as it is permitted, I will send you the publications that have appeared in my department between 1939 and 1942, the year of the clash with the Germans, when I stopped all publishing. The other universities did not have such a formal clash, though all of them were languishing. Much of my own recent work has been centred on "das angeborene auslosende Schema" ('releasing mechanism'); field work on *Satyrus semele*, published in *Z. f. Tierpsychologie*; laboratory work with the three-spined stickleback, an excellent object (most of this work still unpublished); laboratory work with a number of Cichlid fishes (unpublished); and field work with the herring gull (only short papers on fragments of the work). Continuation of this last piece of work will be impossible for some years, to my great regret, as the dunes are 'peppered' with land mines.

Bierens de Haan, after nearly dying of starvation, is all right again; he has written a voluminous book on instincts, and now is writing one on the psychology of the dog. Portielje is all right, and active as ever. He wrote an interesting study of the orang-utan. Verwey had to leave his laboratory in Den Helder, which in the course of the War was absolutely robbed by the Germans; he was fifteen months among us as a hostage in the same internment camp, as also were Prof. Van der Klaauw, and Koningsberger, the Utrecht botanist, successor of Went. A new star in the sky of animal psychology is A. Kortlandt, a young fellow, very clever, very original, very 'cormorant-minded'; for years he has lived among the Lekkerkerk cormorants, day and night, most of the time in a hide in the nest-trees, where he often stayed for one or more weeks, day and night continuously, receiving his food by a 'téléférique' (*Drahtseilbahn*).

Kluyver, the starling man, is all right; he had to leave Wageningen in September 1944, and his house was badly damaged, but he managed to save all the notes of his extensive study on the great tit, and most of his books, and has recently returned. The Government Phytopathological Service, where Kluyver was the ornithologist, has been absolutely ruined by the Germans. All records and files have been burned, as well as the library, one of the many instances of the enormous setback caused by the War. Sirks, Hazelhoff, Dijkgraaf (nephew and pupil of Von Frisch), Raven, Krijgsman, my brother L. Tinbergen, Ihle, De Beaufort are all right. Ihle very nearly died of starvation. Owing to the very limited possibilities of travelling and writing (no trains; cycling only possible during some hours of the night, to avoid the German slave-hunters), we heard such things mostly too late to help each other. De Burlet, much to our regret, has been co-operating with the Germans. He has fled and nobody knows where he is. Hirsch, who was a German, seems to be in Germany.

You may wonder whether we will have time to resume 'pure' scientific research, now that all kinds of reconstruction work will demand so much of our energy. I am sure that we will succeed in keeping part of our time for research.

From Dr. Buzzati-Traverso:

It has been possible for myself and some of my students to carry out a good deal of work (largely published in Italy) on the population genetics of various European species of *Drosophila*, and on induced chromosome mutations. The work was planned jointly with Timoféeff-Ressovsky, in whose Institute in Berlin I worked for five months in 1942. (The last news I had of Timoféeff-Ressovsky was from Hans Bauer in November 1944, to say that he was still working in Berlin. Bauer was then working near Tübingen, where the whole Kaiser Wilhelm Institut für Biologie had been transferred, after being slightly damaged in the early bombing of Berlin.) In Italy the work was done at the University of Pavia. As soon as possible after the Italian armistice, I transported everything I could from Pavia to the Istituto Italiano di Idrobiologia at Pallanza, and thus was saved from destruction a collection of more than two hundred stock cultures of *Drosophila*. This, I believe, is the only collection of *Drosophila* stocks surviving in continental Europe outside the U.S.S.R.

The Istituto Italiano di Idrobiologia was founded in 1939. It is a private foundation with two main laboratories, the principal at Pallanza, the other at Varenna on Lake Como. This is a research institute devoted to the study of problems of lake biology and of limnology. The director, Prof. Edgardo Baldi, is interested in problems of freshwater biology which are of significance for more general biological questions; the Institute is largely concerned with problems of the biology of the animals of freshwater basins. During the last couple of years, a number of such questions have been investigated from the point of view of population genetics.

