NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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THE UNITED NATIONS

THE San Francisco Conference which issued in the United Nations Charter, signed on June 26, after nine weeks deliberations on the proposals formulated last autumn at Dumbarton Oaks, by the fifty nations represented, has been compared by President Truman with the Philadelphia Convention of 1787 which led to the framing of the Constitution of the United States. Like that Constitution, the United Nations Charter represents a compromise, the outcome of close debate and sometimes sharp exchange of conflicting opinions. Like that Constitution again, the Charter is not claimed to be a final or perfect instrument ; and, more clearly than the Covenant of the League of Nations, it provides expressly for its own revision and modification in the light of experience.

Whether the San Francisco Conference will take its place in history with the Philadelphia Convention has yet to be seen. It is only the first step towards a lasting peace—the forging of an instrument, which, whatever the merits or demerits of its content, is truly what the League of Nations never was, a world organization. The signatures on the same Charter of the United States and of Soviet Russia is a greater achievement than any of its 111 articles, and the promptness with which President Truman has sent the Charter to the United States Senate for ratification, and the Russian disposition to stress the responsibilities of the major Powers rather than their privileges, are hopeful signs. Even more hopeful is the sober restraint which has characterized the recognition of this great achievement. There is now far wider recognition that no international instrument, no constitutional specific will suffice to maintain peace ; and the absence of extravagant hopes may be one of the firmest assurances that the Charter will command the loyalty and understanding which alone can make it effective.

Regional arrangements are clearly encouraged, the need for peaceful change is duly emphasized, and the clause inserted in Article 1 affirming as one purpose "international co-operation . . . in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion", does something to meet the call for an international bill of rights inspired by the terrible atrocities of recent years. The biggest step in meeting American criticisms of the Dumbarton Oaks scheme is probably the inclusion of entirely new chapters on trusteeship for non-self-governing territories. These three chapters involve the establishment of an international trusteeship system with a trusteeship council possessing similar functions to those of the League Mandates Commission.

The system thus established holds promise of removing some of the causes of friction and misunderstanding between Great Britain and the United States, as well as between other countries ; and these articles, with their emphasis on the encouragement of research and promotion of development, are of special interest to scientific workers. A like observation may be made of the second major addition to

the Dumbarton Oaks document—the much fuller elaboration of the scope and functions of the Economic and Social Council. Dismissed rather perfunctorily in Chapter 9 of the Dumbarton Oaks proposals, this scheme has now been developed at length in Chapters 9 and 10 of the new Charter embracing Articles 55–72. The Economic and Social Council, which will consist of eighteen members, is now named as one of the principal organs of the United Nations, and its duties will include that of initiating research and of recommending action to the Assembly on all international economic and social questions, including health.

This is not the place for a detailed examination of the nineteen chapters and 111 articles to which the Charter now runs, but the importance of the document cannot be over-emphasized. It represents first, as already noted, the cardinal and central fact that it is the duty of the powerful nations to assume the responsibility of leadership towards a world of peace, though it should not be forgotten that restraint will also be demanded of the smaller countries in the Economic and Social Council and in the Assembly if dissensions are not to arise. Next, the Charter represents a reasonable attempt to utilize available experience, both of regional bodies and of functional organizations. As President Truman rightly said, it shows that the lessons of military and economic co-operation during the War have been learnt, and that the pooling of experience and resources in the work of the Combined Raw Materials Board, the Food Board and the Combined Chief of Staffs Committee is to be turned to our advantage for the purposes of peace and not rashly jettisoned as in 1919.

But despite the embodiment of such methods and experience in the new Charter, and its close relation to the policies and organization already represented by the United Nations Relief and Rehabilitation Administration, the Food and Agricultural Organization, the monetary Conference at Bretton Woods, and the aviation conference at Chicago, the kernel of the new organization is the Security Council ; and, like the League of Nations, the United Nations will ultimately stand or fall by the success or failure of its machinery for the maintenance of peace.

The Charter itself is nothing if it fails to hold the loyalty of the major Powers, who alone can give it body and life. Already it is clear that the leaders of Great Britain, the United States, and the U.S.S.R. are ready to assume the responsibility of leadership towards a world of peace. In addition, we require indeed an effective agency for constant and thorough interchange of thought and ideas, through which alone can come a better and more tolerant understanding among nations and among peoples. An enduring peace involves a victory in the minds of men over the evil ideas and passions that have divided mankind and plunged the world into chaos. It involves the formation of a world opinion which clearly understands the price that has to be paid for peace, the restraints which must be accepted as the alternative to anarchy—the limitations as well as the opportunities of world organization. The creation of that opinion is a matter of education in which there is a place for every man and woman of good will.

R.A.F. AERIAL SURVEY IN PEACE-TIME

THE necessities of war have brought about the development of photographic reconnaissance upon a scale previously unapproached, and at a technical and administrative level of great competence. To achieve this the Royal Air Force has built upon the pioneer experience of the War of 1914–18, on Services and commercial experience between the Wars, and on the scientific knowledge of many types of imported specialists in fields related to aerial survey, such, for example, as archæologists, geographers and ecologists.

Now that a stage of hostilities has been reached when peace-time organization deserves attention, it is appropriate to recognize that in this branch of R.A.F. activities there exist material and experience of great potential value for those years of post-war development which lie ahead, and during which Great Britain cannot afford to neglect any prospective means of scientific and technical advancement.

These considerations are prompted by a memorandum circulated by the British Ecological Society to scientific authorities and responsible government departments, and headed "Memorandum on the Establishment of an Aerial Unit for Scientific Work". Ecology, which has been defined as "scientific natural history", has brought modern techniques of science to bear upon the complex phenomena of plant and animal life in relation to its natural environment. Its workers have constantly concerned themselves with problems of relationships between vegetation, animal life, topography and soil. Their outlook has progressively established itself as fundamental to the disciplines of forestry, agriculture, geography and archæology. It is suitable therefore that ecologists should raise this issue ; but it must be apparent that even wider fields than those they mention can be served by the widespread use of aerial mapping.

Photographic aerial survey has immense advantages over ground mapping : apart from the speed with which maps can be constructed from an air survey, air photography records automatically a multitude of distributional features of vegetational, geological, archæological and economic interest, and these remain available for inspection and analysis in the photographic prints. The aerial photographer, even when mapping without specific aim, cannot help but record an infinity of useful facts, of which he remains unaware, but which deliberate ground mapping could either not yield at all or yield only with immense labour. The value of this speedy, accurate and comprehensive mapping is too apparent to need stressing. It immediately affects geography, engineering, economics, and regional and town planning, especially perhaps in areas of great extent, complexity, or inaccessibility. It is, however, to its great potentialities in less obvious directions that our attention is now specially directed.

Archæologists were from the first keenly aware of the potential value to them of the point of view given

by the aeroplane, and many new and important sites have been disclosed by its aid. Thus air photography led to the excavation of Woodhenge in Wiltshire, and its counterpart at Arminghall in Norfolk, and disclosed the Romano-British system of field boundaries in relation with the prehistoric river systems of the East Anglian fens. Readers will indeed already be familiar with such achievements through the publications of Mr. O. G. S. Crawford on the subject, and through the admirable pioneer investigations of Wing Commander Insall.

Foresters have seized the opportunities of aerial survey no less readily. Dr. Dudley Stamp in 1925 published results of an aerial survey of Burmese forests in the Irrawaddy Delta ; Dr. Bourne, of the Imperial Forestry Institute, in 1930, indicated its immense potentialities in regional survey, illustrating his thesis by the aerial survey of tracts of southern England ; Dr. B. Lindquist of Lund was able, by air survey at a season when the beech foliage contrasted with that of other trees, to complete a survey of the beech forests throughout southern Sweden ; and more recently foresters in Canada and the United States have mapped and classified immense areas of forest land, and from the air photographs have derived information not only of vegetation types, tree species, and tree density, but also details of composition, age, and structure of the most direct importance to forest management. Other vegetation surveyed from the air includes types so divergent as prairie, sphagnum bog, coastal cliffs and submerged seaweed beds. Very often the changes such types show are intimately associated with topographic processes of great importance, such as those of soil erosion and coastal modification. The study of aerial plankton, the wind's freight of dust, pollen, bacteria, fungus spores and aphids, the rapid detection and report of the movements of big game or of locust swarms, the control of pests by spraying or dusting from the air, are yet other instances which indicate the wide scope of further application of the aeroplane to the service of biological science.

With the proved value of these applications in mind, and supported by an informative schedule of provisional schemes of investigation, the British Ecological Society suggests that after the War there should be established a permanent R.A.F. unit the services of which should be available for scientific work, not necessarily limited to photographic survey though chiefly concerned therein. To the arguments which are offered of the scientific potentialities of air survey thus fostered we would add that the effect upon the service unit of constant contact with men of science of varied kinds, and of attempts jointly with them to solve scientific problems of diverse character, must have the effect of keeping outlook and methods flexible and modern. Moreover, just as in war-time photographic survey has drawn extensively upon the services of academic men of science to help in such problems as the evaluation of cover, penetrability, and similar qualities of unfamiliar vegetation, so it remains desirable from the service point of view to keep and strengthen the links already made with such men of science.

The air photographs already obtained by the R.A.F. are of immense value to Britain, and the memorandum rightly recommends the establishment of a central library of air photographs available for scientific use. There should be destruction of negatives and prints of aerial photographs only where national security clearly demands it : the normal course should be for all good-quality negatives to go to the central library for indexing, and flights for training in air photography could with advantage regularly be made over targets selected for scientific usefulness.

We have mentioned but a fraction of the scientific issues touched by the new proposal, but it is clearly one which must receive warm support from men of science in all parts of the Commonwealth. If suitable administrative machinery can be devised, it should become a tool of great usefulness, helping men of science to maintain in the peace the quality of service they have so conspicuously upheld throughout the War.

GENETICS AND MAJOR EVOLUTIONARY CHANGE

Tempo and Mode in Evolution

By George Gaylord Simpson. (Columbia Biological Series, No. 15.) Pp. xviii+237. (New York : Columbia University Press ; London : Oxford University Press, 1944.) 23*s*. 6*d*. net.

IN "Tempo and Mode in Evolution" G. G. Simpson has done for palæontology what Ernst Mayr, in his "Systematics and the Origin of Species", did for taxonomy—he has reviewed the facts of his special branch of biology in the light of modern genetics. The result is an interesting and significant contribution to the synthesis now occurring in the general field of evolution.

Palæontology had indeed tended to build up its own set of evolutionary concepts, such as orthogenesis, racial senility, evolutionary momentum, and the like, between which and the concepts of neo-mendelism there seemed to be little or no possible connexion. Dr. Simpson has performed the double task of reminding neo-zoologists of many facts of palæontology which they have tended to overlook as unfamiliar or inconvenient, and at the same time showing the possibility of accounting for them in genetic terms.

The most familiar phenomenon brought to light by palæontology is the existence of evolutionary trends, as in the horses, the titanotheres, and almost every group of which there is abundant fossil record. The term orthogenesis has been applied to these sometimes as a description, sometimes as an explanation. Dr. Simpson reminds us that in point of fact these trends, though often broadly directional, are rarely rectilinear for more than short periods, that they may change in rate, that they may be reversed, that they show much branching (the horse stock has at least twelve branches of generic rank, besides the conventionally 'main' line leading to *Equus*). The facts are "flatly inconsistent with the idea of any inherent rectilinearity, predetermined trend, or solely preadaptive control". They can, however, be ex

plained on the basis of orthoselection—selection acting in general in the same direction over long periods.

As a minor additional mechanism, he agrees that certain facts which otherwise demand a mysterious directional urge can be explained as by-products of allometric growth : thus Robb's data indicate clearly that the relative increase of facial length in horses is an automatic by-product of increase in absolute body-size. There are some rather disturbing theoretical consequences of such potentialities being implicit in the original short-faced ancestor ; but if we recognize that selection can alter the rate of allometry (a point not clearly brought out by the author) the difficulties are not so great.

At any one period, each main trend or line tends to break up into separate species, adapted to slightly different environments. This Dr. Simpson would explain in essentially the same way as the taxonomist explains the formation of present-day species—by isolation, usually geographical, followed by divergence under the influence of selection. He would, I gather, attach rather more importance to the separating-out, by means of geographical isolation, of different characters, already co-existing in the original population. In support of this point, he adduces some facts (from ammonites) which show that a new line may have unusually low variability at the time of its origin, but that this is later gradually increased to normal. Such studies will be of great importance for evolution theory*.

A fact neglected by most zoologists is that within a general gradual trend, qualitative differentiation may occur, and if so, appears to be (geologically speaking) rapid. Thus the transition from browsing to grazing teeth occurred, in the ancestral true horses, during the Miocene. Dr. Simpson's analysis of this is very interesting. Grazing requires extremely long (hypsodont) teeth, because the food is so abrasive. However, even in browsing types increased size alone means somewhat greater hypsodonty, to meet the greater length of life. For this reason, by the early Miocene, equid teeth were beginning to approach a height suitable for grazing, so that then and only then could selection for grazing begin to act, and suitably isolated populations could evolve rapidly in the grazing direction.

Dr. Simpson then reminds us of the large gaps in the palæontological record, and of the consistency of their occurrence. In spite of the great progress made in tracing continuity of evolution *within* mammalian orders, no fossils have been found bridging the gaps between orders ; and this phenomenon is virtually universal. To account for this, he supposes that, for one reason or another, breeding populations in the missing lines were at such periods isolated and small. As Sewall Wright has shown, in such populations evolution may be more rapid than normal, but is also largely non-adaptive. However (and here Dr. Simpson makes a rather new point), such non-adaptive evolution, in relation to existing conditions, may in occasional cases be pre-adaptive in relation to a new mode of life or a new environment; and if so, there will be strong selection-pressure favouring further adaptation along these lines.

If this is correct, we should scarcely ever expect to find transitional forms, as these would be extremely few in numbers and their evolution into the new type would be unusually rapid.

The only question which will occur to geneticists is whether the very small isolated populations postulated by Sewall Wright as needed for non-adaptive evolution could persist for the millions of years postulated by Dr. Simpson (for example, p. 121) for his periods of rapid major change.

When a new favourable area is invaded, an 'explosive' evolution generally occurs, and we may then find some of the process preserved in fossils. Thus among the South American ungulates in their earliest phase, "there are so many transitional forms, some of them quite plainly adaptively unstable, that the taxonomic problem seems almost hopeless".

Dr. Simpson explicitly rejects Goldschmidt's view that large-scale evolution operates by sudden rearrangements of the germinal material to produce new 'reaction systems', and indeed adduces many arguments against it. His main thesis is that there are three main types of evolution—speciation, phyletic or gradual directional change, and the rapid major changes we have just discussed, to which he gives the perhaps not very satisfactory name of 'quantum evolution'. The attention of palæontologists has been chiefly focused on phyletic trends, that of neo-zoologists on speciation : the time has now come for an exchange of views.

There are many other points of interest discussed by Dr. Simpson. One is the question of evolutionary rate. Thus, on palæontological evidence, he is able to conclude that "carnivores have evolved, on an average, at least ten times as fast as pelecypod molluscs". Within a phyletic trend, different branches may show markedly different rates for the evolution of a given character.

It seems clear that the general phyletic evolution of a group may be slow, as seems to be the case for Pelecypods. But there is also the point that phyletic evolution may reach a limit, when specialization has been pushed as far as ortho-selection can take it (most mammalian orders) : after this limit, phyletic evolution will cease and be replaced, in Dr. Simpson's terminology, by speciation (though this may extend to the production of new genera). With this, the rate of evolutionary change will clearly be much slowed down. I think that palæontology should further clarify this question of different types of slow evolutionary rate and the reasons for them. Attention might also have been given to the difference between (one-sided) specialization and (all-round) progress, and its genetic implications.

However, we must not quarrel with a pioneer for not having covered every aspect of the subject. He has introduced us to a new field, where the co-operation of geneticists, taxonomists and palæontologists is needed. The palæontologist alone can provide certain types of data urgently required for any comprehensive theory of evolution. But as Dr. Simpson points out, the main part of his work in this field is still to do ; even with such a well-worked group as the horses "the study of equid evolution has barely begun" ! The neo-zoologists can play their part by suggesting what types of investigation are most needed, and later by helping in the interpretation of the results.

Meanwhile biologists will be grateful to Dr. Simpson for a stimulating book, undoubtedly destined to be the parent of much new work and many valuable conclusions.

JULIAN S. HUXLEY.

