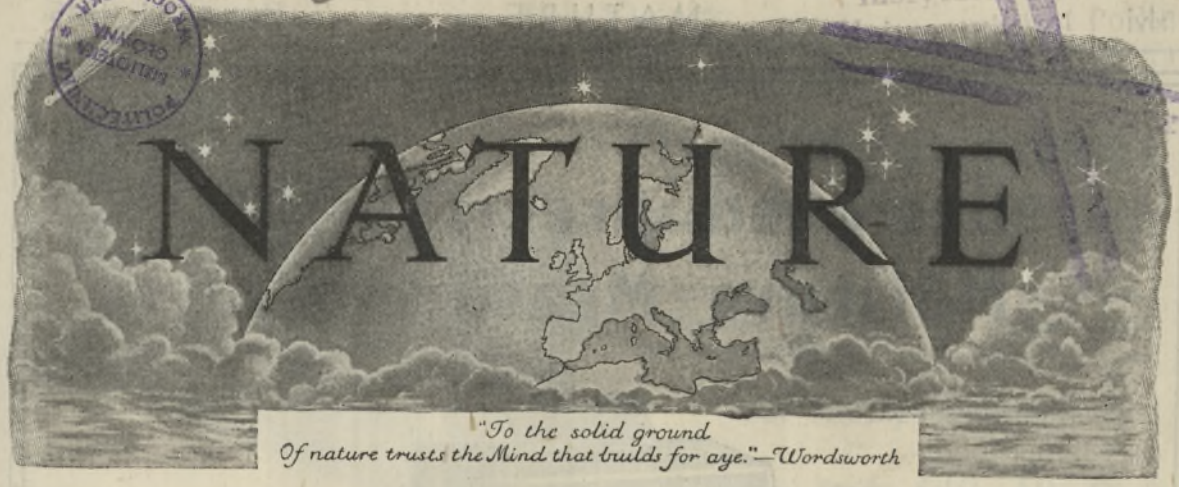

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CONTENTS

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ATOMIC ENERGY: AN INTERNATIONAL RESPONSIBILITY

THE announcement by President Truman on August 6 that the United States Air Forces have used an 'atomic bomb' against the Japanese army base at Hiroshima was accompanied by the issue by the Prime Minister of a statement prepared by Mr. Winston Churchill some time ago on the history of the plans made in connexion with this project. The early stages of the research work involved were carried out mainly in the universities of Britain, particularly at Oxford, Cambridge, the Imperial College of Science and Technology, Liverpool and Birmingham. The Ministry of Aircraft Production was responsible for the work, being advised by a committee of scientific men. In 1941 the project was brought before the Chiefs of Staff Committee, which gave it the maximum priority.

At this time a special division of the Department of Scientific and Industrial Research was set up to direct the work, which was given the title of Directorate of Tube Alloys; and a consultative council and a technical committee were appointed. Both university and industrial laboratories were pressed into service; throughout, leading men in Britain associated with the physics and chemistry of atomic structure were brought in. In the autumn of 1941, President Roosevelt suggested closer relations with American men of science working on the same subject, as a result of which there was a fusion of efforts and several workers went from Britain to the United States to continue their researches. A year later such progress had been made that it became necessary to decide where the enormous plants which would apparently be necessary for large-scale production should be erected; since Great Britain was already fully occupied and on account of the relative security from interference afforded by the United States, that country was chosen. Most of the prodigious cost now fell on the United States. Canada also came in, providing part of the raw material and facilities for one section of the work.

Such is the bare outline of the genesis of the atomic bomb, the secret of which was well kept. But the matter cannot be allowed to rest there. On the face of it, some of the ablest scientific brains of the United Nations have been devoted for a period of years to the production of an engine of destruction; this is not, however, the whole story. For many years past it has been known that the break-up of the nucleus of an atom would lead to the release of great amounts of energy; and several writers with scientific knowledge and interests have based fascinating and almost prophetic stories upon the possibility of its achievement. During all this time scientific research has been going steadily on, step by step, delving into the interior of the atom. In time, there can be no doubt that the release of atomic energy would have been achieved; but the outbreak of war, with its threat to the world, made atomic energy a prize which would speedily sway the battle, and men and resources were provided regardless of cost. As in many other cases which could be quoted, war

sharpened the interest in research of those who control the public purse, and as a result every facility was provided for promoting an investigation which in peace-time would probably have received scanty support. It is known that the Germans as well as ourselves were seeking the solution ; but, fortunately for the world, they were not able to achieve practical results.

Nevertheless, the very successfulness of the investigation induces a feeling akin to dismay that science should contribute such an engine of destruction to the world. This feeling must be put aside, though the possibilities must never be forgotten. We must remember that this new source of energy now being tapped, "long mercifully withheld from man", as Mr. Churchill wrote, can and must in the years of peace be harnessed to the needs of industry, to supplement the forms of power now in use. Research into the regulated release of atomic energy, if this has not already been achieved, will be carried on from a new basis and with redoubled energy. No doubt much painstaking work will be necessary before the new source of energy can be utilized in economic competition with fuel and wind- and water-power, but the present position clearly holds possibilities of the utmost significance.

There is another facet of the world situation which this scientific and technical development has brought to the forefront, namely, the immense responsibility now placed in the hands of those with exact knowledge of the steps necessary to release atomic energy. It has been stated that adequate measures have been taken to secure patents on all vital processes, and all rights in such patents have been assigned to the Governments concerned. At present, this must mean that the United Nations, and especially Great Britain, the United States and Canada, hold in their hands a weapon with which they can dominate the world—a responsibility the discharge of which will require the highest degree of statesmanship. They also hold a potential source of power capable of contributing immensely to the welfare and material progress of mankind—a further and even greater responsibility. How will they use it ? Governments are notoriously impersonal, and they come and go. It therefore devolves upon the individual, be he man of science or layman, to understand the potentialities of atomic energy, even if he comprehends little of the method of its release ; and to ensure that his elected representatives, from whom his Government is chosen, are also aware of their responsibilities in the matter. It is not a matter of exact knowledge so much as an appreciation of right and wrong in dealing with our neighbours, who are now every nation of the world ; indeed, the alternatives would seem to be an international brotherhood of nations or chaos. There can be no question of halting investigations until mankind is fitter to receive them ; if material research has outstripped the progress of knowledge of man, then the tempo of investigation of man as a social being must be increased until both can progress, side by side, carrying man onwards to the higher ideals of life for which the best of each generation are always striving.

MAN-POWER AND TRAINING IN THE SCIENTIFIC INSTRUMENT INDUSTRY

IN an article in *Nature* towards the end of 1943*, attention was directed to the dependence on a live and efficient scientific instrument industry in Britain of the hopes that the technical and research resources and facilities of industry would be raised to a level which would allow of full application being made of scientific knowledge and of advancement in that knowledge. Further, it was pointed out that in no branch of industry is the need of technical knowledge and facilities greater than in the scientific instrument industry. At the time these observations were made, the manufacturers of scientific instruments and equipment were completely occupied in fulfilling the demands of the Government in respect of war requirements and, indeed, this state of affairs still persists. It is, however, reasonable to suppose that the post-war period now lies in the near, rather than in the distant, future, and it is opportune to review the position of the manufacturers of scientific instruments and of laboratory equipment in relation to their ability to meet their vital commitments to the nation during the period of the re-creation of national prosperity.

Two factors which are vital to the efficient manufacture of scientific instruments and equipment are craftsmanship and technical knowledge in its widest sense and, while neither was in a very healthy condition before the War, both have certainly been adversely affected by the War. The desperate demands on man-power of the Fighting Services during the past six years have inevitably resulted in the scientific instrument industry, in common with all other industries, being engaged in a losing battle with the Ministry of Labour and National Service for the retention of its craftsmen and technicians. Moreover, for six years the industry has been engaged in the mass-production of instruments for Service use, and it will be appreciated that, excellent as the British war-time instruments have been, there is a vast difference between the delicacy of instruments designed for accurate measurement under reasonable conditions and that of instruments required to be as accurate as possible under the very robust conditions which must exist in the tank, aeroplane and other engines of war. In consequence, the craftsmen, generally those of mature age and experience, who have remained in the industry, have not been required to exercise their craft to the full, and will, to some extent, have to regain their skill. As regards technicians, the demands of the research and development departments of the Services have been such that it has been impossible for the industry to avoid losing much of its technical personnel, and have prevented any recruitment being made by the industry to make good its technical deficiencies. Further, the large extent to which development has taken place within Service departments has reacted unfavourably on

* *Nature*, **152**, 704 (1943).

the maintenance of efficient development in the industry itself. The industry therefore faces its post-war commitments under the shadow of a very serious deficiency both in craftsmen and technicians; and, in view of the vital function of the scientific instrument industry in the national life, the position calls for serious thought and remedial action.

It has already been remarked that craftsmanship and technology within the scientific instrument industry—and indeed in all industries—have not been what they should or might have been; and it is an encouraging sign that there is a general recognition of this fact within the industry itself, and that serious consideration is being given to the means of ensuring a marked improvement in the future. It is evident, however, that any policy which may be adopted to this end must be a long-term one, for neither craftsmen nor technicians in sufficient numbers can be produced by any means other than by education and training over a long period. It is well that such a policy should be pursued, but it must be realized that three immediate tasks, which cannot depend on any long-term policy, confront the industry: the home demands for instruments and equipment in the industrial, educational and other civil spheres must be met, and it should be noted that the industry is already some two years behind in the fulfilment of orders; the industry must take its full share in the rehabilitation of the technical facilities of liberated Europe; the industry's export trade has to be recovered and extended, and it is relevant to observe that foreign governments have long realized that the scientific instrument is, from every point of view, the ideal article for export. If these tasks are to be carried out with some measure of adequacy, a short-term policy must be evolved which will ameliorate the conditions at present existing in the industry. The continuing war in the East must necessarily restrict the possibility of certain procedures being adopted, but it is well to state the actions which might be taken to instil confidence in the industry as it faces these tasks, and to increase its competence to carry them out. Three of these actions may be briefly stated. There are craftsmen in the Armed Forces whose service may continue for some considerable time: their release would confer great benefit on the industry. There are young craftsmen who have achieved a considerable degree of skill but who will normally be called up for service in the near future: their retention in the industry is most desirable. There are older and more mature craftsmen in the industry who have been long starved of the opportunity to exercise their peculiar skill in full measure: encouragement to the industry to recommence, even on a limited scale, the manufacture of its civil and export products would not only provide a preparation for production for the future, but also would furnish an excellent refresher course for these craftsmen. No such encouragement has yet been received.

What has been said of craftsmen applies, to some extent, to technicians, but the formulation of a short-term policy to meet the technical needs of the industry presents considerable difficulty. Scientific instruments and equipment are produced in Britain by relatively small firms which are distributed over the whole of the country, and, in consequence, it is almost impossible that adequate technical facilities should exist in every individual firm. Here then surely is a case in which, certainly for some years, a considerable proportion of the technical, and especially the research, facilities of the industry must be found in its research association. The British Scientific Instrument Research Association has evolved a scheme of expansion which, if quickly achieved, should go a long way towards covering the whole field of problems associated with the manufacture of scientific instruments. It would seem that in whole-hearted co-operation with its research association lies the best hope of the industry to resolve its technical difficulties, at least until any long-term policy to deal with the technological aspects of instrument production has had time to affect the situation.

Any immediate action which may be taken to meet the pressing need of the moment should in no way prejudice the pursuance of policies by the industry to overcome deficiencies in craftsmanship and technology. In a book recently published*, Mr. F. Twyman has described the rise and fall of the apprenticeship system and has put forward a passionate plea for its revival. It is only too frequently true that apprentices to-day receive no systematic instruction in their crafts but have of necessity to pick up their knowledge as best they may. The training of apprentices cannot be fully efficient while their work is considered to be an integral part of production, and it would be of inestimable worth to the industry if a scientific instrument apprentices school were established from which a steady stream of trained craftsmen could flow into the industry and thus provide a solid core of craftsmanship. The wide distribution of the industry renders any local system of training very difficult, but it is conceivable that united action by the entire industry might evoke the co-operation of the Ministry of Education and result in the establishment of a true school of apprenticeship for scientific instrument makers, which might effectively resolve the question of craftsmanship and would constitute a national asset. The provision of technicians in the industry will be vitally affected by the nature of academic and technical education in the future. In this connexion the recommendations of Lord Eustace Percy's Committee will be awaited with interest. Again, the hope may be expressed that in the post-war period a far more adequate liaison will exist between the academic scientific worker and the industrialist than has been the case in the past. The research association movement has now achieved considerable dimensions and a large measure of stability, and forms a very useful halfway house between science and industry. The research association would seem to provide a very convenient channel through which scientific men who desire to enter industry might well pass in their transition from academic to industrial life.

Long-term policies, however, cannot affect the

* "Apprenticeship for a Skilled Trade." By F. Twyman. (London: Charles Griffin and Co., Ltd., 1944.) 5s. net.

immediate future. There is every reason to anticipate that victory over Japan will not be long delayed, and that, in the near future, industry in Great Britain will be called upon to make perhaps its greatest effort in order to secure the future well-being of the country. There is no more important tool in industry than the scientific instrument, and it is to be hoped that no unnecessary restriction imposed at the present moment will cause the manufacturer of scientific instruments to falter when the demand is made on him for the tools vital to the technical rehabilitation of our national life.

VOLCANIC FORMS AND STRUCTURES

Volcanoes as Landscape Forms

By Prof. C. A. Cotton. Pp. xv+416. (Christchurch and London: Whitcombe and Tombs, Ltd., 1944.) 32*s*. 6*d*.

IT is no accident that the varied landscapes of New Zealand should have stimulated Prof. Cotton to enrich the literature of geomorphology with a series of books of outstanding interest and importance. In no other country of comparable size can a greater variety of geological agents and processes be seen in active operation, and since land-forms result from the interaction of the internal and external processes, it follows that New Zealand is a geomorphologist's paradise.

In his latest work Prof. Cotton gives us for the first time a detailed and systematic account of volcanic land-forms and their subsequent modifications. Along this line of approach, discussion of theories of vulcanism and petrogenesis is not to be expected. Nevertheless, the author devotes six introductory chapters (Part 1) to the mechanism of volcanic activity, and when he comes to volcanic landscapes (Part 2) he continues to adopt a treatment which, throughout the ten chapters dealing with the primary forms of construction and destruction, is quite rightly genetic as well as descriptive. The last two chapters, which deserve expansion and might well have formed a third part, are concerned with the erosion and dissection of volcanic plateaus and mountains. Volcanic contributions to atmosphere and ocean are briefly discussed in an appendix.

The author emphasizes the fundamental distinction between (*a*) dominantly lava volcanoes, mainly basaltic, and characterized by relatively quiet effusion; and (*b*) dominantly pyroclastic volcanoes, generally emitting more silicic materials and characterized by explosive eruptions, which not infrequently reach catastrophic intensity. An attempt is made to correlate this striking contrast in behaviour with the chemical compositions of the lavas concerned. Attention is directed to the importance of iron oxides in promoting mobility and high temperature (by reaction of Fe_2O_3 with juvenile hydrogen), and it is surmised that the high viscosity and lower temperature at which the more silicic lavas commonly arrive at the surface may be partly due to their lower content of iron. The development of this idea in relation to other elements is less happy. Thus, after suggesting that the peculiarities of the Vesuvius eruptions may be related to the highly potassic character of the lavas, the author goes on to say (p. 63): "The lava of Etna also is a potash-rich basalt, and the activity of Etna is not very unlike that of Vesuvius". Actually, the lavas of Vesuvius are leucite-tephrite with 7·5 per cent of K_2O, while those of Etna are andesitic basalts with only 1·6 per cent. Moreover, on p. 47, it is wrongly assumed that the dome-building volcanoes of central Africa are basaltic. Far from being basaltic, the lavas of Nyamlagira and Ninagongo are felspathoidal types with 3·5 and 5·5 per cent of K_2O respectively. These examples add point to the author's own warning (p. 63), based on the eruptions of Tarawera, "against too confident prediction of the eruptive properties of magmas from chemical composition".

Other warnings may not be out of place in relation to Part 1. Admittedly the problems of mechanism remain intractable, but no useful purpose is served by the uncritical reiteration of immature or untenable hypotheses. Jaggar's conception of the mechanism responsible for the Hawaiian cycle of activity might be of value if it were intelligibly expressed, but on pp. 33–34 the author, like earlier writers (including Jaggar himself), merely succeeds in befogging the reader. Again, in dealing with the sources of magma on p. 46, it is unfortunate that Hobbs's naïve and unacceptable assumption that local relief of pressure leads to the fusion of sediments should be cited, especially as attention is directed later on to the necessity for changes of composition by introduction of emanations from the depths.

Part 2 is concerned with less controversial topics and is an invaluable storehouse of information, admirably classified and discussed, and so thoroughly up to date that the new Mexican volcano, Paricutin, and the 1944 eruption of Vesuvius both receive appropriate mention. The chapters deal in turn with basaltic domes and cones; lava plateaux and plains; lava fields and their minor relief forms, including lava surfaces, fire fountains and their effects, bombs and spatter cones; coulees (the thick tongue-like convex flows of viscid non-basaltic lavas), tholoids (spreading cumulo-domes exuded in and over craters) and plug domes of piston-like protrusion; *nuée ardentes*, ash showers and ignimbrite sheets (a chapter that deserves special commendation); ash-built and stratified cones, with a good account of lahars of various kinds; maars and meteor craters; submarine eruptions and pillow lavas; craters, calderas, volcano-tectonic depressions (for example, that of Lake Toba) and volcanic lakes; the dissection of basalt and ignimbrite plateaux; and finally the erosion of volcanic mountains. In this last chapter welcome features are the accounts of erosion calderas and the planeze stage of dissection, a *planeze* being a dwindling sector of the initial constructional surface, surviving for a time between deeply eroded consequent valleys. The section on volcanic skeletons is, however, disappointingly brief. The collection and correlation of successive members of denudation series is a long-overdue task which Prof. Cotton is well equipped to undertake successfully. In particular it should be possible to trace ring structures from the surface manifestations developed on volcanoes such as Kilauea, Mauna Kea and Niuafo'ou, down to the ring-dykes and cone-sheets revealed at the roots of old volcanic centres, as in Mull. As it is, ring structures receive scant attention; and in Fig. 7 what are obviously cone-sheets are wrongly described as ring-dykes.

Such criticism as is offered above is meant to be helpful in the preparation of later editions, for the book as a whole is so good that it should soon progress from youth to maturity. It will be welcomed and appreciated by a wide circle of readers—for who is not interested in volcanoes ?—and more especially because the author, apart from his own valuable contributions, has made readily available, with full references, the scattered results of such active vulcanologists as Jaggar, Perret, Stearns and Howel Williams. Apart from the price, the book shows no signs of being a war-time production, but is attractively printed and profusely illustrated on good-quality glossy paper. Author and publisher alike are to be warmly congratulated on their combined success in the fields of scientific exposition and craftsmanship.

ARTHUR HOLMES.

CHILD GUIDANCE GROWS UP

An Introduction to Child Guidance

By W. Mary Burbury, Edna M. Balint and Bridget J. Yapp. Pp. viii+200. (London: Macmillan and Co., Ltd., 1945.) 7*s*. 6*d*. net.

VERY little has been published in Great Britain on the work of child guidance clinics, and ignorance on the subject is widespread. It is therefore perhaps ungenerous to criticize the authors of this small book for attempting to cover too wide a field or to address too wide an audience. The fact remains that many aspects of the work have received but scant reference, and the authors' hope to meet the needs of "all those who are actively concerned with the problems of children and young people, whether as members of education or youth committees, as magistrates, probation officers, teachers, doctors or social workers ... and ... also be found useful by students intending to work in child guidance clinics, as well as by those studying education, social science, psychological medicine or pediatrics" is too ambitious. While child guidance as a team approach to the problems of childhood strictly emanated from the United States, when the demonstration clinic was founded in London with Commonwealth Fund monies in 1928, Prof. Cyril Burt had been doing work on similar lines since 1909. Before the East London Child Guidance Clinic was opened in 1927 a pioneer group of medical men at the Tavistock Clinic, some of whom later became directors of the early clinics, dealt with more than five hundred children, assisted by a social worker who was one of the first to train in the United States and qualify as psychiatric social worker. Since that time child guidance in Great Britain has developed its own essentially British characteristics, and as every young movement needs to be jealous of its reputation and avoid inviting deserved opposition, one must needs be critical of matters that might otherwise be passed over as details.

Some duplication and contradiction is inevitable in any symposium, but slightly more careful editing might have prevented the introduction of technical terms before their description or definition. The term "intelligence quotient" is introduced in Chapters 3 and 6, and the reader has to wait until Chapter 8 before finding any explanation. Similarly, in one chapter the suggestion is made that maladjustments of foster children could be avoided only if there were panels of specially selected homes, but no mention is made of the Foster Home Register until nearly a hundred pages further on. I think one might also question undesirable jargon such as "neurotic reasons" in relation to adoptive parents, "dreaded rival" as a description of a boy's attitude to his father, "supernormal" for intelligence above the average, and the reference to "rationalisations more or less unconscious". The use of this kind of language justifies the criticisms on the part of the layman to which Dr. Burbury refers in her introduction. Keeping the general reader in mind, debatable statements might well be omitted, such as that foster mothers undertake the care of children primarily as a congenial method of adding to their income, that the mother whose brass knocker is always the brightest in the street and whose windows gleam in front of spotless white curtains is an obsessional neurotic who can never rest, or that the child who lies awake for long hours is commonly masturbating. Such situations may and do occur, but it would be a pity if the reader were tempted to generalize and the captious critic provoked to caustic comment.

Perhaps the best part of the book is the last, dealing with the methods of examination and treatment, although psychotherapy of children is a particularly difficult subject to describe clearly to the outsider. Chapters 7 and 12, on the job of the psychiatric social worker, are especially well done, and Chapter 14 on future trends is thoughtful and stimulating although it touches only on the fringes of what could and should be done in the preventive fields. Child guidance stands for one of the earliest approaches to children's problems along the lines of social medicine, investigating and attempting to correct the causes of maladjustment of the individual to his environment. It is "concerned primarily with unsatisfied inner needs rather than with physical or intellectual difficulties", but such dissatisfaction gives rise to many types of symptom, and treatment stands as much for environmental change as individual therapy. The scales are carefully balanced between the rights of the individual and the demands of society, and there is reason to hope that the principles that underlie child guidance may expand far outside the clinics into the schools and homes of the people.

It may be hoped that this small work will have a reception that will encourage its authors and others working in the same field to write further and more comprehensive books on the subject.

ALAN MABERLY.

CLIMATOLOGY FOR METEOROLOGISTS

Climatology

By Prof. Bernhard Haurwitz and Prof. James M. Austin. Pp. xi+410+17 plates. (New York: McGraw-Hill Book Co., Inc., 1944.) 4.50 dollars.

THE authors of this book set out to provide an introduction to climatology for the student of meteorology. Since the public which they aim at interesting is meteorologically educated, the authors are free to use meteorological terms, and they have made use of this freedom to write a book on climatology which is rather different from any other book on this subject. In the course of the last two decades, synoptic meteorology has been steadily progressing,

mainly along the lines of analysis of weather charts developed at Bergen in Norway. Weather is now interpreted in terms of air masses and of the fronts which separate them, with an enormous gain in understanding of the physical processes underlying the changes of weather with place and time.

Climatology may be defined, perhaps a little crudely, as the time-integral of weather, and so there should be a close correlation between the interpretation of climatic data and the interpretation of the facts depicted on the synoptic chart over a selected interval of time. Hitherto this correlation has not been very obvious in the text-books of climatology.

In the book under review, Profs. Haurwitz and Austin have broken new ground in endeavouring to interpret climatological data in terms of air-masses, and their book is a definite step forward in the development of climatology. The book is in two parts, the first dealing with general climatology, the second with regional climatology. Under the heading of general climatology we find a discussion of solar radiation and heat balance of the atmosphere, temperature, wind and pressure, hydrometeors, air masses, fronts, cyclones and anticyclones. The discussion of these topics is of necessity brief, but is perhaps ample for the purpose of the later sections of the book. Many of the diagrams used have not hitherto appeared in text-books, and the authors are to be congratulated on their effective choice of diagrams for illustrating these early chapters. In the subsequent chapters of the first part of the book, the authors describe in some detail Köppen's classification of climates, in the form which this classification finally took (Köppen-Geiger, "Handbuch der Klimatologie", vol. 1C). This is the classification which the authors adopt as the basis of the second part of the book. But between the chapters describing the types of climate and those dealing with regional climatology is interposed a chapter on micro-climatology, which seems curiously aloof from the rest of the book. What is in general called micro-climatology is not in reality climatology, and could more logically be called micro-meteorology. The inclusion of a chapter on the subject in the middle of the present book appears to the present reviewer a tactical error, since it is a barrier to the smooth development of the plan of the book.