My stay here has shown me that the combination of field work and study with genetics is likely to be fruitful. Accordingly, Dr. Baldi and I have decided to set up a genetics department of the Institute, under my supervision. We have a number of able young men available for work in this field, including Dr. L. Carvalli, a brilliant worker in statistical genetics and biometry. Our financial prospects appear bright.

In 1943, Prof. Baldi organized a symposium, in which about a dozen biologists, palæontologists and geologists took part, on micro-evolution during the Pleistocene. We have also worked out plans for co-operative work in the mountains above Trieste and in the region of Monte Circeo between Rome and

Naples, though the political and military position has so far not permitted their realization.

Italian biology was not good even before the War, and has since become worse owing to the destruction of many university laboratories and libraries. We feel that there is not much to hope for immediately from the academic milieu, because on one hand the new Italian Government is facing much more urgent problems than university re-organization, and on the other hand many professors of biology are wholly out of sympathy with modern ideas in this subject, and unlikely to be removed from their posts. Accordingly, we believe that the only way to improve the level of biological research and to raise a new generation of modern-minded biologists is to have institutes outside the universities which, keeping the closest possible contacts with foreign laboratories, should introduce the methods and the approach which I have had the good fortune to know and to appreciate in the United States, in Britain, and in some German laboratories. We think that for the time being such extra-university institutes might be the Istituto di Idrobiologia, the Stazione Zoologica in Naples, and perhaps the Istituto do Sanità Pubblica in Rome, which includes well-known physicists, such as Edoardo Amandi, who are very much interested in biophysical problems.

The most urgent need for us now is to become acquainted with the scientific production of the Allied Nations during the last five years. We need books and journals concerning genetic, ecological and general biological problems, to make our existing library comprehensive and up to date.

I suppose that in connexion with any new international organization, some kind of committee for international scientific co-operation is likely to be set up.

Dr. Huxley has also added the following postscript containing further information which he has obtained while in Switzerland and France during September.

(1) *German Ornithology.* While in Switzerland, I was given a copy of a letter written on August 1 by Dr. Erwin Stresemann of Berlin, the leading continental ornithologist, to a Swiss colleague:

The centre of the city has been almost completely destroyed and has become a ghastly heap of rubble. Our museum, however, has not been too badly damaged and we have been doing repair work for some weeks, with a view to opening the collection to the public. Two rooms of the bird department were very badly damaged during an air raid on March 18, 1945, thus unfortunately destroying almost the entire scientific collection of stuffed birds of 1810–88, as it had not been possible to move these from their cases owing to lack of space and means of transport—for there are (or were) 25,000 specimens! I was, however, able to evacuate most of the types to safety, as well as the modern collection of skins and all the books. I have for some time been engaged in bringing these back to their old home and arranging the bird department as it used to be. I am being helped in this work by Mr. Hermann Grote, who has been appointed as my assistant. The important library of the Deutsche Ornithologische Gesellschaft and the stock of unsold journals (*J. Ornithologie*, *Ornith. Monatsberichte*, etc.) have also been saved.

As we in Berlin are cut off from the world, I still know little about the fate of ornithologists in other parts of Germany. Dr. Oskar Heinroth died of pneumonia on May 31, 1945, consequent upon many nights spent in an air-raid shelter during the heavy raids of March and April—an irreplaceable loss. No news of Schuster. Dr. Otto Schnurre visited me a short time ago: he is now *kommisarischer* director of the Berlin City Library. Dr. E. Schütz wrote from Danzig last March, when that town was encircled and being attacked by the Russians—what may his fate have been? Dr. F. Tischler has remained in East Prussia. There is no news at all of the numerous Silesian ornithologists. The bird observatories of Heligoland and Rossitten are probably things of the past—for all time. I cannot at the present moment say whether I shall ever be able to re-start the *J. Ornithologie* and the *Ornith. Monatsberichte*; for the time being their resumption is unthinkable.