* In connexion with variability, Dr. Simpson's statement that man does not show an unusually high degree of variability would appear to apply to groups within the human species, not to the species as a whole. Further clarification of this point is desirable.

EXPLOSIVES IN WAR AND PEACE

The Science of Explosives

An Introduction to their Chemistry, Production and Analysis. By Prof. Martin Meyer. Pp. xi+452. (New York: Thomas Y. Crowell Co., 1943.) 4.50 dollars.

MODERN warfare calls for the rapid liberation, on an enormous scale, of free nitrogen from organic combination, with a correspondingly swift and lavish release of hoarded energy. This process is brought about through the intermediary of explosives. Contrary to the popular impression, explosives do not administer solely, or even mainly, to the destructive activities of 'the devilish cannon' and its complicated progeny. Explosives do not fade into insignificance in times of peace, although they may forsake the headlines. In the book under notice Prof. Meyer states that in 1940 more than 95 per cent of the total production of explosives in the United States was devoted to various essential activities of peace-time, such as the mining of coal and minerals and the accomplishment of construction work of many kinds. The American peace-time production of 423 million pounds in 1940 underwent a tremendous expansion after the Japanese attack on Pearl Harbour. "A first-class nation," states the author, "may annually use as much as 300,000 tons in peace, and this figure may rise to 3,000,000 tons or more in war."

A little reflexion will show what enormous inroads global warfare is bound to make, for the production of explosives only, upon the world's resources of fats, cotton, and coal, to say nothing of a great variety of other indispensable materials. A little more reflexion will reveal that explosives are not unique examples of discoveries that man has richly misapplied. To take a simpler example, explosives are concentrated forms of fire; and fire, as we know, is a good servant but a bad master. Man must learn to control the application not only of fire and of explosives, but also of thousands of other discoveries and inventions. This means, in the last analysis, that he must learn to control himself. That would be his crowning achievement.

In the work before us, the author offers in a clear and compact form an account of the chief types of explosives, and there are also chapters dealing with more general aspects of the subject, such as the theory of explosive action, grain size and shape, practical explosive and initiatory devices, together with descriptions of the inspection and analysis of explosives and of their application and use. Notes on the packing, shipping, storage, and safety of explosives are followed by a bibliography and index. Much additional information is given in the numerous tables and illustrations. Altogether, the work provides a handy and readable store of information, presented from an American point of view, for all who are interested in the nature, manufacture, properties, analysis, and applications of explosives.

A major criticism applicable to the book is that a specialized treatment of explosives scarcely calls for detailed descriptions, amounting to the best part of two chapters or some 10 per cent of the text, of the manufacture and properties of sulphuric and nitric acids; moreover, it seems unnecessary to include an illustration of a chemical balance, with directions for using it and for calibrating weights, or to devote the whole of four end-papers to a reproduction in duplicate of a table of the atomic numbers and atomic weights of 86 elements. A lack of proportion is shown also in the allocation of only seventeen pages to the important topics of black powder, pyrotechnics, and incendiaries.

Coming to one or two points of detail, it is unorthodox to discuss orientation effects in aromatic nitration under the title of "stereochemistry of the nitro compounds". Also, in spite of a decided paucity of simple expositions of explosives, it is not strictly accurate to claim in the prefatory statement that "there is an absence of material of this kind written in relatively simple and readable style and assembled in one book". What is perhaps the simplest of all such treatments is not mentioned in the lengthy bibliography.

JOHN READ.

POTENTIAL THEORY

The Theory of Potential and Spherical Harmonics

By Wolfgang J. Sternberg and Prof. Turner L. Smith. (Mathematical Expositions, No. 3.) Pp. xii+312. (Toronto: University of Toronto Press, 1944.) n.p.

THIS book is the third of a series published under the auspices of the University of Toronto, to meet the ever-growing need for mathematical books in English, which bridge the gap between the elementary text-book and the exhaustive (and often exhausting) treatise.

The important subject about which the authors have taken it upon themselves to write is an example of this nature. Kellogg's "Foundations of Potential Theory" could be regarded as the treatise, in this case, and there are many elementary books in mathematical physics which contain, among their pages, sections and paragraphs (often scattered and badly presented) dealing with those aspects of potential theory necessary for their particular applications. Nowhere, however, until the publication of this volume, was there any connected account, in English, of the subject which could be read as a 'subject-in-itself' by those desirous of making its acquaintance for its own sake.

In spite of the valuable material to be found in its pages, this book just fails to reach the high standard which the authors set out to attain. Within the compass available, it seems undesirable to insist on too much pure mathematical rigour, particularly when the physical aspect has, perforce, to suffer in consequence. Complete and elaborate convergence arguments fulfil an essential role in a treatise or specialized tract in function theory, but those which are merely elaborate, and yet still incomplete, serve very little purpose, especially in a work of this kind. Again, the authors take great care to point out that consistent use of vector analysis is a characteristic feature of their book; but there are very few places where it has been used at all, except to convert a result which has been derived (often unnecessarily laboriously) in some co-ordinate system, into vector notation. Not only is there a large amount of time and space wasted in this way, but the reader also inevitably gets the entirely false impression that the use of vectors in mathematical physics is completely artificial.

As an illustration, the symbol $\partial/\partial n$, denoting differentiation along the normal to a curve or surface, is occasionally written as $\mathbf{n}$. grad; but scarcely ever as the compound operator $\mathbf{n}.\nabla$, whereas it is only in this guise that its real significance as an invariant operator manifests itself.

After a brief introduction on the ideas of vectors

and scalars, the book opens with two chapters dealing with Newtonian force fields in two and three dimensions and the corresponding potential functions *in that order*. This, in itself, seems an unfortunate beginning, for in most of the elementary problems in mathematical physics the force fields are calculated *after* the potential has been derived. It would seem to be much more reasonable to define the potential as a line-integral, pointing out necessary and sufficient conditions for its existence, and to deduce from it the vector equation $\mathbf{F} = -\nabla U$; and then proceeding to show at once that the Newtonian inverse square law of attraction is derivable from the potential $U = 1/r$, and finally building up the more complicated functions (for example, those due to doublets, surface and volume distributions, and so on) by the ordinary processes of integration and summation.

Chapter 3 discusses the so-called integral theorems: namely, the theorems of Gauss and Stokes and their various corollaries. It is in this chapter that the authors really fail to give their vector analysis a free hand. It is true that the complete proofs of these theorems present formidable topological difficulties; but as these have been laid aside, in any event, as being outside the scope of such a work as this, there can be no excuse for not presenting simple and elegant proofs along formal lines. Furthermore, the theorems of the equivalent layer (or Green's formulæ) follow much more obviously by vector methods than by the (admittedly equivalent) Cartesian methods used in the text.

In the fourth chapter, the ideas of expansion of potential functions in series of spherical harmonics are treated. Much of the convergence theory could, one feels, be cut out with advantage, as it could be supplied by any competent reader, if so desired. In addition, the more elaborate properties of Legendre's polynomials and the associated functions can only be dealt with, satisfactorily, by complex function theory; and one is left with the distasteful impression that, in certain cases, it is only by luck, rather than judgment, that the correct results are obtained by the cruder arguments involving real variables only.

From Chapter 5 onwards, the book becomes infinitely more interesting, and it is in this and the remaining six chapters that the authors have provided a most valuable contribution to mathematical literature. Chapter 5 gives an account of the behaviour of the potential at points occupied by mass and is sufficiently accurate and comprehensive for most ordinary students. A short chapter on the relations of the two-dimensional theory to that of the functions of a complex variable is followed by a very lucid discussion of the boundary value problems of Dirichlet and Neumann, and a proof of the uniqueness of their solution, if it is assumed to exist.

The problems in the case of the circle and the sphere are solved explicitly in Chapters 8 and 9, by means of Poisson's integral; and certain results from the theory of Fourier series, which arise from these, are provided (with proofs where these can be easily supplied). The theory of Green's function is also most adequately dealt with and the existence of this function is shown to be equivalent to that of the mapping function in the fundamental theorem of Riemann, dealing with the conformal representation of any simply connected region with more than one boundary point on the interior of the unit circle.

In the last two chapters the existence of the solution of both the boundary-value problems (previously quoted) is shown to be equivalent to the existence of a solution of the various types of Fredholm's integral-equation, of which an excellent account is given in Chapter 10.

In spite of having made so much adverse criticism, I think there is no doubt that this book will prove to be of great value as a work of reference. It has been provided with a very detailed table of contents and quite a useful index. J. H. PEARCE.

OPERATIONAL CALCULUS

Heaviside's Operation Calculus Made Easy

By Dr. T. H. Turney. Pp. vii+96. (London: Chapman and Hall, 1944.) 10*s*. 6*d*. net.

The Simple Calculation of Electrical Transients

An Elementary Treatment of Transient Problems in Linear Electrical Circuits, by Heaviside's Operational Method. By G. W. Carter. Pp. viii+120. (Cambridge: At the University Press, 1944.) 8*s*. 6*d*. net.

CAN any subject be made easy? Did Silvanus Thompson's "Calculus Made Easy" save a single headache in the younger generation when it tried to master the mathematical tools of its elders? The first of the above books ought to be one which has been long awaited, namely, a graduated introduction to the powerful tool devised by Heaviside. The colloquial style does not, however, inspire confidence; and the early analogies, for example, that of a battery and condenser, and a general disregard of physical principles in favour of simplifying or grouping mathematical representations, are apt to lead an innocent reader astray. Just interchanging voltages and currents in formulæ simply will not do, even if this bright idea appears to help in simple applications. If the author's deduction (p. 12) that non-proportionality of current and flux in a laminated inductance leads to the idea that "the term inductance has little meaning in any case" were really true, most electrical engineers would be profoundly grateful. Then in two short paragraphs, which seem to have slipped forward, we are suddenly confronted with the properties of p. We soon come, however, to p and j, Helmholtz's circuit law, and Heaviside's unit function. Through partial fractions we are led to the application of Heaviside's expansion theorem to transmission lines, and to the development of the treatment of impulses. Dr. Turney finally compares Fourier and Heaviside integrals. The author is always on thin ice; although we do not expect rigour in an introduction to a difficult subject, at least we expect discipline. Mathematicians will certainly not commend this book.

The second book has a more restrictive title, although covering a similar section of the subject. The author is on much surer ground, needs no flourishes of style, comes much more quickly to the point at issue, holds on to physical aspects of his problems, and states quite clearly his assumptions of knowledge in the reader; his high-grade examples are closely woven into the text. The student is apt to be diffident in the usage of Heaviside's calculus, except in its simplest applications, in which he often knows the answer from more protracted but less intuitive methods; the present book should through its exercises give students that confidence which is the educational stimulus to go further. Perhaps this is the text-book we have been waiting for.

L. E. C. HUGHES.

DIRECT CHEMICAL ACTION UPON NERVE CENTRES IN BIOLOGY AND MEDICINE

By Prof. LENA STERN

Physiological Institute, Academy of Sciences of the U.S.S.R., Moscow

IN the course of evolution, as organisms have become more complex, they have also become more sensitive to their internal environment, for example, in higher animals, to the temperature, *p*H, and osmotic pressure of the blood and lymph. Minute changes in the properties of the internal milieu may result in serious dislocation of the functioning of the organism. As Claude Bernard said : "La fixité du milieu intérieur est la condition de la vie libre".

Local Environment

In addition to the general internal milieu common to all parts of an organism, there has evolved for each individual organ a specialized 'local' milieu, for which we have proposed the name 'immediate' or 'intimate' environment. Each organ derives the materials necessary for its functioning from the cellular fluid forming its local environment ; and into this local environment the organism discharges the products of its metabolism. The physical and chemical properties of the fluid which is the local environment of an organ are related to the structure and functions of that organ. Any abnormal change in the composition of this environment leads to a corresponding disturbance in the organ ; the disturbance may be so serious as to bring about the death of the whole organism.

The local environment of each organ is separated from the general internal environment by a physiological mechanism to which we have given the name 'histo-hæmatic' barrier. These barriers regulate the exchange between the blood and the immediate environment of each organ ; they control the inward passage of substances from the blood stream ; they facilitate the discharge from the local environment of the organ into the blood stream of the products of metabolism ; they maintain the constancy of the local environment.

It is clear, therefore, that the proper functioning of each organ depends on the integrity of the histo-hæmatic barrier surrounding its local environment. For example, an increase in the permeability of the barrier would expose the organ to any drugs circulating in the blood, which might not be able to penetrate the barrier under normal conditions.

The Hæmato-Encephalic Barrier

The spinal fluid is the local environment of the brain and the spinal cord. We have found that the properties of the spinal fluid depend largely upon the regulating action of what we call the 'hæmato-encephalic' barrier, which comprises the endothelium of the capillaries and the neuroglia. This barrier protects the central nervous system from toxins, virus, bacteria, etc., in the blood stream ; it controls the entry of substances necessary for the nutrition of the central nervous system ; it allows the passage from the spinal fluid into the blood stream of metabolic products of the brain which would, if they accumulated, disturb the activity of the central nervous system. The hæmato-encephalic barrier possesses selective permeability not only for substances foreign to the organism, but also for various natural products of metabolism, for example, antitoxins, hormones, etc. The permeability is, moreover, asymmetric : there is more selection in the direction blood→spinal fluid than in the direction spinal fluid→blood. This concept of histo-hæmatic barriers (particularly the hæmato-encephalic barrier) has been the basis of our work on the differences between the effects of drugs injected into the blood stream and into the fluid of the spinal cord.

There is a close relation between the permeability of the hæmato-encephalic barrier for any particular substance in the blood, and the possibility of this substance affecting the central nervous system. The only substances which affect the central nervous system when added to the blood are those which penetrate into the nutritional milieu of the brain, that is, the spinal fluid. Other substances which normally produce no neurotropic effect may affect the nervous system profoundly if they enter the spinal fluid. Consequently, when defining the neurotropic properties of a substance, it is necessary to know whether or not the substance has penetrated the hæmato-encephalic barrier, and been admitted to the immediate environment of the nervous system.

It is of considerable theoretical and practical interest that the selective permeability of the hæmato-encephalic barrier is considerably less in new-born animals with an undeveloped brain (for example, dog, rabbit, cat, rat) than in adult animals of the same species. This is probably true, too, for the new-born human being. This view is consistent with two facts : it is known that the substances introduced for therapeutic purposes into the circulatory system of a new-born child have effects quite different from the same substances in an adult ; and the peculiar clinical manifestations of some diseases in the child (cramps, high temperature) are consistent with the view that in the child toxic substances present in the blood pass into the spinal fluid much more easily than they do in an adult. It is our view that there is a parallel development of the central nervous system and the hæmato-encephalic barrier, not only ontogenetically but also phylogenetically.

The defensive action of the hæmato-encephalic barrier not only increases during early development ; it also varies according to the physiological condition of the organism. In pregnant animals, for example, the permeability of the barrier is easily changed by chemical or physical agents which scarcely affect the barrier in animals which are not pregnant. Animals heavily drugged with alcohol show, in the same way, a much greater sensitivity of the hæmato-encephalic barrier : in such animals even a slight change of temperature affects the permeability of the barrier.

The selective permeability of the hæmato-encephalic barrier safeguards in health the nerve centres against invasion by toxic substances. But in sickness, the barrier may be a hindrance, because it may prevent the penetration of therapeutic substances to the diseased nerve centres. This view is supported by clinical data. We have evidence that the pathological symptoms of the nervous system in some infectious diseases (for example, tetanus, encephalitis) are due to the direct action of the toxin or virus concerned upon the brain. We have evidence, too, that attempts to cure disorders of the central nervous system by the application of therapeutic agents into the blood stream are ineffectual because the barrier prevents the agents from passing into the spinal fluid.

Direct Introduction of Substances into the Spinal Fluid

There are two ways in which a therapeutic agent can be brought into the local environment of the central nervous system: (1) by lowering the resistance of the barrier (by increasing its permeability) and (2) by avoiding the barrier (by introducing the substance directly into the cavity of the cerebral ventricles).

It is possible through changes of temperature, *p*H, osmotic pressure, etc., to increase the permeability of the hæmato-encephalic barrier. But the clinical value of this treatment is questionable, for the permeability is increased not only to the substance it is required to introduce, but also to any noxious substances and toxins which may be in the blood stream. The second method, of introducing the substance directly into the cavities of the cerebral ventricles, has been intensively studied by us in recent years. We have, for example, introduced anti-tetanus serum into animals suffering from tetanus. In all experiments where the serum was introduced into the circulation, it gave positive results if introduced before the first symptoms of tetanus appeared. In experiments where the serum was introduced into the cerebral ventricles even after the onset of tetanus, the disease was arrested and there was total recovery: provided, of course, that the interval between the onset of symptoms and the time of injection was not too great.