The second part of the book deals with regional climatology of the globe, dividing the globe into eight areas, and devoting one chapter to each area. In each chapter are discussed briefly the physical features, the mean distribution of pressure and wind, ocean currents, the prevalent air-masses, fronts, cyclones and anticyclones, and the climatic types occurring within the area. The amount of information given under each heading varies from area to area. For example, the accurate description of air masses over most of Africa is not possible in the absence of adequate upper air data, and the brevity of the three chapters dealing with Australia and New Zealand, with arctic and antarctic, and with oceanic regions, is to be ascribed to the inadequacy of certain types of data from a very large part of the globe.

Each of the eight chapters contains tables of frequencies of wind directions in January and July for a selection of stations, and tables of mean temperature, precipitation, and cloudiness in January, April, July and October, for a number of selected stations. The times of observation are not stated.

A revolution in the method of presentation of climatological data appears to be inevitable, but much intense work will have to be done before this revolution is achieved. The authors of the present book have made a beginning, and it is likely that shortly there will be much fuller meteorological data available for nearly the whole globe, the discussion of which will make it possible to give fuller treatment of many of the topics they have discussed.

The book under review is to be recommended to all who take an intelligent interest in climatology, be they meteorologists or geographers.

D. Brunt.

THE RACE PROBLEM IN SOUTH AMERICA

El Indoamericanismo y el Problema Racial en las Américas

Por Prof. Dr. Alejandro Lipschutz. Segunda edicion. Pp. 501+32 plates. (Santiago: Editorial Nascimento, 1944.) n.p.

PROF. LIPSCHUTZ explains that what he means by Indo-americanism is the vindication of the economic and cultural rights of the masses of Indians and mestizos of America, who have been up to the present "disinherited". His book is a plea for an "Indo-american resurrection", which, it may be noted, has already been partly brought about in Mexico. He attacks what he calls "racial hypocrisy", that is, the justification of the inferior social position in which certain portions of the population are kept, by the excuse that those of American Indian or African Negro blood are racially inferior to the descendants of Europeans. A considerable part of the book is a discussion of the supposed biological inferiority and superiority of different races of mankind, and the degeneration that is popularly supposed to result from racial miscegenation. He deals not only with the American Indians but also with the African Negro, and makes use of the abundant anthropological literature that now exists on this subject.

The racial problem, as the author says, is not really a biological but a social problem, and it presents itself in different forms in different countries. What Prof. Lipschutz is concerned with is that the descendants of the conquered Indian tribes and of the African slaves constitute what may be called a deprived class condemned by the present social system to occupy, economically and culturally, an inferior position. This, he thinks, must be remedied by a widespread social reform if the Spanish American republics are to survive as independent national entities by the side of the United States within a united American continent.

The author thinks that the future of the whole American continent depends on the racial problem of North America. He recognizes the gravity of the problem of racial discrimination against the Negroes of the United States, but finds some grounds for optimism in the fact that sixty or seventy years ago the American Indians were in that country regarded as an essentially inferior race and that the attitude towards them has now greatly changed.

A. R. Radcliffe-Brown.

THE SECRETION OF MILK*

By Prof. H. D. KAY, O.B.E., F.R.S.

National Institute for Research in Dairying, Shinfield

OUR knowledge of the cytology of milk secretion—what structures in the large cells lining the alveoli of the mammary gland are concerned with the formation of the various milk constituents—is meagre. There is no doubt that all the milk constituents are secreted by the same type of cell; there are not separate cells secreting fat, others secreting casein, others secreting salts and so on. It is now usually agreed also that the milk-secreting cells are fairly permanent structures; that is, that milk does not originate from the breakdown and dissolution of complete cells which are renewed again and again from the basement membrane. This would entail far more mitosis and repair in cell structure than can be seen in the actual functioning gland, and would probably entail the presence in milk of fairly large amounts of substances derived from the cell nuclei, such as nucleoproteins or breakdown products of these proteins which are, in fact, only present in traces in milk. What appears to be the case is that apart from occasional breakdown and repair, the alveolar cells maintain their nuclei and general integrity throughout a large part of a lactation period.

The day's work of one of these cubical cells entails the following cycle of operations. It begins as a rather short squat cell with the nucleus in the middle. Granules or globules, some of which stain with fat-soluble dyes, then begin to appear in the part of the cell nearest the alveolar space. The cell begins to increase in length and size, the nucleus remaining fairly close to the basement membrane. The secretory products soon fill the whole of one end of the tall, distended cell. These products, and possibly a small part of the cytoplasm of the cell itself, are now extruded into the lumen of the alveolus as milk, following which discharge the cell returns to its original squat shape. This whole process is repeated several times until the alveolar spaces become distended with secreted milk and the whole of the rest of the storage space in the gland is also occupied, whereupon further secretion ceases. During twenty-four hours in an actively lactating cow there may be up to four or five or even more cellular cycles of operation. Milk secretion proceeds continuously throughout the major part of the twenty-four hours, possibly interrupted during the actual milking process.

Though the cells are tiny compared with, say, the size of an *Amœba*, there is plenty of room inside each one for a very complicated structure, a part of which has been revealed by ordinary microscope and histological methods. The development of the electron microscope gives an increased hope of further accurate knowledge of the lay-out of these tiny factories, but it will probably be a long time before their detailed structure, the mode of action of the enzymic systems which are known to exist in these cells, and the associated biochemical changes, many of which have already been observed, and which I now propose to discuss, have been completely co-ordinated.

* From a Royal Institution discourse delivered on May 18.

The Biochemistry of Milk Synthesis

It is clear that the basic materials from which milk is made, as well as those needed for producing the energy for milk secretion, must be brought to the mammary gland by the circulating blood. The main problems can be stated in the following general terms: (1) What are the chemical materials in this blood which are used for (*a*) the manufacture by the milk-secreting cells of the principal milk constituents, (*b*) as a source of energy for the work done by the active gland? (2) How is this manufacture actually brought about in these cells? In the cow, two mammary arteries, one of which serves the front and rear quarters on each side of the udder, provide the whole of the incoming blood. The arteries rapidly sub-divide to form arterioles and capillaries in close touch with the alveolar cells. A sample of blood taken from any part of the arterial system will contain all the materials either for milk manufacture or to meet the energy needs of the udder.

Three constituents of milk (Table 1), at least, are not present as such in the circulating blood, namely, milk fat, casein and lactose. Two at least of these, namely, lactose and casein, are produced nowhere in Nature but in the cells of the mammary gland.

TABLE 1. RELATION BETWEEN THE CONSTITUENTS OF COWS' BLOOD AND THOSE OF COWS' MILK.

(Quantities shown in mgm. per 100 ml.).

Constituent	Blood plasma	Milk	Ratio (approx.) blood : milk
Casein	Nil	2800–3000	—
Lactalbumin	Nil	350–450	—
Globulin	1200–2000	50–150	1 : 0·1
Lactose	Nil	4600–4900	Blood glucose : milk lactose as 1 : 80
Glucose	45–60	Traces	
Fat (as fatty acids)	150–300	3000–4000	1 : 15
Ca (total)	10–12	120–140	1 : 12
K	16–20	120–180	1 : 9
Cl	270–300	90–120	1 : 0·4
Inorganic P	4–6	60–80	1 : 15
Total acid-soluble P	4·2–6·5	65–90	1 : 15
Lipin P	5–7	4–12	1 : 1·5
Urea	30–40	30–40	?1 : 1

Other constituents of milk are present either in much larger or much smaller concentrations than in blood. A very few, such as urea, which is freely diffusable through most of the tissues of the body, are present in equal concentration in both blood and milk. Whereas the inorganic salts of milk must clearly come from the inorganic salts of the blood plasma (for example, calcium, potassium and chlorine) it is by no means necessary that the organic constituents of the milk are derived from the more or less obvious precursors in the blood, for example, milk sugar from blood sugar.

As regards venous drainage, the system of blood vessels is more complicated. There are actually three routes by which venous blood leaves the gland, the main one being the subcutaneous abdominal vein which goes forward from the gland just below the skin (the so-called milk vein) and enters the abdomen through a small hole—the 'milk well'—in the abdominal wall. There are considerable anastomoses between the various veins, so that a sample of blood taken from the 'milk vein' gives a fair picture of the composition of the blood leaving the gland.

By comparing, therefore, the composition of the arterial blood reaching the secreting gland with that

of the venous blood leaving it, one should, it would seem, be able to determine what blood constituents are being used by the gland.

The veins are not, however, the only channel through which circulating fluid leaves the mammary gland. There is also, as in most other active tissues of the body, a well-developed lymph drainage system, as extensive as the venous system. The lymphatic system drains the tissue spaces, whence the fluid which originates from the circulating blood is slowly but continuously removed, passed through lymph nodes (there is a particularly large lymph node, up to some 10 cm. long, on the top of the udder on each side) and by a long lymphatic channel furnished, like the venous system, with valves, and returned to the circulating blood through the so-called thoracic duct, which pours a slow stream of lymph into the venous blood of the anterior vena cava, just before the blood reaches the heart. The rate of lymph flow from the mammary gland is undoubtedly very much less than that of the venous blood flow, but in what quantitative relationship the two stand is at present a matter of guesswork. Nevertheless, any balance sheet which might otherwise be drawn up over any given period of secretion, say twenty-four hours, as between the quantity and constituents of blood entering the gland on one side, and the blood plus milk leaving the gland on the other, is complicated by this small but quantitatively unassessed expenditure from the arterial blood which does not appear either in the venous blood or in the milk itself.

The first whole-hearted attempts to discover the nature of the milk precursors gave misleading results. The particular method used was to analyse samples, taken simultaneously, of mammary venous blood and of jugular venous blood. Satisfactory methods for obtaining true arterial blood had not then been worked out, and it was assumed that the easily obtainable jugular blood, draining the head, which was considered to be a relatively inactive part of the organism, in the cow at any rate, would be fairly close in composition to true arterial blood.

This was clearly shown, by later workers at the Hannah Research Institute, not to be the case, so that one at least of the main conclusions drawn from the first experiments, that butter fat in milk was mainly derived from the phosphorized fats of the blood, was incorrect.

Most of the recent work, that is, since about 1932, has been carried out by more reliable methods. Methods of arterial sampling without disturbance of the cow have been developed in various research centres; for example, sampling from the internal iliac artery, which can be easily approached through the rectum of the animal, or principally in goats, from a portion of the carotid artery which has in a previous minor operation been exteriorized in a loop of skin. It may be said at once that the method of obtaining the blood samples is more than half the battle. It was clearly demonstrated at the National Institute for Research in Dairying, at Shinfield, in 1934, that disturbance of the animal during sampling must be avoided, otherwise analysis of the blood samples was largely waste of time. It is not at all easy to take an arterial and venous blood sample practically simultaneously without some disturbance, though individual animals vary very greatly in their perturbability.

To get over this difficulty, two other methods have been used fairly recently: one is the use of an anæsthetic, nembutal, which removes nervous excitement and appears not to interfere with the secretory process; the other is by, so to speak, removal of the animal altogether (a method first used, tentatively, by Foá some thirty-five years ago), namely, by excising the mammary gland and perfusing the latter, with as little delay as possible, either with oxygenated defibrinated blood or with oxygenated whole blood prevented from clotting with a suitable anticoagulant such as sodium citrate or heparin.

None of these methods is perfect, but each has its advantages and disadvantages. The perfusion technique very recently developed by Petersen, Shaw and Visscher in Minnesota is one requiring much experimental skill. It is said that the gland can be in action within seven or eight minutes of the slaughter of the cow. By this method various blood pressures can be used, various materials can be added to the arterial blood, and blood sampling, both 'arterial' and venous (a single venous exit is arranged), is easy, while milk can be collected without too much difficulty. The isolated gland cannot be used too long as it is, of course, steadily deteriorating, and again the question arises as to how far the interference with lymphatic drainage affects the findings.

The nembutal anæsthesia method, also developed in the United States during the War, is said to have no effect on blood sugar or on the rate of milk secretion in goats, or on the energy requirements of the mammary gland.

An entirely different method for the study of mammary gland metabolism is the incubation, in well-oxygenated salt solutions, of fresh slices of mammary tissue with various possible precursors of the milk constituents.

Still another method is by the use of radioactive elements such as radioactive phosphorus or calcium, or of 'heavy' elements such as deuterium ('heavy hydrogen') or 'heavy' nitrogen, which, suitably combined, can be given to a lactating animal by mouth or intravenously, and followed through into the milk by appropriate physical means. This very promising method has so far been used only in a preliminary way, though Hevesy and Aten in Holland, in 1938, made a few useful observations using radioactive phosphorus.

Chemical Changes from Arterial to Venous Blood

Blood sugar. These changes are the largest in actual percentage; there is a fall varying from 10 to 25 or even 30 per cent of the total arterial blood sugar.

Blood fat. There is a fall of about 3–5 per cent in the neutral fat of the blood in passing through the gland.

Lactic acid. The position here is not yet clear. Some earlier experimenters claimed that fairly large amounts of blood lactic acid disappear while going through the mammary gland. More recent work shows little change with normal, unanæsthetized animals, but there appears to be a slight uptake by anæsthetized animals in the first twenty minutes of anæsthesia, but not, it seems, later. It is an open question whether lactic acid is or is not one of the blood constituents normally used by the secreting cells.

β-*Hydroxybutyric acid.* This substance, which occurs in normal cow's blood in appreciable quantities, and in animals in 'ketosis' in much larger amounts, is taken up by the mammary gland in

quantities which appear to vary with the concentration in the blood.

Globulin. Apparently an appreciable quantity of plasma globulin, but no albumin, leaves the blood in traversing the mammary gland. The globulin which is mainly involved is a glycoprotein, the molecule of which contains some 9 per cent of a sugar complex containing galactose, mannose and glucosamine. There is some evidence that plasma albumin is actually greater in mammary venous blood than in arterial blood.

Amino-acids. Small quantities of uncombined amino-acids appear to leave the arterial blood, and there is a suggestion that slightly more urea nitrogen is present in mammary venous blood than arterial blood.

Inorganic phosphorus. There is a drop of about 5–7 per cent in the amount of inorganic phosphorus in blood plasma in passing through the gland.

Calcium. A fall takes place of about 2·5 per cent in the amount of calcium in the arterial blood.

Since the milk contains relatively large quantities of end-products, of which several of the materials just mentioned must be the precursors, it is obvious that, since there is such a small quantity of precursor removed from unit volume of blood, the rate of blood-flow through the gland must be very high (see below).

Mammary Gland Slices

Grant, working in Great Britain, found some years ago that lactose was formed when mammary gland slices were incubated in oxygenated physiological salt solutions containing glucose, but not, apparently, if fructose, mannose, galactose or various sugar-phosphoric acid esters were used. Some of these findings were later called into question, but very recent work of Knodt and Petersen has confirmed that lactose is formed when mammary slices are incubated with glucose, and also with glucose plus lactic acid, maltose and glycogen. It is not perhaps surprising that the last two should give positive results, since both will presumably be hydrolysed to glucose by enzymes present in mammary gland tissue. β-Hydroxybutyric acid disappeared when incubated with mammary slices, the rate depending on the amount of the acid present.

Perfusion of Excised Mammary Gland

It has been shown that tissue glycogen is increased by perfusion of the excised mammary gland with blood containing added quantities of glucose, but increased blood glucose caused no significant change in the amount of lactose secreted in a six-hour period. It is very likely that, as in other tissues, glycogen can be synthesized from various normal blood constituents by the mammary cells, and later hydrolysed again to form glucose and, through glucose, lactose. Normal mammary tissue contains about 0·2 per cent of glycogen, according to American findings.

Further sidelights on the biochemistry of milk secretion are thrown by the study of the composition of milk when the secreting tissue is infected by *Streptococcus agalactiæ*, which may persist in the gland for long periods without too seriously inhibiting the flow of milk.

In the infection known as streptococcal mastitis, the secreting cells are physiologically abnormal in that instead of true milk, a fluid is secreted in which the characteristic milk constituents lactose, casein and fat and the less characteristic but very important constituent vitamin A are diminished. There is an increase in globulin and a large increase in chloride. Davies believed that mastitis milk could be regarded as ordinary milk containing larger or smaller proportions of what he called "an isotonic diluent" approximating in composition to blood plasma, with its relatively high proportion of globulin and sodium chloride. A varying proportion of udder tissue is, in effect, in a catarrhal condition and forms an ineffective barrier against this leakage. This view has recently received some support from the finding that while in the blood plasma of a cow receiving green fodder carotene is high, in normal milk the carotene content is only 3 per cent of that in blood, but in mastitis milk (even say from one infected quarter of a cow the other three quarters of which may be still normal) the carotene may be as high as 20 per cent or even more of the blood level. Vitamin A, on the other hand, is lower in blood plasma than in milk—it is not yet certain whether the udder cells concentrate the vitamin A of the plasma or actually synthesize it from blood carotene—but in mastitis milk it is, like the fat, lower than in normal milk.

Any connected account of the processes by which milk is made in the udder must provide an explanation of the interesting carotene-vitamin A-butter fat relationships in milk. Both carotene and vitamin A are present in milk in solution in the fat globules; but it has been shown quite recently that whereas the vitamin A-butter fat ratio is more or less independent of the size of the fat globule in milk, the carotene-fat ratio in the fat globule increases as the size of the globule diminishes, that is, as its relative surface area increases. This suggests that fat and vitamin A are synthesized, or perhaps one had better say assembled, by the same mechanism in the secreting cell, whereas the closely related (and also fat-soluble) carotene finds its way into milk by a different process associated in some unknown way with the *surface* of the fat globules.

All the water-soluble vitamins investigated—vitamin C, riboflavin and vitamin B_1—are considerably more concentrated in milk than in blood. Vitamin C is concentrated some eight times, riboflavin perhaps about four times, and total vitamin B_1 two or three times. All three are depressed in amount in mastitis milk, as would perhaps be expected since a function of the normal secretory cell is to take them up from the blood and concentrate them, a function which partially breaks down in the infected cell.

Energy Changes in Milk Secretion

Despite the rapid flow of blood through the mammary gland, a considerable proportion of the oxygen reaching the gland from the arterial blood is used up for combustion of one or more oxidizable substances in the tissue. Quantitatively, in some Shinfield experiments in which we were satisfied that the cows were undisturbed, the amount of oxygen used by the secreting gland was 4–5 volumes for each 100 volumes of blood, while at the same time 5–7 volumes of carbon dioxide were given out to the venous blood. The so-called respiratory quotient—volumes of carbon dioxide given out divided by volumes of oxygen used—was invariably higher than 1 in all experiments where the cows were undisturbed.

Similar findings have been made in at least two laboratories abroad, with both goats and cows; that

is, in the undisturbed, normal animal, a mammary gland respiratory quotient of well above 1, usually between 1·1 and 1·3, is found.

If these findings are to be interpreted along the usual lines, it would mean that the secreting cells were synthesizing fat from carbohydrate. The American workers, who found that β-hydroxybutyric acid was being taken up from the blood by the gland, suggested that it was being partially oxidized and partially transformed into the short-chain fatty acids which occur specifically in milk fat. But it is known that the amount of blood *fat* taken up by the mammary gland is sufficient to account for all the milk fat secreted, so that this suggestion requires further evidence before it can be accepted.

Until we are fairly certain what substances are actually serving the gland as sources of energy and what blood precursors are transformed into milk constituents, exact knowledge of the energy changes in the gland will not be forthcoming, and it is probably idle to make any thermodynamic speculations at present.

Rate of Blood Flow through the Secreting Udder

One of the earliest estimates of the number of volumes of blood required, on the average, to produce one volume of milk, was made by the Shinfield workers in 1935, by comparing the fall in fatty acid, inorganic phosphorus and sugar between arterial and mammary venous blood. It was considered that probably between 400 and 500 volumes of blood must circulate through the udder to produce one volume of milk. This figure was little more than a guided guess, and it was pointed out at the time that implicit in this conclusion was the view that the lymphatic drainage of the udder could be regarded for the purpose of calculation as negligible—a likely assumption, but little more than an assumption. Afterwards, by use of a 'stromuhr' or volume-meter actually inserted in the circulation, Graham found that the blood flow was only about half our estimate. Still later findings of Shaw and others, who have used a rather different method of assessment, namely, by determining the amount of total calcium and total phosphorus taken, on the average, out of unit volume of blood by the udder, and the amount of the same materials in the milk secreted by the same animal during twenty-four hours, point again towards our original estimate of 400–500 volumes. Their average figure is given as 494 volumes of blood for each volume of milk—an average finding, of course, the lowest figure being 331 volumes for total phosphorus in one experiment and the highest 650 in one experiment for total calcium.

The results summarized in the accompanying table are probably not very far from the truth, though the experimental errors in the second column are quite appreciable, and also the efficiency of uptake of any blood precursor by the mammary cells will, like the efficiency of any other physiological process, undoubtedly vary from one cow to another and in the same cow at different stages in the lactation period and even at different times on the same day. It may nevertheless be concluded that, with a reasonably good cow at the peak of her lactation, giving say four gallons of milk a day, approximately nine tons of blood, say eighteen times her own weight, will pass through the udder each day.

Table 2. Mammary Gland Balance. Summary.

(From Shaw, Powell and Knodt, 1942.)

Blood precursor	Gland utilization per litre of blood (gm.)	Suggested end product				Ratio of blood volume to milk volume
		Milk substance	24 hr. production (gm.)	Blood required (litres)	Milk produced (litres)	
Calcium	0·0021	Calcium	22·52	10,931	19·40	563 : 1
Phosphorus	0·0021	Phosphorus	17·61	8,246	,,	425 : 1
Calcium + phosphorus	0·0042	Calcium + phosphorus	40·13	9,588	,,	494 : 1
Neutral fat	0·0684	Fat	707·5	10,317	,,	532 : 1
Glucose	0·1122	Lactose	985·5	9,070	,,	468 : 1

Precursors of Milk Constituents

To sum up, our present knowledge of the precursors of the main milk constituents is as follows :

Milk fat. This is almost certainly derived from the neutral fat of the blood. The short-chain fatty acids in milk fat are probably derived, as Hilditch first suggested, from the breakdown of some of the long-chain fatty acids in the blood fat, though the recent findings of Barcroft and his co-workers that the ruminant is able to take up short-chain fatty acids direct from the rumen and that these may circulate in the blood has to be borne in mind.

Lactose. This is almost certainly derived from the glucose of the circulating blood, though the latter sugar may pass, in part in any event, through intermediate stages such as lactic acid or even glycogen in the gland cells before being transformed into the lactose. Part of the lactose may come from the sugar-containing globulin which is taken up by the active gland cells from the blood.

Casein and lactalbumin. There is little doubt that amino-acids in the circulating blood contribute at least a little toward the synthesis of one or both of these proteins by the gland cells. Doubtless a major portion is contributed by the blood globulin which is now known to be taken up by the secreting tissue. Using radioactive phosphorus, it has been shown that the inorganic phosphate of the circulating blood provides the phosphorus organically combined in the casein molecule. We know less about protein synthesis by the gland than about fat and carbohydrate synthesis.

Energy. We know next to nothing as to what carbon compound is burnt in the mammary gland to provide the energy needed for synthesis of the milk constituents. It may be glucose, lactic acid, the sugar-containing moiety of the blood globulins just mentioned, or β-hydroxybutyric acid, or a part of the blood fat, or a combination of two or more of these.

In this connexion it seems more than likely that the secreting cells may be capable, like other tissues of the body, of using different materials for energy production or for milk production at different times and under different nutritional conditions. Although the secreting tissue of the mammary gland appears histologically to be simpler than that of, say, the kidney, it is clear from what has just been said that the activities of these large mammary cells are very complex. Their internal structural pattern and enzymic equipment are at present almost unknown.

CERVICO-FACIAL PIGMENTATION (MELANOSIS OF RIEHL-POIKILODERMA)*

By Dr. GEORGES GARNIER
Paris

Translator's Note. On a recent visit to Paris I was struck by the number of women suffering from diffuse pigmentation of the face. I saw my first cases in the streets and only learnt the nature of the condition when I visited the hospitals, where it is a commonplace in all dermatological clinics.