That great pioneer in animal psychology, Prof. Konrad Lorenz, was last summer reported missing near Vitebsk, probably killed; he was working as a doctor in a front-line hospital.

I expect that professional circles abroad will be interested to hear how the War and the collapse of Germany have affected German ornithology. I dare not think that it has disappeared for ever, and as long as I am able to do so I will devote all my energies to it, so that it may, at some future time, rise phœnix-like from its ashes. . . .

P.S.—The ringing records of the bird observatory at Rossitten were removed to Central Germany in time, and I expect that they are safe and can be used again in the future.

It may be recalled that Dr. Stresemann gave active help and encouragement during the War to two young British prisoner-of-war ornithologists, who organized groups in their prison camps to study the detailed behaviour of certain bird species. We may shortly expect the publication of their valuable data, obtained in circumstances that must be unprecedented.

(2) *German Genetics.* Through Prof. Boris Ephrussi of Paris I heard the welcome news that Dr. Timoféeff-Ressovsky, the eminent Berlin geneticist of Russian origin, has made satisfactory arrangements with the Russian authorities to continue his work in the U.S.S.R., and has already left Berlin with most of the staff and equipment of his Institute.

(3) *General Biology in Germany.* Inquiries in zoological circles in Switzerland elicited the following facts concerning German and Austrian biologists.

Hans Baur (Berlin), M. Henze (previously of Innsbruck), E. Rotmann (Cologne Vogt) and probably A. Kühn are alive. Von Buddenbrock, the well-known comparative physiologist, was demoted (*strafversetzt*) from Halle to Vienna in 1942 because of his general opposition to Nazi ideas, and was thence evacuated by the Americans with many other men of science to the American zone in Germany, where (in late August of this year) he was in grave financial straits and was not allowed to receive or send correspondence to foreign countries. The third volume of his great book on comparative physiology, dealing with hormones, is now in slip proof, and he has begun writing the fourth volume. As it is probably impossible for him to return to Vienna, it would seem highly desirable for this eminent and non-Nazi man of science to be given a post, in Germany or elsewhere, as soon as possible.

A. Penners of Vienna was very badly treated by the Nazis, and was probably dismissed from his post.

He attempted unsuccessfully to go to Switzerland before the outbreak of the War. His present whereabouts are uncertain. Ries, Wettstein and probably Seidel are dead. K. Henke and E. v. Holst (Göttingen), Paula Hertwig (Berlin), Hans Nachtsheim and Otto Warburg (Berlin-Dahlem) appear to have been alive at the end of the War, but no news of them has since been received. J. Haemmerling moved from Berlin-Dahlem to the Institut für Seenforschung on the Lake of Constance, but nothing has recently been heard from him.

(4) *Hungary and Czechoslovakia.* I have just heard through the Red Cross that Dr. Alexander Wolsky, the zoologist at the Biological Research Station at Tihany, is alive and well (and also his family) and that the Research Station is undamaged.

I have also heard that Prof. Jan Belehradek, one-time professor of zoology and later rector of the Karlovy University of Prague, is well, though he was imprisoned in a concentration camp for a considerable period.

Those who knew Dr. Wolsky and Prof. Belehradek when they were doing research in London in the '30's will be especially glad to hear this good news of them.

RESEARCH IN THE U.S.S.R. ON THE PHYSIOLOGY OF VISION

THE physiology of vision has always held a peculiar fascination for the physiological theorist, but recently the urgency of immediate practical problems, brought to a focus by the War, has led to a renewed and more direct approach both in this country and abroad. Recent Russian work in this field is published in *Problemy Physiologitchesky Optiky*, 2 (Moscow, 1944), which contains sixteen papers from eleven different laboratories. The papers are in Russian, but a generous English abstract of each is given.