These results secured with experimental animals have been applied successfully to horses suffering from tetanus and have been confirmed by clinical practice. Patients suffering from tetanus have been injected with anti-tetanus serum by cisternal injection. In the great majority of cases, if the injections were applied in time, the patients improved rapidly. This treatment is now being applied successfully in Army hospitals: simultaneously with an intravenous or intramuscular injection, 10–20 ml. antitetanus serum—that is, 15,000–30,000 American units—are introduced by cisternal injection into the cerebro-spinal canal, after removing an equal volume of spinal fluid. The method has recently been applied by Prof. E. M. Steblov, of the Neurological Institute in Alma-Ata, to treat the after-effects of seasonal encephalitis. Twenty-two cases were treated with reconvalescent serum. In only two of these cases, where the syndrome was of more than twenty years standing, did the injections produce no effect. In the other twenty cases there was visible improvement after the fifth injection, and in some patients even some power of movement was restored.

It is possible that the method may be extended to treat successfully other disorders of the brain and nervous system, even by the introduction direct into the spinal fluid of the patient's own blood serum.

Antagonistic Action of Chemicals

The work of O. Loewi and others has shown that nerve action is accompanied by the production of mediators: chemical substances resembling adrenaline and acetylcholine. These mediators have the same sort of action on effectors as direct stimulation by a corresponding nerve; they support and enhance the effects of excitation on the peripheral parts of the vegetative nervous system.

Our experimental results, and others already published, demonstrate that these mediators have a precisely opposite action on the corresponding parts of the central nervous system. They penetrate the hæmato-encephalic barrier from the blood stream to the spinal fluid, and there they tend to neutralize the effect they have produced on the peripheral system. These mediators, by neutralizing at one pole of the nervous system the effects they have produced at the other pole, provide a means of autoregulation in the organism. Their antagonistic effect is shared by humeral agents, too.

The work of a great number of scientific workers indicates that the metabolites of the brain exert a similar autoregulating function. Substances produced in the central nervous system (for example, substances present in blood flowing from the brain) affect the peripheral elements quite differently from the central nervous system. The conclusion can be drawn that these chemical substances, by their contrasting action on different parts of the organism, play an important part in autoregulation. The brain controls not only by nervous impulses, but also by liberating chemical agents.

Arising out of this antagonism, there is another application of the method of direct injection into the spinal fluid, which depends on the fact established by us, that the effect of some inorganic substances (for example, salts of potassium and calcium) on the peripheral elements of the vegetative system and their effector organs differs totally from the effect of the same substances on the central nervous system. Thus it has been established that an increase in the quotient K/Ca in the spinal fluid increases the tonus of the sympathetic nervous system; but in the blood the same changes in the quotient K/Ca lead to diametrically opposite results. It is sufficient to introduce a minimal quantity (a few mgm.) of K ions into the cerebral ventricles to call forth a strong excitation of vegetative organs; augmentation of cardiac activity; increase of muscle tonus, metabolism and excitability: all results diametrically the opposite of those produced if potassium is introduced into the blood stream. The same contrast is brought about by certain other materials (metabolites of organs, hormones, mediators, etc.) when applied to the blood on one hand and to the spinal fluid on the other.

Treatment of Shock

Since many pathological states, including vegetative neuroses, are due to changes in the tonus of the sympathetic and parasympathetic centres, or in the relation between the tonus of these centres, the method of direct application of drugs to these centres has considerable clinical possibilities. The results we have obtained in the treatment of shock in the wounded are of particular interest.

The role of the vegetative nervous system in the development of shock has been developed especially by W. Cannon and his collaborators, and it has been confirmed by many other workers and by ourselves. Shock is directly due to changes in the tonus of the nervous system, in particular to the diminution of the tonus of the sympathetic centres following their extreme excitation. An analysis of the spinal fluid in the later stages of shock shows a decrease in the quotient K/Ca, owing mainly to a decrease in potassium. This is accompanied by a spontaneous decrease in inorganic phosphate. These observations lead us to the conclusion that the first task in the treatment of shock is to introduce potassium phosphate directly into the cerebral ventricles in order to restore the K/Ca quotient.

This treatment proved effective on animals. Soon after the introduction of the solution, blood pressure increases rapidly, respiration becomes deeper, the excitability and reactivity of the animal are restored. The injection must be performed as early as possible because the capacity of the vegetative centres to respond to treatment decreases during shock. Clinical treatment of shock confirms these experiments. The method now being successfully applied to war cases is to introduce suboccipitally to the vegetative centres a mixture of mono- and di-potassium phosphates (6·5 mgm. K per ml., with a *p*H of 7·4–7·5). For clinical treatment the quantity used ranges from 2 to 7 ml., according to the severity of the shock, and for animals, 0·1 ml. per kgm. live-weight. The patient reacts in one or two minutes. It is essential that the material should penetrate the ventricle cavity; failure of the treatment is usually due to technical errors in its administration.

Other Possible Applications

The results encourage us to suppose that the method of direct action upon the nerve centres may be effective in the treatment of other nervous disorders. For example, diseases believed to be due to excessive tonus of the parasympathetic system (vagotonia) or of the sympathetic nervous system (sympatheticotonia) might be treated by introducing into the cerebral ventricles potassium phosphate in one case and calcium salts in the other. Promising results have been obtained by Prof. Y. Y. Sendulsky of Alma-Ata, in the treatment of certain kinds of deafness associated with the vegetative nervous system by cisternal injections of potassium phosphate, and for some kinds of dystrophia and chronic sepsis, by injection of vitamin B_1.

A further extension of our investigations in recent years has revealed that certain metabolites of organs (for example, the thyroid gland) affect the nervous system in a way quite different from their effects through the blood stream. There is an interesting field for the study of the effects of other metabolites on the nervous system. It is possible that, by the use of this method of direct injection into the spinal fluid, some diseases of the nervous system hitherto regarded as incurable may yield to treatment.

PHYSICAL AND CHEMICAL DEGRADATION OF RUBBER

ALTHOUGH chemical unsaturation is not essential to the occurrence of 'rubbery properties', all forms of 'rubber' which to-day find extensive application consist of long-chain molecules with frequently recurring ethylenic linkages. Admittedly, the chemical unsaturation may, and does, have adverse influence on the service life of rubber articles, but it also enables the material to be submitted to various forms of chemical treatment for the fuller control of its manipulation during manufacture and for enhancement of the physical characteristics of the manufactured products. Fortunately, the degree of chemical reactivity is so moderate as to permit a practical compromise leaving a large credit balance on the side of mechanical stability and endurance.

It is difficult to dissociate sharply the phenomena associated respectively with the chemical and physical instability of rubber. They have been of very great importance ever since the inception of the rubber industry. The deterioration of some of his early products was a grievous trouble to Charles Goodyear a century ago, and would have daunted a less pertinacious and resilient pioneer. Thanks to his basic achievements in the United States and to those of Thomas Hancock in Britain, supplemented by other discoveries, the rubber industry has made striking advances, and rubber articles are to-day capable of long service under conditions which then would have been deemed quite impracticable.

The recent achievement of the American chemical industries in producing synthetic rubber on a scale commensurate with the pre-war output of the rubber-plantation areas has incidentally necessitated still greater attention to the deliberate and controlled 'breakdown' of rubber; even more than natural rubber, the chief new material, so-called GR–S synthetic rubber, demands plasticization as a preliminary stage in its conversion into manufactured products.

In view of the many-sided importance of the subject and its associated problems, a symposium was held in Birmingham on May 12, on the initiative of the Midland Section of the Institution of the Rubber Industry, to discuss the "Physical and Chemical Breakdown of Rubber". As stated at the symposium by its chairman, Mr. F. G. W. King, technical director of the Dunlop Rubber Co., the magnitude of the contribution of the rubber industry to the allied war effort is difficult to appreciate fully, and the difficulties which have been surmounted are realized only by those directly concerned. Many of these difficulties fall within the range of the subject discussed.

The nine papers submitted revealed the breadth of the research activities of the industry, three contributions being presented by the British Rubber Producers' Research Association, two by the Research Association of British Rubber Manufacturers, two by the Rubber Division of Imperial Chemical Industries, Ltd., and two by the Technical Department of the Dunlop Rubber Co., Ltd.

The first paper to be read gave a preliminary report by Drs. W. J. C. Orr and J. L. Bolland, of the British Rubber Producers' Research Association, on the "Thermal Breakdown of Rubber" observed with comminuted 'sol' rubber, carefully freed from dissolved oxygen. Up to 200° C., the rubber is stable; but at 220–270° C. it shows gradual degradation without substantial loss of unsaturation but with the formation of a small proportion of volatile products, mainly isoprene and dipentene, approximately one molecule of the former and four of the latter being found when the molecular weight of the rubber, by osmotic measurements, has fallen to half its original value. On further heating, the rubber again becomes more viscous and finally sets to a benzene-insoluble, non-sticky solid. This latter change indicates that the degradation mechanism must be complicated by secondary reactions between the intermediate scission products and other molecular chains. By applying the 'resonance' concept and considering the energy of splitting of the chain molecule at the possible points, it is deduced that both the isoprene and dipentene are formed by fission at the ends of the rubber molecule, little if any of the latter arising from dimerization of pre-formed isoprene.

Details of another piece of fundamental research from the Association's laboratories were given by Dr. L. C. Bateman on the "Photochemical Breakdown

of Rubber". When finely cut, purified, *Hevea* rubber in an exhausted silica tube is exposed to light from a mercury arc, formation of a small quantity of gaseous products is observed, largely free hydrogen: the rubber concurrently becomes insoluble, with increase in molecular weight and slight decrease in iodine value. From quantum considerations these results are regarded as being in line with those to be expected from the known behaviour of simpler olefines.

The third investigation from the Associations' Laboratories, described by Dr. E. H. Farmer, related to the "Oxidative Breakdown of Rubber". The first stage in the autoxidative process with rubber involves the absorption of whole molecules of oxygen by the rubber, with formation of unstable organic peroxides; decomposition of these may occur in different ways, but, for natural rubber, gives rise normally to chain scission resulting in softening, with loss of elasticity and strength; whereas for synthetic rubbers it tends to result in toughening caused by polymerization or 'oxygen vulcanization'. For the fuller elucidation of the behaviour of the initial unstable peroxidic rubber product, that of various simpler olefine peroxides was also examined and discussed. The thermal and catalytic acceleration of the decomposition of the unstable 'rubber peroxide' are probably highly important factors in the autoxidative degradation of rubber and demand more intensive investigation than they have received hitherto.

The importance of the promoted degradation of rubber as a laboratory 'tool' was emphasized by two papers dealing with accelerated ageing. "The Heat Ageing of GR–S Vulcanisates" by Dr. J. R. Scott, of the Research Association of British Rubber Manufacturers, was one paper, of two only, devoted solely to synthetic rubber. Dr. Scott reported the results of numerous heat-ageing tests in air or oxygen at atmospheric pressure or higher, and gave due attention to the views of other investigators. The alteration in tensile strength, elongation and modulus of the vulcanizates is found to proceed about $2\frac{1}{4}$ times as rapidly for each 10° C. rise in temperature, which is in agreement with earlier estimates. In contrast to natural-rubber vulcanizates, however, the alteration of GR–S vulcanizates with ageing tends to be less the longer the period of vulcanization; the stability of GR–S towards ageing also appears to be favoured by the use of low proportions of sulphur for vulcanization. Oxidation during ageing is capable of a twofold effect, the predominant result normally being stiffening, presumably by oxygen-bridging of the molecules; with severe oxidation of under-vulcanized samples, however, loss in tensile strength may occur in consequence of chain scission. Hycar EP, another copolymer of butadiene and styrene, shows similar heat ageing to GR–S, but with rather better retention of tensile strength at higher temperatures.

The other paper on accelerated ageing, by Messrs. J. M. Buist and G. N. Welding, of Imperial Chemical Industries, Ltd., dealt with the "Use and Misuse of Accelerated Ageing Tests", and gave a careful survey of the aim of such tests and their limitations as an index to the probable behaviour in service. Permanent alteration in the rubber after ageing, according to circumstances, may concern only a thin skin, or a thick surface layer, or the whole mass. These three types of result were discussed in detail, and appropriate accelerated tests, both by heat-ageing and light-ageing, were brought under consideration. The skin effect is commonly associated with the influence of light. Deep surface effects include atmospheric cracking (apparently initiated by traces of ozone) and surface-hardening or -softening by oxygen attack at higher temperatures; the hardening or softening, if prolonged, may extend throughout the mass. The authors conclude that the processes leading to the breakdown of rubber are too diverse for all to be capable of easy or satisfactory reproduction in a single accelerated test. Moreover, for the correct use of accelerated ageing tests, a clear understanding of the differences between the types of ageing is essential and each such test should, so far as possible, accelerate only one process; for example, that affecting the elongation at break, so that it can be studied independently of others.

Three papers contributed to the meeting dealt with ageing as caused or induced by exposure to 'weather'. The first of these, by Mr. H. C. Harrison, of Imperial Chemical Industries, Ltd., on the "Weathering of GR–S", confirmed the paper last mentioned, in questioning the general applicability of accelerated ageing tests. Contrary to early indications from accelerated tests, the weathering characteristics of GR–S are disappointing; cracks develop in the material when exposed under slight tension, fresh air and increased air circulation being conducive to an intensified effect; light is not a main cause. Anti-oxidants give little benefit, and compounding generally provides no satisfactory remedy except for the beneficial influence of a small percentage of certain waxes, particularly those with microcrystalline structure, such as beeswax or paraffin wax. This problem presented by GR–S rubber was considered by the author in detail not only for stout sheets of the material but also for thin 'proofings' on fabrics.

This subject of atmospheric cracking, in its relation to natural and synthetic rubbers, was dealt with from a wide angle in a concise and comprehensive paper by Dr. R. G. Newton, of the Research Association of the British Rubber Manufacturers, entitled "The Mechanism of Exposure Cracking". The rate of 'exposure cracking' (a term which the author prefers to 'atmospheric cracking') is found to be proportional to the ozone content of the air or ozonized oxygen surrounding the rubber. The normal ozone content of the outside air is sufficient for the purpose, but inside buildings it is generally too low. Not only does light not produce cracks, but also it frequently prevents their development by giving rise to an oxidized skin which prevents access of the ozone to the actual rubber surface. Strain is necessary as well as ozone, and, in line with some other investigators, the author agrees that a maximum in the severity of cracking, as judged visually, is observed with an elongation of roughly 20 per cent. The occurrence of this so-called 'critical elongation' is attributed to the mutual interference of neighbouring cracks; cracks formed under the lower elongations join up to form longer and more obvious ones, whereas those formed in more highly stretched rubber tend to remain discrete. Exposure-cracking can be prevented by eliminating strains from the rubber, and cable makers are said to adopt more than one device to this end. Waxes capable of forming a continuous surface 'bloom' on the rubber can afford some protection, but if the film is incomplete, or incapable of self-repair when broken by flexing or further stretching, localized attack may arise with worse results eventually than if no wax had been used.

This importance of complete continuity, if a film of wax bloom, or of any coating preparation, is to give useful protection and not intensified deteriora-

tion, was also stressed in a paper by Messrs. E. F. Powell and V. E. Gough, of the Dunlop Rubber Co. Ltd., on "The Mechanism of Rubber Cracking". While challenging the concept of the existence of a 'critical elongation', these authors agree as to the coarser and more serious nature of the cracks formed at lower elongations than at higher, although the cracks are less numerous in the former case. Consideration was given to the statistical nature of the distribution of the cracks, and several practical aspects of the cracking problem were discussed, such as the distribution of stresses at the bottom of grooves or slits in masses of rubber, for example, in tyre treads, and its influence on the location and direction of crack growth. A parallel seems to exist between the relation of the type of cracking to the probability of attack and to the rate of propagation of previously formed cracks, and the importance of 'probability of attack' and 'conditional velocity' as revealed in metal-corrosion researches.