The melanosis of Riehl[1] is, to most British dermatologists, only a name, as it is a rarity in Great Britain as much in war-time as in peace. Its appearance in the War of 1914–18 and in this in starved populations seems more than mere coincidence, but the title 'war melanosis' given to the condition by Hoffmann and Habermann[2] has been challenged by Comel[3]. The condition is the subject of much discussion in France and there is great diversity of opinion as to its cause. Dietetic deficiency is not always obvious: the condition is seen in well-fed country dwellers as well as in city dwellers who have, on the whole, a very low dietetic intake. 'Nervous shock', so often invoked in conditions of unknown origin, has not been forgotten. Dr. A. Touraine, at the May meeting of the Société Française de Dermatologie et de Syphiligraphie, made a strong plea for the acceptance of the use of hair dyes as an important cause, but was just as strongly challenged by other members of the Society.

Dr. Georges Garnier's paper, which he has generously allowed me to translate, gives a well-balanced account of the various clinical and etiological aspects of cervico-facial pigmentation.

James Marshall.

THE obvious increase in incidence of cases of cervico-facial pigmentation directs attention again to this curious dermatological syndrome, which raises a series of clinical and etiological problems. Dermatologists describe the condition either under the name of melanosis of Riehl, the Viennese author who described it in 1917, or under the name of reticulate pigmentary poikiloderma of the face and neck, as described by Civatte in 1922[4]. For a certain number of authors these are two different conditions, closely related and almost completely identical histologically (Petges; Pierini and Bosq; Noguer More and Grau Barbera). For others (Civatte, Sézary), on the contrary, there is only one disease, or rather one single syndrome, in spite of the clinical differences to be described later. Until the last few years published observations have usually appeared under the title of reticulate pigmentary poikiloderma of the face and neck. More recently in France, Sézary, Jausion, Gougerot, Degos and Garnier have reported their observations under the title of melanosis of Riehl.

Whatever the term adopted, it must be recognized that it lumps together a number of features which may appear a little incongruous when one tries to detail the etiology and pathogenesis. There must first be distinguished groups where abnormal pigmentation is secondary to a pre-existing dermatosis. With R. Degos I described to the Society of Dermatologists in 1943 the case of a patient who presented clinical signs of poikiloderma (pigmentation and telangiectases) and who also had lichen planus. This dermatosis, so often productive of pigmentation, had assumed the appearance of reticulate cervico-facial melanosis. In studying earlier observations I have been struck to see how often lichen planus has been evoked or suspected in like cases, and where, in spite of a somewhat hesitant diagnosis, the publication carried the title of cervico-facial poikiloderma. There is a case described by Nomland[5] where Finnerud and Oliver do not accept the diagnosis and suspect a lichen. Similarly, Louste, Lévy-Franckel and Cailliau[6] describe a case where there were shiny papules with atrophic centres and a buccal leuco-keratosis, the condition being improved by 'Acetylarsan', a common therapeutic agent in lichen planus. In this connexion there can also be cited the observations of Gaté, Cuilleret and Bret[7], of F. Wise[8], and of Wiessenbach, Lévy-Franckel and Martineau[9]. It seems, therefore, that a certain number of cases described as reticulate pigmentary poikiloderma are in fact more or less typical cases of lichen planus and that this is a diagnosis which should be suspected more frequently.

Whatever they may be, these cervico-facial pigmentations present the following clinical picture: the patient, usually a woman, sees the progressive development of a pigmentation composed at first of isolated spots, soon becoming confluent into more or less extended patches on the forehead, temples, cheeks and lower eyelids and descending along the jaws to reach the sides and sometimes the nape of the neck. Usually the pigmentation stops one or two centimetres from the hair margin. In some cases an extension to the forearms has been described. The colour of the pigmentation varies from a deep greyish-brown through chocolate, sometimes reaching violet. It is disposed in irregular plaques with islands where the skin has kept its normal colour (notably around the pilo-sebaceous orifices), producing a reticulate aspect which sometimes suggests poikiloderma. However, there is usually lacking a symptom which is part of the classical triad of poikiloderma, namely, telangiectiasis. This is not mentioned by Riehl nor in most of the observations recently published in France under this name. Atrophy also may be lacking or may exist only in a most discrete fashion on certain regions, notably the temples. It must be admitted, however, that atrophy is not always easy to recognize clinically, and might be more frequently found on histological examination.

Such is the appearance in most cases of war melanosis of the type described by Riehl, and which corresponds to those recently observed. In the observations of Civatte and certain others there have been noted also the association of telangiectiases with reticulate pigmentation. Melanosis may extend to the arms and forearms, and certain authors have even noted patches of pigmentation on the buccal mucosa. Finally, one may see on certain patients special lesions, punctate blackish hyperkeratotic papules on the dorsa of the fingers, on the hands, and even on the forearms, resembling, when most marked, a follicular keratosis or pityriasis rubra pilaris, or even giving the appearance of oil acne. It is a question then of people working with tar derivatives, or with oils, the lesions being at maximum in the toxic lichenoid melanoderma of Hoffmann and Habermann in which hæmorrhagic bullae have been noted, and where there is a professional factor (tar workers).

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It is necessary in the consideration of the etiology of the condition to distinguish external and internal factors.

External Factors

Light has been invoked as a cause by numerous authors. It must be admitted that the localization of the melanosis on uncovered regions obliges us to take note of this. Light may act directly or in conjunction with a photo-sensitizing substance. In the case of direct action, the influence of light can be manifested by the appearance of an erythema which, more or less intense, sometimes precedes the appearance of pigmentation. Such was the case of one of the patients I recently described. This was a well-nourished woman of seventy years, in whom the melanoderma appeared after exposure to July sunshine which had caused intense redness of the face.

In other cases the action of light is exercised indirectly through the intermediary of a photo-sensitizing substance, which may act locally on the skin or be absorbed by the organism. The most important examples of the first type are tar and its derivatives, in which is found a fluorescent substance that is particularly photo-dynamic, acridine (Hoffmann). In the second type the sensitivity results from the respiratory or digestive absorption of the noxious substances (Kismeyer, Meyrovosky).

Other authors have blamed contact with lubricating oils (Thibierge); coal, in the case of an engine driver (Lortat-Jacob, Legrain and Cléret); creosote in railway sleepers, in the case of a platelayer (Hudelo, Cailliau, and Mornet); certain dye substances (Gougerot and Weil); cresyl (Garnier); and certain paints (Garnier). In a patient I saw recently I suspected hair dye as the cause. The dye involved was a substance of the chrysoidine type which gave no immediate cutaneous reaction but which sensitized the skin to ultra-violet light, as was shown by test. In this patient were associated both internal and external factors as, besides the action of the dye, there was a high porphyrinuria which further explained the photo-sensitization.

Internal Factors

These are many. Some cases show signs of visceral disease. Alcoholic liver damage was noted in numerous observations (Civatte, Lortat-Jacob, Sézary), and this would explain a porphyrinuria.

Other cases show endocrine disorders, notably ovarian (Civatte) and suprarenal (Sézary, Navarro-Martin and Aguilera). The role of the latter in pigmentogenesis is well known. The influence of the suprarenal must be investigated even if it does not appear to be the cause at first sight. I published in 1938[10] an observation on a woman with a typical melanosis of Riehl where cresyl might have been the cause, but who, a year later, died of Addison's disease. Sometimes it is the pituitary which is incriminated, but the influence of this gland is more difficult to decide.

We arrive finally at the elementary factors which, from the start, have been evoked by Riehl and which predominate in the pathogenesis of melanosis. It is striking to note that the first cases were observed in Central Europe, where the dietetic restrictions were particularly severe during the War of 1914–18, and that similar cases are now arising among our starved populations. Riehl at first suspected as the cause certain *ersatz* substances which were used in wartime bread (flour made from various leguminous plants). Hoffmann incriminated maize, others suspected margarine (Baschk) and barley (Kerl). All these products were capable of producing a photo-sensitization analogous to that produced in pellagra and in certain animal diseases (fagopyrism and trifoliosis). Avitaminoses must also be mentioned, notably deficiency of vitamin P.P. which is involved in the metabolism of the porphyrins. The role of porphyrinuria in the pathogenesis of the melanosis of Riehl is not considered important by some authors (Petges, Jausion), while others take the opposite view. The quantity of urinary porphyrins, which is normally from twenty to forty gammas per litre, may attain two hundred and eighty gammas (Garnier), and even sixteen hundred gammas in a case described by Degos and Carrot[11] in a prisoner-of-war whose pigmentation improved after his return to more normal diet.

Vitamin C deficiency may also be a cause. Moravitz has suggested that it has a part in the pigmentation of Addison's disease. One of my patients presented a marked diminution of urinary ascorbic acid and was much improved after administration of vitamin C.

To summarize, it is necessary to consider cervico-facial melanosis as a syndrome which can arise from different causes. Some are external, for example, (1) light; (2) tar products acting as photo-sensitizers; (3) direct action of toxic products on the skin. Others are internal, for example, (1) visceral and endocrine deficiencies; (2) disorders of porphyrin metabolism; (3) avitaminoses. The pathogenesis of the cervico-facial pigmentations is most complex, as all these causes may act alone or, oftener, in association.

From the clinical point of view it is difficult to classify the cervico-facial melanosis syndrome. Abroad, numerous authors (Kinnear, Noguer More, Grau Barbera, Pierini and Bosq) distinguish: (1) Melanosis of Riehl, a pure pigmentation in which is lacking clinical evidence of telangiectases and atrophy and in which contact with external factors is a part of the history. (The toxic lichenoid melanoderma of Hoffmann is classed only as a particularly intense variety in which professional causes preponderate.) (2) The reticulate pigmentary cervico-facial poikiloderma of Civatte in which the melanosis is associated with telangiectases and atrophy. This variety is classed as a localized form of the poikiloderma of the type described by Petges and Jacoby. Internal factors, notably endocrine, predominate, and external causes blamed in the melanosis of Riehl are not found.

In reality, these differentiations are more academic than real. Many of the clinical characteristics invoked to distinguish these two groups are disputable. The pathogenic factors, external in the melanosis of Riehl, internal in the cervical-facial poikiloderma of Civatte, are alike insufficient to draw exact limits. We have seen that Riehl himself suggested a dietetic cause for the melanosis he described, and is it not possible in a cervico-facial poikiloderma lacking external causes at least to admit the possibility of light being a factor and adding its action to visceral and endocrine disorders? On the other hand, it seems to me necessary to set aside a group of cervico-facial melanoses in which the pigmentation is secondary to a pre-existing dermatosis, often undiagnosed, in particular, lichen planus.

Treatment

By its slow persistent evolution on the face and neck it constitutes for patients an æsthetic trauma which, in certain women, can lead to a veritable

obsession. It is important, therefore, to apply treatment which, though it cannot be rapidly effective, will at least retard the extension of the disease and hasten its regression. Locally, the bleaching lotions normally used are without effect. It is necessary to avoid injury by light and to prescribe an anti-actinic cream containing 6 per cent of menthyl salicylate. The handling of noxious substances, tar and its derivatives, dyestuffs or paints must be stopped. In certain cases one must compensate endocrine deficiencies (ovary and suprarenal particularly). Finally, one must counteract the various vitamin deficiencies, in particular of vitamin P.P. and vitamin C. It is necessary to give a high dosage of nicotinamide (0·6 gm. per day at least, by mouth) and to add, if deficiency of vitamin C is suspected or proved, ascorbic acid (0·3 gm. per day at least).

[1] Ri hl, *Wien. klin. Wschr.*, **30**, 780 (1917).
[2] Hoffmann and Habermann, *Deutsche med. wschr.*, **44**, 261 (1918).
[3] Comel, *Gior. ital. de derm. et sif.* (June 1933).
[4] Civatte, *Ann. de derm. et syph.*, **4**, 605 (1923).
[5] Nomland, *Arch. of Derm. and Syph.*, **22**, 184 (1930).
[6] Louste, Lévy-Franckel and Caillian, *Bull. Soc. derm. et syph.*, 679 (1932).
[7] Gaté, Cuilleret and Bret, *Bull. Soc. derm. et syph.*, 583 (1934).
[8] Wise, *Arch. of Derm. and Syph.*, 587 (1934).
[9] Wiessenbach, Lévy-Franckel and Martineau, *Bull. Soc. derm. et syph.*, 574 (1935).
[10] Garnier, *Bull. Soc. derm. et syph.*, 900 (1938).
[11] Degos and Carrot, *Soc. franç. de derm. et syph.* (Dec. 1942).

NEWS and VIEWS

Prof. L. Bairstow, C.B.E., F.R.S.

THE retirement of Prof. L. Bairstow from the post of Zaharoff professor of aeronautics in the University of London marks the departure of a pioneer from the scientific side of aviation. Bairstow began his work on aerodynamics so long ago as 1909. He was then on the scientific staff of the Engineering Department of the National Physical Laboratory, and when it was decided to undertake aerodynamic research in the Laboratory, he was charged with the formation of a small group of workers and the carrying out of research under the general control of the Advisory Committee for Aeronautics. He very quickly justified the confidence placed in him and began to lay the foundations of the new science. Seeing at once the fundamental importance to aerodynamics of the theory of dynamic similarity, he initiated experiments in air and water to prove its truth to the unbelieving. By 1911, he and his collaborators had made a number of investigations on wind tunnel design and had succeeded in producing what was the first really satisfactory wind tunnel in Britain. About the same time he was studying the theory of the stability of aeroplanes, as laid down by Bryan, which he extended very greatly as time went on and generalized to cover all six degrees of freedom. He employed the wind tunnel to measure aerodynamic stability derivatives, and by using the values so obtained in the light of the theory, he produced the first clear account of the disturbed motions of aircraft, and established the fundamental basis of all later developments in this field. He even traced the motion of an aeroplane as it flew through a prescribed gust. An example of his experimental versatility was an attempt to investigate the motions of airships by tests on models about six inches long in a water stream flowing at a few inches a second ! He was responsible for the first investigation in Britain on the subject of flutter, and he contributed much to the knowledge of practical flying by his investigations of flying accidents. The Aerodynamics Division of the National Physical Laboratory, as it exists to-day, owes Prof. Bairstow an immense debt of gratitude for the work he did in establishing it. This work was recognized in 1917 by the award of the C.B.E., and by his election to the fellowship of the Royal Society.

Prof. Bairstow was the first superintendent when aerodynamics became a separate Department of the National Physical Laboratory, but he left in June 1917 and took up duties at the Air Ministry. In 1920 he became professor of aerodynamics under Sir Richard Glazebrook, who then held the Zaharoff chair at the Imperial College, London. He succeeded to this chair in 1923 and has held it ever since, thus spending a large part of his life in guiding the destinies of students in the College where he himself had been educated. He became Dean of the Faculty of Engineering at London in 1935, and was appointed to the Senate in 1936. The excellence of his work at the University is well shown by the number of his students who to-day occupy important positions in industry and in the Government research institutions. Prof. Bairstow was also very active outside the University. He was vice-president of the Royal Aeronautical Society during 1930–34, but his greatest contribution, apart from his research and teaching, was his service on the Aeronautical Research Committee, of which he has been vice-chairman for many years, besides occupying the chair of several of its important sub-committees. His book, "Applied Aerodynamics", is almost a classic, and is by far the most comprehensive work on the subject by an Englishman. To those who have known him intimately, Bairstow has always been ready with counsel and advice, and has endeared himself to his many friends by his delightful personality and charm. Though he deserves a well-earned rest after a long life's work, it is to be hoped that he will still be able to spare a little of his time to help forward the great advance of aeronautics which the future appears to hold in store.

Museums and the Community

THE case for the museum in relation to modern educational and cultural developments is well and fairly examined in Part 1 of a 39-page pamphlet entitled "New Zealand Museums" by Dr. W. R. B. Oliver (Dominion Museum, Wellington, 1944). The subjects of research, display of exhibits, reference collections, buildings, policy and administration are fully reviewed, but those sections dealing with education are worthy, perhaps, of particular attention. In reference to adult education, Dr. Oliver writes: "The kind of information distributed through the Museum services is not limited to a few subjects such as biology, ethnology and geology. . . . Those subjects not dealt with in the exhibition galleries can be covered very effectively and thoroughly by films shown during the regular educational screenings. By means of films and authoritative lectures, the Museum can extend its province to cover the entire range of human knowledge." This is a fine conception of the work lying within the grasp of the

larger museums, but its fulfilment, both in Great Britain and elsewhere, would seem to require closer co-operation between the museums, all other kinds of educational institutions, scientific and art societies, and individual specialists than has generally been the case hitherto. Only when the work of each is mutually understood and appreciated will the museum be able to establish itself fully as the link between the research worker and specialist, who continually advance our knowledge, and the ordinary men and women, who need to be kept informed of such advances.

With regard to school services an interesting development in the Dominion Museum is well worth attention. Before the War, this Museum provided regular instruction for visiting classes of school-children. On each visit the children were first given a lecture—usually illustrated by a film—in the lecture hall. There then followed a lesson in the Museum. Here the children were divided into groups, each of which was under the charge and instruction of a student teacher from the training college. Six teachers at a time attended the Museum for this purpose for a period of six weeks, and in this way gained valuable experience in the use of museum material. They, themselves, were instructed by members of the Museum's professional staff, and so, ". . . the value of the museum to the community was emphasized to the students, who left the institution with sufficient knowledge of its capabilities and functions to enable them to educate their future charges in the purposeful use of the public museums". Part 2 of this valuable pamphlet deals more particularly with the present buildings, administration, equipment, finance, etc., of New Zealand museums.

Belgian Biological Publications during the War

Dr. Julian Huxley has received a letter from Prof. C. J. Van der Klaauw, of the Department of Zoology of the University of Leyden, and one of the directors of *Acta-*, *Folia-*, *Bibliographia-*, *Bibliotheca-Biotheoretica*. Prof. Van der Klaauw states that he is well, as is also his lecturer in experimental zoology, Dr. N. Tinbergen, although both of them spent some two years in a concentration camp, with about twenty of their colleagues from Leyden. After release from imprisonment, Prof. Van der Klaauw was exiled to the eastern part of Belgium. He adds that Prof. H. J. Jordan, professor of comparative physiology in the University of Utrecht, died of apoplexy during the War.

During the occupation of Belgium, vigorous efforts were made—with a considerable measure of success—to keep alive the biological journals referred to above, and to maintain their international character. Since May 1940, the last two parts of vol. 5 of *Acta Biotheoretica* have appeared. They contain a paper by a German (Frieling), three by writers in the United States (Rashevsky, Lafleur) and one by a Russian in France (Kostitzin, in French). Vol. 6 appeared in 1942, containing four papers in German (Friederichs, Hofstaetter, Kuhn, Meyer-Abich), two by a Pole (Wilzýnsky, in English and French), and one by a Dutchman (Ariëns Kappers, in English). Vol. 7 appeared in 1943 and contains three papers in German (Meyer-Abich, Friederichs, Thienemann), one by a Norwegian (Ubisch, in German), three by Dutchmen (Voûte, Raven, Pos; two of them in French, one in English); two papers by a Pole (Wilzýnsky, in English). Another paper by Wilzýnsky (in English) and one by a Dutchman (Baas Becking, in English) will fill part of the next volume. The series entitled *Bibliotheca Biotheoretica* started during the War. There have appeared: No. 1 (1941), a paper by Prof. H. J. Jordan, in German; No. 2 (1942), a rather long paper in German by a Russian (Schaxel); No. 3 (1942), a long paper in English by Dr. N. Tinbergen; No. 4 (1944), a long paper in English by two Dutchmen (Booy and Wolvekamp). In the series *Bibliographia Biotheoretica* there appeared: Vol. 2 (literature 1930–34) in 1941, the last part of Vol. 3 (1935–39) in 1942, and in 1944 the first part (82 pp.) of the fourth volume (literature 1940–44).

Prof. Van der Klaauw and his colleagues have clearly done their best to maintain the international scope of the periodicals produced by the Prof. Dr. Jan Van der Hoeven-Stichting. They hope that British scientific workers will use their journals in the future.

Historical Background of Planning

In Occasional Pamphlet No. 1 issued by the Society for Freedom in Science (April 1945. 1*s.* 6*d.*), under the title "Is the Progress of Science Controlled by the Material Wants of Man?", Dr. F. Sherwood Taylor makes a spirited attack on the main thesis of a memorandum issued by the Association of Scientific Workers in November 1943 on "The Development of Science". Dr. Taylor challenges the historical arguments advanced in that memorandum in favour of the planning of science and, apart altogether from the question whether or not those arguments are justly inferred from true historical data, Dr. Taylor's pamphlet is to be welcomed as a corrective to an undoubted tendency to mix propaganda and history. It should stimulate clearer thinking about the development of science: science, he reminds us, is something done by people, and if it is organized at all, it is organized by people. He urges that no causes should be looked for outside the internal logic of science, until those within it have been exhausted. Listing the great discoveries of the years 1775–1800, he considers that only Watt's improvements in the steam engine, Cort's puddling of iron and Jenner's vaccination can be said to be dictated by human needs; and similarly, while applied science workers are concerned to bring the discoveries in pure science into rapid use, the great discoveries of the last fifty years were not dictated by human needs. Simply from the point of view of causing discoveries to be made, the community must take a long-term view and encourage science to advance in its own way.

Dr. Taylor frankly challenges the practicability of planning pure science, even by men of science; let the community plan applied science if it can, he says. If any planning or direction of funds has to be done, let the planning and direction be on the basis of the maximum increase of research directed to knowledge and irrespective of use. But while he rightly argues that to ensure the maximum of scientific research will give the maximum useful rewards to the whole world, he passes over the fact that resources are limited, that the research front is uneven and advance in some fields is retarded by neglect elsewhere. So, too, while he is right to urge the reading of the works of the great men of science instead of modern books advancing not wholly uncoloured views about them—advice which might well be heeded by many scientific workers, apart from the public, who would thus be better able to

understand the nature of the scientific man and his methods—he is just a little too sweeping in his condemnation of the reading list provided in the A.S.W. pamphlet, and he might have strengthened his case by a reference to the "Source Books in the History of Sciences" published by the McGraw-Hill Book Co., which within their limits overcome the difficulty of accessibility to which Dr. Taylor refers.

Colonial Geological Surveys of Africa

Sir Edmund Teale's important address on "The Contribution of Colonial Geological Survey to the Development of the Mineral and other Resources of East and West Africa", delivered before the Royal Society of Arts, is published in the Society's *Journal* of April 13, 1945, pp. 245–56. The success of the early mineral surveys, of which the first was started in Nigeria in 1903, made it clear that larger staffs and fuller facilities for the wide extension of geological work on more systematic lines would be amply justified. The first permanent Geological Survey was started on the Gold Coast in 1910, to be followed in 1918 by one in Nigeria, and later by others in Uganda, Tanganyika, Nyasaland, Sierra Leone and Kenya. Their economic activities are summarized as (*a*) *exploratory*: dealing essentially with investigations which yield results in the actual discovery of new deposits of minerals, or in mapping the geological features which assist prospectors or mining engineers to locate and open up mineral occurrences; and (*b*) *advisory*: including numerous forms of assistance regarding engineering, industrial, commercial, agricultural and welfare interests (for example, water supply, soil conservation and site locations). Much of this assistance, though it has far-reaching influence on colonial development, does not usually lend itself to statistical valuation.

On the exploratory side, however, actual mineral discoveries by Survey geologists have yielded direct revenue in royalties alone which have repaid many times over the total cost of all the Colonial Geological Surveys. The cumulative values of some of the more important Survey discoveries are as follows (up to 1939 or 1940):

Gold Coast	Diamonds	£7,613,186
	Manganese ore	10,062,594
Sierra Leone	Iron ore	2,640,966
	Diamonds	4,700,272
Nigeria	Coal	1,860,000

Certain other minerals, such as mica, tin and tungsten ores, and above all bauxite (of which the estimated reserves are 250 million tons in the Gold Coast and 60 million tons in Nyasaland), have afforded important supplies to the strategic mineral requirements of the War.

High Polymer Bulletin

Anyone familiar with present developments on the academic side of micro-molecular chemistry and physics cannot fail to be impressed by the contributions made to the subject by Prof. H. Mark, now of the Polytechnic Institute, Brooklyn, New York. In this Institute there has been established a Bureau of High-Polymer Research, the business of which is to carry out research on all problems of high-polymer chemistry and to organize and to conduct courses of instruction and also discussions on various aspects of the subject. In order to let the scientific public know more about the activities of the Bureau than would be gleaned by reading papers in the scientific journals, a *Polymer Bulletin*, issued bi-monthly, has made its appearance under the editorship of Paul M. Doty. The first number gives a brief description of some of the equipment of the laboratory and of the researches now in progress, but not yet published in the usual journals. While this preview of what is to come from the laboratory is of great interest to high-polymer chemists, it is somewhat unusual, and incidentally an interesting experiment, to find an academic laboratory publishing its own 'science news'. Thus yet another publication is added to the list which a busy investigator must scan to make sure that his own work is not likely to be out of date before it is published. In a quickly advancing subject like high polymers, at the present stage the desire to found new journals inevitably arises; the measure of success depends upon what support is given to the venture in its initial stages.