Dealing first with work of immediate practical application, V. G. Samsonova has studied the influence of size of image, central brightness, ratio of central to peripheral brightness on the visual discrimination time, and has constructed nomograms from which optimum conditions of lighting for factories, etc., can be computed. O. P. Kholmskaya has measured the visibility of traffic lights against a black screen of varying size. The minimum size of screen for optimum visibility is one which subtends an angle of 12′; when the subtended angle is less than 3′ visibility is worse than with no screen at all. C. I. Krol finds that with several stimuli in the visual field and the total area of stimulation kept constant, the sensitivity of the eye varies inversely as the number of stimuli. S. V. Kravkov records changes in visual acuity resulting from auditory stimulation, and O. A. Dobriakova finds that various extraneous stimuli increase the critical frequency for flicker at the red end of the spectrum and decrease it at the blue end; there is a peak of increase in the orange-red and of decrease in the blue-green and an intermediate neutral zone in the yellow.

Turning to more fundamental researches, N. I. Pinegin has made a detailed quantitative study of the absolute sensitivity of the eye in the ultra-violet; at 365μ the eye is 11,000 times less sensitive than at 546μ, and the lower limit of vision is 302μ (Goodeve, Lythgoe and Schneider recently placed the lower limit at 309μ). Evidence is provided that the effects were due to direct retinal stimulation at this wavelength and were not the result of fluorescence in the eye media. M. N. Livanov has studied action potentials in the visual cortex and lateral geniculate body with the electroencephalograph. P. I. Spielberg has recorded action currents from the human eye by means of special electrodes applied to the eyeball; the method is fairly simple and may prove useful in ophthalmic practice. A. I. Bogoslovsky has investigated the response of the human eye to electrical excitation. Bogoslovsky has also found that in dark adaptation, while the excitability of the retina increases, that of the visual cortex decreases and the two seem to be reciprocally related.

When a coloured object is viewed at increasing distances, a point is reached (when the subtended angle is 10–20′) at which the colour changes in a characteristic fashion. B. N. Kompaneisky has studied these colour changes and concludes that the results can best be interpreted on a classical trichromatic theory of colour vision. The method also provides a sensitive test of colour vision; there are some variations even among normal individuals, and colour defectives are readily identified.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

THE DISCOVERY OF X-RAYS
50TH ANNIVERSARY COMMEMORATION PROGRAMME

Medical Meeting

Saturday, November 10
At the Institution of Electrical Engineers, at 2 p.m.

Scientific Meeting

Saturday, November 10
At the Royal Institution, at 10 a.m.

Historical Reviews

Saturday, November 10
At the Institution of Electrical Engineers, at 3.30 p.m.

Saturday, November 10

BIOCHEMICAL SOCIETY (at the London School of Hygiene, Keppel Street, London, W.C.1), at 11.30 a.m.—Discussion on "The Chemical Basis of Cell Structure and Function" (to be opened by Dr. J. F. Danielli and others).

IRON AND STEEL INSTITUTE (joint meeting with the SCOTTISH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN) (at the Royal Technical College, George Street, Glasgow), at 3 p.m.—Mr. Basil Gray: "The German Steel Foundry Industry".

Monday, November 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 5.30 p.m.—Prof. H. W. Ahlmann: "Summary of Glaciological Researches, 1918–1940".

Tuesday, November 13

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. F. C. Vokes: "The Modern System of Sewage Disposal and the Methods and Materials Employed" (Bossom Gift Lecture)*.

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. Müller: "50th Anniversary of the Discovery of X-Rays", (ii) "After the Discovery of X-Rays".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5.30 p.m.—Discussion on "Forward Psychiatry in the Army" (to be opened by Lieut.-Colonel H. A. Palmer, Major C. Kenton, Lieut.-Colonel H. B. Craigie and Lieut.-Colonel T. F. Main).

BRITISH ASSOCIATION OF CHEMISTS, NORTHERN SECTION (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 7 p.m.—Mr. R. Booth: "The Development and Properties of Safety Glass".

Wednesday, November 14

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. C. Hartley: "Operation PLUTO".

INSTITUTE OF PETROLEUM (at 26 Portland Place, London, W.1), at 5.30 p.m.—Flight-Lieut. E. Mikolajewski: "Investigation of Piston Ring Sticking in High Duty Aero Engines".