The last paper of the meeting, on "The Behaviour of Natural Rubber and GR–S under Repeated Stress Cycles" by Dr. D. Parkinson and Mr. J. L. Bloxham, of the Dunlop Rubber Co., Ltd., recorded results obtained with the Dunlop fatigue-testing machine, which has been described elsewhere. Under repeated cycles of stress lasting over considerable periods, GR–S 'compounds' develop higher temperatures than those attained by analogous natural-rubber 'compounds', but under such conditions they will withstand a higher steadily maintained temperature; so that despite the admitted superiority of natural-rubber vulcanizates in resistance to fatigue, its advantages in this respect are less than might be anticipated from its higher tensile- and tear-strength. Incorporation of carbon black in either form of rubber increases the resistance to fatigue, and 'furnace blacks' have a greater effect than 'channel blacks'. For each type of carbon black there is an optimum concentration which is generally greater for compounded GR–S than for compounded *Hevea* rubber.

In terminating the proceedings, the chairman remarked on the successful issue of the gathering, the first all-day symposium in Great Britain to be devoted to a single group of problems of the rubber industry. The potential value of such discussions and interchange of views between research workers is very great. The full papers and subsequent discussions will be made available in the *Transactions of the Institution of the Rubber Industry*. The Institution will no doubt take steps to ensure that further meetings of similar type are arranged to deal with other outstanding problems. D. F. Twiss.

VITAMIN A DEFICIENCY AND THE REQUIREMENTS OF HUMAN ADULTS

In response to a request from the Ministry of Food, the Vitamin A Sub-Committee of the Accessory Food Factors Committee (Lister Institute and Medical Research Council) undertook an experiment to obtain information on the human requirement of vitamin A and of carotene. The experiment was carried out at the Sorby Research Institute, Sheffield, for the Medical Research Council, by which it was financed. It lasted from July 1942 until October 1944.

Twenty-three 'conscientious objectors', twenty men and three women, volunteered to live on a diet designed to be deficient in these substances but complete in every other respect. The absence of vitamin A and its precursors was confirmed spectrophotometrically and biologically. Young rats fed on the diet grew well when supplied with vitamin A but, without it, failed to thrive and their livers at autopsy were devoid of vitamin A. The disappearance of carotene from the blood plasma of the deprived volunteers confirmed the absence of these substances from the diet. Prophylactic and therapeutic tests were made with vitamin A and carotene, and fæcal excretion tests were made with carotene from different sources. No attempt was made to differentiate between the biological values of different isomers of carotene.

As the experiment lasted more than two years, the results obtained were extensive and cannot quickly be prepared for publication, but, since their implications in assessing nutritional status and requirements in respect of vitamin A are far-reaching, it is important that some of them should be widely known. It has therefore been decided to publish the chief conclusions about which the team of workers is unanimously in agreement. Full details with a discussion of the literature will appear later.

With efficiency for dark adaptation and plasma values for vitamin A as criteria, none of the sixteen deprived subjects became depleted within a year. Eleven of these continued the test for more than thirteen months, and only three showed marked signs of depletion, after fourteen, seventeen and twenty-two months, respectively. Most of the remainder showed no changes attributable to vitamin A deficiency, except a gradual fall in the plasma value for vitamin A, estimated by the antimony trichloride method; but one failed to show this sign of deterioration even after twenty-two months. The state of the vitamin A reserves of this sample of the population of Great Britain in the summer of 1942 would thus seem to have been sufficient to meet the requirements for from one to two years. This conclusion is in harmony with the finding, at about the same period, of a median value of 600,000 I.U. for the total vitamin A reserves of the liver, determined at autopsy, in cases of accidental death.

Signs of depletion. In the three markedly depleted subjects, the value for vitamin A in the blood plasma declined from about 90 I.U per 100 ml. to about 30 I.U. In the test of the capacity for dark adaptation, measured with the Wald-Steven modification of the Hecht-Shlaer adaptometer, the values for the final rod-threshold ranged, at the start, from 1·55 to 1·95 log. micromillilamberts, and rose to between 2·38 and 3·44; at about the same time, the time of transition from cone to rod vision, which was at first from five to ten minutes, increased to as much in one case as thirty-three minutes.

In contrast with the slow fall in the value for vitamin A in the plasma which occurred in almost all the subjects undergoing depletion, the value for total carotenoids fell quickly and remained low. Chromatography of a pooled sample of plasma after nine months of depletion showed it to contain 18 μgm. total carotenoids per 100 ml., but no measurable amount of α- or β-carotene. The value for the final rod-threshold in all the subjects, whether undergoing depletion or not, deteriorated significantly during the first winter, seven months from the start, but, in most cases, recovered in the spring to the initial level.

The explanation of this phenomenon is unknown, but the risk of misinterpretation thus introduced is clearly great. The value did not again deteriorate significantly until much later, when the plasma value for vitamin A had declined to about 40 I.U. per 100 ml. There did not appear to be any correlation between the value for vitamin A in the plasma and the value for the final rod-threshold until both had deteriorated significantly.

Three different laboratories carried out the blood tests, the samples being distributed by post; their results often varied much for the same sample, but the average of a sufficient number yielded consistent results. All three laboratories agreed that no great reliance could be placed on the result of a single estimation for vitamin A in plasma.

From the thirteenth month of the experiment onwards, P. C. Livingston applied his new technique of rod scotometry to examination of the volunteers. By this method the field of vision was mapped under conditions of dark adaptation with test objects of known very low luminosity[1]. The technique confirmed the existence of defective night vision in the three volunteers whose final rod-threshold was raised and cone-rod transition time lengthened. In addition, this method revealed the night vision as defective in five of the other deprived subjects who gave normal readings with the adaptometers of Craik and of Wald and Steven. On treatment with vitamin A or carotene, the scotometry readings returned to normal. Rod scotometry thus seemed to detect deterioration of capacity for dark adaptation earlier than was possible by measurement of the dark-adaptation curve.

There were no objective changes on general clinical examination, or conjunctival changes perceptible with the slit-lamp microscope; there were no changes in the blood picture or platelet count. Only one subject showed follicular hyperkeratosis, but a study of the case history indicated that the condition was present from the start and was not specifically affected by variations in the vitamin A supply. There were no definite changes in response to memory and fatigue tests. There was no consistent loss of weight.

Absorption tests. A comparison of the dietary and fæcal carotene for the volunteers receiving a carotene supplement showed that the disappearance of carotene from the gastro-intestinal tract was highest when the carotene was dissolved in fat (arachis oil or margarine); on the average, 28 per cent of carotene given in this form was excreted. The percentage excretion of carotene from green vegetables (cabbage or spinach) was in the region of 60, and from sliced carrots in the region of 75. The individual variations were wide.

Requirement of vitamin A and of carotene. Seven volunteers without previous depletion received, for periods of from six and a half to twenty-two and a half months, a daily supplement of about 2,500 I.U. vitamin A as distilled natural esters in oil, or of about 5,000 I.U. carotene, in oil or from various natural sources, and showed no changes attributable to vitamin A deficiency.

The three subjects who developed defective night vision and low plasma values for vitamin A were dosed with vitamin A or β-carotene in oil while the deficient diet continued. In one case treatment with a daily dose of 1,300 I.U. vitamin A restored dark adaptation and plasma vitamin A values to normal levels within five months. A second case did not respond to a dose of 1,300 I.U. carotene daily but improved in the course of five months when the dose was changed to one of 2,600 I.U. daily. In the third case, where the degree of deficiency was milder, a daily dose of 2,600 I.U. carotene promptly improved dark adaptation and the concentration of vitamin A in the plasma.

When the amount of carotene excreted was deducted, the amount of vitamin A and of carotene which brought about the same result would thus appear to be about the same.

For assessing the requirement the relevant results are the following:

A daily dose of 1,300 I.U. vitamin A or of 2,600 I.U. carotene was sufficient to *cure* a mild state of vitamin A deficiency. The body reserves of vitamin A, presumed as already mentioned to have had a median value of about 600,000 I.U., were sufficient in all sixteen deprived subjects to prevent the onset of definite signs of vitamin A deficiency for from twelve to twenty months; such a reserve would correspond with an average rate of consumption of 1,300 I.U. daily for fifteen months.

Thus, inclusion in the diet of a daily dose of 2,500 I.U. vitamin A, or of 5,000 I.U. carotene, may be regarded as adequate for maintenance of normal human adults and as leaving a fair margin of safety.

The following members of the Vitamin A Sub-Committee, Dr. K. H. Coward, Miss E. M. Hume (secretary), Dr. S. K. Kon, Dr. T. Moore and Prof. R. A. Morton, formed part of a team which included Mr. W. C. Bartley, Prof. H. A. Krebs, Dr. K. Mellanby and Dr. J. Pemberton, each of whom undertook responsibilities in Sheffield and, with Mr. T. W. Goodwin, Dr. H. M. Sinclair and Miss C. M. Wood, participated in the work and in the regular meetings concerned with the conduct of the investigation. Many other workers, whose contributions will be recorded in the full report, supplemented the work of the Sub-Committee.

[1] Livingston, P. C., *Lancet*, i, 33 (1944).

OBITUARIES

Prof. Alexander Fersman

PROF. ALEXANDER FERSMAN, the distinguished Russian mineralogist and geochemist, died on May 20 at the age of sixty-two. The death of his former teacher, Prof. V. I. Vernadsky, a brilliant investigator in the same field, occurred a few months earlier[1]. The double loss is a grievous blow to the science of geochemistry, for both men occupied the leading positions in the vigorous Russian schools of geochemical studies of which a short account was given recently in the pages of *Nature*[2].

For the present notice on Fersman's work, some data have been drawn from a note supplied by Prof. A. Vinogradov, of the Academy of Sciences, Moscow.

Graduating from the University of Moscow in 1907, Fersman first worked in the laboratory of Vernadsky. He was ultimately to become director of the Lomonosov Institute of Mineralogy, Crystallography and Geochemistry in Moscow, a new institute founded in recent years by the fusion of four departments of the Academy of Sciences of the U.S.S.R.

Fersman's early researches were essentially crystallographic and mineralogical: he worked in Paris and Heidelberg and travelled in Switzerland

and Italy, eventually contributing a paper on the mineralogy of Elba. He was co-author with V. Goldschmidt of Heidelberg of an elaborate memoir on the crystal morphology of the diamond, and later produced an authoritative treatise on the precious stones of Russia.

In 1912 Fersman was appointed to a professorship in mineralogy and to a curatorship of the Museum of Mineralogy attached to the Academy of Sciences. From this time his interests were to be devoted to the field of geochemistry. There were to follow during the next twenty-five years his monumental works on geochemistry, and while it is still too early to assess the value of some of the daring theoretical treatment his exuberant genius brought to the interpretation of the factual data, experimental and observational, which he had amassed, his rank as a leader of international reputation has rested on brilliant achievement over a wide field. Between the two World Wars his contributions included detailed investigations on the geochemistry of pegmatites, particularly those of granite and alkali-syenite type; researches on the geochemical migration of elements within sedimentary terrains remote from magmatic centres, and numerous other studies in regional mineralogy.

Many geological expeditions fostered by the Academy of Sciences within the vast territories of the U.S.S.R. were organized under his leadership, and he personally conducted explorations in Central Asia, the Urals and the Kola Peninsula. These investigations led to highly important economic developments, notably with the discovery of great apatite deposits of magmatic origin in Kola and of large workable deposits of sulphur in the Kara-Kum desert of Transcaspia.

Of Fersman's many achievements, his researches on the great alkali igneous complexes of Khibin and Lovozero in the Kola region rank among the most outstanding. In the elucidation of these unique intrusions, Fersman's own studies were dominant. They have greatly widened our knowledge of the chemistry and mineralogy of alkali magmas and of the conditions controlling the peculiar sodic (agpaitic) type of differentiation.

As director of the Khibin Scientific Arctic Station near Kirovsk, Fersman inspired much of the later work of his younger colleagues in the same field, and it was under their guidance that the participants in the Kola Excursion of the 1937 International Geological Congress were able to appreciate to the full the magnificent pioneer researches linked with his name.

Fersman's most important memoirs, including his works on geochemistry (four vols., 1933–37), pegmatites (1931, 1940) and other studies in regional mineralogy, are in Russian. In English, his "Scientific Study of Soviet Mineral Resources" (1935) provides a succinct account of the planning and development of the mineralogical researches in which he himself played so prominent a part.

In addition to his scientific work—he was author of some five hundred scientific books and papers—Fersman was active in public life. He had a gift for the exposition of scientific knowledge in popular form, and his artistic sense was shown in his articles about chemical elements, minerals and rocks. Member of the presidium of the Academy of Sciences, he was at one time chief editor of its scientific publications.

Fersman was the recipient of a Stalin Prize and was awarded the Order of the Red Banner of Labour by the Soviet Government. Abroad, his honours included foreign membership of the American and British Mineralogical Societies and the award of the Wollaston Medal of the Geological Society of London in 1943.

C. E. TILLEY.

[1] *Nature*, **155**, 296 (1945).
[2] *Nature*, **154**, 814 (1944).

Sir Martin Forster, F.R.S.

THE death in Mysore City on May 24 at the age of seventy-two of Martin Onslow Forster has removed from our midst an organic chemist who, prior to 1922, was an outstanding figure in British chemistry. Forster received his early education at Dover Hill House, Margate, and having decided upon a chemical career he entered the Finsbury Technical College, where he received an excellent training under the late Prof. R. Meldola. As was customary at the time, when the opportunities for research in Britain were somewhat limited, he proceeded to Germany, where he worked at Würzburg under Prof. E. Fischer. The debt which Forster owed to him was in some measure repaid by the brilliant memorial lecture which he delivered to the Chemical Society in October 1920. Returning with his Ph.D. degree, Forster in 1894 came under the influence of Prof. H. E. Armstrong, in whose laboratory he worked as the holder of a Salters' Research Fellowship, and so arose a life-long friendship. His tenure of the fellowship was short, since in 1895 he was appointed by Sir William Tilden to a demonstratorship in chemistry at the Royal College of Science, and there followed a period of amazing scientific activity which rapidly placed Forster in the front rank of British organic chemists.

For many years Forster's investigations were confined almost entirely to the chemistry of camphor, on which subject he published more than thirty memoirs under the general title "Studies in the Camphane Series". Many of these are now only of historic interest; but his work on β-bromocamphor and on the oximes of camphor and *epi*camphor are of lasting value, and the latter form a remarkable contribution to stereochemistry. In 1907, he broke new ground when, in collaboration with H. E. Fierz, the first of a long series of papers on the triazo-group appeared. This work, which was not devoid of personal risk and actually resulted in grievous injury to one of his research students, was actively pursued until 1913, when he resigned his appointment at the Royal College of Science, having been an assistant professor since 1902. Almost all Forster's papers were communicated to the Chemical Society, and they are notable for the clarity and brilliance of their exposition. This latter quality was not confined to the written word, since it was generally regarded as a 'field-day' when Forster read a paper at one of the Society's meetings.

Forster's resignation and his decision to enter politics somewhat surprised his friends, and was undoubtedly due in part to his disappointment at not having been appointed to a full professorship. The outbreak of the War in 1914 brought Forster back to chemistry and in 1915 he was appointed a director of British Dyes, Ltd., a post which he held until 1918. In these critical years he served British chemistry well. His activities were not confined to the technical side of the industry; he was mindful of the importance of social amenities for the staff, being responsible for the first staff club at Huddersfield. During 1918–22 he filled the newly created post

of director of the Salters' Institute of Industrial Chemistry, where his experience both as a teacher and in industry undoubtedly proved of the greatest value. His keen interest in the City of London Companies was further shown by his election in 1919 as prime warden of the Worshipful Company of Dyers.

Although so actively engaged in experimental research, Forster found the time to participate in the administration of the Chemical Society. After serving on the Council, he was honorary secretary during 1904–10, treasurer 1913–22 and vice-president 1910–13. The value of his contributions to science were recognized by the Society in 1918 by the award of its highest distinction, the Longstaff Medal. He was elected to the Royal Society in 1905 at the unusually early age of thirty-three, and he served on the Council. He was a regular attendant at the meetings of the British Association, being president of Section B at the Edinburgh meeting in 1920.

A complete change in Forster's life and one made at considerable personal sacrifice came in 1922 when, at the request of his friend Sir William Pope, he accepted the post of director of the Indian Institute of Science, Bangalore. The Institute, which we owe to the munificence of the Tata family, had passed through a somewhat difficult period, and it was clear that if it was to fulfil the hopes of its founders, a director of outstanding quality was required. This it found in Forster, and perhaps in the Institute will be found Forster's most lasting contribution to science. Not only did he win the loyalty and friendship of his staff, but he gained also the confidence and affection of the students. He and Lady Forster, whom he married in 1925, realized to the full their many difficulties. Their hospitality was boundless, and the Institute became a very happy family. His success as a director was due not only to his scientific attainments. He was a fine speaker, and he delighted in the social obligations which his position involved. No one will question that the high position which the Institute has now attained in India is due in large measure to the work which he did.