The World To-day

With its last issue, for June 23, the *Bulletin of International News* has been replaced by a monthly review, *The World To-day*, and a *Chronology of International Events and Documents* appearing twice monthly. Each issue of the former will contain "Notes of the Month" and five or six articles. The first issue for July includes five, dealing with the municipal elections in France, the Allied zones of occupation in Germany, Germany and European reconstruction, international air transport and Guernsey under German occupation. It is hoped that by articles giving factual background to current international problems and first-hand accounts of conditions in foreign countries, *The World To-day* will help to meet the demand of the general reader for such factual information; while the Supplement will be for the specialist who requires the reference material in connexion with his work as a student of international affairs, lecturer or writer, business man or diplomat. The new arrangement will also permit the most economical use of the available paper.

Energy Regulators

The energy regulator made available by Sunvic Controls, Ltd., operates by periodically switching the power on and off, the ratio on-time/total time determining the average power input. The regulator is generally cheaper and far less bulky than a variable resistance. The control is effected without the energy loss in a resistance, it is variable continuously from no load to full load, and is substantially independent of mains voltage fluctuations up to about 20 per cent. Two forms are available, one for industrial purposes having a minimum time-cycle of about 30 sec., and another for laboratory use with a cycle of about 10 sec. The regulator consists essentially of a bimetal strip carrying a heater winding, connected in parallel with the load to be controlled. A snap action switch is in series with the load and is normally closed, so that current flows through the heater winding and through the load. The bimetal warms up and, in bending, opens the switch, interrupting the current both to the heater winding and the load. The bimetal then cools down and the cycle is repeated. The ratio of the time during which the contacts are made to the total time of the cycle determines the average input.

Some applications of the regulator are as follows: (1) in apparatus where it is inconvenient or impossible to fit a thermostat—for example, hot plates, injection moulding nozzles, moulding platens, etc.; (2) for small, high-temperature ovens and furnaces where

the cost of temperature control would be excessive; (3) for any heating process where the temperature is a function of power input only; (4) to control the rate of change of temperature in a furnace in order to reduce the temperature differential permitted by conventional temperature controllers; (5) for controlling the input to a furnace so as to obtain rapid heating-up without undue over-run at the operating temperature; (6) to control the average output of a motor driving, for example, a conveyor or pump where there is no objection to the motor being periodically started and stopped, such as a pump filling a tank or a motor driving an automatic stoker or a belt travelling through a furnace. The regulator can also be employed to obtain an adjustable time delay of 10–120 sec. and as a flasher with adjustable on/off ratio.

Future of Electricity Supply in Matabeleland

A PAPER on this subject is contributed by Mr. A. R. Sibson to the February 1945 issue of the *Journal of the Institution of Electrical Engineers* (**92**, Pt. 2, No. 25). Southern Rhodesia is now coming to life industrially, and the problems of electricity supply require careful consideration if the Colony is to progress on sound economic lines. In this paper, the existing economic and geographical conditions are first outlined, together with the sources of raw materials, power and water. The probable development of basic industries in Matabeleland is discussed and other possible avenues of electricity consumption are detailed, including railway traction and the natural growth of existing load centres. The author then investigates three different methods of supplying the power demand of the future, two of which involve the transmission of large blocks of power over distances in excess of two hundred miles. The peculiar problems inherent in long-distance transmission in Rhodesia are dealt with, and the economics of overhead lines operating at 250 kV. are examined. The author reaches the final conclusion that the use of hydro-electric power, up to a total of 100,000 kW., from the Victoria Falls should be seriously considered as part of a comprehensive scheme for future supplies.

Insecticides

SOME useful information about the phytopathological uses of the new insecticide D.D.T. (dichlorodiphenyl trichlorethane) has been given by H. Martin and R. L. Wain (*J. Roy. Hort. Soc.*, **69**, Pt. 12, Dec. 1944). This substance, at insecticidal strength, is harmless to man and farm animals, but acts both as a contact and stomach poison to insects. D.D.T. could probably replace lead arsenate in the combined spray with lime sulphur, without any objectionable sludge of lead sulphide. Perhaps its most outstanding possibility, however, is its use as a persistent contact insecticide. It is unaffected by light and moisture, in contrast to the pyrethrins and rotenone, and offers the horticultural possibility of applying a contact insecticide at any convenient period—not, as hitherto, when the insects are actually exposed upon the plant. This should provide a useful method of control for such pests as apple blossom weevil and the leaf miners, which are usually protected from any direct spray, but move about the plant for certain limited periods. D.D.T. does not seem to have any egg-destroying properties, and is somewhat slow in action, but these defects are small in comparison with the positive benefits. A short anonymous account following the above reference directs attention to a new thiocyanate winter wash. The toxic agent is β-butoxy-β′-thiocyanodiethyl ether, and this is incorporated with petroleum oil. Thiocyanate washes are non-poisonous to human beings, domestic animals and poultry, are more convenient in use than dinitro-*ortho*-cresol (D.N.C.) and give a good control of woolly aphis, which has hitherto eluded all attempts to control it by spraying.

Palæontographical Society's Centenary, 1947

THE Council of the Palæontographical Society has accepted a recommendation from its Centenary Committee urging the publication of a directory of British fossiliferous localities. The object of the scheme is to produce a small handbook from which any person interested in fossils can ascertain where particular formations and assemblages of fossils can be conveniently studied, and where in any district there is a reasonable chance of collecting typical fossils. Institutions and persons known to have an interest in geology will be circularized and their co-operation sought in supplying data about useful localities in their respective districts. Offers of help from anyone with precise and recent knowledge of fossiliferous localities will be cordially welcomed. Further details may be obtained from Mr. R. V. Melville, Palæontographical Society, c/o Geological Survey and Museum, Exhibition Road, London, S.W.7.

Display and Bower Building in Bower Birds

MR. E. NUBLING, Normanhurst, N.S.W., has written with reference to the paragraphs under this heading in *Nature* of January 27, 1945, p. 105. These notes were intended as an acknowledgment and condensed version of a very long communication submitted by Mr. Nubling for which space could not be found in *Nature*. We regret that in preparing this abstract a mistake was made: the remark on the whole proceeding of courtship and nidification occurring during decreasing light refers to the lyre-bird, not to the satin bower-bird as stated there.

Parliamentary Representatives of the Universities

THE following have been elected members of Parliament, to represent the Universities of Great Britain and Northern Ireland: *Oxford:* Sir Arthur Salter and Mr. A. P. Herbert; *Cambridge:* Mr. K. Pickthorn and Mr. H. Wilson Harris; *London:* Sir E. Graham-Little; *Wales:* Prof. W. J. Gruffydd; *Queen's, Belfast:* Prof. D. L. Savory; *Combined English Universities:* Miss Eleanor Rathbone and Mr. Kenneth Lindsay; *Scottish Universities:* Sir John Anderson, Sir John Orr and Sir John Graham Kerr.

Announcements

THE Lord President of the Council has appointed Dr. W. F. P. McLintock to be director of the Geological Survey of Great Britain and Museum of Practical Geology; Dr. McLintock has been deputy director since 1937.

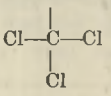
THE Ministry of Supply has agreed to the release of Dr. H. J. Gough, chief scientific officer to the Ministry. The University of Cambridge has consented to continue the loan to the Ministry of Prof. J. E. Lennard-Jones, who has been appointed chief scientific officer in succession to Dr. Gough. Prof. Lennard-Jones has been chief superintendent of the Armaments Research Department, Ministry of Supply, since 1942.

LETTERS TO THE EDITORS

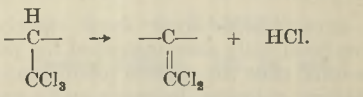
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Insecticidal Action of D.D.T.

THE remarkable insecticidal powers of the compound D.D.T. (alpha alpha *bis*-(4-chlorphenyl)-beta beta beta trichlorethane) have attracted some attention for their theoretical interest as well as for their practical utilization. Two quite independent hypotheses concerning its outstanding toxicity have been published so far. They are alike in ascribing it to a combination of a toxic component of the molecule with a grouping conferring lipoid solubility; but there they part company. Dr. Läuger[1] and his colleagues believe that the toxic component is the linked *p*-chlorbenzene rings, on the grounds that they have found several compounds of this type toxic to insects when ingested. They infer that the group

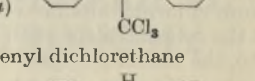


(cf. chloroform) imparts lipoid solubility. Dr. Hubert Martin[2], on the contrary, suggests that it is the chlorbenzene rings which confer lipoid solubility and that the remainder of the molecule is responsible for toxicity, by splitting off hydrochloric acid at the vital centres, thus:

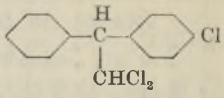


In the past year, an investigation of the toxicity of D.D.T. and a number of analogous compounds has been made in this Laboratory. The results have been considered in relation to the above theories but cannot be simply explained by either of them. The compounds most carefully examined were the following:

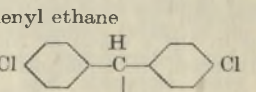
I. D.D.T. (*para para*)



II. *iso*-D.D.T. (*ortho para*)

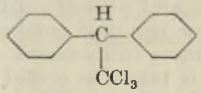


III. Dichlor diphenyl dichlorethane

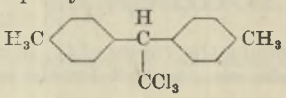


IV. Dichlor diphenyl ethane

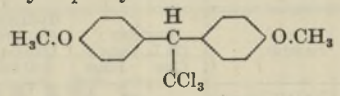
V. Diphenyl trichlorethane



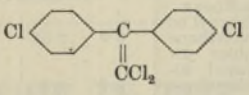
VI. Dimethyl diphenyl trichlorethane



VII. Dimethoxy diphenyl trichlorethane



VIII. Dichlor diphenyl dichlorethylene



Toxicity to Insects. Figures giving the relative toxicity of the samples were obtained for the body louse (*Pediculus humanus*) and the bed bug (*Cimex lectularius*). The samples were dissolved in refined white oil and sprayed directly on to the insects in the tower designed by Potter[3]. Concentration-mortality relations were determined by keeping the deposit constant (at 0·36 mgm. per sq. cm.) and varying concentrations. The results were plotted as log. concentration-probit regression lines, and median lethal concentrations taken from them are given in the accompanying table.

It will be observed that the relative toxicity of the various analogues is fairly similar for the two test insects. This fact, together with the evident similarity in the symptoms produced by the more toxic samples (continuous unco-ordinated activity), suggests that their mode of action is similar. The comparatively high toxicity of dimethoxy diphenyl trichlorethane (VII), especially to *Cimex*, is noteworthy. Dr. Läuger makes no attempt to explain this.

Ease of hydrolysis. The various samples were hydrolysed as 0·008 molar solutions in methyl alcohol, using $N/20$ caustic potash, at 18–20° C. The relative speeds of hydrolysis are indicated in the table by the percentages of molecules from which HCl has been split off after 240 minutes.

It is interesting to find that D.D.T. (I) is most rapidly hydrolysed under these conditions. But the dimethoxy compound (VII) remains an exception; its low speed of hydrolysis is not commensurate with its high toxicity.

Lipoid solubility. Both the theories which have been mentioned make reference to lipoid solubility, but there seems to be no actual evidence of the lipoid solubility of the complete compounds.

In order to form an impression of the lipoid solubility of the various analogues, some approximate measurements were made of their solubility in olive oil and white oil (rather similar to liquid paraffin). The results are shown in the table in comparison with the median lethal concentrations to lice and bugs.

From this table there is no evidence that the most toxic analogues are most compatible with lipoids: indeed there is a suggestion of an inverse relationship. A partial explanation of this situation was sought on the lines suggested by Ferguson[4] for various narcotic poisons. As an approximation to Ferguson's 'chemical potentials', the relative degree of saturation of the substances in the carrier liquid and hence in the phases in contact with it (cuticle waxes and lipoids) may be considered. Since the more toxic compounds are least soluble, *some* of the differences in toxicity should disappear if the insects are exposed to dry films or saturated solutions. Experiments with lice, however, gave no indication of this. The insects were confined for various periods on filter papers impregnated with saturated solutions of the compounds in white oil. The times necessary for

Sample	Toxicity: (M.L. Conc.) Lice	Bugs	Hydrolysis: (% hydrolysed after 240 min.)	Solubility: (w/v% at 18° C.) Olive oil	White oil
I D.D.T. (*para para*)	0·3	0·53	100	10	2–3
VII Dimethoxy diphenyl trichlorethane	0·9	0·55	10	8–10	1–2
III Dichlor diphenyl dichlorethane	0·9	1·2	33	10	1–2
VI Dimethyl diphenyl trichlorethane	1·7	3·6	8	18–20	6–8
II *iso*-D.D.T. (*ortho para*)	5·5	>20	13	25	10–14
V Diphenyl trichlorethane	7·5	,,	10	25–30	10–12
IV Dichlor diphenyl ethane	8·5	,,	—	30	25
VIII Dichlor diphenyl dichlorethylene	>20	,,	—	14–18	8–10

50 per cent of the lice to pick up a lethal dose of the different substances were as widely dispersed as the median lethal concentrations, and the compounds showed the same order of toxicity.

The general conclusion to be drawn from the data presented here seems to be that, at present, there is insufficient data to formulate a theory of the action of D.D.T. Some attempts to support current hypotheses with quantitative data have met with no success. Of particular interest is the low toxicity of the *ortho-para* D.D.T. and the fairly high toxicity of the dimethoxy compound. It seems possible that the shape and size of the molecule are important.

I am indebted to Prof. P. A. Buxton for reading and criticizing this account and to Dr. J. H. Birkinshaw for suggesting the method of hydrolysis. Most of the samples were prepared at the Chemical Defence Experimental Station of the Ministry of Supply, but Nos. V and VI were made by Dr. J. G. Mitchell of the D.S.I.R. Chemical Research Laboratory.

J. R. Busvine.

Ministry of Health,
Entomological Laboratory,
c/o London School of Hygiene
and Tropical Medicine,
Keppel Street, Gower Street, W.C.1.

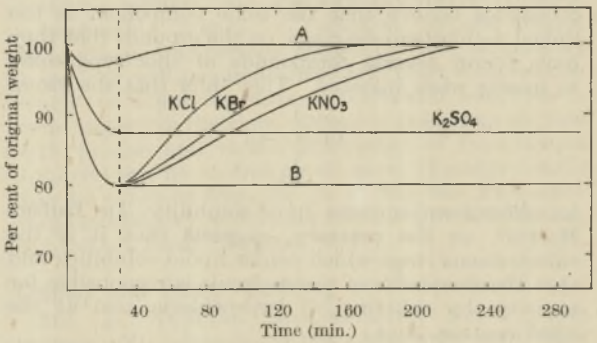
[1] Läuger, P., Martin, H., and Müller, P., *Helv. Acta Chim.*, **27**, 892 (1944).
[2] Martin, H., and Wain, R. L., *Nature*, **154**, 512 (1944).
[3] Potter, C., *Ann. Appl. Biol.*, **28**, 142 (1941).
[4] Ferguson, J., *Proc. Roy. Soc.*, B, **127**, 387 (1939).

Cation and Anion Permeability Constants for the Muscle Fibre Membrane

The following simple experiments allow of first approximate determinations of permeability constants of salts of potassium, rubidium and cæsium across the muscle membrane of the frog's sartorius. (As will be shown later, ammonium salts are unexpected in their behaviour.)

When weighed sartorius muscles of frogs are immersed at room temperature in Ringer fluid containing 110 m.eq. sodium chloride per litre plus 30 m.eq. potassium chloride (to prevent K loss) and a small addition of phosphate for buffering (about $M/500$), pH = 7·0, curve A is obtained for the mean muscle weight, relative to the fresh weight. After a slight fall and return (due to potassium chloride) it remains steady over some hours. Throughout the immersions the muscles were stirred by bubbling with oxygen, and they are removed for weighing from time to time. If such Ringer fluid contained 210 m.eq. sodium chloride instead of 110 m.eq., curve B is obtained, parallel with A after 20–30 minutes.

When, after reaching a steady weight along the B curve, the muscles are removed into a similar Ringer fluid in which 100 m.eq. potassium chloride have been substituted for 100 m.eq. sodium chloride, there is a return to the normal level as shown in the graph. If the chlorine ions are replaced throughout by bromide or nitrate, the corresponding curves shown in the graph are obtained. The graph likewise shows the effect of the sulphate ion substitution (in equivalent concentration throughout).



Such experiments show very clearly (what has otherwise been fully demonstrated for potassium and chlorine ions) that the muscle membrane is permeable to potassium, chlorine, bromine and nitrate ions, also to rubidium and cæsium ions, but not to sodium and sulphate ions. Assuming that the form of the potassium chloride curve in the graph is determined solely by the entrance of potassium chloride, the entrance of water being much faster, we can write:

$$dQ/dt = D \times \frac{(C_0 - C_1)}{l_m} \times \text{surface}, \quad . \quad . \quad (1)$$

or, the rate of penetration is proportional to the gradient of concentration across the membrane multiplied by the surface and a membrane diffusion constant D.

Integrating this equation, it may be noted that potassium chloride outside will diffuse into the fibres, so that the concentration then added is approximately equal to the external value[1]. Hence it follows that

$$2{\cdot}3 \log C_0/(C_0 - C_1) = \frac{D}{l_m} \times t \times \frac{\text{surface}}{V}, \quad . \quad (2)$$

where C_0 is the external concentration, and C_1 the concentration of the added potassium chloride. Putting in the t value as that when the process is half advanced, the equation may be written

$$P = D/l_m = 0{\cdot}276\, r/t_{0\cdot5} \quad . \quad . \quad . \quad (3)$$

This value of P, or permeability constant (as used by Jacobs and others[2]), gives the diffusion rate per unit surface per unit concentration difference across the membrane (dimensions $= L/T$). When the unit of length is taken as μ and the mean value of r for the sartorius muscle fibre as 20 μ, then

$$P = 5{\cdot}5/t_{0\cdot5} \quad . \quad . \quad . \quad . \quad (4)$$

Inserting the values of $t_{0\cdot5}$ in minutes for potassium chloride, etc., we get for the values of P at 15° C.:

[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.]

UNIVERSITY COLLEGE, LONDON

LEVERHULME STUDENTSHIPS IN CHEMICAL ENGINEERING

(Founded in 1932 by the Trustees of the Will of the first Viscount Leverhulme)

These Studentships are to enable graduates in Chemistry or Engineering to obtain advanced training in the principles and practice of Chemical Engineering in the Ramsay Memorial Laboratory of Chemical Engineering at this College.

The Studentships are of the annual value of £250. They are awarded in the first instance for one year.

Candidates must either be engaged in, or be definitely prepared to enter, the chemical industry. They must have obtained a good University degree with Chemistry or Engineering as the principal subject. They must also satisfy the Trustees that they have adequate acquaintance gained by employment or otherwise, with factory or business conditions.

The holders of the Studentships may, at the discretion of the Ramsay Professor of Chemical Engineering, either follow the ordinary course of study leading to the College Diploma in Chemical Engineering or a special course of study in that subject, or carry out original research work.

Two Studentships are available for the session 1945/46.—Applications for these Studentships must be received by the Secretary, University College, London (Gower Street, W.C.1), not later than September 1, 1945.

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION

Applications are invited by September 7 for the following positions:

Principal or Superintending Metallurgist with Headquarters in London to take charge of this field of activity of the Research Association.

Senior or Principal Scientific Officer for refractories, moulding sands, slags, etc., preferably a physical chemist.

A Senior or Principal Scientific Officer for instruments and automatic control in all fields of the Iron and Steel Industry, preferably a physicist.

Other posts of a more junior category for chemists, physicists, engineers and metallurgists.

The salary scales for Scientific Officers are as follows:

Scientific Officers: £300–£550.
Senior Scientific Officers: £600–£800.
Principal Scientific Officers: £840–£1,200.
Superintendent: £1,250 per annum upwards.

There is an additional scale for officers and assistants whose qualifications are below those required for a Scientific Officer.

All Technical appointments to the Association are pensionable in accordance with the F.S.S.U. Scheme.

Applications will be considered irrespective of the date when the applicant is free to take up an appointment.

Applications for the above positions should be submitted, with full details of qualifications and experience, to the Secretary of the British Iron and Steel Research Association, Steel House, Tothill Street, Westminster, S.W.1. Additional posts will be announced later.

UNIVERSITY OF MANCHESTER

The following posts are vacant in the Agricultural Advisory Dept., Manchester University.

ASSISTANT TO THE ADVISORY CHEMIST (Temp. S.S.A.). Candidates should possess a degree in Chemistry and have a knowledge of Agriculture. Experience in soil analytical methods and laboratory technique is essential. The appointment is temporary and not superannuated. Salary £300–£375 per annum, according to qualifications, plus bonus at present £60 p.a.

TEMPORARY JUNIOR SCIENTIFIC ASSISTANT. The person appointed (male or female) will be required to undertake soil sampling work in connection with a Survey of Fertilizer Practice. Knowledge of agriculture is essential and possession of a car will be necessary. Salary £240–£300 per annum, plus bonus, at present, men £60 p.a., women £48 p.a., and subsistence expenses according to scale. Applications, together with two recent testimonials, should be forwarded to the undersigned by August 22, 1945.

ARTHUR JONES,
Chief Advisory Officer.

The University,
Manchester, 13.

VETERINARY EDUCATIONAL TRUST

UNDERGRADUATE VETERINARY SCHOLARSHIPS

The Council of the Veterinary Educational Trust will proceed to award the following undergraduate scholarships.

BOOTS' SCHOLARSHIPS: Three scholarships of the value of £200 per annum for five years.

HALFORD SCHOLARSHIPS: Two scholarships each of the value of £100 per annum for five years.

Applicants must have matriculated and should be eligible for entry into one of the veterinary schools in September 1945.

Forms of application to be completed and returned on or before August 20, 1945, can be obtained from the Secretary, Veterinary Educational Trust, 40 Westminster Palace Gardens, Artillery Row, London, S.W.1.

A stamped addressed envelope must accompany each request for a form of application.

UNIVERSITY OF BRISTOL

DEPARTMENT OF AGRICULTURE AND HORTICULTURE

Applications are invited for the post of PROVINCIAL ADVISORY CHEMIST on the Staff of the University, which will become vacant on September 1, 1945.

The appointment will be in the Graded Service Scheme approved by the Ministry of Agriculture and Fisheries for Advisory Officers and the grading and salary of the successful candidate will be determined in accordance with his qualifications and experience.

Candidates should possess a University Degree or equivalent in Chemistry and have had considerable experience in Agricultural Chemistry.

Further particulars may be obtained from the undersigned, to whom applications, together with copies of three recent testimonials, should be addressed not later than August 18, 1945.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY OF ABERDEEN

LECTURESHIP IN INORGANIC AND ANALYTICAL CHEMISTRY

The University Court invite applications for the Lectureship in Inorganic and Analytical Chemistry.

Salary according to qualifications and experience: from £400 to £650.

Persons desirous of being considered for the office are requested to lodge their names with the Secretary to the University by October 15, 1945.

Successful candidates on National Service may be granted leave of absence until released.

The conditions of appointment may be obtained from the undersigned.

H. J. BUTCHART,
The University, Aberdeen. Secretary.

UNIVERSITY OF ABERDEEN

LECTURESHIP IN APPLIED MATHEMATICS

The University Court will shortly proceed to the appointment of a Lecturer in Applied Mathematics within the Department of Natural Philosophy.

Salary according to qualifications and experience: from £400 to £650.

The conditions of appointment may be obtained from the undersigned.

H. J. BUTCHART,
The University, Aberdeen. Secretary.

ESSEX EDUCATION COMMITTEE

MID-ESSEX TECHNICAL COLLEGE AND SCHOOL OF ART, CHELMSFORD

Required in September, Graduate LECTURER with high qualifications in ORGANIC CHEMISTRY to take the subject to A.R.I.C. and Special B.Sc. (Lond.) standard: industrial or research experience, also subsidiary qualifications in Mathematics an advantage.

Application forms and further particulars obtainable on receipt of stamped addressed envelope from the Clerk to the Governors, at the College, Market Road, Chelmsford, to whom forms should be returned by August 15.

B. E. LAWRENCE,
Chief Education Officer

UNIVERSITY OF LONDON

THE COLLEGE OF THE PHARMACEUTICAL SOCIETY

Applications are invited for the post of LECTURER in Inorganic and Physical (Pharmaceutical) Chemistry. Initial salary £500 per annum. Duties to commence September 1, 1945.—Send full particulars of training, qualifications and research experience to Professor W. H. Linnell, 17 Bloomsbury Square, W.C.1.