INSTITUTION OF ELECTRICAL ENGINEERS, TRANSMISSION SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. W. J. Nicholls: "Recent Progress in the Design of the High-Voltage Overhead Lines of the British Grid System".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Neville Hall, Westgate Road, Newcastle-upon-Tyne), at 6 p.m.—Mr. S. G. Button: "U.H.F. Aerial Systems".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.15 p.m.—Discussion on the Radio Industry Council Report on "Post-War European Broadcasting" (to be opened by Mr. R. G. Clark).

Thursday, November 15

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Annual General Meeting. Prof. L. J. Mordell, F.R.S.: "Thoughts on Number-Theory" (Presidential Address).

CHEMICAL SOCIETY (in the Muspratt Lecture Theatre, The University, Liverpool), at 4 p.m.—Mr. R. P. Bell, F.R.S.: "The Structure of the Boron Hydrides and Related Compounds".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S.: "The Anatomy and Functions of the Brain in Lower Vertebrates", (iii) "Birds".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. Davis: "High-Voltage Research at the National Physical Laboratory" (Parsons Memorial Lecture).

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (in the Bacteriological Laboratory of the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 8 p.m.—Laboratory Meeting.

Friday, November 16

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. O. Rankine, F.R.S.: "The Dispersal of Fog on Airfields".

CHEMICAL SOCIETY (joint meeting with the UNIVERSITY CHEMICAL SOCIETY) (in the Chemistry Lecture Theatre, The University, Sheffield), at 5.30 p.m.—Prof. I. M. Heilbron, F.R.S.: "Our War Against Insect Pests".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Sir Edward Appleton, K.C.B., F.R.S.: "The Scientist in War Time" (Thirty-second Thomas Hawksley Lecture).

CHEMICAL SOCIETY (in the Chemistry Lecture Theatre, The University, Manchester), at 6 p.m.—Original Papers.

ROYAL INSTITUTE OF CHEMISTRY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Mr. W. Gordon Carey: "Water and Public Health" (Twenty-eighth Streatfeild Memorial Lecture).

BRITISH INSTITUTION OF RADIO ENGINEERS (in the Physics Lecture Theatre, University College, Southampton), at 6.15 p.m.—Dr. Hilary Moss: "Engineering Methods in the Design of the Cathode Ray Tube".

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP (joint meeting of the BIRMINGHAM AND MIDLANDS SECTIONS of the SOCIETY and the ROYAL INSTITUTE OF CHEMISTRY) (in the English Theatre, The University, Edmund Street, Birmingham), at 6.30 p.m.—Dr. J. C. Swallow: "Polythene".

CHEMICAL SOCIETY (at the Royal Technical College, Glasgow), at 7.15 p.m.—Prof. J. M. Gulland, F.R.S.: "Polynucleotides and Nucleoproteins".

APPOINTMENTS VACANT

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

LABORATORY STEWARD FOR CHEMISTRY, a LABORATORY STEWARD FOR PHYSICS, and LABORATORY ASSISTANTS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (November 14).

ROUTINE CHEMIST for Trinidad, British West Indies, by a firm producing and refining petroleum products—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.5055.XA (November 16).

HEAD OF THE ENGINEERING DEPARTMENT of the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport (November 16).

GRADUATE TEACHER to take classes in PHYSICS and MATHEMATICS up to Higher School Certificate standard, or Engineering Subjects—The Principal, Stroud and District Technical College, Stroud, Glos. (November 17).

SPECIAL SALT DEVELOPMENT OFFICER to the Government of Bengal—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.2057.A (November 24).

ASSISTANT LECTURER IN PREPARING, COMBING AND SPINNING in the Bradford Technical College—The Director of Education, Town Hall, Bradford (November 24).

LECTURER IN GEOGRAPHY—The Registrar, The University, Manchester 13 (November 25).

SENIOR ASSISTANT IN ENGINEERING DEPARTMENT, and a LECTURER IN GENERAL ENGINEERING SUBJECTS, in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (November 26).