The many administrative duties of his post prevented Forster from continuing his scientific work in Bangalore, although for the first few years he did direct the work of some research students. But his interest in science never abated, and I personally owe much to his advice and encouragement. He was president of the Indian Science Congress in 1925 and he was an original fellow of the National Institute of Sciences. On his retirement in 1933, Forster settled in Mysore City, making occasional visits to Britain, the last being in 1939. After Lady Forster's death in 1941, his life was somewhat lonely, and he had every intention of returning permanently to London at the end of the War. He had hoped to enjoy once more the scientific life in which he had once played so prominent a part. J. L. Simonsen.

Prof. John Borg

The death, on May 4, is reported of Prof. John Borg, the most renowned of Maltese botanists. He was formerly superintendent of agriculture, professor of natural history in the University, and director of the Botanic Garden in Malta. From these official posts he retired in 1933; but up to his death he maintained his interests in botany and agriculture, and he held the title of emeritus professor of natural history in the Royal University.

Borg's contributions to the advancement of biology were varied and included research in both the pure and applied fields. His influence on education was not limited to his academic activities but extended to public lectures and to articles in the local Press and other publications written in English or Maltese. In agriculture and horticulture, his work included published accounts on the cultivation and diseases of fruit trees in the Maltese Islands, on orange culture, on vines, on scale insects, and on the pig. His book "Cacti. A Gardener's Handbook for their Identification and Cultivation" (London: Macmillan and Co., Ltd.) is well known and widely used.

The most valuable of Borg's works in systematic botany, and one that will maintain his name among all interested in the flora of the Mediterranean region, is his "Descriptive Flora of the Maltese Islands including the Ferns and Flowering Plants" (Malta: Government Printing Office, 1927). This is a book of 846 pages written in English. It includes a lucid introduction to the history of botanical investigation of the islands, their geology, vegetation and flora. The bulk of the volume consists of carefully prepared descriptions of the families, genera and species of the vascular plants, including those naturalized or commonly cultivated, of Malta and the associated islands, together with their Maltese localities and Maltese and English names. The flora gives the impression not only of conscientious preparation but also of intimate personal acquaintance with the plants described. Malta is intensively cultivated over much of its surface and almost all the rest is heavily grazed (if grazed be the right word) by the almost omnivorous goats, and there is little natural vegetation left; but its flora is surprisingly rich and of considerable importance in studies of the phytogeographical problems of the Mediterranean Basin.

I met Borg only once, in his department in the University of Valetta, and recall him as a quiet, unassuming man devoted to his work but with the widest interest in all that related to his country. His widow, to whom his "Flora" is dedicated and who was his constant companion and assistant on botanical rambles, survives him. His large collection of cacti and other succulents has been left to the Argotti Botanic Gardens and he has made other bequests to his University. W. B. Turrill.

Prof. E. Rádl

Some time in May 1942, Dr. Emanuel Rádl died in Prague at the age of sixty-nine. In early life he was a biologist of local distinction. His critical abilities first reached a wider public in 1909 when he published his "History of the Development of Biological Theories", in which he stressed the changes that had occurred with regard to the significance and the evidence for evolution during the nineteenth century. He was critical of certain Continental schools of biological thought and of various 'cell theories', of temporary 'fashions' in science and of Driesch's ideas on entelechy.

Later Rádl turned his attention to philosophy, changing his chair of biology for that of philosophy at the University of Prague. He wrote several works on the history and modern trends of philosophy, and in his "Present State of Philosophy and Psychology" (1933) he expressed the opinion that Anglo-Saxon countries were then "being infected with the bacilli of moral anarchy, spiritual decadence and cold

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942–3, do not apply.

The Royal Institute of Chemistry of Great Britain & Ireland

(Founded 1877)
(Incorporated by Royal Charter, 1885)

APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates and Senior Registered Students), who are available for appointments or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to The Registrar, the Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

UNIVERSITY COLLEGE OF SWANSEA

(A constituent College of the University of Wales)

Principal: C. A. Edwards, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS

METALLURGY

Professor: C. A. Edwards, D.Sc. (Manchester), F.R.S.
Assistant Professor: R. Higgins, Ph.D. (Glasgow).
Lecturers: R. Griffiths, M.Sc. (Wales); T. B. Wilkinson, Ph.D., B.Eng. (Liverpool), A.M.I. Mech.E.; D. W. Hopkins, B.Sc. (Wales).

ENGINEERING

Professor: R. N. Arnold, D.Sc. (Glasgow), Ph.D. (Sheffield), M.S. (Illinois), A.R.T.C., M.I.Mech.E.
Lecturer in Electrical Engineering: R. G. Isaacs, M.Sc. (Bristol), B.Sc. (London), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. Fordham, Ph.D. (London), Assoc. M.Inst.C.E., M.I.Struct.E.
Lecturer in Mechanical Engineering: J. Selwyn Caswell, M.Sc. (Wales), M.I.Mech.E., Assoc. M.Inst. C.E.
Lecturer: W. E. J. Farvis, B.Sc. (Bristol).

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Metallurgy or in Engineering. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The Manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (a) Metallurgy; (b) Metallurgical Engineering; (c) Civil Engineering; (d) Mechanical Engineering; (e) Electrical Engineering; and (2) for Diplomas of the College in (a) Metallurgy; (b) Civil Engineering; (c) Mechanical Engineering; (d) Electrical Engineering.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College classes provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in April 1946.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park,
Swansea.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

Principal: J. E. Myers, O.B.E., D.Sc. (Manchester), A.R.I.C., J.P.

DEGREE COURSES IN TECHNOLOGY

The Prospectus of University Courses gives particulars of the courses leading to the Manchester University Degrees (B.Sc.Tech., M.Sc.Tech., and Ph.D.) and Certificates in the Faculty of Technology, in the following Departments:

MECHANICAL ENGINEERING (Professor H. Wright Baker, D.Sc., M.I.Mech.E., M.I.A.E.).
ELECTRICAL ENGINEERING (Professor J. Hollingworth, M.A., D.Sc., M.Sc.Tech., F.C.G.I., M.I.E.E.).
MUNICIPAL ENGINEERING (R. J. Cornish, M.Sc., M.Inst.C.E., A.M.I.Mech.E., A.M.I. Struct.E., F.R.San.I.).
APPLIED CHEMISTRY, including General Chemical Technology, Metallurgy and Assaying, Fermentation Processes (including Brewing), Electro-Chemistry, Colouring Matters, Foodstuffs, Fuels, and Chemical Engineering. (Professor J. Kenner, D.Sc., Ph.D., F.R.S.).
TEXTILE CHEMISTRY (Bleaching, Dyeing, Printing and Finishing; Paper Manufacture). (F. Scholefield, M.Sc., F.R.I.C., F.T.I.).
TEXTILE TECHNOLOGY (Professor W. E. Morton, M.Sc.Tech., F.T.I.).
BUILDING (W. B. McKay, M.Sc.Tech., M.I. Struct.E.).
INDUSTRIAL ADMINISTRATION (Post-Graduate Certificate Course), (A. Roberts, M.Com., Ph.D.).

Part-time (Evening) Courses are provided in Engineering, Mathematics, and Physics, leading to the external degrees of London University in Engineering and Science.

MATHEMATICS DEPARTMENT (F. Bowman, M.A., M.Sc.Tech.).
PHYSICS DEPARTMENT (W. H. Taylor, Ph.D., D.Sc.).

For further information apply to the Registrar, College of Technology, Manchester, 1.

BEDFORD CORPORATION WATERWORKS

APPOINTMENT OF BIOLOGIST/BACTERIOLOGIST

Applications are invited for the above appointment. Salary will be at the rate of £310 per annum rising, subject to satisfactory service, by annual increments of £15, to a maximum of £355 per annum, plus £59 16s. War Bonus. These figures apply to males; the figures for females are: commencing salary £230 per annum by one annual increment of £15 and two of £10 to £265 per annum, with £48 2s. War Bonus.

The appointment will be terminable by one month's notice on either side.

The post will be a designated one under the Corporation's Superannuation Scheme. The selected candidate will be required to pass a medical examination and to contribute to the Superannuation Fund.

Applicants should have a thorough knowledge of microscopic fresh-water biology and be capable of carrying out qualitative and quantitative examinations of water. Previous experience of such work in relation to water supply, although not essential, will be considered advantageous. Some bacteriological knowledge is desirable.

All other points being equal, preference will be given to applicants holding appropriate scientific or technical qualifications.

Applications endorsed "Biologist/Bacteriologist" must be delivered together with the names of three persons to whom reference may be made, to the undersigned not later than Saturday, July 14, 1945.

Canvassing, directly or indirectly, will disqualify.

CHARLES H. BLAKEWAY, M.Inst.M. & Cy.E.,
Borough Engineer, Surveyor,
Water Engineer.

Newnham House,
Horne Lane, Bedford.

UNIVERSITY OF BIRMINGHAM

MEDICAL OFFICER TO THE UNIVERSITY

The Council invites applications from Registered Medical Practitioners (Male) for the post of Medical Officer to the University.

The appointment will date from October 1, 1945, or January 1, 1946—salary £1,000 per annum.

Further particulars of the appointment and duties may be obtained from the undersigned, to whom applications (three copies) must be submitted, with the names of three referees, on or before September 3, 1945.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

UNIVERSITY OF BIRMINGHAM

LUCAS CHAIR IN THE PRINCIPLES OF ENGINEERING PRODUCTION

Applications are invited for the Lucas Chair in the Principles of Engineering Production, which has been founded to promote Post-Graduate courses and research in this subject. Applicants should have high qualifications in Engineering and experience in industry. Opportunity may be provided for the successful candidate to visit America and other countries before entering on his duties. The salary will be not less than £1,500.

Details may be obtained from the undersigned, to whom *three* copies of applications should be sent not later than September 1, 1945.

C. G. BURTON,
Secretary.

The University,
Birmingham, 3.

UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF PHYSICS

Applications are invited for a Lectureship in the Department of Physics at a commencing salary of £500. The salary may, however, be on a higher scale according to qualifications.

Applications should be forwarded to the undersigned not later than July 14, 1945.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

UNIVERSITY OF CAMBRIDGE

LECTURESHIP IN GEOLOGY

The Appointments Committee of the Faculty of Geography and Geology give notice that they intend to appoint a University Lecturer in Geology to hold office from October 1, 1945. The Lecturer will be required to give instruction in Stratigraphy and Tectonics. The initial basic stipend of a University Lecturer is £250 a year; but the Faculty Board with the approval of the General Board may resolve that an additional payment of £250 a year be made to a Lecturer who is not a Fellow of a College, and additional payment may also be made for any teaching given at the request of the Faculty Board in excess of the basic amount.

Candidates are requested to state their age and give the names of not more than three referees. Applications should reach the Secretary of the Appointments Committee of the Faculty of Geography and Geology, Department of Mineralogy and Petrology, Cambridge, on or before Monday, July 30, 1945.

UNIVERSITY OF LEEDS

I.C.I. RESEARCH FELLOWSHIPS

The University invites applications for not more than three "Imperial Chemical Industries Limited" Research Fellowships in subjects set out below. Value about £600 per annum according to qualifications. Permission to defer the beginning of the tenure can be granted to persons engaged upon national service. Particulars as to tenure and conditions and method of application can be obtained from the Assistant Clerk to the Senate, the University, Leeds 2, by whom applications must be received not later than August 25.

Subjects: Chemistry, Physics, Bio-Chemistry, Chemical Engineering, Chemotherapy, Colloid Science, Colour Chemistry and Dyeing, Engineering, Fuel and Refractories, Chemistry of Leather Manufacture, Metallurgy, Pharmacology, Textiles (Protein Chemistry).

UNIVERSITY OF LIVERPOOL

DEPARTMENT OF INORGANIC AND PHYSICAL CHEMISTRY

Applications for the post of Lecturer in Chemical Physics are invited, the initial salary being not less than £600 per annum according to qualifications and experience. The person appointed will be expected to lecture on quantum mechanics to Honours and post-graduate students in physical chemistry. He will not be expected to carry out experimental work, but, in addition to his own research, one of his main functions will be that of giving assistance in the theoretical interpretation of experimental results arising out of the research activities of the Department.

The University will consider applications from candidates who are still serving in the Forces or are engaged upon other national service, and leave of absence can be given to a successful candidate until some time after the date of release from the Forces or other national service.

Applications, giving details of career, accompanied by testimonials and/or references, should be forwarded to the undersigned not later than Saturday, July 14, 1945.

STANLEY DUMBELL,
Registrar.

EDINBURGH AND EAST OF SCOTLAND COLLEGE OF AGRICULTURE

INVESTIGATION INTO BOVINE MASTITIS

Wanted Temporary Assistant to the Advisory Bacteriologist. Applicants should possess a qualification in Bacteriology, preferably an Honours degree or have equivalent post-graduate experience. Maximum salary £300 plus war bonus.

Applications, stating age, qualification and experience and copies of testimonials, should be lodged with the undersigned not later than July 21, 1945.

THOMAS BLACKBURN,
13 George Square, Secretary.
Edinburgh, 8.

DERBY TECHNICAL COLLEGE

NORMANTON ROAD, DERBY

The Governors invite applications for a full-time lecturership in Mathematics. Applicants should be graduates of a British University. Ability to teach either Mathematics up to Final Degree standard in Engineering and Science or the applications of Mathematics to Engineering will be an added recommendation.

Salary according to Burnham Scale. Application forms, to be returned by July 20, and further particulars may be obtained from the undersigned.

W. ALFRED RICHARDSON,
Principal.

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Principal: H. V. Field, B.Sc., Wh.Sch., M.I.E.E.

Applications invited for post of LECTURER IN CHEMISTRY. Candidates should hold good Honours Degree in Chemistry, and should preferably have had industrial experience. Ability to teach Metallurgy an advantage.

Burnham Technical Scale salary. Appointment on September 1, or as soon as possible after that date.

Application forms and further information from the undersigned, to whom the forms should be returned not later than July 21.

STANLEY HIRST,
Education Offices, Director of Education.
Middlesborough.

BRADFORD EDUCATION COMMITTEE

TECHNICAL COLLEGE, BRADFORD

APPLICATIONS are invited for APPOINTMENT of ASSISTANT LECTURER in CHEMISTRY in the College.

Salary at present according to the old Burnham scale, which is £186–£480 per annum. Commencing salary according to qualifications and experience. A war bonus of £52 per annum is also paid. The salary scale is at present under review.

Further particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and completed forms should be returned to the Principal of the College not later than July 14, 1945.

THOS. BOYCE,
Director of Education.

UNIVERSITY COLLEGE NOTTINGHAM

The Council invites applications for the following appointments:

Assistant Lecturer in Physics. Commencing salary £350.

Demonstrator in Zoology. Commencing salary £

In each case the candidate appointed will be expected to take up duties on September 1 or very shortly afterwards. Further information and the form of application, which must be returned not later than July 21, 1945, may be obtained from the Registrar.

UNIVERSITY OF DUBLIN

TRINITY COLLEGE

Applications are invited for a Lectureship in Chemistry. Candidates must possess a University degree with first-class Honours and have some experience of research in physical or inorganic chemistry. The successful candidate will be expected to take up duty in October, 1945, but a later date may be fixed if he is not available then. Further particulars may be obtained from the Registrar, Trinity College, Dublin. Applications should reach him later than August 20.

ROYAL SOCIETY

GOVERNMENT GRANT FOR SCIENTIFIC INVESTIGATIONS

Applications for grants from the second allotment of the Government Grant for Scientific Investigations, for the year 1945, should be made as soon as possible, in a manner specified in regulations to be obtained from the Assistant Secretary of the Royal Society, Winforton, Herefordshire. No application can be considered which is received later than July 31, 1945.

Applicants must be of British nationality. Grants can be made for scientific apparatus, research expenses and materials and, in certain cases, for travelling expenses incidental to research, but not for maintenance or in aid of publications.

UNIVERSITY COLLEGE OF SWANSEA

The Council invites applications for the post of Assistant Lecturer in the Department of Engineering. Salary £350 per annum. The appointment will date from October 1, 1945. Candidates should possess a good Degree in Engineering of a British University. Further particulars may be obtained from the Registrar, University College, Singleton Park, Swansea, by whom applications must be received on or before July 30, 1945.