UNIVERSITY OF ST. ANDREWS

The University Court of the University of St. Andrews invites applications for the appointment of a Lecturer in Natural Philosophy at University College, Dundee. The appointment is for an initial period of five years and may be renewed for subsequent periods. The salary scale is £450 rising by annual increments of £25 to £550 per annum. Candidates are requested to submit their applications with particulars of teaching experience, research or Service qualifications and the names of not more than three referees to the undersigned (from whom further particulars may be obtained) before October 1, 1945. The candidate appointed, if now on National Service, will not be required to take up his duties until released.

DAVID J. B. RITCHIE,
The University, St. Andrews. Secretary.

UNIVERSITY OF DURHAM

KING'S COLLEGE, NEWCASTLE-UPON-TYNE

LECTURER IN PHYSICS

Applications are invited for the post of Lecturer in Physics. Duties to commence October 1, 1945, or as soon thereafter as possible. Salary between £450 and £550 per annum according to qualifications and experience.

Further particulars may be obtained from the undersigned, to whom ten copies of application, together with names of not more than three referees, should be sent not later than Monday, September 3, 1945.

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

THE UNIVERSITY OF LIVERPOOL

Applications are invited for the post of Assistant Lecturer (Grade III) in Geology, with qualifications in Palaeontology and Stratigraphy, at an initial salary of £350 per annum, together with superannuation within the Federated Superannuation System for Universities and child allowances.

The appointment will date from October 1, 1945, and be for one year in the first instance, renewable on two occasions. The University will consider applications from candidates in the Forces or engaged upon other national service, even though they may have no immediate prospect of release.

Applications, accompanied by testimonials and/or references, should be received by the undersigned not later than August 31, 1945.

STANLEY DUMBELL,
Registrar.

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

Applications are invited for the post of Librarian at the above College in Trinidad, British West Indies. Salary £450—25—575 (with efficiency bar after £500) with temporary cost of living bonus, F.S.S.U. scheme, house or house allowance if married, passage out and home and four months full pay leave every other year. Income tax low in Trinidad. Candidates should be science graduates holding Diploma in Librarianship. Typing an advantage. Applications from women will be considered and should be made by August 31 on forms obtainable from the Secretary, Imperial College of Tropical Agriculture, Grand Buildings, Trafalgar Square, London, W.C.2. Candidates overseas should apply by airletter, giving full particulars, age, career, and naming three referees.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE

(UNIVERSITY OF LONDON)

Temporary Address:
c/o UNIVERSITY COLLEGE, LEICESTER

APPLICATIONS are invited for appointment as ASSISTANT LECTURER and DEMONSTRATOR in the PHYSICS DEPARTMENT, as from October 1945.

Applications, together with copies of three testimonials, should reach the Secretary (from whom further details may be obtained) as soon as possible.

NORTHAMPTON POLYTECHNIC

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

Applications are invited for the position of full-time LENS WORKSHOP INSTRUCTOR.

Sound experience of precision lens working and testing essential, also capacity to take charge of well-equipped lens workshop and to undertake lecture duties in optical subjects.

Salary in accordance with London Burnham Scale for Technical Teachers.

Particulars and form of application from the Secretary.

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

BRITISH RUBBER PRODUCERS RESEARCH ASSOCIATION

Superintendent of Applied Research required. The new Superintendent will be expected to work under and in close collaboration with the Director of Research but will be personally in charge of the technological department, the development department and the engineering department. It will be his duty to take the results of research work through the technological and development stages, to supervise patent applications, and to negotiate on behalf of the Board licences and other arrangements to enable commercial production to be started. He should, if possible, be a trained chemical engineer with considerable experience in taking work from the laboratory to the commercial production stage. Salary £1,200, rising by annual increments of £100 to £1,500 per annum, plus war bonus at Civil Servants rates, plus superannuation under the F.S.S.U. Scheme. Applications to the Secretary, G. E. Coombs, 19 Fenchurch Street, E.C.3.

THE CHEMICAL SOCIETY

Applications are invited for the post of full-time Editor for its publications. Salary according to experience, but not less than £750 per annum. Application (six copies) giving qualifications and experience and names of three persons to whom reference may be made should be sent to the Honorary Secretaries, The Chemical Society, Burlington House, Piccadilly, W.1, by Monday, September 3, 1945.

GIRTON COLLEGE, CAMBRIDGE

A TUCKER-PRICE SCIENTIFIC RESEARCH FELLOWSHIP of the value of £250 a year, tenable for three years, and open to women graduates of any University, is offered for research in Mathematics, Natural Sciences and allied subjects. Further particulars can be obtained from the Secretary, Girton College, Cambridge, to whom applications should be sent on or before January 15, 1946.

Physicist, age 30-40, required for senior position on Development and Research on discharge lamps. Experience of a similar nature essential. Salary according to age, qualifications and experience. Apply, giving details of previous experience, etc., to Box No. 678, L.P.E., 110 St. Martin's Lane, London, W.C.2.

The Directors of The Forestal Land, TIMBER and RAILWAYS COMPANY, LIMITED, offer a FORESTAL RESEARCH SCHOLARSHIP of an annual value of £350 tenable at the University of Leeds for two years.

The successful candidate, who should be a graduate of a British University, preferably with First Class Honours in Pure or Applied, Organic, Physical, or Bio-Chemistry, will be required to carry out original work under the direction of Professor Douglas M'Candlish in the Leather Industries Department.

The scholar and the proposed research problem must be approved by the University. The research should have a direct bearing on some fundamental aspect of the constitution of the Tannins and/or their combination with collagen. The results obtained should be reported in a form suitable for presentation as a thesis for the degree of Doctor of Philosophy (Ph.D.) and subsequent publication in accordance with the Statutes of the University.

Applications in writing, with full particulars of the applicants' age, nationality, education and two references, should be addressed to G. R. P. Ross, M.Sc., Forestal Central Laboratories, Harpenden Rise, Harpenden, Hertfordshire, on or before August 24, 1945.

University of London. The Senate invite applications for the University Chair of Anatomy tenable at St. Bartholomew's Hospital Medical College (salary not less than £1,150). Applications must be received not later than October 31, 1945, by the Academic Registrar, University of London, Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

University College, London, has vacancies for Temporary Assistant Lecturers in Zoology. The posts will, in the first instance, be temporary and at a salary, varying with experience, of £300 to £350 a year.—Application should be made to the Secretary, University College, London (Gower Street, W.C.1), from whom further particulars may be obtained.

Geophysical Prospecting Instruments for sale. Magnetometers (Watts), Meggers (E.and V.), Potentiometers, etc. (Tinsley); excellent condition. Box P.126, T. G. Scott and Son, Ltd., 9, Arundel Street, London, W.C.2.

Midland Agricultural College, Sutton BONINGTON, LOUGHBOROUGH. Applications are invited for the post of ADVISORY BACTERIOLOGIST for the East Midland Province. Candidates should possess a Science Degree of a recognized University, with experience in Bacteriology as applied to Agriculture and Dairying. The salary will be in the range of £400 to £650 per annum, plus War Bonus.—Applications, enclosing copies of two recent testimonials, must be sent to the Principal not later than August 25.

Assistant required with knowledge of Physical apparatus and setting up of lecture demonstrations, some experience in glass-blowing an advantage.

The salary offered is £260–£290 per annum.

Apply in writing before August 20, marking envelope "Appointment", to Professor Sir George P. Thomson, F.R.S., Imperial College, London, S.W.7.

Research Laboratories, West London, require librarian-trained abstractor for scientific library (mainly biochemistry and nutrition). Typing essential. Knowledge German desirable. Post permanent, pensionable. Suitably qualified disabled ex-serviceman would be very favourably considered. Write Box 843, Spottiswoodes, Regent House, Kingsway, W.C.2.

Electro-Plating Laboratory requires junior assistant, exempt, for scheduled undertaking in S.W. London. Staff position, good prospects for the right person.—Box 389, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Important pharmaceutical house re- quires two Graduates with Hons. Degree in Botany, for work of special importance in Plant Physiology. Box No. 385, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Leitz Microscope for Sale: 2/3, 1/6 and 1/12 objectives. Excellent condition. Best offer over £35.—H. Wilkinson, St. Mary's Hospital, London, W.2.

Microscopes, of all descriptions, only a few available, second-hand, perfect condition. Send details of your requirements, enclosing 3d. stamp.—Telephone or correspondence only. Chards, Forest Hill, S.E.23 (Spring Park 1628).

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KCl	= 0·12	RbCl	= 0·04
KBr	= 0·08	CsCl	= 0·01
KNO_3	= 0·06		

When the unit of concentration difference across the membrane is referred to a volume of one litre, these values are multiplied by 10^{-15}, and when the second is used as the unit of time instead of the minute, they are multiplied by $10^{-15}/60$.

Besides the usual approximations involved in the determination of permeability constants, which involve but little error, the following arises. It is assumed that no appreciable error is introduced by ignoring the time to reach equality of concentration in the muscle interspaces and the external solution. Since the half-value period for the first part of the curve *B* is only about five minutes, it is clear that no serious error arises from this source, the value for potassium chloride as given being at most depressed by 12 per cent, and for the other salts in much lesser amounts.

If we are to attach a meaning to the permeability constants of the separate cation and anion species in these experiments, then it will appear that the rates for potassium and chlorine ions must each be either equal to or greater than the potassium chloride value, and also that the figures for the single ion species, bromide, nitrate, cæsium and rubidium, are near the values given for the corresponding salts.

Such figures for the permeability constants are at present being further refined upon. The experiments include studies of single fibres from the semi-tendinosus muscle of the frog.

E. J. Conway.
P. T. Moore.

Department of Biochemistry,
University College,
Dublin.
May 6.

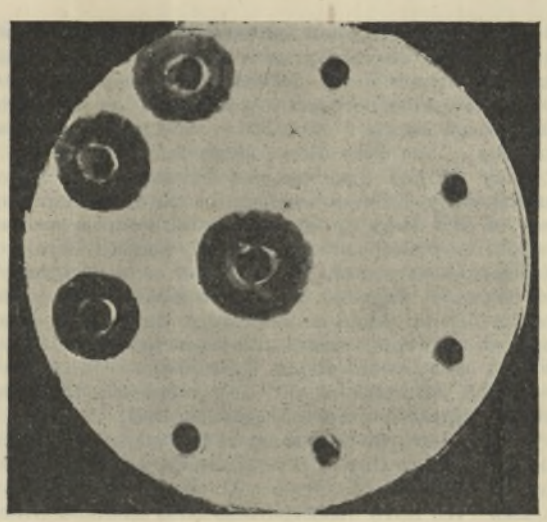
[1] Boyle, P. J., and Conway, E. J., *J. Physiol.*, **100**, 1 (1941).
[2] Davson, H., and Danielli, J. F., "The Permeability of Natural Membranes" (Camb. Univ. Press, 1943).

Anti-bacterial Action of 'Polyporin' against Typhoid, Cholera, Dysentery and *B. coli*

Since my preliminary note on 'polyporin'[1], further trials of polyporin (filtrate of a *Polyporus* sp. in Czapek-Dox medium-*p*H 7) have been carried out *in vitro* in plate-cultures (agar-cup method) of typhoid, cholera, dysentery and *B. coli*, 14–25 mm. clear lytic zones have been obtained (see accompanying illustration). A sodium salt of polyporin has been prepared by following with modifications the method of Berger[2]; it is found to have greater potency than the crude filtrate. In broth-cultures of typhoid and *Staphylococcus aureus* the sodium salt produces lytic action in the course of about twenty hours.

Sporophore extracts from dried fruit-body of the *Polyporus* in distilled and saline water produce clear lytic zones in plate-cultures of typhoid, cholera and *Staphylococcus aureus* (Oxford strain); thus they have distinct bacteriolytic action.

The animal experiments with polyporin have shown it to be completely non-toxic. Polyporin is non-hæmolytic; in intramuscular injections it produces no pyrogenic effect in men; it has been found that polyporin retains its potency at room temperature (22°–32° C.) for about a month if maintained in a sterile condition.



The typhoid plate, agar-cup method. The size of the circular zones bears relationship to the amount of polyporin in the four cups.

In vivo experiments on typhoid and cholera patients in our college hospital are just going on; the results of these with short case-notes will be communicated in due course.

I wish to thank the Indian Health Institute and Laboratory, Ltd., of Beliaghata, Calcutta, for financing this research.

S. R. Bose.

Carmichael Medical College,
Calcutta.
June 12.

[1] *Current Sci.*, 13 (Sept. 1944).
[2] *Brit. Med. J.*, Jan. 27, 1945.

Microbiological Assay of Riboflavin

Mr. E. C. Wood's plea[1] for a more critical examination of the data of microbiological assays is more than timely. Such an examination not only permits a more accurate interpretation of the results; it can also give an indication of the directions in which the technique most needs improvement.

Because of the presence, in certain types of sample, of substances stimulatory to *L. helveticus*, invalid assays of the type quoted by Mr. Wood are not uncommon. The stimulation is diminished by ether-extraction of the sample[2] and by precipitation of the acid extract at *p*H 4·5[3], but in our experience it is frequently not entirely eliminated. Although $(a - A)$ may not be statistically significant in a *single experiment*, there is cause for concern in the fact that it is usually positive.

It is now well known that there are many substances that stimulate *L. helveticus* in the presence of sub-optimal concentrations of riboflavin, and it is obviously impracticable—even if it were desirable—to include them all in the basal medium. It is suggested, however, that a medium which gives enhanced responses with sub-optimal doses of riboflavin might be expected to yield more valid assays.

We have confirmed the superiority in this respect of the modified medium proposed by Greene and Black[4]. Higher responses have also been obtained in these Laboratories by increasing the concentration of the factors provided by yeast. Using these 'enriched' media, we have found that there is no longer

a direct linear relation between dose and response, but that the curve conforms closely to the normal semi-logarithmic form. Repeatedly we have observed a linear relation between response and log dose over the dosage range 0·04–0·125 γ, and the statistical analysis of the data then follows familiar lines.

Many of the discrepancies between the figures published by different workers for the riboflavin content of the same or similar cereal samples are incompatible with the precision usually claimed for microbiological assays, namely, ± 10 per cent. Andrews[5], for example, reported wide variations between the results of individual collaborators, though a decided improvement was evident in a later survey[6]. Barton-Wright and Booth[7] found higher values for cereals than did Andrews *et al.*[8], and suggested that the latters' extracts were too concentrated.

In our view, pre-treatment of the extracts by some such method as that of Strong and Carpenter is essential for the assay of cereals with the media at present in use. We have observed also that extracts which give positive values for $(a - A)$—and, in consequence, invalid assays—yield considerably lower results on the 'enriched' media referred to above. It is suggested that the lower, rather than the higher, results are likely to be closer estimates of the riboflavin content.

The real solution of these difficulties clearly lies in improving the medium, for attempts to remove stimulatory factors from extracts are, in themselves, admissions of its incompleteness.

Stanley A. Price.

The Research Laboratories,
Vitamins, Ltd.,
23 Upper Mall,
Hammersmith, London, W.6.

[1] Wood, E. C., *Nature*, **155**, 632 (1945).
[2] Bauernfeind, J. C., Sotier, A. L., and Boruff, C. S., *Ind. and Eng. Chem.* (Anal. Ed.), **14**, 666 (1942).
[3] Strong, F. M., and Carpenter, L. E., *Ind. and Eng. Chem.* (Anal. Ed.), **14**, 909 (1942).
[4] Greene, R. D., and Black, A., *J. Amer. Pharm. Assoc.*, **32**, 217 (1943).
[5] Andrews, J. S., *Cereal Chem.*, **20**. 613 (1943).
[6] Andrews, J. S., *Cereal Chem.*, **21**, 398 (1944).
[7] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, **37**, 25 (1943).
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Records of *Culex* (*Barraudius*) *modestus* Ficalbi (Diptera, Culicidæ) obtained in the South of England

In the years 1932 and 1940 respectively, two species of mosquitoes which are widely distributed in the Mediterranean region, namely, *Anopheles algeriensis* and *Theobaldia longiareolata*, were recorded for the first time in Britain: the former from a coastal area in Norfolk[1], and the latter from Portsmouth (Hants)[2]. When recording the first-mentioned immigrants, the late F. W. Edwards suggested that they might have been introduced into Britain by aeroplane, and it seems highly probable that the later invasion admits of a similar explanation; although the alternative that the intruders were sea-borne is admittedly (at any rate where the seaport area of Portsmouth is concerned) a possibility. As, however, no descendants of either of these invaders are known to have survived the ensuing winter, the following British records of yet another Mediterranean species may be found of interest. All the specimens concerned in the present case were collected and identified, by my assistant, J. Staley, in the ordinary course of the mosquito control operations which are carried out under his supervision throughout a coastal area of Hampshire having an area of about forty square miles.

On July 27, 1944, while inspecting coastal ditches on the mainland north of Hayling Island, Mr. Staley caught a female mosquito (after allowing it to bite him) which resembled no known British species. This female took a further blood meal, in the laboratory, two days later, but died on August 1. On July 29, however, a similar female had been captured in a house at Hayling Island, situated about three miles south of the point where the first specimen had been taken. I will denote the points of capture of the first and second specimen by *A* and *B* respectively. The second female refused a blood meal and died shortly afterwards. Reference to literature indicated that the females were of the species *Culex* (*Barraudius*) *modestus* Ficalbi.

During the past three years, our control work has included the monthly inspection of N.F.S. static water tanks in the city of Portsmouth; and on August 24, 1944, when examining in the laboratory some mosquito larvæ collected from one of these tanks, Mr. Staley found (in company with larvæ of *Anopheles atroparvus* and *Culex pipiens*) three larvæ of a non-British species which corresponded in every respect with the illustrations accompanying Callot's description of *C. modestus*[3]. On the following day, before the infested water had been oiled by the N.F.S. authorities, three more similar larvæ were collected. From the six larvæ thus obtained, one male and five females were reared. Comparison of the hypopygium of the male with the illustrations given respectively by Martini[4], Barraud[5] and Callot[3] showed that of the last-mentioned writer to be the only entirely correct one.

The tank in which the larvæ were found is situated within two miles of an airport and about five miles to the south-west, and about three and a half miles to the west, of the points *A* and *B* respectively. The fact that the prevailing wind is south-west suggests that the two females captured may have originated from the tank; it is to be noted, however, that the points *A* and *B* are respectively only about two and three miles distant from an aerodrome located eastwards of them.

I reported the above facts to the local authorities concerned, but directed no other attention to the *modestus* immigrants, as I considered it extremely unlikely that any of their progeny would live through an English winter. This assumption, however, has now proved to be incorrect. On May 15 last, in a garden at Hayling Island about half a mile from the point *B*, Mr. Staley was attacked by, and captured, another *C. modestus* female: and on June 15, when examining in the laboratory mosquito larvæ collected in the Borough of Gosport district (into which our control work has recently been extended), he found four more larvæ of the species in question. These larvæ had been collected (in company with larvæ of the salt marsh species, *Aedes detritus*) in a small pool of brackish water situated within a few yards of a river and nearly five miles due west of the tank in which the '1944' larvæ had been found. As this pool had been abolished (by 'filling in') before the collected larvæ had been examined in the laboratory, no attempts to obtain additional specimens could be made. It is to be noted that the Gosport *modestus* larvæ were found in brackish water, whereas the Portsmouth ones of last year were found in a tank

containing non-salt water : a fact which accords with Martini's statement that this species breeds both in fresh and partly salt water[4].

The four larvæ were placed in an incubator having an above-water capacity of about 40 cubic inches, and three males and a female eventually developed. One of the males died soon after emergence, and microscopic examination of its genitalia has confirmed the accuracy of Callot's illustrations. The female was given a blood meal on June 30, and laid an egg raft (the eggs of which duly hatched) on July 5. Callot's statement that *C. modestus* is eurygamous is therefore incorrect.

C. modestus is common in many parts of the Mediterranean region, in Asia Minor and in one part of India (Kashmir). Up to now, its most northerly record is from Richelieu, France (about two hundred miles south-west of Paris), where, according to Callot[3], "it attacks men and animals mercilessly". Ficalbi[6] has stated that this species "frequents woods and thickets but also enters houses" ; that "it bites during the day, the twilight and the night" ; and that "its bite is very painful".

Whether *C. modestus* is further extending its range in Britain remains to be seen. It would obviously be an undesirable addition to the list of British species.

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July 18.

[1] Edwards, F. W., *J. Ent. Soc. S. Eng.*, **1**, 26 (1932).
[2] Staley, J., *Nature*, **146**, 368 (1940).
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Granules of the Human Polymorphonuclear Leucocyte

THE oxidase granules of the human polymorphonuclear leucocyte are taken to be protein in nature. Characteristic of the later myeloid cells, these granules are examined in the leukæmic blood disorders in an attempt to define the origin of primitive cells, although the technique for their demonstration is not too easy. This note describes a simple method for the staining of the granules and suggests that they are composed of, or contain, lipines.

Air-dried blood films are fixed for one minute in acetone and air-dried again. Pass the slide through 70 per cent alcohol and leave for ten minutes in a saturated solution of Sudan Black in 70 per cent alcohol. Rinse well in three to six changes of 50 per cent alcohol. Dry in air. Stain with Leishman's or any other of the routine blood stains.

The polymorphonuclear leucocytes show their cytoplasm to be packed with discrete fine granules. These cells are the only ones in the blood smear with the granules, the lymphocyte and monocyte lacking them.

It is noteworthy that the stain used for the demonstration of the granules—Sudan Black—was introduced by Lison[1] as being soluble in all, or nearly all, classes of fats and in fats only. About two per cent of the polymorphonuclear leucocytes contain fat with Sudan IV and this is taken as an indication of aging. The fact that the granules stain with Sudan Black and not with Sudan IV suggests that they are lipine in nature, or contain lipine, and their insolubility in acetone suggests that they are lecithin although by no means proving the point. The fatty nature of the granules seems to be proved finally by their complete solution in ether-alcohol.

Preliminary studies indicate that the Sudan Black granules are present in the cells of the late myeloblast series, as seen in narrow punctures, and that none of the cells obtained in lymph node punctures contain such structures. The granules persist during purulent processes and appear to pass out into the pus. No gross change is noticeable in these granules as a result of fasting or feeding, or in the usual infections encountered in an army general hospital. Studies are being undertaken to investigate the utility of the method in the leukæmias and to demonstrate the Sudan Black material in the leukocyte in various disorders of fat metabolism.

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[1] Lison, L., "Histochimie Animale" (Paris : Gauthier-Villars, 1936).

Origin of Haploid-Diploid Twin Embryos in Angiosperms

IN an interesting article entitled "The present status of Plant Embryology" Dr. Donald A. Johansen[1] makes the following observation (p. 101) regarding the origin of polyembryony : "To cite another instance, if one of the twin seedlings is haploid and the other diploid, it can ordinarily be taken for granted that the diploid seedling arose from a fertilized egg, while the haploid seedling developed either from an unfertilized synergid or from the nucellus or inner integument".

Regarding the first part of the statement, it is necessary to point out that the tissues of the nucellus and inner integument have the sporophytic number of chromosomes and hence any embryo arising from these must be diploid and *not* haploid. Adventive embryos of this kind are of a metromorphic type resembling the maternal parent in chromosome number and other characters.

In respect of twin seedlings, of which one is haploid and the other diploid, it is not easy to be sure if the latter arose from a fertilized egg and the former from a reduced but unfertilized synergid. Kihara (1936 ; quoted by Cooper[2]), who reported a case of haploid-diploid twins in *Triticum durum*, believes the reverse to be the case, namely, that the haploid member arose from an unfertilized egg and the diploid member from a fertilized synergid. Yamamoto[3] postulated a similar origin for the twins found by him in *Triticum vulgare*. There are also cases on record of antipodal cells giving rise to embryos, which may be diploid or haploid depending on whether any nuclear fusions took place or not prior to the cell undergoing divisions to give rise to the embryo. In *Poa arctica*[4], the origin of the twin embryos, one haploid and the other diploid, has been traced to two different embryo sacs, one originating from a megaspore and therefore having the reduced number of chromosomes and the other originating from a nucellar cell (aposporous) and therefore diploid. The eggs of both the embryo sacs develop parthenogenetically, giving rise to one haploid and one diploid embryo.

Briefly, then, while in any case of twin seedlings, one haploid and the other diploid, it is quite possible and even likely that the former has arisen from an unfertilized synergid and the latter from a zygote, the condition needs careful scrutiny before any judgment can be given. Adventive embryos, however, whether originating from the nucellus or the integument, are diploid.