DRILLING ENGINEER for service in the Sudan, on the operation of Drilling Plant and well digging under the direction of the Sudan Government Geologist—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2855.A (November 26).

ASSISTANT EXAMINER OF QUESTIONED DOCUMENTS, Government of India—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.5101.A (November 26).

ENGINEERING ASSISTANT (completed A.M.I.C.E. examination), a JUNIOR ENGINEERING ASSISTANT (completed A.M.I.C.E. examination), and a JUNIOR ENGINEERING ASSISTANT (not completed A.M.I.C.E. examination), on the staff of the Engineer of the River Ouse Catchment Board—The Clerk of the Board, 7 Langcliffe Avenue, Harrogate (November 28).

DIRECTOR OF MUSEUMS—The Town Clerk, Municipal Buildings, Dale Street, Liverpool 2, endorsed 'Director of Museums' (November 30).

CIVIL, MECHANICAL AND ELECTRICAL ENGINEERS in Malaya and Hong Kong—Civil Engineers (Ref. E.2097.A) should have had experience of construction of railways or open-line maintenance, alternatively, they should have had experience of construction and maintenance of roads, or of Urban Water Supply and Draining, or of Irrigation and Land Drainage; Mechanical Engineers (Ref. C.2904.A) should have had practical experience of power generation and distribution and manufacture of plant used therein; Electrical Engineers (Ref. D.1535.A) should have had training in Telegraph, Telephone and Radio Engineering—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (November 30).

LECTURER IN THE DEPARTMENT OF NAVAL ARCHITECTURE—The Registrar, King's College, Newcastle-upon-Tyne (November 30).

ASSISTANT REGISTRAR in the Medical School—The Registrar, King's College, Newcastle-upon-Tyne (November 30).

LECTURER IN THE DEPARTMENT OF BACTERIOLOGY—The Registrar, King's College, Newcastle-upon-Tyne (November 30).

LECTURER IN GEOGRAPHY—The Secretary, The University, Edinburgh (November 30).

ASSISTANT LECTURER IN INORGANIC AND PHYSICAL CHEMISTRY—The Acting Registrar, Queen Mary College, Mile End Road, London, E.1 (November 30).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governors, Battersea Polytechnic, Battersea, London, S.W.11 (December 14).

RESEARCH WORKER in the POMOLOGY SECTION for field experiments, and an ASSISTANT MYCOLOGIST AND BACTERIOLOGIST in the Plant Pathology Section—The Secretary, East Malling Research Station, Maidstone, Kent (December 15).

READER IN ZOOLOGY and HEAD OF THE DEPARTMENT OF ZOOLOGY in the Durham Colleges—The Registrar, University of Durham Office, 46 North Bailey, Durham (December 31).

PROFESSOR OF PHYSICS, a PROFESSOR OF AGRICULTURE, a PROFESSOR OF AGRICULTURAL ECONOMICS (who is also Adviser in Agricultural Economics for Wales), and the GREGYNOG CHAIR OF GEOGRAPHY AND ANTHROPOLOGY—The Registrar, University College of Wales, Aberystwyth (December 31).

ASSISTANT LECTURER IN MATHEMATICS—The Registrar, The University, Sheffield (December 31).

ENTOMOLOGIST, and a PLANT PATHOLOGIST, at the Tobacco Research Station, Trelawney, Southern Rhodesia—The Chairman, Tobacco Research Board, P.O. Box 387, Salisbury, Southern Rhodesia (December 31).

ASSISTANT LECTURER (Grade III) IN THE DEPARTMENT OF METALLURGY—The Registrar, The University, Liverpool (January 1).

PRINCIPAL—The Secretary, King's College of Household and Social Science, c/o University College, Leicester (January 1).

SUB-LIBRARIAN—The Secretary, The University, Aberdeen (February 15).

LECTURER IN PHYSIOLOGY—The Registrar, The University, Leeds, 2 (February 16).

SECRETARY—The Secretary, Executive Council of the Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, Dartmouth Street, London, S.W.1 (April 7).

LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Principal, Birmingham Central Technical College, Suffolk Street, Birmingham 1.

TEACHER (full-time) OF ENGINEERING SUBJECTS—The Principal, Workington Technical College, Workington, Cumberland.

TEACHER (Graduate, or equivalent) with industrial experience in Engineering and qualified to teach ELECTRICAL ENGINEERING to the Ordinary National Certificate stage—The Principal, Technical College, Stretford, Lancs.

LECTURER (full-time) IN THE DEPARTMENT OF MATHEMATICS—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER (full-time) highly qualified in MATHEMATICS, for advanced Engineering Courses preparing for Final B.Sc. and Higher National Certificate—The Organizer of Further Education in Rugby, College of Technology and Arts, Eastlands, Rugby.

LABORATORY ATTENDANT FOR PHYSICS LABORATORY—The Secretary to the Governors, Royal Holloway College, Englefield Green, Surrey.

LECTURER (full-time) IN MATHEMATICS—The Principal, College of Technology and Commerce, Leicester.

ASSISTANT (with a special knowledge of Physical Chemistry) IN THE DEPARTMENT OF CHEMISTRY—The Secretary, The University, Aberdeen.

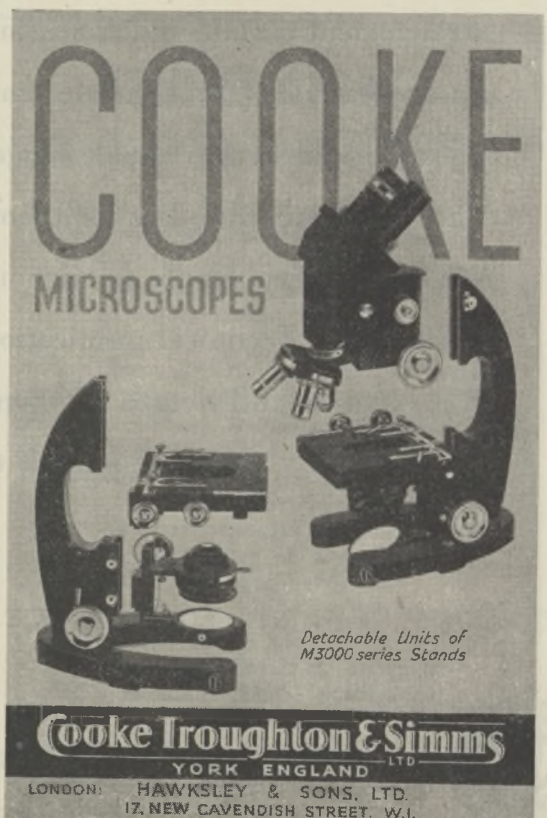
LABORATORY STEWARD IN THE DEPARTMENT OF BOTANY—The Head of the Department of Botany, University College, Hull.

GRADUATE PHYSICAL CHEMIST with an aptitude for scientific research to work on the permeability of packaging materials and packages to gases, and a GRADUATE PHYSICAL CHEMIST with an aptitude for scientific research to work on the physical and chemical properties of adhesives used in the packaging and printing industries—The Director of Research, Printing and Allied Trades Research Association, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

SENIOR PHYSICIST to organize and collate investigations on the physical properties of leather—The Director, British Leather Manufacturers' Research Association, 1–6 Nelson Square, London, S.E.1.

LABORATORY ASSISTANTS (men or women) for work in pharmacological laboratories, and PHARMACOLOGICAL ASSISTANTS (men or women)—The Secretary, Wellcome Laboratories of Tropical Medicine, 183 Euston Road, London, N.W.1.