VICTORIA UNIVERSITY COLLEGE

WELLINGTON, NEW ZEALAND

Applications are invited for a LECTURESHIP IN PHYSICAL CHEMISTRY. Salary £575 per annum (N.Z. currency) subject to deductions for superannuation. Allowance for travelling expenses. Appointment (for three years in first instance) to commence February 1946. Further particulars and application form may be obtained from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

UNIVERSITY OF ABERDEEN

ASSISTANT IN BOTANY

Salary £300 to £350 according to qualifications. Applications should be sent not later than July 30, 1945, to the Secretary to the University, from whom further particulars may be obtained. The Assistant will take up duty on October 1, 1945.

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

UNIVERSITY OF READING

Applications are invited for the post of LECTURER IN AGRICULTURAL ECONOMICS. Initial salary from £400 to £500 per annum, according to qualifications and experience. Applications should be submitted not later than July 12 to the Registrar, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER in PHYSICS. Stipend £350 per annum. Duties to commence on September 29, 1945. All applications must be sent not later than July 18, to the Registrar, the University, Manchester 13, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER in ZOOLOGY. Stipend £350 per annum. Duties to commence September 29, 1945. All applications must be sent not later than July 18, to the Registrar, the University, Manchester, 13, from whom further particulars may be obtained.

WOOLWICH POLYTECHNIC, S.E.18

Applications are invited for the post of Chief Laboratory Steward in the Chemistry Department. Some knowledge of Chemistry and general laboratory technique is essential. Wages (up to £5 weekly plus present bonus of 23s. (men) and 15s. 6d. (women)) according to experience.

Application forms and particulars of the post may be obtained from the Clerk to the Governors.

UNIVERSITY COLLEGE SOUTHAMPTON

DEPARTMENT OF GEOGRAPHY

Assistant Lecturer or Lecturer required. Good qualifications in Geomorphology desirable. Applications from suitable persons in the Forces will be considered. For further particulars apply to the Registrar.

GUY'S HOSPITAL MEDICAL SCHOOL

(UNIVERSITY OF LONDON)

A Demonstrator is required in the Physics Department for general teaching duties to start on October 1, 1945. Initial salary £350–£450 according to qualifications, experience, etc. Applications, with the names of two referees, should reach the Dean, Guy's Hospital Medical School, London Bridge, S.E.1, not later than July 14.

THE UNIVERSITY OF TASMANIA

LECTURER IN MATHEMATICS

Applications are invited for appointment as a Lecturer in Mathematics in the University of Tasmania. Salary scale £500–£650 Australian currency. Particulars may be obtained from the Agent General for Tasmania, Australia House, Aldwych, London, W.C.2. Applications close on August 15.

Laboratory Assistants (female) required for routine testing, research and development work associated with high vacuum technique over a wide range of application. Two grades are required, one with educational standard up to Matriculation and the other Inter. B.Sc. (Physics or Engineering) or equivalent technical standard. Industrial Laboratory experience for both grades desirable with experience of Scientific Measurements and familiarity with Physical or Engineering research. Salary up to £250 and £350 for the two grades respectively. Posts are permanent and interesting, with superannuation opportunities and every encouragement for advancement. This advertisement is published by permission of the Ministry of Labour and National Service under the Control of Engagement Order, 1945. Box 380, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Glass-blower and Instrument-maker seeks permanent post with a progressive college or scientific manufacturing firm. Has constructed scientific apparatus for the Air Ministry and various Universities. For ten years senior laboratory technician in charge in a Dept. of Physiology. Holds the Institute of Physics diploma for technicians. Excellent references. Box P.121, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Two Engineers or Physicists required for Research and Development Department of Aeronautical and Meteorological Instrument Manufacturers (Hampshire Area). Previous experience of instrument design and experimental work essential. Write, stating age, experience, and salary required. Box 372, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The Ministry of Labour and National Service have given permission under the Control of Engagement Order, 1945, for the advertisement of these vacancies.

Applications are invited for the newly- established Professorship of Psychology. Salary £1,200 (with exceptional qualifications, £1,500) per annum (Australian) plus cost of living adjustment, subject to Provident Fund contribution. Full particulars and conditions of appointment may be obtained from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1. Closing date for receipt of applications in Melbourne August 31, 1945.

Publishing House offers post to Young Zoologist University Graduate with a Higher Degree as Editorial Assistant in the preparation of a new work of reference. Apply, stating age and qualifications, to Box No. 371, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

B.Sc. in Chemistry or Metallurgy (capable of abstracting in Russian, German and French) required for interesting post in London Industrial Science Library. Write full details age, experience, salary required to Box 373, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscope. 1st class Leitz Petrological. 3 in., 1 in. and ¼ in. lenses. Complete; mechanical rotating Stage Polariser and Analyser. Offers over £80. Box 374, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: Heavy Type Freezing microtome for preparation of rubber and plastic sections. Offers to Box No. 375, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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intellectualism. . . . Who knows how much of our confusion is due to the fact that England has ceased to be the spiritual backbone of Europe ?"

For Rádl the real, the ultimate issue of our life and our civilization was the problem of whether there is an irresistible guarantee and vindication in our search for truth, whether there is an unshakable hinge on which all our ideas, definitions and standards revolve. Rádl was critical but not pessimistic ; indeed, he disliked and attacked the pessimism of Oswald Sprengler and others. The philosophy of determinism and nihilism was "one of cowardly abdication and of miserable irresponsibility", but even in his own country Rádl met with considerable opposition. In 1935 he showed signs of physical fatigue, and it is clear that he foresaw the oncoming catastrophe. He never recovered and the circumstances of his last years hastened his end.

G. Druce.

We regret to announce the following deaths :

Sir Peter Chalmers Mitchell, C.B.E., F.R.S., secretary of the Zoological Society of London during 1903–34, on July 2, aged eighty.

Mr. F. Oates, O.B.E., chief geologist in Tanganyika Territory, on June 10, aged fifty-six.

Dr. H. C. Redeke, the well-known Dutch authority on hydrobiology and fishery research, on April 10.

NEWS and VIEWS

National Physical Laboratory for India

The committee appointed by the governing body of the Council of Scientific and Industrial Research, India, in February 1943, to prepare a scheme for the establishment of a National Physical Laboratory for India has now issued a tentative report setting out the scope of the proposed laboratory and the staff, equipment and finances required to establish it. Such an institution is regarded as of fundamental importance both for the development of scientific research and for the promotion of organized industries in India, which possesses no metric, electrical, optical or other physical standards which can claim statutory acceptance or scientific precision. The National Physical Laboratory, Teddington, has served as the model for planning an Indian National Physical Laboratory, which as envisaged by the committee will consist of eight sections : weights and measures ; applied mechanics and materials ; heat and power including low-temperature work ; optics (including spectroscopy and photography) ; electricity (including magnetism, X-rays and radioactivity) ; radio, sound and electro-acoustics ; building and housing research ; and shipbuilding and navigational research. Separate institutions for aerodynamics and metallurgy are to be established in India, and accordingly such sections are not included in the proposed Laboratory.

Besides standardization work, the proposed Laboratory should undertake investigations relating to the survey, standardization and processing of primary resources and also fundamental research, and will provide facilities to university teachers for research during the vacations and also to research workers engaged in industry. It will serve as a vital link between the universities and industry. The proposed scheme contemplates the establishment of a Central Specifications Board modelled on the American Federal Specifications Board, which will undertake the formulation of specifications with the aid of the National Physical Laboratory in India and in consultation with consumers, producers and other interests. The report contemplates special grants for pilot plant and emphasizes the importance of having a fully equipped laboratory from the commencement. The emphasis is placed on equipment as much as on the permanent staff or its work, for the Committee considers that a central research station, partly or wholly supported by the State, should be in a position to help any industry requiring facilities for solving problems of immediate interest, besides serving as a repository of general knowledge and carrying out long-range research which will ultimately benefit the whole of industry.

United Nations Relief and Rehabilitation Administration : European Agriculture

The importance of an early improvement in the food situation in Europe is stressed by the inclusion of an agricultural rehabilitation officer in every mission sent by the United Nations Relief and Rehabilitation Administration to the continent of Europe. Missions have been at work for some time in Greece and have more recently entered Jugoslavia and Czechoslovakia ; another is preparing to leave for Poland. A special observer has been sent, at the request of the Dutch Government, to Holland. At the first council meeting of the Administration, the organization was charged with the duty of assisting governments in liberated areas in providing the supplies and service needed to enable farmers to sow and harvest essential crops, maintain dairy herds and rehabilitate farms. To this end the Administration may help in re-establishing experimental stations and essential agricultural institutions, organizations and services. The rehabilitation of fisheries is also within the scope of the Administration's activities. Its assistance has already been requested for the re-equipment of veterinary laboratories in Czechoslovakia, Jugoslavia and Poland, and of the Marine Biological Institute in Greece. It is also pressing for immediate facilities to be granted to the International Office of Epizootics in Paris for the resumption of its valuable work in collecting and disseminating information on the occurrence and spread of epizootic disease, and in general on animal health and the means of preserving it. One of the duties of the agricultural officers of the Administration is to inquire into the state of agricultural, scientific and technical research in the country to which they are accredited, and to suggest where a study of results already obtained in the free world, or possibly the visit of a British or American specialist, might help in the solution of local problems.

National Parks in the United States

The National Park System of the United States appears to be in a healthy and progressive state. A review of its position in recent years is contained as one section in the Annual Report of the Secretary of the Interior for 1944 (Washington, D.C. : U.S.

Printing Office. 45 cents). Rather less than one per cent of the total continental area of the United States comes under the care of the National Park System. In 1944 several small additions were made, but the only one of considerable size was in Texas, and the one of most interest was the home of F. D. Roosevelt, which was classed as a historic site. There were war-time difficulties to be faced. Two parks in particular were threatened by economic needs. A threat to the Sitka pines in the Olympic National Park, which were wanted for aircraft production, was averted by supplies from British Columbia and by the increased production of aluminium. Red spruce and hemlock of the Great Smoky Mountain Park were spared by alternative supplies for paper-making being found. Drought conditions in the spring of 1944 raised a demand for the Californian parks to be opened to cattle grazing, but the Parks Committee, after a full inquiry, did not feel justified in granting the request. The demand, however, is to be renewed. In spite of war conditions, the national parks have remained open to visitors and have been much frequented.

Map of British Isles

A COLOURED map of the British Isles, designed to illustrate several aspects of their geography, has been published as a reprint from a Polish volume compiled under the editorship of Dr. Z. Holub-Pacewicz (Glasgow: Książnica Polska). A brief commentary and the legend, both in English, explain the chief features. The small scale, 1 to 3,000,000, limits the amount of detail and necessitates many generalizations. Perhaps the most noteworthy feature is the analysis of the structure and relief of the coast-line. Eight different types of coast-line are indicated by different colours and symbols. Surface relief is shown by layer colouring, and a few names are given, but, except for the scarps of the south-east, there are no indications of structure. The more important towns are shown with indications of size, but there seems to be a little confusion in the use of the term 'conurbation'. Lost towns in plenty are indicated off the East Riding coast and a few off the Lancashire coast, but none elsewhere. The chief railway lines are marked. The notes accompanying the translated commentary include references to suitable reading, so that the book should help to achieve its object of giving Poles some idea of Great Britain.

Protection of Timber against Powderpost Beetles

ALL who have had anything to do with timber in tropical or semi-tropical regions will have become acquainted with the work of certain boring beetles, or powderpost beetles as they have been termed, of the family Bostrychidæ; posts and sawn timber of most broad-leaved trees are liable to severe damage. The chief damage is done by the larvæ feeding on the sap wood, as is well known. Research and experiments have been carried out in more than one part of the world, with the view of discovering some cheap and practicable method of protecting wood from this type of pest. In leaflet No. 69 (Entomology) of the Forest Research Institute, Dehra Dun, preliminary tests of two methods of protecting timber are dealt with. They are intended to give temporary protection when more standard treatment such as impregnation with preservatives cannot be applied because of lack of plant or material. A mixture of creosote and fuel oil, applied externally, definitely prevents attack for at least nine months and probably longer. A coating of lime gave complete protection over a period of three months when liability to attack was most serious. It is expected that, provided the coating is kept intact, protection will be permanent. In each case, it is emphasized that treatment must be applied within a short period of cutting or sawing.

Fluorescence Microscopy of Tubercle Bacilli

Aparato Respiratorio Y Tuberculosis (9, No. 4, Oct.–Dec. 1944, published in Santiago De Chile) has a paper with the title "La Microscopia Fluorescente En La Investigacion Del Bacilo Tuberculoso" contributed by Dr. B. Juricic, Sr. Nicolás Vuskovic, Drs. Gastón, González, Hernán Durán, and Hipólito Vergara. In this they describe the results of their investigation of 5,044 cases in which samples of expectoration and gastric contents over a period of a year and a half were examined by the fluorescence microscope. The accessories utilized for transforming the microscope into a fluorescence type were those manufactured by the Spencer Lens Co., Buffalo, and consist of an electric bulb of low voltage and high amperage, provided with a blue-violet filter, and in addition, of an aluminized mirror with a yellow filter for the eyepiece. A monocular microscope was found more satisfactory than a binocular, the number of prisms in the latter considerably diminishing the fluorescence. The results are shown in two tables and a third supplies comparative figures for the Ziehl-Neelsen method. The advantages of the fluorescence method are obvious from this comparison; 52 per cent greater positive results being obtained than with the Ziehl-Neelsen method. In addition, less time is spent in staining the specimens, there is greater rapidity in the examination, and the use of oil immersion is avoided. It is claimed that the fluorescence microscope has a brilliant future before it and that its efficiency is susceptible of great improvement in various ways.

An Electrical Moisture Meter

IN a paper read on April 20 before the Institution of Electrical Engineers in London, Dr. L. Hartshorn and Mr. W. Wilson first outline the purpose which moisture meters are intended to serve, and the various types which have already been described, and then describe the development and construction of a new type of meter that has already been put to good use in several industries. A constant alternating voltage is applied to a sample of the material contained in a small vessel, which may be regarded as a fixed air condenser, or in some instances as a conductivity cell. The current passing through the material is measured by means of a sensitive thermionic ammeter of special construction, which can be adjusted to read the capacitance current, proportional to the dielectric constant of the material; the conductance current, proportional to its A.C. conductivity; or some function of both these currents. The current selected is that which shows the most favourable variation with moisture content. The use of the meter for testing seeds and grain, dried foods and flax straw is discussed, and typical results are given, together with a brief outline of other applications.

Determination of Time Corrections

THE Astronomical Institute of the Academy of Sciences of the U.S.S.R. has issued an "Ephemerides for the Determination of Time Corrections by Equal

Altitudes (Zinger's Method) for 1944". The method employed is similar to that used for 1941, a description of which appeared in *Nature* (**153**, 29; 1944). The corresponding volume for 1945 has also been received.

"Annuaire Astronomique de l'URSS pour l'An 1944", published by the Astronomical Institute of the Academy of Sciences of the U.S.S.R., has been received at *Nature* office. It follows the usual procedure, giving the spherical and rectangular coordinates of the sun for each day referred to the mean equator and equinox of 1944.0 and 1950.0, the right ascension and declination of the moon and planets, mean places of stars, 1944.0, etc., with an explanation at the end in which references are made to various pages of the volume; a brief outline of the formulæ and methods of computation employed is given.

Imperial Chemical Industries Fellowships at Cambridge

THE following candidates have been elected to Imperial Chemical Industries Fellowships at Cambridge, the subject of research being indicated in brackets: *Physics:* Dr. C. J. Birkett Clews (analysis by X-rays of the structure of conjugated monomeric hydrocarbons at low temperatures, and of the structure of highly polymerized and allied compounds); Dr. M. F. Perutz (structure of crystalline proteins and related substances by X-ray analysis); Mr. M. Ryle (radio physics). *Chemistry (Physical, Inorganic and Organic):* Dr. J. N. Agar (mechanism of electrochemical oxidation and reduction); Dr. J. Baddiley (chemistry of nucleotides); Dr. K. Bailey (studies on cytoplasmic nucleoproteins and nucleic acids); Dr. P. Johnson (investigation of macromolecular systems by gravitational and diffusion methods). *Engineering:* Mr. A. H. A. Hogg (plasticity).