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Dacca.
April 21.

[1] Johansen, D. A., *Bot. Rev.*, **2**, 87 (1945).
[2] Cooper, D. C., *Amer. J. Bot.*, **30**, 408 (1943).
[3] Yamamoto, Y., *Bot. Mag.* Tokyo, **50**, 573 (1936).
[4] Engelbert, V., *Canadian J. Res.*, C, **19**, 135 (1941).

Origin of Toxicity to Fungi in Wareham Heath Soil

Dr. Brian's discovery of marked antibiotic activity by species of *Penicillium* present in Wareham soil is a welcome addition to our knowledge of the factors directly responsible for the observed inhibition of microbiological activity in this soil, with the resulting pronounced biological inertia and infertility for plant growth[1].

The presence of a factor or factors of biological origin actively toxic or antagonistic to fungus growth and normal root development was suggested by me in a paper published in 1934[2]. The correctness of this hypothesis was later fully established[3]. It would have been indeed a fortunate coincidence if the discovery of penicillin and realization of the important part played in Nature by the production of bacteriostatic and fungistatic substances had come in time to direct attention at that stage of the work to the species of *Penicillium* observed in samples of Wareham soil, more especially in those selected as likely to exhibit the highest degree of toxicity.

Incidentally, our observations suggested that the distribution and abundance of the soil *Penicillium* spp. present is sporadic throughout the experimental area and possibly influenced by seasonal conditions. Until further data are available, it must remain an open question whether gliotoxin as such is the immediate cause of all the observed phenomena in Wareham soil, including especially limitation of growth of those mycorrhizal fungi known to be present involving either complete failure of mycorrhizal activity, or the development of mycorrhizas structurally and functionally abnormal; or whether this substance is one—perhaps the chief initiating cause—of a number of disturbances of microbiological origin leading ultimately to soil infertility. The differential susceptibility of air-borne micro-organisms present on plates tested by the agar-film method had been noted and the resistance of *Penicillium* spp. as compared with *Mucor* spp. and other air-borne infections is possibly of some significance.

Dr. Brian's observations on the mycorrhizal and other fungi sent to him are of particular interest. Of these fungi, *Boletus bovinus*, *B. elegans*, *Mycelium radicis nigrostrigosum* and *Phoma radicis callunæ* are mycorrhiza-formers. *B. bovinus* was the only known mycorrhiza-former of pine and spruce initially present throughout the area. *B. elegans* does not occur on the area but appears in adjoining woods of larch, of which it is a proved mycorrhiza-former; nor has *Mycelium radicis nigrostrigosum* ever been observed unless introduced in soil inocula, although this fungus is extremely abundant as a mycorrhiza-former in woods of Scots pine adjoining the area. *Phoma radicis callunæ* is the mycorrhiza-former of *Calluna vulgaris*, a natural dominant on Wareham heath.

The differential susceptibility of these mycorrhizal fungi to gliotoxin, as recorded by Dr. Brian, is in agreement with all observations and facts relating to growth activity in the case of those present on the experimental area, and, in the case of those not present, for example, *B. elegans* and *M. radicis nigrostrigosum*, accords with expectation.

The case of *Phoma* is of special interest. This endophyte shows relatively slight susceptibility, as might be expected from its wide distribution throughout the area in mycorrhizas of *Calluna*. That some susceptibility exists is in agreement with observations made by me at an early stage of the Wareham researches in respect of relatively slight and varying degrees of abnormality in mycorrhizal development and structure observed in mycorrhizas of *Calluna vulgaris* on the heath-land before ploughing.

The reaction of the pseudomycorrhiza-formers *Mycelium radicis atrovirens* and *Rhizoctonia* sp. is also of interest. *M. radicis atrovirens* is present throughout the area, but is relatively rare and has not been observed to attack either pines or spruces in the field. *Rhizoctonia silvestris*, the form sent to Dr. Brian, does not occur in Wareham soil. In respect of *M. radicis atrovirens*, it would be of particular interest to have a comparative test of a form imported in a Swedish soil that proved to be highly pathogenic to Norway spruce under Wareham conditions[4].

The title given to Dr. Brian's communication is unfortunate. The use of 'mycorrhiza' in the singular to describe the general phenomenon is now recognized as incorrect and has been given up by those familiar with the facts. The toxicity recorded by Dr. Brian is to 'mycorrhizal fungi' and not to 'mycorrhiza'.

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University of London.
June 16.

[1] Brian, P. W., Hemming, H. G., and McGowan, J. C., *Nature*, **155**, 637 (1945).
[2] Rayner, M. C., *Forestry*, **8**, 96 (1934).
[3] Nellson-Jones, W., *J. Agric. Sci.*, **31**, 379 (1941).
[4] Rayner, M. C., *Forestry*, **15**, 1 (1941).

Nutritive Value of Coco-nut

The communications on the nutritive value of coco-nut by Dr. Lucius Nicholls and Sir Jack Drummond[1] were read by us with interest.

In 1941, while working with the microbiological assay of vitamins, stories of seamen and aviators stranded on 'coco-nut isles' became common, and it occurred to us to measure the vitamin content of the 'coco-nut milk' popularly supposed to be the dietary mainstay under such conditions. The values listed are those obtained for the centre fluid of an apparently normal specimen obtained at a local grocery store.

Nicotinic acid	0·64 micrograms/c.c.
Pantothenic acid	0·52 ,,
Biotin	0·02 ,,
Riboflavin	< 0·01 ,,
'Folic acid'	0·003 ,,

The concentration of two other vitamins for which microbiological assays were not available, thiamin and pyridoxine, were so low as to be negative toward colour tests, even though the material was first concentrated to some extent by adsorption and elution.

It is evident that the juice was not of high nutritive quality. The minimum daily requirement of riboflavin, for example, according to the Food and Nutrition Board of the U.S. National Research Council, for a 'very active' individual of 70 kilos is 3·3 mgm. per day. To meet this requirement, the daily consumption of coco-nut juice would have to be at least 330 litres.

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[1] *Nature*, **155**, 392 (1945).

Spectral Analysis of Solid Substances

A METHOD has been developed whereby it is possible to deduce from a single spectral photograph not only the qualitative analysis of a totally unknown mineral powder, but also its *approximate* quantitative composition.

For this purpose mixtures have been made of all spectrographically detectable elements at our disposal; the concentrations were 10, 3, 1, 0·3, 0·1 down to 0·0001 per cent. Pure, washed quartz-sand was used as a basis for the various dilutions.

In order to reduce the amount of work and time required for the preparation of the standard spectrograms, the elements which had to be considered were divided into groups of ten, the sensitive lines of which do not coincide. Quantities of the pure chemical compounds, equivalent to 100 mgm. of the oxides, of all elements of the same group were thoroughly mixed in an agate mortar under alcohol. One tenth of this mixture was added to 900 mgm. of the pure quartz powder, thus obtaining a mixture containing 1 per cent of each of the oxides concerned.

The lower concentration steps have been obtained by diluting this 1 per cent mixture with a calculated amount of pure silica. The higher concentration steps have been prepared as follows: (*a*) for the 10 per cent mixture: 100 mgm. of the oxide of each element were mixed with 900 mgm. of pure silica; (*b*) for the 3 per cent mixture: 300 mgm. of the 10 per cent mixtures of each member of a subgroup of three elements of the same group were ground with 100 mgm. of the pure quartz sand.

Before taking the spectrogram, each mixture was mixed again with half its weight of sodium carbonate.

The photographs were taken with the continuously burning electric arc between very pure, plane carbon electrodes of 5 mm. diameter. The arc burns for 60 sec. at 4 amp., and then for 30 sec. at 7 amp. We used a Hilger E.315 quartz spectrograph. A diffusely and uniformly illuminated slit is obtained by focusing the arc sharply on a screen in which is inserted a rectangular diaphragm; the illuminated opening of this screen is focused enlarged on the collimator lens of the spectrograph.

A rotating step sector (factor $r = 3·5$) was placed before the slit of the spectrograph. The intensity of the lines chosen for analysis is compared for each concentration with the intensity of certain Si-lines from the spectrum (the concentration of silica being approximately constant). This comparison is performed visually, under a twenty-fold enlargement, with a Zeiss spectral projector. The relative intensity (rather the relative exposure) is denoted by the difference in the number of 'steps' to be applied to the two lines under comparison in order that they may show equal blackening[1].

For the lowest concentrations a spectrum is taken with illumination forming an image of the arc on the slit, without a step sector, the cathode layer effect being used. Again the intensities of the weak lines are compared with those of the Si-lines of the stepped spectrum.

Tables have been drawn up, giving the relative intensities as a function of concentration, for the most prominent lines of fifty-six different elements.

A number of synthetic mixtures have been prepared, and then analysed by means of the method described, with the aid of the data of our tables. Some results are given in the accompanying table, which includes also the results for a natural mineral (tourmaline).

It will be seen that a fair estimate of the concentration of the elements present is obtained.

I			II			III (tourmaline)		
	Calculated	Found		Calculated	Found		Chemical analysis	Spectral analysis
CaO	5	3–4	CaO	0·16	0·12	CaO	1·35	1·30
MgO	0·1	0·15	MgO	0·8	0·7	K_2O	2·07	2–3
MnO	0·41	0·40	MnO	0·2	0·35	Na O	2·25	
Fe_2O_3	0·2	0·3	Fe_2O_3	1·0	1·0	Fe_2O_3	12·35	14·2
Al_2O_3	0·04	< 0·4	Al_2O_3	2·5	1·7	Al_2O_3	24·67	30·0
TiO_2	0·1	0·14	TiO_2	0·04	0·05	MgO	7·32	6·3
ZrO_2	0·04	< 0·1	B_2O_3	0·8	0·5	MnO	0·27	0·25
V_2O_5	0·012	0·02	K_2O	0·4	0·3	TiO_2	0·34	0·39
Cr_2O_3	0·012	0·01				B_2O_3	6·89	5·5
						CuO	< 0·05	0·03
						(SiO_2	37·5	18·6)

The complete account of this work has been communicated to the Koninklijke Vlaamsche Academie v. Wetenschappen, Letteren en Schoone Kunsten v. Belgie, and will be published in the *Verhandelingen* from this Society.

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[1] See Breckpot, R., *Spectrochim. Acta*, 1, 2 (1939).

A Tetrabromide of β-Phellandrene

IT has been generally accepted that β-phellandrene does not form a tetrabromide, and indeed we have found no reference in the literature to the formation of such a compound by a conjugated terpene apart from a recent record of a liquid tetrabromide derived from α-terpinene[1]. During examination of the terpene fractions of the oil from *Eucalyptus cneorifolia*, we repeatedly isolated a crystalline tetrabromide which had m.p. 110–112° and was *dextro*-rotatory. After recrystallization from ethyl acetate, the melting point rose to 118–119°, the specific rotation being almost + 54°.

Microanalysis established the formula of the substance as $C_{10}H_{16}Br_4$, and the hydrocarbon recovered on treatment with magnesium and ether[2] showed the

characteristic features of *l*-β-phellandrene, forming, for example, a nitrosite[3] and a nitrosochloride[4]. That the tetrabromide was derived from this hydrocarbon was supported by the formation of a crystalline derivative from a sample of *l*-β-phellandrene isolated from Canada balsam oil. This had practically identical physical properties, and on admixture with the sample from the eucalyptus oil there was no depression of melting point.

The chief feature of the tetrabromide from β-phellandrene is the change of sign of rotation, the *lævo*-rotatory hydrocarbon giving a *dextro*-rotatory tetrabromide. The investigation was further extended by formation of a crystalline tetrabromide from a sample of *d*-β-phellandrene derived from water fennel oil (*Phellandrium aquaticum* L.)[5]. This also had a melting point of 118–119° and had a specific rotation of − 53°.

A detailed account of the work will be published elsewhere.

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April 10.

[1] Ipatieff and Pines, *J. Amer. Chem. Soc.*, **66**, 1120 (1944).
[2] von Braun and Lemke, *Berichte*, **56**, 1562 (1933).
[3] Macbeth, Smith and West, *J. Chem. Soc.*, 119 (1938).
[4] West, *J. Soc. Chem. Ind.*, **58**, 122 (1939).
[5] Berry, Macbeth and Swanson, *J. Chem. Soc.*, 1448 (1937).

Symbols Used to Indicate Hydrogen Ion Concentration and Similar Quantities

The symbols *pH* and *pK*, commonly encountered in chemical literature, each consist of two letters, the second of which may, or may not, be used as a subscript, and either or both of which may be set alternatively in roman type or in italics. There appears to be no generally accepted convention governing the choice from the many resulting possible forms, and inconsistencies are often encountered even within a single published article.

According to its origin, the letter '*p*' in the symbol *pH* is an operator describing a function of the variable denoted by the letter '*H*'. Presumably in order to show the different significances of the two letters in the compound symbol, it was originally written with a subscript '*H*' by Sörensen. This arrangement, besides being somewhat inconvenient, seems to give undue prominence to the operator. In the more recent and common form *p*H, the difference in type sufficiently marks the different duties of the two letters, but is opposite in direction to that conventionally used in other functional symbols, such as log *T* or d*t*. From this point of view, p*H* appears a more consistent form. There is, however, much to be said in favour of dropping the distinction in type between the two letters, and of regarding the quantity denoted by *pH* as an important independent variable without reference to its derived origin. Although the compound symbol may have a unique meaning, this is not necessarily true for its component letters; thus, *H* may denote a concentration and *p* a negative logarithm, or—sometimes more conveniently —*H* a dilution and *p* its logarithm. It is suggested that, in agreement with the accepted convention for single-letter symbols, all compound symbols in which *p* is used as an operator should be set in uniformly italicized type, as *pH*, *pK*, etc., without special advertisement of their derivations.

In chemical texts, the symbol *pH* (or its type variants) is commonly used as a noun, as in the phrase "The determination of *pH*", though for this purpose it is sometimes expanded to '*pH* value'. There is little to be said in favour of '*pH* value', which is longer, and no more descriptive, than *pH*. If the demand for brevity constrains us in the future to replace the noun 'time' by the symbol *t*, the inconsistency of '*t* value' will quickly become obvious. Much the most common plural form of the noun is '*pH* values' (or its type variants), a fact that probably reflects our uncertainty as to the correct plurals of the letters of the alphabet, and our resolve to mind our grammatical P values and Q values. The correct plurals of *p*H, p*H*, pH and *pH* are respectively *p*H's, p*H*s, pH's and *pH*s. The rule is simple. If there can be any doubt whether the final 's' is a plural ending or a part of the symbol proper, an apostrophe is required; but if a difference in type between the final letter of the symbol proper and the plural 's' avoids this ambiguity, no apostrophe should be used.

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Unshrinkable Wool

One of the more recent processes for making wool unshrinkable consists in synthesizing an organic polymer on the surface of the fibres[1], thus masking the surface-scale structure which is the primary cause of shrinkage. Precisely similar results may be obtained with inorganic polymers.

For example, when flannel is immersed in a solution of silicon tetrachloride in carbon tetrachloride, a vigorous reaction takes place between the adsorbed water of the wool and the silicon tetrachloride, a siliceous deposit being formed on the surface of the fibres. In consequence, the treated fabric shrinks very much less than untreated fabric during milling, as may be seen from the following data. These were obtained by treating 2·5 gm. patterns of flannel, previously conditioned at 65 per cent relative humidity and 22·2° C., with 100 c.c. of a solution of silicon tetrachloride in carbon tetrachloride for five minutes at 25° C. After treatment, each pattern was washed in two changes of 100 c.c. of carbon tetrachloride, followed by running water overnight, and the series of patterns was then milled by hand in 5 per cent soap solution.

Concentration of silicon tetrachloride (per cent by volume)	Percentage shrinkage in area during milling
0	28·9
2	18·9
5	6·2
7	3·6
10	2·6

A high degree of unshrinkability is readily obtained, and it is clear that polymerizable inorganic compounds are likely to find important practical applications in the wool textile industry.

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[1] Baldwin, Barr and Speakman, *B.P.* 567,501.

A New Test for 2 × 2 Tables

If an experiment yields results in the form of a 2 × 2 table:

	P	not-P	Total
A	a	c	m
B	b	d	n
Total	r	s	N

where m and n have been fixed in advance, a test for deciding whether there is evidence of association between the attributes A and B and the mutually exclusive and exhaustive attributes P and not-P has been given by Fisher[1]. This test, on the null hypothesis of no association, associates the results with a probability $m!n!r!s!/N!a!b!c!d!$.

It has been usual in the past to apply this test, or some approximation to it[2,3], in cases where we can assume that the probability p_1 that A has P and the probability p_2 that B has P are both constant. The hypothesis tested then becomes $H(p) \equiv p_1 = p_2 = p$.

It is, however, possible to construct a more powerful test of the hypothesis $H(p)$ on the data given. The table above can be represented geometrically by the point (a,b) in a plane lattice diagram of points with integer co-ordinates. Since m and n are fixed in advance, all possible results will then be represented by points of the lattice lying in a rectangle bounded by the x and y axes and the lines $x = m$ and $y = n$. The hypothesis $H(p)$ assigns a 'weight'

$$W(a,b,p) = (m!n!/a!b!c!d!)p^r(1-p)^s$$

to the point (a,b). To obtain a valid test of $H(p)$ on significance level α, we have only to choose a region R in the rectangle such that

$$\operatorname{Max}_{0 \leqslant p \leqslant 1} \Sigma_R W(a,b,p) \leqslant \alpha.$$

This validity condition does not determine R uniquely. To obtain a reasonable test, we must require that R should consist of as many points as possible, and should lie away from that diagonal of the rectangle which passes through the origin. Formulated mathematically, these latter requirements mean that the complement of R must in a certain sense be convex, symmetrical and minimal.

For example, when $m = n = 3$, and $\alpha = 1/32$, R consists of the two points (3,0), (0,3). The corresponding level of significance with Fisher's test is 1/10. Thus the new test is more powerful than Fisher's.

The computation involved in making tables for the new test is heavier than with Fisher's test. But once prepared, the tables for the new test are on the whole more convenient in use.

The relationship between Fisher's test and the new test is similar to that between Pitman's 'exact' test for identity of two distributions and the corresponding t-test. For large values of a, b, c and d, the difference between the two tests becomes small. For large m,n and small a,b, there is an analogue of the new procedure, just as there is an analogue of Fisher's[4].

This work has been carried out as part of the programme of the Ministry of Supply. Full details, with tables, will be published elsewhere.

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May 11.

[1] Fisher, R. A., "Statistical Methods for Research Workers" (Edinburgh: Oliver and Boyd, 1941), 94.
[2] Fisher, *loc. cit.*, 83.
[3] Yates, F., *J. Roy. Stat. Soc.*, Supp. 1, 217 (1934).
[4] Przyborowski, J. and Wilenski, H., *Biometrika*, **31**, 313 (1940).

Crystal Structure of Barium Titanate

Recently Rooksby[1] and Megaw[2] have reported a tetragonal structure for barium titanate. This is of interest to us because we also have obtained X-ray powder photographs of barium titanate, from which we have established a tetragonal structure. In addition we have obtained photographs of a lattice which at first was regarded as near cubic, though in view of our subsequent findings, it appears more correct to regard it as being near tetragonal. However, the reversible temperature change of structure from tetragonal to cubic reported by Miss Megaw[2] raises the question as to whether this cubic structure might not exist at ordinary temperatures, as a result of heat treatment, or method of preparation, or presence of impurities.

The energy difference between the structures may not be large, but the change from tetragonal to cubic would appear to involve a rearrangement of the ions if the cubic structure is to be regarded as of the ideal $G5$ type, as hitherto assumed[3]. The change in structure may be connected with a very slight change in the Ti—O bond-length.

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R. M. Hinde.

Chemical and Metallurgical Laboratory,
British Insulated Cables, Ltd.,
Prescot, Lancs. May 16.

[1] Rooksby, H. P., *Nature*, **155**, 484 (1945).
[2] Megaw, Helen D., *Nature*, **155**, 484 (1945).
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Particle Shape

The recent letters in *Nature* by Messrs. Whittaker and Tomkeieff[1] make no mention of the extensive investigations of particle shape carried out in connexion with road aggregates. A bibliography of the subject is given in my first paper[2].

In my work at the Road Research Laboratory[2,3], shape was defined in terms of the principal dimensions of the particle, which correspond roughly to its length, breadth and thickness. The ratios of length to breadth and thickness to breadth are taken as a measure of the degree of elongation and flakiness of the particle. By selecting arbitrary limits, it is possible to determine the amount of 'elongated' and 'flaky' particles and to express these in percentage by weight as indexes of shape. This assumes a more or less regular distribution of particle shapes in such materials, which has been found to be the case in practice[2,3]. This is the basis of the method adopted in British Standard 812: 1943, "Sampling and Testing of Mineral Aggregates Sands and Fillers" (Method 2).

This method, of course, only gives a partial definition of particle shape. An obvious omission is the degree of roundness of the particles, which is independent of the 'shape' as defined above. Another shape characteristic is the angularity of crushed particles. Particles classified on length and thickness can be further classified according to these characteristics. The shape characteristics of interest to any industry must be determined to suit the particular case.

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Harmondsworth, West Drayton, Middlesex.

[1] *Nature*, **155**, 331 and 639 (1945).
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RESEARCH ITEMS

Previously Spawned Salmon in Irish Rivers

ARTHUR E. J. WENT has discussed the question of the proportion of previously spawned fish in different Irish rivers (*Sci. Proc. Roy. Dublin Soc.*, **24** (N.S.), No. 1, March, 1945). The results are given of the examination of scales from fish taken from nineteen rivers; 25,029 scales were examined, of which 1,078 or 4·3 per cent were from previously spawned fish. Only 1·1 per cent of these had spawned previously on two occasions. None had spawned three or more times. It is found that where there is a large commercial fishery in the tidal waters, there is a tendency for the proportion of previous spawners to be low, but when there are one or more lakes on the river the proportion appears to be high, with few exceptions. Comparing the results with earlier investigations, it is shown that the estimated proportion of previous spawners for the country as a whole is 4·3 per cent. Kelts have little food value, but after recovery may be almost double their original weight—a good reason for protecting them.

Effect of Sulphanilamide on the Sugar Consumption of *Bact. coli*

FURTHER examination of the influence of sulphanilamide compounds on *Bact. coli* (*Prak. Acad. Athens*, **15**, 472; 1940) has been recorded by N. Klissiunis (meeting of Feb. 10, 1944, of the Academy of Athens). Sets of flasks containing 0·4 gm. sugar and 12 c.c. of a 4 per cent peptone-sodium chloride solution were prepared, to some of which sulphanilamide 'prontalbin' was added. After sterilization at 110°, the medium was inoculated with a suspension of *B. coli* and incubated at 37° and at 41°. Four days later, the cultures were boiled, and after precipitation of the albumin by a solution of lead subacetate and subsequent neutralization of the excess lead with sodium sulphate, the flasks were filled up and the contents filtered. A portion of this filtrate was examined for sugar by Bertrand's method. It was found that more sugar had been decomposed in the flask not containing sulphanilamide. The *p*H in presence of sulphanilamide was also slightly changed, while in the controls the *p*H increases to 4·4. The bacteriological examination shows that at 41°, in presence of sulphanilamide, the *B. Coli* were killed more quickly than at 37°.

Blind Seed Disease of Rye-grass

A DETAILED account of the blind seed fungus of rye-grass crops has recently been published by Malcolm Wilson, Mary Noble and Elizabeth G. Gray (*Trans. Roy. Soc. Edin.*, **61**, Pt. 2, No. 12, 327; 1945). The fungus was originally named *Phialea mucosa* but the present authors agree that it is possibly identical with *P. temulenta*. Infected seed shows no external disfigurement, but removal of the glumes reveals caryopses, rusty brown in colour, with masses of macroconidia. No seedling emerges when the seed is sown; it apparently remains undeveloped until May of the following year, when apothecia are produced by the fungus. Ascospores from these fructifications enter between the glumes of the flowering rye-grass and attack the developing seed. The disease was serious in 1938 and 1939, but does not seem to have given a great amount of trouble since. Strains of the fungus producing mycelium only, or mycelium and macroconidia, were found, though both types bore microconidia. The paper discusses possible relationships of the causal organism with endophytic fungi of the rye-grass and related species, and its possible toxicity to farm animals is also considered. Several methods of control have been tried, though not with much success as yet—the parasite is protected against dry seed disinfectants by the glumes.