LABORATORY ASSISTANT IN THE DIVISION OF HISTOLOGY—The Bursar, Royal Veterinary College, Camden Town, London, N.W.1.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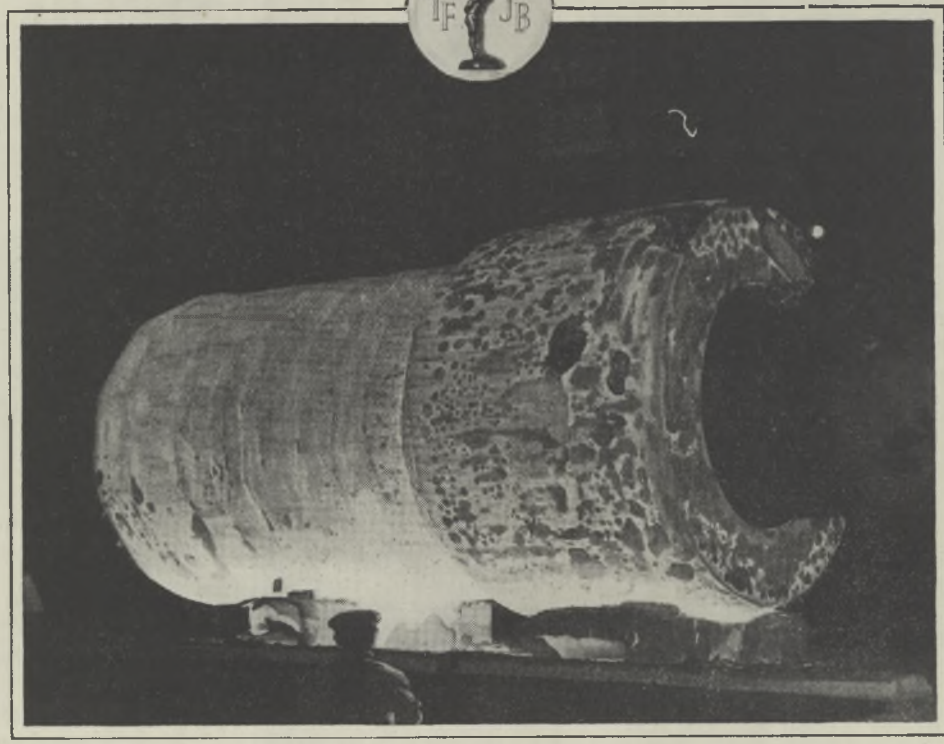

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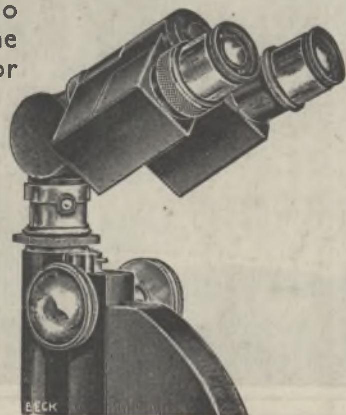

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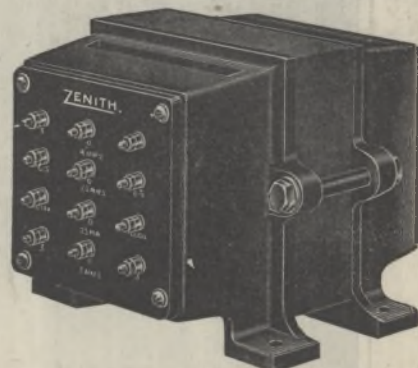

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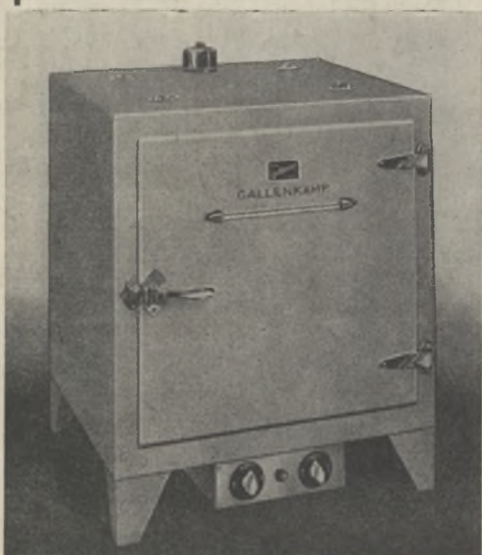

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