Institution of Electrical Engineers Awards

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1944–45, or accepted for publication: Group A. *Kelvin Premium:* Mr. G. F. Shotter; *John Hopkinson Premium:* Mr. R. J. Halsey. Group B. *Non-Section Premiums:* Mr. H. Frohlich (Ayrton Premium), Mr. G. A. Juhlin (Llewellyn B. Atkinson Premium), Dr. R. Pohl (Extra Premium). *Installations Section Premiums:* Mr. R. O. Ackerley (Crompton Premium), Mr. R. T. Lythall (Swan Premium), Mr. L. S. Atkinson (Extra Premium). *Measurements Section Premiums:* Dr. L. Hartshorn and W. Wilson (Silvanus Thompson Premium), Mr. D. J. Desmond (Mather Premium), Mr. H. J. Josephs (Extra Premium). *Radio Section Premiums:* Prof. Willis Jackson and Mr. J. S. A. Forsyth (Duddell Premium), Dr. K. R. Sturley (Ambrose Fleming Premium), Mr. D. G. Fink (Extra Premium). *Transmission Section Premiums:* Mr. D. B. Irving (Sebastian de Ferranti Premium), Messrs. W. Kidd and E. M. S. McWhirter (John Snell Premium), Mr. R. C. Hatton and Dr. J. McCombe (Extra Premium), Mr. J. L. Carr (Extra Premium). Group C. *Fahie Premium:* Messrs. R. B. Armstrong and J. A. Smale. *Paris Exhibition, 1881 Premium:* Messrs. L. J. C. Connoll, O. W. Humphreys, and J. L. Rycroft. *Overseas Premium* (for senior members): Mr. R. H. Paul. *Students' Premiums (value £10):* Mr. W. M. Butler, Mr. G. B. Downham, Mr. J. R. Hanchett, Lieut. L. B. Knowles, Mr. J. Willis. *Students' Premiums (value £5):* Mr. J. Banks, Mr. H. Burton, Mr. T. E. Calverley, Mr. J. B. Higham, Mr. A. C. Robb, Mr. W. B. Robertshaw.

Thomas Gray Memorial Trust

THE Council of the Royal Society of Arts offers a prize of £50 and an award of £50 under the Thomas Gray Memorial Trust, the objects of which are "The Advancement of the Science of Navigation and the Scientific and Educational Interests of the British Mercantile Marine". The prize is open to any person of British or Allied nationality for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1, 1940–December 31, 1945. Competitors must forward their proofs of claim between October 1 and December 31, 1945, to the Acting Secretary, Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

The award of £50 is made to a member of the British Merchant Navy for any deed which is of outstanding professional merit. The period to be covered by the offer will be the year ending September 30, 1945, and the judges will consider their decision on or after January 1, 1946.

Travelling Fellowships in Medicine

THE Medical Research Council announces that preliminary arrangements have been made for the resumption of Rockefeller Medical Fellowships, to be provided from a fund entrusted to the Council by the Rockefeller Foundation of New York. These fellowships are intended for graduates resident in Great Britain who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. It is hoped it may be possible to make a limited number of awards during the academic year 1945–46, depending on the availability of candidates and facilities for travelling.

Announcements

AT Oxford on June 28, the honorary degree of D.C.L. was conferred on Sir D'Arcy Thompson, professor of natural history in the University of St. Andrews.

The Osler Medal for 1945 has been awarded to Dr. C. G. Douglas, University reader and demonstrator in general metabolism.

MR. N. B. KINNEAR, deputy keeper in the Department of Zoology of the British Museum (Natural History), has been appointed keeper in succession to Mr. M. A. C. Hinton, who retired on June 29.

THE Jones-Bateman Cup is offered triennially by the Royal Horticultural Society for original research in fruit culture which has added to our knowledge of cultivation, genetics, or other relative matters. Particulars can be obtained from the Secretary of the Society, Vincent Square, Westminster, London, S.W.1.

REFERENCE was made in *Nature* of June 23 (p. 764) to the Association of Special Libraries and Information Bureaux, but an old address was given; the present address of the Association is 52 Bloomsbury Street, London, W.C.1.

LETTERS TO THE EDITORS

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

Individual Hæmoglobins

It has been known for a long time that whereas living tissue can be successfully transplanted from one site to another in an individual animal, transplantation from one individual to another of the same species does not succeed[1,2]; it has been shown that the red blood corpuscles of individual cattle[3] and fowls[4] can be distinguished from one another by immunity reactions; and it has been pointed out that every individual of a sexually reproducing species is genetically different from every other individual, except in the case of identical twins[5]. Such phenomena must depend upon chemical differences between individuals, particularly between their proteins, and in point of fact differences have been found between the hæmoglobins of individual animals.

Several workers, in analysing the globins of mammals, have reported differences between individuals[6]. C. G. Douglas, J. B. S. Haldane and J. S. Haldane[7] showed that the relative affinity for carbon monoxide and oxygen of the bloods of individual mice differs, and this implies hæmoglobin individuality. Anson, Barcroft, Mirsky and Oinuma[8], using the Hartridge reversion spectroscope, found individual variations in the span (that is, the difference between the wave-length of the axes of oxy- and carboxy-hæmoglobin α-bands) for rabbit, mouse and horse; these differences (not given in the text, no doubt since they were not pertinent to the main research, but deducable from their Fig. 6) again mean individually different relative affinities for carbon monoxide and oxygen.

Using the Hartridge instrument, I have lately determined the axial wave-length of the α-band of oxyhæmoglobin in a number of earthworms and frogs without finding any individual variation within the species, but all of four individual rabbits studied were found to be different from one another. The two most diverse, which were of the same sex, age and colour, differed by 3 A. To be certain that the difference was not due to plasma, red corpuscles were suspended in saline and centrifuged before being laked in distilled water, but the result was unchanged. Measured again with fresh blood a fortnight later, the result was still the same. Since individual rabbits thus have visibly different hæmoglobins I looked next for the same phenomenon in human beings. With the view of getting the greatest differences, if there were any, I studied a West African Negro, a Chinaman, a Chinese woman, an Austrian Jew, an Englishwoman and myself. In all these cases the oxyhæmoglobins were identical as regards the wave-length of the α-band.

The Hartridge spectroscope, with which the axis of the oxyhæmoglobin α-band can be measured to one Ångstrøm unit with an error of about one unit on either side, is a very delicate instrument, and a number of precautions are essential in using it. The apparent wave-length varies with the intensity of absorption; it is therefore necessary each time to use the same blood concentration, which may be matched spectroscopically with a standard dilution of human blood. Successive measurements are seldom identical; in my work, series of ten measurements were therefore made and the mean taken. The calibration of the instrument varies very slightly from day to day, however carefully it is handled; this may perhaps be due to temperature or to changes in the observer's eye, but, whatever the cause, the calibration of the instrument should be checked whenever it is used and this can be done quite simply with the 5853 neon line, which is near the oxyhæmoglobin band. The results of Litarczeck and Dinischiotu[9] with human blood are so strange that I can only ascribe them to spectroscopic errors. These authors used the Hartridge instrument but say nothing of precautions such as I have just enumerated. They found that seven normal human beings had five different oxyhæmoglobins, the extremes of which were 8 A. apart, and five anæmic subjects had four oxyhæmoglobins with extremes 23 A. apart. Moreover, in the course of three months the wave-length changed in one individual by 10 A.

I thought it so important to establish beyond doubt the reality of the difference between my extreme rabbits, a difference not far from the experimental error, that instead of taking only ten readings, I took seventy with each blood. It is undesirable to take more than twenty readings at a time as the eye becomes fatigued and the readings scattered, and for this reason I rested after every twenty readings, which were taken in alternate groups of five readings with each blood. Moreover, half the measurements were made on one day, half on the next day with fresh blood. The means and standard errors for the two rabbits were $5771{\cdot}9 \pm 0{\cdot}2$ and $5775{\cdot}2 \pm 0{\cdot}2$ Ångstrøm units, the difference between 5772 and 5775 being thus statistically significant and the reality of visibly different individual oxyhæmoglobins established. It would be of interest to know if such differences are genetic.

H. Munro Fox.

Bedford College,
University of London.
May 2.

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A Sympathomometic Pressor Substance in Animal Organ Extracts

During a quantitative study of the piperidine content of various animal organs, following the identification of this substance as a normal constituent of urine[1], it was observed that most organs contain considerable amounts of a pressor substance different from piperidine.

The active substance was obtained by continuous fluid extraction with ether of extracts of the following organs: liver, spleen, kidney, heart, lung, voluntary muscle, smooth muscle (intestine), brain, pancreas, testis. No pressor activity was found in extract from human placenta. As a rule, the pressor action was preceded by a fall of short duration in blood pressure on intravenous injection in the cat.

A preparation with a pure pressor effect was obtained when the ether solution used to remove fats and lipoids from the organ extracts was extracted with a 10 per cent sodium sulphate solution. After removal of the inorganic salts by precipitation with alcohol, the activity corresponded to about 0·1–0·5 μgm. adrenalin per gm. of fresh tissue in spleen extracts. Further yields were obtained by repeated extraction of the organ extract with the ether solution of lipoids and extraction of this solution with a salt solution. In the remaining primary organ extract the biological action corresponded to 2–10 μgm. adrenalin per gm. of fresh tissue.

The active pressor substance is dialysable and readily soluble in water and alcohol and also to some extent in a mixture of alcohol and ether. It is quickly destroyed by heating in normal alkaline solution, but is relatively stable to acids.

The biological actions of the purest preparations so far made are as follow: a rise in blood pressure of the cat in chloralose anæsthesia, enhanced by cocaine and reversed by ergotatime; inhibition of the isolated rabbit's intestine and the non-pregnant uterus of the cat after atropine, and stimulation of the isolated rabbit's uterus, and the frog's heart.

The biological reactions point to a sympathomometic substance, and one is led to consider its relation to the "*sympathicusstoff*" of Loewi. The active extracts give colour reactions with ferric chloride of a similar kind to adrenalin and a strong Folin-Cannon-Denis' reaction with phosphotungstic acid. It has not been possible to obtain the colour reaction with iodine, however, though added adrenalin readily gave this.

U. S. v. Euler.

Physiology Department,
Karolinska Institutet,
Stockholm.
April 16.

[1] Euler, U. S. v., *Nature*, **154**, 17 (1944); *Acta Physiol. Scand.*, **8**, 380 (1944); *Acta Pharmacol. Scand.*, **1**, in the press (1944).

Presence of Reddish Pigment in Eggs and Ovarioles of the Desert Locust, and its Probable Phase Significance

I noticed some time ago that in the desert locust, *Schistocerca gregaria* (Forskål), several eggs had a reddish tinge owing to the presence of pink pigment superficially on the egg-chorion, while others lacked this pigment. Generally, in an egg-pod all the eggs are either pink or non-pink, though exceptionally both kinds may occur in the same pod. Hatchings from some 185 pink eggs (from five different egg-pods) and 406 non-pink eggs (from ten different pods) gave the following kinds of first-stage hoppers: (*a*) Pink eggs: 54 per cent *gregaria* (black pattern), 22 per cent intermediate and 24 per cent *solitaria* (green); (*b*) non-pink eggs: 25 per cent, 17 per cent and 58 per cent respectively. These proportions suggest that pink eggs produced a majority of phase *gregaria* hoppers, though it must be mentioned that hatchings from five pods (172 eggs) were contrary to this suggestion.

I also noticed that in some adult females the ovaries have, at the base of many ovarioles, a mass of orange-red pigment lying in the small basal follicle or pedicel which connects the ovariole proper with the egg-calyx. This pigment was found in both *solitaria* and *gregaria* adults and in both 6- and 7-eye-striped individuals (Roonwal[1]), but was absent in fourth- and fifth-stage hoppers. It was also observed in adults of the rice grasshopper, *Hieroglyphus nigrorepletus* Bol., from a *microptera*. The fact that both the egg and ovariole pigments are soluble in acetone and acetic acid, weakly soluble in absolute alcohol, and insoluble in water, 40 per cent formaldehyde and glycerine, suggests their close similarity. Presumably the ripe eggs, while passing through the pedicel during oviposition, become invested with the reddish pigment.

Pink-red pigments play a considerable part in the desert locust. Künckel d'Herculais[2] first noticed it in the body-wall of young adults from swarms, while Johnston[3] showed that the pink occurs only in the *gregaria* phase, the *solitaria* adults not acquiring it at any stage. Chauvin[4–8] has further studied the adult pigments and also shown that a red pigment is ejected with the excreta. In *Locustana* and *Locusta* Faure[9] has suggested the presence of a hypothetical substance, *locustine*, which is responsible for phase production and which can be transmitted from one generation to the next through the medium of the egg-substance. In view of the similarity, as shown above, of the reddish pigment of eggs and ovarioles, the suggestion may be made that this pigment is connected with Faure's *locustine*.

Full results will be published elsewhere.

M. L. Roonwal.

Zoological Survey of India.
March 8.

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'Palolo' Worms in Pacific Waters

Commander Burrows' interesting letter[1] on the palolo worm prompts me to confirm his assumption that this annelid occurs elsewhere than in Fijian and Samoan waters. It exhibits a similar periodic rising at three points off the coast of Ulawa Islands in the Solomons, where its name is 'orku'[2], and it has also been observed from southern Espiritu Santo in the New Hebrides[3]. Specimens which I sent to the British Museum in 1936 from Ulawa were identified by Mr. C. C. A. Munro as *Eunice viridis* Gray, and this is clearly the same as the *Eunice virida* of Commander Burrows.

In Fiji the mbalolo was reported from Vanua levu as long ago as 1936[4], so that this can be added to Ovalau and the Yasawas. As a matter of interest, a resident on Ovalau recently reported[5] that no worms were recorded at Tokou in 1943; but they were seen in the Yasawas and at Savusavu, Vanua levu, in October and November 1943.

R. A. Lever.

Fiji Club, Suva, Fiji.
March 20.

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[5] Anon., *Fiji Times and Herald*, Suva, November 14, 1944.

A Factor in Clover Nodule Formation Associated with the Volume of the Medium Occupied by the Roots

In the course of experiments involving the growing of clover seedlings (Late-flowering Montgomeryshire Red) on agar medium in test-tubes, it was noticed that the number of nodules produced per plant depended upon the number of individual plants occupying the same tube. As the nodule bacteria were present in very large numbers, this variation in nodulation cannot be due to paucity of organisms; indeed the question raised is rather why so few nodules are formed on plants in spite of the massive infections of the root hairs which are known to occur[1].

Experiments to elucidate both these questions are being carried out and a short report of the first result obtained is presented here.

Clover plants were grown in tubes (6 in. × ¾ in.) on slopes of a 1·2 per cent agar medium previously sterilized, containing mineral salts but deficient in nitrogen, and inoculated with nodule bacteria. The experiment was arranged in such a way that the number of plants sown per tube and the volume of agar medium was varied. The number of nodules produced per plant was counted after a period of 120 days, and the mean number of nodules and the volume of medium per tube are entered in Table 1.

Table 1. Mean number of nodules per plant.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	20·4 ± 2·0	9·3 ± 1·9	5·3 ± 1·1
8 c.c.	34·9 ± 3·7	16·1 ± 3·4	12·1 ± 3·1
12 c.c.	31·5 ± 4·6	23·5 ± 6·3	14·4 ± 2·3

It will be noted that for each volume of medium used the number of nodules per plant is inversely related to the number of plants in the tube. Further, the mean number of nodules per plant increases with the volume of medium per tube and is roughly proportional to the volume.

Assuming that these relations are such that: (1) the nodule number is proportional to the volume of the medium, and (2) is inversely proportional to the number of plants present, it is possible to calculate the expected number of nodules for each variant from the mean number of nodules per plant over the whole experiment. The calculated values are entered in Table 2, and with the single exception of the entry for one plant in 12 c.c. medium, the agreement between expected and observed values is very satisfactory.

Table 2. Calculated mean numbers of nodules per plant.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	16·4	8·2	5·5
8 c.c.	32·7	16·4	10·9
12 c.c.	49·1	24·5	16·4

The simplest hypothesis that this effect is due to direct competition for nutrients has been shown by later experiments to be inadequate to explain the results given above. That the effect is also not due to delay in nodulation is shown by the figures for mean leaf number at the time of primary infection in Table 3.