Phosphorus Deficiency of Fruit Trees

Both in Great Britain and in America phosphorus deficiency of fruit trees in the field is of rare occurrence, but L. R. Bryant and R. Gardner (*Proc. Amer. Soc. Hort. Sci.*, **42**, 101; 1943) describe symptoms exhibited by pears grown in a soil in which sunflowers responded exceptionally well to phosphate dressings. The leaves of the pear were smaller than normal and showed a severe marginal and apical burning early in the season. Fruit failed to develop and there was a die-back of new shoots. Pot cultures indicated that the development of these symptoms could be prevented by the addition of superphosphate to the soil. Sulphur (10 lb. per tree) too was beneficial, but potash dressings were without effect.

Use of Carbon Dioxide in Fruit Storage and Transport

A NUMBER of papers (*Proc. Amer. Soc. Hort. Sci.*) indicate some of the ways in which carbon dioxide may be employed to reduce losses during transport and short-period storage of fruits. F. Gerhardt, E. Smith and H. English (**38**, 243; 1941) find that in an atmosphere containing carbon dioxide ripening of apricots is retarded. The effect is almost as great with five per cent as with twenty per cent carbon dioxide; but if the period required for ripening exceeds ten days, mealiness, a pale colour and insipid flavour and discoloration near the stone may result, but the ill-effects of the carbon dioxide are much less noticeable at low (30° F.) than at higher (45° F.) temperatures. Peaches are more tolerant of carbon dioxide and do not deteriorate if the carbon dioxide concentration reaches twenty per cent. Fifteen per cent of carbon dioxide in the atmosphere will maintain strawberries in good condition for three to four days at 50° F., the colour being retained better at this temperature than at 32° F. (A. V. Doreen, M. B. Hoffman and R. M. Smock, **38**, 231; 1941). Sweet cherries may be kept for three weeks at 40° F. in air containing twenty per cent of carbon dioxide, and with this concentration of carbon dioxide, brown rot and other decays of the fruit are checked. Ten per cent of carbon dioxide and a temperature of 42° F. retard the ripening of plums as effectively at a temperature of 32° F. in ordinary air (F. W. Allen, W. T. Pentzer and C. O. Bratley, **44**, 141; 1944). The use of carbon dioxide permits the storage of plums at a higher temperature than would otherwise be possible, and this is important as with some varieties breakdown occurs unless the storage temperature is above 40° F. (W. T. Pentzer and F. W. Allen, **44**, 148; 1944).

Post-Jurassic Intrusions of the Aldan Region, Eastern Siberia

A VALUABLE contribution by Y. A. Bilibin to the petrogenesis of alkaline igneous rocks has been published in *Petrography of U.S.S.R.*, Ser. 1, *Regional Petrography* No. 10; *Inst. Geol. Sci., U.S.S.R. Acad. Sci.*, 1941 (in Russian). The Aldan Plateau, between the Lena River and the Stanovoi Mountains, consists of a Pre-Cambrian complex with flat overlying

Cambrian limestones and Jurassic shales. Later intrusive rocks show the following sequence :

1. Concordant masses of porphyry with or without quartz, together with melanocratic varieties.
2. Laccoliths, stocks and dykes of a wide range of alkali rocks, including pseudoleucite-syenite, -porphyry, -tinguaite and -leucitite, and shonkinite, foyaite, pulaskite, sölvsbergite and bostonite.
3. Laccoliths, stocks and rare dykes of fine-grained calc-alkali rocks, including monzonite, augite-syenite and melanocratic syenite.
4. Stocks and dykes of aegirine-granite, grano-syenite and corresponding porphyries.

The author discusses the various hypotheses that have been suggested to account for the origin of alkali rocks. Desilication by limestone assimilation is rejected for this region on the grounds that (*a*) alkali rocks occur not only in the Cambrian limestones but also in the Pre-Cambrian complex, even at levels 300–400 m. below the base of the limestone ; and (*b*) contact action against the limestone is demonstrably negligible, except by the augite-syenites, where the reaction products are basic dioritic rocks. Concentration of alkalis by volatiles is dismissed, since there is no mineralogical evidence of the former presence of any unusual abundance of volatiles. It is inferred that the rocks were not produced by magmatic differentiation at the levels now exposed. The author suggests the possibility that dissociation of, for example, the leucite molecule takes place at depth. By differential diffusion of the liberated constituents, the peripheral zone of the magma reservoir becomes enriched in K_2O ; the intermediate zone in K_2O and SiO_2 ; and the central part in Al_2O_3.

Atomic Weight of Beryllium

THE accepted international atomic weight of beryllium is 9·02. This is almost 0·1 per cent smaller than the value given by the most recent determination by the mass spectrograph—9·0126—reported by Flügge and Mattauch (*Ber.*, **76**, 1 ; 1943). Johannsen (*Naturwiss.*, **31**, 592 ; 1943) has therefore undertaken a revision of the atomic weight of beryllium by chemical methods, using the ratios $BeCl_2 : 2Ag$ and $BeCl_2 : 2AgCl$. This method was used in 1922 by Hönigschmid and Birckenbach (*Ber.*, **55**, 4) who obtained 9·018 for the atomic weight. In the present work, pure beryllium chloride was made by the action of chlorine on beryllium oxide and sugar charcoal at a red heat. The substance was then sublimed, first in an atmosphere of chlorine, then in nitrogen, and finally in a high vacuum, without the substance melting, thus avoiding any action on the containing vessel. The sublimed chloride was a snow-white, micro-crystalline mass. The substance was weighed in evacuated sealed tubes, which were then broken under water. The chlorine in the solution was determined against silver by the nephelometric method. Eleven determinations of the ratio $BeCl_2 : 2Ag$ gave values lying between 9·012 and 9·015, the mean value being $9·013 \pm 0·0007$. Ten determinations of the ratio $BeCl_2 : 2AgCl$ gave values lying between 9·011 and 9·015, with a mean of $9·013 \pm 0·0012$. The most probable value of the atomic weight of beryllium is thus 9·013, agreeing well with the mass-spectrographic value.

Separation of Casein

ALTHOUGH there was evidence that casein is not a pure homogeneous protein, it was not until Linderstrøm-Lang and Kodama, in 1925, published solubility studies that casein was definitely known to be a mixture. In 1939, Mellanby reported an electrophoretic study, finding three peaks, which he designated α, β and γ casein. R. C. Warner (*J. Amer. Chem. Soc.*, **66**, 1725 ; 1944), by an application of the Tiselius electrophoretic method, correlated with methods of chemical fractionation designed to be as mild as possible, finds a separation into two fractions, α- and β-casein, which represent the two peaks in the electrophoretic pattern of casein at *p*H 7. The fractions were not electrophoretically homogeneous under all conditions, but they were purified so that neither fraction contained any of the other. The possibility of the existence of complex formation between α- and β-casein is discussed.

Long Transmission-line Problems

IN a recently published paper (*J. Inst. Elec. Eng.*, **92**, Pt. 2, No. 25, Feb. 1945), R. H. Paul presents two rigorous methods of solving transmission-line problems which avoid the use of charts or tables of hyperbolic functions of complex angles. In the first of these, the voltage and current at any point are shown to be due to two waves, one travelling forward, the other backward, attenuating as they travel, the vectors of the two waves being calculated from receiving end conditions. From these the wave vectors at any other point are derived and the latter, when compounded, lead to the voltage and current at that point. In the second method the complex angle of the load is determined from the forward and backward wave vectors and to this is added the complex angle of the line. The voltage and current are proportional to the hyperbolic cosine and sine respectively of the total angle. The magnitudes of these can be calculated, using circular and hyperbolic functions of real angles. A semi-graphical method of finding the current and voltage at several points on the line is then developed.

Southern Comparison Stars for Eros

R. H. Stoy and A. Menzies, in "Re-Observation of the Magnitudes of the Southern Comparison Stars for Eros" (*Mon. Not. Roy. Astro. Soc.*, **104**, 298 ; 1944), have produced a sequel to an earlier paper in which an attempt was made to link the Cape magnitude system with the international system. The earlier paper was based on the observation of certain members of the Hyades, Præsepe and Pleiades clusters ; but owing to the absence for these stars of well-determined magnitudes on the international scale, the attempt was not altogether a success. For this reason re-observations of some of the southern comparison stars of Eros have been conducted at the Royal Observatory, Cape of Good Hope, and comparisons of these with other results are interesting. Table 2 gives the magnitudes, on the Cape system, of 247 of the stars which were used as comparisons for Eros during its 1931 opposition, and of 86 brighter stars in the same region of the sky. On comparing these magnitudes with those determined at Yerkes and Mount Wilson, it is seen that the Yerkes magnitudes require a large systematic correction, depending on the declination, for both photographic and photovisual magnitudes. The lower the stars are in the sky at Yerkes, the brighter they appear, and it seems probable that something of this systematic effect has been carried over into the Mount Wilson magnitudes. Some of the causes for this effect are discussed, and in view of the large systematic errors that affect both the Mount Wilson and Yerkes magnitudes of the Eros comparison stars, neither series can be regarded as an accurate representation of the international scale as embodied in the North Polar sequence.

SWEDISH OCEANOGRAPHY DURING THE WAR

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ON January 24, 1939, the Oceanografiska Institutet in Göteborg, given to the Royal Society of Göteborg by the Wallenberg Foundation, was inaugurated[1]. Since then it has worked in close co-operation with the Svenska Hydrografisk-Biologiska Kommissionen, which has in this way received a valuable addition to its own research facilities, Bornö Station and Havsfiskelaboratoriet, both situated at the Gullmar Fjord, and the research ship *Skagerak*. At the beginning of August 1939 the *Skagerak* was engaged on an international cruise in the Baltic. One month later the ship was commandeered by the Swedish Navy and has since then been serving as an auxiliary gun-boat.

Cut off in this manner from active work at sea, Swedish oceanographers have had to fall back on work in the laboratory and within territorial waters on board chartered vessels. Occasionally, thanks to the courtesy of the naval command and of the Hydrographic Office in Stockholm, short cruises for special purposes have been carried out with the *Skagerak* and with the survey ships *Gustaf af Klint* and *Svensksund*. Some results gained in the course of five years work are summarized here.

Current measurements in the Baltic made with O. Pettersson's recording current meter suspended from submerged carrier buoys had in 1931 led to the discovery of rotating 'inertia-currents' with a period of twelve pendulum hours. During the cruise in the summer of 1939 four ships were co-operating according to a programme proposed by Sweden at the last meeting of the International Council before the War. Observations made simultaneously from these anchored ships led to important results, published by Dr. B. Kullenberg of this Institute in co-operation with Dr. I. Hela of the Havsforskningsinstitutet in Helsingfors[2]. Except close to the coast-line, rotating currents were found at all stations. At fifteen metres depth they had an amplitude of nearly 20 cm./sec. and, within the margin of experimental errors, the same phase. At two of the stations tidal currents of the M_2-period with an amplitude of 1–2 cm./sec. were discovered, the first record of tidal currents in the Baltic.

In the 'plankton-shaft' of the new Institute, which is twelve metres deep and two metres in diameter, large-scale plankton cultures under controlled conditions have been made with diatoms from the spring increase, a good crop of *Skeletonema costatum et al.* being obtained[3]. Afterwards a brood of copepods was kept alive for several weeks in the shaft. Unfortunately, Dr. Fabius Gross, who in the spring of 1939 arrived from Edinburgh to carry out these experiments together with Dr. F. Koczy of this Institute, has been prevented by the War from co-operating in the continued work. Attempts at 'manuring' the water of a small Swedish fjord, undertaken originally by the author some years before, have recently been resumed here in an enclosed bight particularly suited for the purpose. Excellent results from similar experiments made in Scotch lochs have in the meantime been reported by Dr. Gross and co-workers[4].

Research on the vitamin content in marine phytoplankton by the author has been continued in co-operation with the State Institute of Public Health in Stockholm, where the biological analyses for vitamin D have been made. From large catches of diatoms collected during the spring increase, weighing up to 80 kgm. in a wet condition, the fat-soluble substances have been extracted and tested for antirachitic vitamins with and without previous irradiation by ultra-violet light. Whereas experiments with non-irradiated plankton and extracts gave indefinite results, the extracted oil, after exposure to ultra-violet light, gave variable but fairly large yields of vitamin D; in one case a maximum of 2,800 I.U. per gram of the oil was found. This implies that there are fair amounts of the provitamin, probably 7-dehydrocholesterol, present in the diatoms. Separate tests with chickens are now being made in order to ascertain whether the active substance is vitamin D_3 or not. The conversion of the provitamin into the vitamin by submarine daylight must remain a subject for further research.

The last-named results give an enhanced interest to the short-wave components of submarine daylight and their possible importance for the ecology of the sea. Dr. N. G. Johnsson at Bornö Station has at the author's request carried out measurements on the intensity of the antirachitic rays in the waters of the Gullmar Fjord, using rectifying selenium cells deprived of their lacquer coating and exposed behind liquid filters enclosed within hemispherical quartz walls. Consistent results proving the presence of antirachitic rays of wave-lengths between 3,000 A. and 3,200 A. were found immediately beneath the surface, the rate of extinction in fairly clear sea water being about 35 per cent per decimetre, so that already in a depth of one metre the intensity is reduced to between 1 and 2 per cent of its surface value. These results, apparently the first obtained with submarine ultra-violet light, have been confirmed by biological tests, in which preparations of 7-dehydro-cholesterol were exposed to sub-surface light behind transparent quartz disks at depths varying between 5 cm. and 1·5 metres.

Shortly before the outbreak of the War, at the request of the International Council, the work on the standardization of rectifying cells used for submarine photometry was transferred from Copenhagen to the Oceanografiska Institutet in Göteborg. In collaboration with Mr. H. Olsson of the Meteorological Office in Stockholm, Dr. Johnsson has worked out a practical method[5] for standardizing the cells by means of sunlight, as originally proposed by Dr. A. Ångstrøm. More recently, Kullenberg and Johnsson have been able to work out a simple method for converting the photo-current readings of submarine daylight into energy-values by means of conversion factors, suited to different conditions of surface illumination and of water transparency. Except in the very uppermost layers, less than 1 metre thick, where deviations due to infra-red radiation, etc., are somewhat larger, the results are assumed to be accurate to a degree corresponding to an error of only 0·25 metre in the depth, which is quite satisfactory for biological as well as for most geophysical purposes. Future light-measurements from oceanographic cruises and stations will become much simplified and the results comparable *inter se* thanks to this method. A standard transparency meter for sub-surface measurements has been constructed by Dr. Johnsson[6].

Work by the author and Kullenberg on improved core-samplers for marine sediments has made satisfactory progress[7], the longest cores hitherto obtained

having a length of nearly eighteen metres. This new technique will have to undergo severe tests in much greater depths than those at present accessible (240 metres) before it can be recommended for deep-sea work. Cores with perfectly undisturbed varves from the estuary of Indalsälven, Gulf of Bothnia, have been obtained by one of the new core-samplers by Kullenberg[8].

Measurements of the radium content of deep-sea deposits and of manganese nodules from the *Challenger*, the Monaco and Agassiz collections have been made by the author[9]. The fall-off in radium content with the depth below the nodule surface indicates a rate of growth of about 1 mm. in a thousand years for manganese nodules from the Pacific Ocean, an increased rate of growth in an upward direction being interpreted as probably due to sedimentation at the rate of 0·5 mm. in a thousand years. The beautifully regular decrease in radium content with depth below the sediment surface, found by Piggot and Urry in long cores from the Atlantic Ocean[10], seems to confirm the suggestion offered by the author in 1937[11], that a precipitation of ionium together with ferric hydroxide occurs in the ocean and gives rise to part of the radium entering into the sediment, at the same time depleting the ocean water by about 90 per cent of the radium, which would correspond to its uranium content, about $1{\cdot}3 \times 10^{-6}$ ‰ according to B. Karlik[12]. From measurements of thorium in the red clay, made here by Dr. F. Koczy, it can be inferred that thorium also has been very thoroughly extracted from the water by the same *Mitreissreaktion*, the thorium content in the water being less than $0{\cdot}5 \times 10^{-8}$ ‰, as compared with an earlier value for the upper limit of $0{\cdot}5 \times 10^{-6}$ ‰ found by E. Föyn and E. Rona[13].

A special study of the manganese and iron present in deep-sea sediments, made by the author[14], provides important evidence against the hypothesis of a biological extraction from the sea water of these elements and their subsequent deposition on the bottom together with the foraminiferic shells, recently revived by W. Correns[15]. On the other hand, an extraction of the manganese present in the water through adsorption on very fine particles of volcanic ash, settling slowly through the water, does not appear improbable. The very pronounced local variations in the iron and, especially, in the manganese content of deep-sea sediments may be due to submarine volcanism, the deep-seated magma ejected over the ocean floor being presumably richer in manganese than continental basalts. The same agency, submarine volcanism, the author also holds to be at least partly responsible for the disappearance of the calcium carbonate from the red clay, due to mineral acids released in the reaction between the hot magma and the bottom water. If cold bottom water were the only lime-dissolving agency there ought to be no red clay below 1 or 2 metres from the sediment surface, owing to the higher temperature during the Tertiary age; a conclusion open to future tests by means of the new core-sampling devices.

[1] *Medd. Oc. Inst.*, No. 1 (1939).
[2] *Sv. H.B.Komm. Skrifter, Hydr.*, **6** (1942).
[3] *Medd. Oc. Inst.*, No. 2 (1939).
[4] *Nature*, **153**, 483 (1944).
[5] *Comm. Statens Met. Hydr. Anst. Sthlm.*, No. 47 (1944).
[6] *Sv. H.B.Komm. Skrifter Hydr.*, **19** (1944).
[7] *Medd. Oc. Inst.*, No. 5 (1941).
[8] *Geol. Fören. Förh. Sthlm.*, **66**, 501 (1944).
[9] *Medd. Oc. Inst.*, No. 8 (1944).
[10] *Amer. J. Sci.*, **38**, 81 (1941).
[11] *Wien. Anz.*, **16**, 1 (1937).
[12] *Medd. Oc. Inst.*, No. 2 (1939).
[13] *Medd. Oc. Inst.*, No. 2 (1939).
[14] *Medd. Oc. Inst.*, No. 9 (1945).
[15] *Göttinger Akad. Nachr.*, **5**, 219 (1941).

CERATIUM AND MARINE HYDROGRAPHY

THE recognized importance of the study of plankton distribution in relation to marine hydrography has called forth a number of intensive investigations in recent years. Three reports* dealing with the distribution of the dinoflagellate genus *Ceratium* are of special interest in this connexion owing to the widespread representation of this genus in all oceans. The important conclusions reached by Graham and Bronikovsky from the examination of the *Ceratium* material gathered during the last cruise of the *Carnegie* in 1928–29 are briefly summarized in the following paragraphs. The survey deals not only with wide areas of the Pacific, but also with the North Atlantic; and, on the basis of the *Ceratium* floras, five regions are distinguished, namely, cold North Atlantic, warm Atlantic, cold North Pacific, warm Pacific and south-east Pacific. These regions are also characterized hydrographically.

Among the factors determining the horizontal distribution of *Ceratium*, temperature plays a foremost part. Apart from a few cosmopolitan (for example, *C. fusus*, *C. horridum*) and subpolar species (for example, *C. arcticum*, *C. lineatum*), the bulk are regarded as tropical. The latter are, however, grouped as species intolerant of colder water and rather closely confined to surface temperatures of 19° C. and above (for example, *C. breve*, *C. lunula*), as slightly tolerant of colder water (for example, *C. contortum*) and as very tolerant tropical species, such as *C. massiliense* and *C. hexacanthum* (*cf.* below). In the opinion of the authors there are no species distinctive of temperate latitudes, such being populated by tolerant tropical and cosmopolitan, with occasional sub-polar, forms.

The influence of the amount of nutritive salts (based on phosphate-determinations) is less easily assessed. Regions of very low phosphate content (for example, the warm Atlantic) are in general characterized by a scanty *Ceratium* flora comprising a large number of species, while those with a high content (for example, the North Atlantic and the North Pacific) tend to be more densely populated by a restricted number of species. There is, however, no exact correlation, and the authors conclude that the phosphate-content has no considerable effect on the horizontal distribution of the species of *Ceratium*, although in a given area relative values may be of some significance. Nielsen's view that the concentration of organic products derived from the plankton is an important factor in determining the distribution of *Ceratium*, a view based principally on the distribution of neritic and oceanic forms, is briefly considered but no data for or against the theory are provided.

The probable value of species of *Ceratium* as current indicators could not be very fully assessed in a gross survey like that undertaken by the *Carnegie*. Currents displace both the flora and its environment, so that species can exist in regions which are unfavourable to them until, by mixing with the adjacent water, that of the current becomes unsuitable and the species disappears. Good examples of displacement

* Peters, N., "Die Bevölkerung des südatlantischen Ozeans mit Ceratien", Wiss. Ergebn. Deutsch. Atlant. Exped. *Meteor*, 1925–7, **12** (1932); Nielsen, E. S., "Untersuchungen über die V breitung, Biologie und Variation der Ceratien im Südlichen Stillen Ozean", *Dana* Report, No. 4 (1934). Graham, H. W., and Bronikovsky, N., "The Genus *Ceratium* in the Pacific and North Atlantic Oceans", Scient. Res. Cruise VII *Carnegie* (1928–9), etc. Carnegie Instit. Washington, Publ. 565 (1944).

by currents are furnished by the tolerant tropical species. Thus, the Gulf Stream carries *C. extensum* to the British Isles (surface temperatures 12·4° C.) and *C. hexacanthum* to Iceland (surface temperatures 8·9° C.), although elsewhere these two species are not found at temperatures below 14·9° and 18·9° C. respectively. It does not appear that the equatorial currents appreciably affect the distribution of species of *Ceratium*.

Comparison of the *Ceratium* floras of the two great oceans shows that only eight of the fifty-eight species recorded are restricted to one ocean only and that is always the Pacific. The species in question (*C. deflexum*, *C. bigelowii*, etc.) are either strictly tropical or only slightly tolerant of colder waters, and the seas around Cape Horn may form an impassable barrier to their extension into the Atlantic. Certain differences in the distribution of species common to the two oceans suggest that there may be greater differences between their *Ceratium* floras than is at present apparent. Thus, although the North Atlantic and the North Pacific resemble one another in the occurrence in both of the subpolar *C. lineatum* and *C. arcticum*, there are striking differences which suggest biological isolation. *C. pentagonum*, a species widespread in the tropical seas of both Oceans, is absent from the North Atlantic while represented in the North Pacific by the very divergent subspecies *pacificum*. Again *C. macroceros*, with the subspecies *gallicum* frequent in all warm-water regions, is represented in the North Atlantic by the sub-species *macroceros*, though lacking in the North Pacific.

Twenty of the recorded species (for example, *C. praelongum*, *C. tenue*) show an increase in frequency from the surface to 100 metres. Such species have thin cells crowded with chromatophores which also extend into the horns when these are present. On the whole there is considerable agreement between the *Carnegie* data and those of Nielsen as regards these 'shade' species. The authors of the *Carnegie* Report, however, suggest that, apart from attunement to shade conditions, such forms may tend to move into layers of the water with a richer supply of nitrates and phosphates than are to be found in the surface layers at times of high plankton production.

F. E. Fritsch.

CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

THE forty-third annual report of the Carnegie Trust for the Universities of Scotland covers the academic year 1943–44, and includes a summary of the interim distribution of grants for the period October 1, 1943–September 30, 1944, with details of assistance to students and the abstract of financial accounts for the year ended September 30, 1944. In view of the continuation of war conditions, the Committee deemed it inexpedient to revert to the method of quinquennial distribution, and maintained the interim distribution on the same basis as previously. With regard to research, the situation was very similar to that recorded in 1942–43 and the abstract of accounts shows that a sum amounting to £15,497 has been accumulated, which is being held on behalf of fellows and scholars at present engaged on one or other form of national service, and of recipients of grants who have now been unable to make use of their awards. As it is unlikely that all those who have been awarded fellowships or scholarships since the outbreak of war will elect to begin or resume their researches under the ægis of the Trust, it is possible that a substantial reserve will have been created for the development of the Trust's plans for aiding research.

The decline in the number of beneficiaries was most marked in the Faculty of Arts where there were 164 less than in the previous session. The decline of 55 in science on the figure for the previous session was more than offset by a sharp rise in the number of beneficiaries in the Medical Faculty, the increase in medicine being 80 over the previous year. It is essential that it should be made known as widely as possible that, unless in the future the number of the beneficiaries falls very considerably, the resources at the disposal of the Trust will not permit any additions to the amount at present given by way of assistance in the several faculties.

The report on the work of investigators under the research schemes during the year referred to Miss E. M. Gorgeson's work on the flow of fluids through perforated tubes and through tubes the walls of which offer little resistance to diametrical expansion. Tribute is paid to the achievements of Dr. Hwan-Wu-Peng in a new approach to the quantum theory of fields. Researches in geology, palæontology and geography have been still more restricted, and during the period, scholars in chemistry, with few exceptions, held their scholarships in suspense pending a return to academic studies. Reference, however, is made to Mr. A. M. Mathieson's work on the comparison of the structure of certain sulphur compounds, to Mr. A. C. Docherty's work on thermal diffusion in liquids and related systems and to Mr. W. Graham's discovery of a greatly improved method of obtaining a degradation product of colchicin of primary importance in relation to the structure of this alkaloid, and his synthesis of a new hydrocarbon with five condensed benzene nuclei attained by fusing an additional benzene ring on to the chrysene molecule.

In the Biological and Medical Sections reference is made to Dr. G. Pontecorvo's work on the behaviour of the chromosomes of the germ cells in securing transmission of the normal hereditary constitution, while yet providing for transmission of slight intrinsic variations of the genes, which afford the opportunity for the operation of natural selection and thus for the possible production of mutant forms. Dr. L. Auber continued to investigate the influence of physical and chemical factors upon the meal moth, and Mrs. C. M. Ritchie her investigations on carbohydrate metabolism in collaboration with Dr. H. W. Kosteritz. A list of publications by fellows and scholars and recipients of grants received from September 30, 1943, is appended.

The report of the Laboratory of the Royal College of Physicians, which includes some reference to Dr. Edith K. Dawson's investigations on the sarcoma of the breast and on another rare neoplastic condition. In the field of biochemistry under Dr. W. O. Kermack important progress has been made in the synthesis of various *o*-phenanthroline derivatives substituted in the 2-position by basic side-chains similar to those present in such active compounds as mepacrin or plasmoquin, and effort has now turned to the synthesis of *o*-phenanthrolines substituted in the 9 or 10 position. Mr. Jacomb has concentrated on the preparation of analogous compounds to give *p*-phenanthroline derivatives with a basic side-chain in position 9 or 10 on the benzene ring instead of in the 2-position. 9-Bromo-*p*-phenanthroline has been prepared and

readily converted into amino-phenanthroline under conditions described by R. V. Haworth and W. O. Sykes. Before Mr. Dobson left the laboratory at the end of September, he had made excellent progress in the synthesis of pyridoacridine derivatives carrying basic side-chains of various types, some of which had given very promising results on biological tests. Some progress had been made in the related group of the benzacridines, some of which are also active. The work on the pyridoacridines is being continued by Mr. Hutchison, who has concentrated on the synthesis of compounds with various substituents in the nucleus. Further evidence has been obtained of the correctness of the assigned structure of the 4-hydroxy-*m*-phenanthroline synthesized by Dr. Tebrich. Dr. Eggleton and Dr. Kermack have also continued their mathematical work on problems of diffusion such as are encountered in connexion with the diffusion of compounds into and out of the tissues, and under Dr. Levinthal experimental work for the development of a general bacteriological medium is being pursued.

UNIVERSITIES AND THE NEEDS OF THE COMMUNITY

UNDER the title "Some Comparisons between Universities", the proceedings of the Second Education Conference of the Association of University Professors and Lecturers of the Allied Countries in Great Britain have now been published*. The report includes a summary of the proceedings by Prof. R. D. Laurie and a foreword by Sir Ernest Barker which emphasizes the wide range of thought which was pooled at the Conference. None of the British universities and none of the Western universities have, as Prof. E. Vermeil noted in an address on "The University Spirit in Germany and in the Western Democracies", succumbed to the domination of a political dogma, and similarly, as Mr. Willard Connely reminded the Conference, American universities were among the first in the United States to see the inevitability of American participation in the world struggle for freedom.

The report gives indeed an encouraging picture of the influence of the university on society which should be remembered when we are considering some current criticism of the universities. Mr. Connely can rightly point to such presidents of American universities as Lowell and J. B. Conant, who contended that universities must counteract rather than copy the defects of contemporary civilization, and have helped to make the American university a main instrument of fostering an international outlook. Sir Ernest Barker too refers to the strength which we can draw in facing the future from looking back on the past achievements of our universities and their contribution to religious life and national culture. The tradition of unselfish learning and the inheritance of national culture, which the ancient universities of Europe have steadily sought to accumulate and transmit from generation to generation, will be sorely needed as we face the task of reconstructing European society, and whatever changes or developments may be called for should not be such as to weaken that tradition or the love of learning, the passion for research and for teaching which have flowered in that old, rich and deep soil.

That the comparisons between universities made in this report leave first of all a deep impression of common traditions and ideals does not necessarily invalidate certain criticisms and suggestions for improving contacts made at the Conference. Prof. Jean Timmermans, who remarked on some points in which British practice in the organization of scientific research might be adopted on the Continent, believes that the exchange of scientific publications between Great Britain and the Continent is on an insufficient scale, and suggested a wider distribution of European periodicals in British universities. He also believes that there is a tendency to insularity in British universities, and that contact with them before the War was difficult. It was necessary to approach each university separately, and from this point of view he welcomed the proposal for a university council contained in the recent report of the British Association's Committee on Post-War Education.

Contacts are not entirely lacking, but Prof. Timmermans' view should be duly noted in considering the re-organization of the universities of Britain and their development to meet the larger demands both for teaching and research which will be made upon them in the immediate future. So too should the important point made by Sir Fred Clarke, in speaking on "The University and the Teaching Profession", that a university is scarcely entitled to prepare students for any profession unless within its walls the problems of that profession are being systematically studied. The condition is reasonably well fulfilled for such professions as medicine and engineering; but it is only beginning to be fulfilled in that of teaching—or, it might be added, of law. Again, the university is above all the guardian of standards, standards both of teaching and of attainment, in students, and no point will require more careful watching in these immediate post-war years.

On some of the other points of criticism expressed at the Conference there was less general agreement, and the suggestion in Mr. Bruce Truscot's paper on "Contact with the Student Mind" that a wide gap exists between the professor or lecturer and the student was not supported either by Prof. R. D. Laurie, who presented the paper, or by Sir Ernest Barker or by others: Mr. S. Grzybowski, a student of the Polish Medical School in Edinburgh, for example, was impressed by the closeness of the relation between the professor and the students. While Mr. Truscot's suggestion for the improvement of contacts between the university and the school was not entirely acceptable, the Conference appeared to recognize that it is important to strengthen that contact as much as possible. Again, Prof. Vaucher thought that the Continental scholar would be most impressed by the tutorial system in the older universities of Britain and the supervisor system in the newer ones; and Mr. Grzybowski thought that the British system is better for the average student, whereas the system of many Continental universities gives a better chance to the best students.

The relative position of teaching and research in the universities was just touched upon at the Conference without going deep enough to add anything to the present debate. Mr. Grzybowski thought that it is more commonly recognized in Britain than in some Continental universities that much the most important duty of the university staff is teaching.

* Association of University Professors and Lecturers of the Allied Countries in Great Britain. Second Education Conference, April 15, 1944: Some Comparisons between Universities. Pp. xvi+64. (Oxford: Basil Blackwell, 1944.) 2*s*. 6*d*. net.

On the whole, it must be admitted that the four papers contributed at the session on research, apart from Prof. Timmermans' appeal for fuller exchange of scientific publications, and Prof. G. I. Finch's plea for British assistance to universities and research schools on the Continent in the form of interchange of apparatus and workers and teachers as well as literature, contributed little fresh. Dr. M. Ruhemann, in a paper on the organization of research in the U.S.S.R., while urging that organization is only a means to an end, never an end in itself, believes that some combination of a political, an economic and a scientific body is fundamental in order that research may be organized effectively on a national scale. To organize science without taking into consideration the economic needs of the country would lead to a divorce of science from the life of the people, and thus to a lifeless and scholastic science, while the organization of national economy without some political directive might be impossible.

More vital, on the whole, than the sessions on research and on teaching in the universities were those concerned with the influence of the university on the student and the influence of the universities on society. In the former, Miss M. R. Gale, secretary of the International Council of Students in Great Britain, and of the National Union of Students, stated that the students' union is a most important factor in training students in committee work, public speaking, and similar activities fitting them to take part in public life. Some Continental speakers remarked on a distinct gap between the student body in Great Britain and the rest of the community. Mr. J. L. Henderson, general secretary to the British Committee of World Student Relief, in speaking of what is already being done in this field of student relief and of the plans of the British Committee of World Student Relief for developing post-war activities, indicated at the same time one way of re-integration of student life with that of the community. He foresees during the post-war years a tendency among students to political apathy, frivolous irresponsibility, as well as to hatred and despair, especially among those who can appreciate most clearly the inadequacy of the political conditions which surround them. To rekindle the flame of true scholarship, to re-create moral values and spiritual principles may perhaps be done best by working empirically from the bonds which necessity in the shape of famine and disease has forged between all sorts of men holding all sorts of rival opinions. The immediate need in centres such as Vienna, Prague, Warsaw or Belgrade will be the establishment of student committees of self-help to plan and control, in association with whatever foreign assistance may be available, the relief work among local university students.

Mr. Henderson's plea for an act of imagination and faith, to restore student life to a worthy place in the community, was in keeping with the high note that was generally struck at the Conference. There was no disposition to ignore the fact that the Western universities have enemies. They were clearly enunciated by Prof. E. Vermeil as specialization, mechanization of learning and undue interference by the State; and Prof. Vermeil developed something of the argument of Mr. A. S. Nash in his book on "The University in the Modern World" which appeared after the Conference. The Western tradition of humanism, resting on the Greco-Latin humanities, on certain elements in Christianity, on the liberalism of the eighteenth century and the social spirit of the nineteenth, has always regarded the university as the chosen soil for the unimpeded growth of scientific research and culture. But the plans for university reform, for the shaping of Western universities so that they may serve more effectively the needs of to-day, will come to nothing unless they are based on a renewed conception of the university spirit, on general culture and its role in the democracies of to-morrow.

No one would pretend that this Conference made a fundamental contribution to the evolution of a new philosophy of the university, but it at least points to some of the fundamental questions that have to be faced, to some problems where practical action might easily be taken. In such thinking, it is no small matter to have this evidence that the problems of university expansion and its relation to the needs of the community, to which so much thought has already been given in Great Britain, are problems on which the best minds of Western Europe and the United States have also been exercised, that the great traditions of university life are held in common with them, and that from their experience also we may draw both guidance and inspiration.

TUNAS OF THE PACIFIC*

FOUR species of *Tuna* play an important part in the fisheries of California, Mexico and Central America: the skipjack *Katsuwonus pelamis* (Linnæus), the yellowfin tuna *Neothunnus macropterus* (Temminck and Schlegel), the albacore *Thunnus germo* (Lacépède) and the bluefin tuna *Thunnus thynnus* (Linnæus). The big-eyed tuna *Parathunnus mebachi* (Kishinouye) was also investigated and compared with the others. The present study was undertaken in March 1940, to determine the geographical range of these and the relationships between them and similar species occurring in the Central, Western and Equatorial Pacific. This entailed a detailed anatomical treatment which will form a firm foundation upon which investigations may be extended into lines more directly applicable to conservation.

The work has shown concerning the skipjack that within the entire fishing area in the Eastern Pacific extending along the Central and North American coast-line from the equator to California and offshore to include all the outlying islands, there is but a single species, and specimens from all these areas are furthermore individually indistinguishable from those obtained from Japan and the Hawaiian Islands.

In the case of the yellowfin tuna, again there is a single species throughout the fishing area, and these fish are individually indistinguishable from the specimens obtained from the Hawaiian Islands, Japan and Peru. Distinct populations may exist within this larger area, but conclusions concerning these await the analysis of data collected.

The albacore of the North American coast-line proved to be the same species as that from Japan and the Hawaiian Islands, with a geographical distribution extending across the north temperate Pacific.

* A Systematic Study of the Pacific Tunas. By H. C. Godsil and Robert D. Byers. (Bureau of Marine Fisheries, California Division of Fish and Game: State of California Department of Natural Resources, Division of Fish and Game. Fish Bulletin No. 60.) (Sacramento: California State Printing Office, 1944.)

The bluefin tuna from southern and lower California are essentially one species and, until adequate descriptions are available from all localities, must be assigned to the same species as *Thunnus thynnus* of the Atlantic. Lacking material from Japan, comparison with Kishinouye's (1923) description of *Thunnus orientalis* (the oriental bluefin) shows that this is probably a different species.

With regard to the chief morphological features, it was found that the appearance of the viscera *in situ* is a valuable identifying character. Other differences appear in the presence or absence of air bladder, differences in excretory system, and the circulatory system which is unique in many respects. The differences in circulatory system were used by Kishinouye in classifying the tunas. The present observations were confined largely, but not exclusively, to the arterial system. The post-cardinal vein is present in all but the genus *Thunnus*, but its course and degree of development differ. The skeletal elements are remarkably alike, and the authors believe that they offer less promise for specific identification than other anatomical parts. Nevertheless a key is given to the five species studied, based on these skeletal elements; also a table giving a summary of anatomical differences.

In the most important characters the skipjack differs from all the others. Alone it can be distinguished at once by the external features. It lacks an air bladder. The intestine is not folded. The ventral view of the viscera *in situ* is distinctive and differentiates it. In its blood system and excretory system it differs sharply from the others. It is the easiest to identify of the five species.

Foreseeing the necessity of a more detailed population study of some species, a large number of both external and internal measurements and counts were added to the routine. These are reserved for a future work.

A METEORIC THEORY OF THE ORIGIN OF THE EARTH AND PLANETS

O. J. SCHMIDT has a paper with this title in *Comptes Rendus (Doklady) de L'Académie des Sciences de L'URSS.* (**45**, No. 6; 1944), in which he propounds a new theory of the origin of the planetary system. At the basis of the theory there are two fundamental facts—the rotation of the Galaxy and the presence near its central plane of large masses of obscuring matter. During its motion round the centre of gravity of the Galaxy, the sun crossed a dark cloud of dust and meteorites and captured portions of this, compelling the particles to revolve around its centre. In the course of time these captured particles united into larger formations, thus producing the planets.

In a previous paper (*C.R. Acad. Sci. URSS.*, **44**, No. 1; 1944), the author dealt with the formation of binaries in a rotating Galaxy. The motions of stars are a combined result of the attraction of the central galactic masses and of external masses and the neighbouring individual stars, and under certain conditions two stars can come into such a position that they are drawn closer together, so that capture and the formation of a double star occur. The following assumptions, considered to correspond to statistical averages, were made in dealing with this problem: (*a*) The stars move along circular orbits, subject to the attraction of the Galaxy, supposed to be concentrated in its centre. (*b*) The orbits lie in different planes inclined at small angles to one another. (*c*) Capture takes place when the two stars pass the position of the shortest distance between the orbits.

On these assumptions, a formula has been derived which connects the semi-major axis and eccentricity of the orbit of the binary with a quantity which depends on "the galactic parameter of the stars". This is a function of the distance to the galactic centre, the mass of the inner portion of the Galaxy, the total mass of the two stars, and the angle between the orbital planes of the stars previous to capture. While the formula is not strictly applicable in every case, as it considers mean results, nevertheless it is sufficiently accurate to apply to the problem of the capture of meteoric matter by the sun.

It is essential to the theory that the plane of the sun's galactic orbit should be inclined at an angle of about 3° to the central plane of the Galaxy. If the sun while at one of the nodes of its orbit passes through a cloud of matter, meteorites are captured in accordance with the same laws as underlie the formation of double stars. Both direct and retrograde motions take place with the captured meteorites; but if the sun passes near the edge of the cloud its density is not uniform, and in consequence more meteorites revolve in one direction about the sun. Those revolving in the opposite direction collide with the more numerous portion of the swarm and lose their momentum, ultimately falling into the sun. The main mass segregates in the course of time into larger bodies from which the planets are formed, and this segregation proceeds through smaller particles falling on larger ones just as meteorites fall on the earth at present. As the swarm of meteorites has the form of a flat lens, the planets in the process of formation have their orbits lying approximately in one plane—the central plane of the lens—and as the meteorites ultimately revolve in one direction, for reasons already suggested, the planets will also revolve in one direction. In the early stage the major axes of the swarm have a tendency to distribute their axes along the shortest distance between the galactic orbit of the sun and that of the cloud, but they are deflected from this direction by mutual perturbations. Hence no planet formed in the manner suggested can have a preferential direction for its major axis.

The problem of the angular momenta of the planets, which has been an insuperable difficulty with many theories of the formation of the solar system, is avoided by the present view, as the galactic momentum of the meteorites supplies the necessary angular momenta. Dr. Schmidt hopes that the theory will be further developed to bring within its scope such problems as the rotation of the sun and of the planets, the age of the planetary system, the formation of the satellites, etc. In addition, certain features concerning the internal structure of the earth are explicable, and Dr. Schmidt is engaged in the preparation of papers which will discuss such problems. The present paper contains some quantitative results regarding the distribution of mass and momentum in the planetary system and also the extent of agreement between the theory and observational evidence. These are largely provisional, and additional evidence in support of the theory will be forthcoming in the papers which are to be published in due course.

FORTHCOMING EVENT

Tuesday, August 14

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

APPOINTMENTS VACANT

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

SENIOR IRRIGATION ENGINEERS for the Directorate-General of Irrigation, Iraq—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting E.1817.A (August 17).

TECHNICAL SUPERINTENDENT OF THE BLACKBURN ELECTRICITY UNDERTAKING—The Engineer and Manager, Electricity Offices, Jubilee Street, Blackburn (August 18).

LECTURER IN MATHEMATICS, and a LECTURER IN NATURAL PHILOSOPHY in the United College, St. Andrews—The Secretary, The University, St. Andrews (August 18).

PROVINCIAL ADVISORY CHEMIST in the Department of Agriculture and Horticulture—The Secretary and Registrar, The University, Bristol (August 18).

LECTURER IN MECHANICAL ENGINEERING—The Registrar, College of Technology, Manchester 1 (August 20).

ASSISTANT MASTER to take PHYSICS and CHEMISTRY—The Principal, Enfield Technical College, Queensway, Enfield, Middx. (August 20).

LECTURER IN CHEMISTRY at the Widnes Municipal Technical College—The Divisional Education Officer, Town Hall, Widnes, Lancs. (August 24).

TECHNICAL ASSISTANT IN AGRICULTURAL ECONOMICS—The Acting Registrar, The University, Leeds (August 24).

BOROUGH ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, Municipal Offices, Grimsby, endorsed 'Borough Electrical Engineer and Manager' (August 24).

GAS RESEARCH FELLOWSHIP of the Institution of Gas Engineers tenable at the University of Leeds—The Assistant Clerk to the Senate, The University, Leeds (August 25).

DEPUTY BOROUGH ENGINEER AND SURVEYOR—The Town Clerk, Town Hall, East Ham, London, E.6 (August 25).

ASSISTANT LECTURER IN INTERNATIONAL RELATIONS—The Secretary, London School of Economics, Houghton Street, Aldwych, London, W.C.2 (August 27).

LECTURER IN BIOCHEMISTRY, an ASSISTANT LECTURER IN BIOCHEMISTRY, and a DEMONSTRATOR IN PHYSIOLOGY—The Acting Registrar, The University, Leeds 2 (August 27).

DEPUTY GENERAL MANAGER AND ENGINEER to the Sheffield Corporation Electricity Department—The Town Clerk, Town Hall, Sheffield 1 (August 28).

ASSISTANT ENGINEER to the Nigerian Electric Supply Corporation, Ltd.—The Ministry of Labour and National Service, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting D.1297.XA (August 29).

ASSISTANT LECTURER AND DEMONSTRATOR IN ENGINEERING—The Registrar, University College, Cathays Park, Cardiff (August 30).

LECTURER IN AGRICULTURAL ECONOMICS, and an ASSISTANT LECTURER IN AGRICULTURE, at the Essex Institute of Agriculture, Writtle, near Chelmsford—The Chief Education Officer, County Offices, Chelmsford (August 31).

PROBATIONARY ASSISTANT LECTURER IN ECONOMICS (specially qualified in Statistics)—The Acting Registrar, University College of North Wales, Bangor (August 31).

COUNTY ORGANIZER OF YOUNG FARMERS' CLUBS—The Acting Secretary, North Riding Federation of Young Farmers' Clubs, The Court House, Northallerton, Yorks (August 31).

RESEARCH PHYSICIST, Division of Radiophysics, Sydney—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (August 31).

EDITOR of the publications of the Chemical Society—The Hon. Secretaries, Chemical Society, Burlington House, Piccadilly, London, W.1 (September 3).

REGISTRAR—The Registrar, University Registry, Cathays Park, Cardiff (September 8).

PROFESSOR OF AERODYNAMICS, a PROFESSOR OF AIRCRAFT STRUCTURES, ENGINEERING AND DESIGN, and a PROFESSOR OF ENGINES AND SYSTEMS OF PROPULSION—The Secretary to the Board of Governors, College of Aeronautics, 14 Belgrave Square, London, S.W.1 (September 15).

REGISTRAR, and an ASSISTANT REGISTRAR AND BURSAR—The Secretary to the Board of Governors, College of Aeronautics, 14 Belgrave Square, London, S.W.1 (September 15).

LECTURER IN GEOGRAPHY, and a LECTURER IN ZOOLOGY, in the Natal University College, Pietermaritzburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (September 15).

LECTURER (specially interested in Physical Metallurgy) in the DEPARTMENT OF METALLURGY—The Registrar, The University, Sheffield (September 15).

LECTURER IN MATHEMATICS—The Secretary, Queen's University, Belfast (September 30).

MASTER OF METHOD AND LECTURER IN SCIENCE AND MATHEMATICS at the Edinburgh Training Centre (Moray House)—The Executive Officer, 140 Princes Street, Edinburgh (October 10).

LECTURER IN INORGANIC AND ANALYTICAL CHEMISTRY—The Secretary, The University, Aberdeen (October 15).

CHAIR OF METALLURGY tenable at the Imperial College of Science and Technology—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 31).

LIBRARIAN of Auckland University College, Auckland, New Zealand—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (December 1).

TECHNICAL ASSISTANT—Chief Engineer, Newcastle and District Electric Lighting Co., Ltd., 81 Westgate Road, Newcastle-upon-Tyne.

AREA SUPERVISOR (home-based, to live in the Newport, Shropshire, area), and an ASSISTANT AREA SUPERVISOR (to live in the Warwick area), under the National Milk Testing and Advisory Scheme—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

ASSISTANTS (male) for PETROLEUM LABORATORY work and for operation of small experimental plants on shifts—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2, quoting Q.N.410.

INDEXER AND ABSTRACTOR of technical publications in the Mineral Resources Department—The Establishment Officer, Imperial Institute, South Kensington, London, S.W.7.

LECTURER IN INORGANIC AND PHYSICAL (PHARMACEUTICAL) CHEMISTRY—Prof. W. H. LINNELL, College of the Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1.

RADIUM CUSTODIAN (woman)—The Clerk to the Governors, St. Bartholomew's Hospital, London, E.C.1.

FORESTER (practical, experienced, working) for the Isle of Man—The Secretary, Isle of Man Forestry Board, Atholl Street, Douglas, Isle of Man.

ASSISTANT LECTURERS (temporary) IN ZOOLOGY—The Secretary, University College, Gower Street, London, W.C.1.

TEACHER (well qualified) OF CHEMISTRY and GENERAL SCIENCE—The Principal, Technical Institute, Tunbridge Wells.

LECTURER IN MECHANICAL ENGINEERING—The Secretary, Woolwich Polytechnic, Woolwich, London, S.E.18.

TEACHER OF ENGINEERING SUBJECTS, and a WORKSHOP INSTRUCTOR, in the Harrogate Technical Institute—The Municipal Officer, Harrogate.

LECTURER IN HYGIENE AND APPLIED SCIENCE—The Principal, Normal College, Bangor, North Wales.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council. War Memorandum No. 15: The Sterilization, Use and Care of Syringes. By a Committee appointed by the Medical Research Council. Pp. 24. (London: H.M. Stationery Office, 1945.) 4*d*. net. [177

The Journal of Documentation: devoted to the Recording, Organization and Dissemination of Specialized Knowledge. Published quarterly. Vol. 1, No. 1, June 1945. Pp. 64. (London: Association of Special Libraries and Information Bureaux, 1945.) 7*s*. 6*d*.; Subscription, 25*s*. a year. [177

Empire Cotton Growing Corporation. Progress Reports from Experiment Stations, Season 1943–1944; Programmes of Experiments, Season 1944–1945. Pp. ii+176. (London: Empire Cotton Growing Corporation, 1945.) 3*s*. [187

King Edward's Hospital Fund for London. Second Memorandum on Hospital Diet: for Consideration by Hospitals. Pp. 60. (London: Geo. Barber and Son, Ltd., 1945.) 9*d*. net. [197

Other Countries

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