Table 3. Mean leaf number at primary infection.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	1·94 ± 0·10	2·31 ± 0·13	2·02 ± 0·07
8 c.c.	2·31 ± 0·22	2·25 ± 0·17	2·54 ± 0·20
12 c.c.	2·18 ± 0·20	1·72 ± 0·23	1·79 ± 0·09

With regard to the question of the comparatively few nodules formed on the root system in any treatment, the generally discarded hypothesis is revived that the nodule is a metamorphosed lateral root and that the maximum number of nodules is determined solely by the potential number of lateral root primordia present in the primary and secondary roots. In the course of this work selected lines of plants have been secured displaying large variations in nodule number under conditions already described. In such cases the rate of increase in nodule number agrees strikingly with the rate of lateral root production in control uninoculated plants, but not with the rate of increase in total length or extent of the root system. It has further been shown that diminution in nodule number following crowding of plants in a given volume follows closely the reduction of lateral roots under the same conditions.

In the absence of detectable competition effects as a clue to this specific volume relationship, it appears probable that the phenomenon can be attributed to some nodule- and lateral root-inhibiting excretion from the roots, the concentration of which varies with plant number and the volume of the root medium.

Experiments to test this hypothesis are now under way.

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[1] McCoy, E., *Proc. Roy. Soc.*, B, 110 (1932).

Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate

Attention has recently been directed[1] to the break-up of single crystals of Rochelle salt and of potassium dihydrogen phosphate (KH_2PO_4) into crystal 'hybrids' when these substances are cooled below their transition points. A similar phenomenon has now also been established by means of Bragg photographs in the case of potassium dihydrogen arsenate (KH_2AsO_4).

A number of novel features about the size and mutual relationships of the sub-crystalline regions within a 'hybrid' single crystal (cf. ref. 1 and Fig. 2) has been observed by means of Laue photographs. Fig. 1 shows portions of Laue photographs of potassium dihydrogen phosphate below and above the transition point. For these exposures, the crystal was mounted at the centre of a cylindrical camera, with the *c* axis vertical, and with the (100) face approximately at 37° to the beam of white X-rays. Below the transition point (Fig. 1, *a*), the Laue reflexions from the hybrid are split into two, three or four components according to their indices. Fig. 1 (*b*) was taken without changing the position of the crystal, some hours after its temperature had been

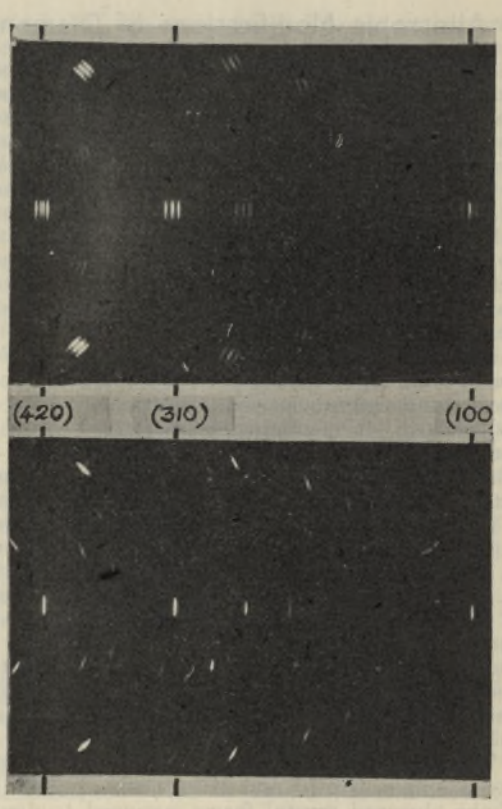

Fig. 1. Laue photograph of KH_2PO_4. (*a*) At approximately − 183° C. (*b*) Repeat exposure with identical orientation after 18 hours at room temperature.

raised above the transition point. The components of the split reflexions have merged to give the pattern of the original single crystal.

From these split Laue reflexions, interesting information can be obtained about the mutual relationships between the sub-crystalline regions within a 'hybrid' single crystal, about the size of the regions, and about the time required for the change from hybrid to single crystal and back again.

The fact that single Laue reflexions above the transition point are split into a finite number of components, rather than spread into a broad band, when the crystal changes to a hybrid, implies that the sub-crystalline regions of lower symmetry assume only a limited number of directions with respect to the original tetragonal axes. In general, a (*hk*0) reflexion is found to split into four components, when $h \neq k \neq 0$. The separation of these components varies with the ratio h/k, and the (100) and (010) show three components only, whereas the (110) shows only two. This can be accounted for by the fact that keeping the *c* axis the same, a sub-crystalline region of lower symmetry can be produced in four distinct orientations with respect to the original framework, and yet preserve one of its axes in common with the *a* or *b* tetragonal axes of the original single crystal (cf. Fig. 2).

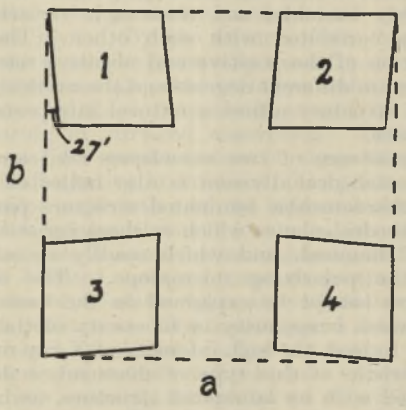

Fig. 2. Possible positions of subcrystalline units in the hybrid with respect to original crystal axes. (1) and (2) *a* axis unchanged. (3) and (4) *b* axis unchanged.

Information about the size of the sub-crystalline regions can be obtained from observations on the relative intensities of the components of a split reflexion. The intensities of each of a pair of components corresponding with orientations (1) and (2), or (3) and (4) of the units (cf. Fig. 2), are found to be the same, showing that the crystal as a whole remains electrically neutral. But in general, the intensity of one pair may be notably greater or smaller than that of the other. If the portion of the crystal illuminated by X-rays were of about the same size as, or smaller than, a single sub-crystalline unit, only one of the four components would be observed for any given setting of the crystal. On the other hand, if the portion of crystal illuminated were so large as to contain very many units, statistical smoothing would lead to equal intensities for all four components. In actual fact, with the sizes of crystals and X-ray beam used, the relative intensities of the components lie between these two extremes. From this, a provisional estimate of the size of the sub-units is about 5×10^{-3} cm. side.

Finally, Laue reflexions permit some estimate of the time of reversion from a hybrid to a true single crystal, when the temperature is raised above the transition point. With some crystal specimens, this change is completed within a few minutes at room temperatures. With others, hysteresis is more marked and split reflexions can be observed which coalesce after a few hours to give the pattern of a single crystal (Fig. 1).

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[1] *Nature*, **155**, 170 (1945).

Afterglow Effects in High-Pressure Gases

We have recently demonstrated[1] the existence of afterglows following intense spark discharges in argon, hydrogen and other gases at pressures of 1–2 atmospheres. The submission of this further note, in advance of a more detailed publication[2], is prompted by Lord Rayleigh's recent experiment[3] and Jabłoński's comments[4]. The recent work of O'Doherty[5,6] is also relevant.

Experiments with square current-pulses indicate that afterglows persist after the cessation of current flow. Fig. 1 shows an oscillogram of the current wave for a discharge across a 0·5 cm. gap between tungsten electrodes in hydrogen at 18 lb./sq. in.

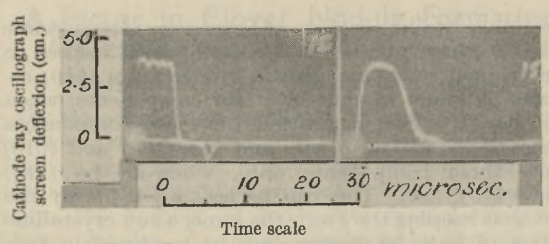

Fig. 1. Fig. 2.

pressure. The light output from the discharge, as recorded by a photo-electric electron multiplier, is shown in the oscillogram of Fig. 2. An afterglow of short duration, about 2 microsec., is observed, which was not observable in our earlier rotating mirror experiments[1] with damped condenser discharges.

The afterglow in hydrogen is explained by us[2] as due to the finite thermal capacity of the spark channel, leading to the delayed emission of light by electron/ion recombination, by the simple thermal excitation process, or by a combination of both effects. Radiationless three-body collisions are also probably of importance, since the ion densities in the spark channels are very high (10^{17} ions/c.c. or more).

Lord Rayleigh[3] showed that afterglows of about 10 microsec. were observable with electrodeless discharges in hydrogen at 0·2 mm. pressure and, despite the calculated rise in gas temperature of about 38,000° due to the extremely high instantaneous power dissipation in the discharges, no interpretation of the results was given. It was pointed out, however, that the time of persistence (about 10 microsec.) of the Balmer lines was about a thousand times as long as the life of the excited states in question.

In our experiments the spark channels were fairly sharply defined, so that estimates of surface area, rate of heat loss, etc., can be made[2]. It is found that the thermal time constant is of the order required to explain Fig. 2, and although it is difficult to make similar calculations for Lord Rayleigh's tube, it is considered likely that the afterglows observed with it can be explained in the same way. The persistence of the Balmer lines for times greater than the normal life-time of excited atoms is therefore to be expected. Jabłoński's suggestions are to be supported, with the important addition of thermal excitation as a means for providing delayed emission.

The experiments are being continued and extended in several directions[7] with increased accuracy, in particular to decide the relative importance of the various effects responsible for afterglows and to investigate spark channels and other transient gas discharges.

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April 4.

[1] Meek, J. M., and Craggs, J. D., *Nature*, **152**, 538 (1943).
[2] Craggs, J. D., and Meek, J. M., submitted for publication; work completed July 1944.
[3] Lord Rayleigh, *Proc. Roy. Soc.*, A, **183**, 26 (1944).
[4] Jabłoński, A., *Nature*, **155**, 397 (1945).
[5] O'Doherty, J. J., *Nature*, **153**. 558 (1944).
[6] O'Doherty, J. J., *Nature*, **154**, 339 (1944).
[7] Craggs, J. D., *Quart. J. Roy. Met. Soc.*, **70**, 167 (1944) (discussion on paper by T. E. Allibone).

Allotropic Modifications of Diamond

The relationships which exist between the structural symmetry of a molecule and its spectroscopic behaviour have been fully worked out by Placzek[1]. One result of his theory is that if a molecule has the symmetry of the crystallographic point-group *Oh*, the activity of its vibrations in infra-red absorption and in light-scattering are mutually exclusive. On the other hand, if the molecular symmetry is that of the point-group *Td*, every vibration of the triply degenerate class must appear both in light-scattering and in infra-red absorption, or else be absent in both.

Placzek's theory is applicable, *mutatis mutandis*, to the spectroscopic behaviour of crystals in respect of their fundamental lattice vibrations. The consequences of it mentioned above afford a straightforward explanation of the remarkable fact that, while all diamonds exhibit in light-scattering an intense line with a spectral frequency shift of about 1,332 wave numbers, the corresponding infra-red absorption appears only in some diamonds, but not in others. This difference in spectroscopic behaviour is, in fact, a complete demonstration of the existence of allotropic modifications of diamond and shows further that the forms more commonly met with showing the infra red absorption have only tetrahedral symmetry of structure, while the less common variety, in which the absorption is absent, has the full symmetry of the cubic system.

The crystallographers of the nineteenth century (for example, Groth[2] and Miers[3]) who, on the basis of the observed crystal forms, assigned to diamond the lower or tetrahedral symmetry, recognized it as a necessary consequence that two variants of it, namely, the positive and negative tetrahedral forms, must exist, and explained the comparative rarity of forms clearly exhibiting the lower symmetry as the result of their interpenetration. Apart from the crystallographic evidence which supports this explanation, there is an array of experimental facts concerning diamond established by my work and that of my collaborators[4], which proves that such an interpenetration does really exist in diamonds having tetrahedral symmetry of structure. The evidence can be summarized in the statement that while the characteristic infra-red absorption goes hand in hand with various other physical properties, for example, blue luminescence, ultra-violet opacity, feeble but sharply defined classical X-ray reflexions and small photo-conductivity, all these properties themselves are highly variable, and that such variations are perfectly correlated with each other. The interpenetration of the positive and negative tetrahedral structures in different degrees and the resulting variations of structure afford a natural interpretation of these facts.

The existence of two sub-classes *Oh* I and *Oh* II in the octahedral division is also indicated by the highly characteristic laminated structure parallel to the octahedral planes which is characteristic of this type of diamond, and which readily reveals itself under the polarizing microscope. The observed structures cannot be explained on the basis merely of a random irregularity or mosaicity of the crystal lattice. Indeed, the high intensity of X-ray reflexions characteristic of this type of diamond is definitely associated with its laminated structure, as has been clearly demonstrated by the X-ray topographs of Mr. G. N. Ramachandran[5]. Finally, it should be

remarked that the appearance of geometric patterns in cleavage plates of diamond exhibiting the local variations in the various physical properties mentioned above is a convincing ocular demonstration of the fact that we are really dealing with distinct allotropic forms of diamond, as also with the consequences of their interpenetration and/or intertwinning.

The above statement of the case is by way of reply to Mrs. Lonsdale's letter published in *Nature* of February 3 last. She does not discuss the array of facts brought forward in the symposium but 'challenges' what she refers to as a 'speculation' on the basis of certain minor aspects of the X-ray behaviour of diamond, which are not really fundamental to the issues under consideration. Mrs. Lonsdale believes that the specific points mentioned by her controvert the main thesis established by the work of my collaborators and myself; this is not so. As the present letter, however, is already of sufficient length, a detailed examination of those points must be reserved for a separate communication.

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March 20.

[1] Placzek, G., "Handbuch der Radiologie", Part 2, p. 297, table 9 (2nd Edit., 1934).
[2] Groth, P., "Physikalische Kristallographie" (Leipzig, 1895), 575.
[3] Miers, H. A., "Mineralogy" (Macmillan, 1902), 282.
[4] Raman, C. V., and collaborators, *Proc. Ind. Acad. Sci.*, A, **19**, 189 (1944).
[5] Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, A, **19**, 280 (1944).

Infra-Red Spectrum of Diamond

The new theory of crystal dynamics put forward by Sir C. V. Raman[1] leads in the case of diamond to the result that the atomic vibration spectrum of this crystal should exhibit eight distinct monochromatic frequencies. Of these, the mode of highest frequency (1,332 cm.$^{-1}$) corresponds to the triply degenerate vibration of the two Bravais lattices of carbon atoms with respect to each other, and this is active or inactive in infra-red absorption according as the crystal structure of the diamond possesses tetrahedral or octahedral symmetry. The other seven frequencies represent oscillations of the layers of carbon atoms parallel to the faces of the octahedron or the cube occurring normal or tangential to these planes, with the phase reversed at each successive equivalent layer. By the nature of the case, such oscillations should be *inactive* in the infra-red absorption as fundamentals; but owing to anharmonicity, the octaves of these frequencies should be capable of appearing in infra-red absorption. Besides the octaves, various combinations of these frequencies would also be active in infra-red absorption.

A detailed exploration of the infra-red absorption band exhibited by diamond in the region of wavelengths between 4 μ and 5 μ was made by Robertson, Fox and Martin[2], using a concave grating of one metre focus of echelette type, in conjunction with a prismatic instrument. The investigation showed that the band had an observable fine structure; indeed a whole series of sharply defined peaks or absorption maxima was noticed, the positions of which were capable of exact measurement within a few wave-numbers.

These results must be considered surprising on the basis of the older theories of crystal dynamics, according to which the vibration spectrum of a crystal is essentially a continuous one. Indeed, it is not easy to see how any explanation of the experimental facts could be offered on the basis of those theories. On the other hand, they find a natural explanation on the basis of the new dynamics as explained above.

Both in the earlier investigation of Robertson, Fox and Martin[3] and the later one mentioned above, the two most conspicuous and sharply defined absorption peaks are those at wave-numbers 2170 and 2028. These agree within a wave-number or two with the octaves of 1088 and 1013 respectively which represent the frequencies (determined by other spectroscopic methods) of the atomic vibrations normal to the octahedral planes. The other peaks in Robertson, Fox and Martin's curve may also be explained quite accurately as allowed combinations of the lattice frequencies.

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[1] Raman, C. V., *Proc. Ind. Acad. Sci.*, A, **18**, 237 (1943).
[2] Robertson, Fox and Martin, *Proc. Roy. Soc.*, A, **157**, 579 (1936).
[3] Robertson, Fox and Martin, *Phil. Trans. Roy. Soc.*, **232**, 463 (1934).

Shear Modes in Non-Piezo-Electric Crystal Plates

Recently we described a new method[1] for the determination of the elastic constants of crystals, utilizing ultrasonic waves of continuously varying frequency. At that time, it was thought that the method would not permit the thickness transverse vibrations to be detected. The full set of elastic constants could be obtained only after supplementing the work by a few static torsion observations.

Further work has now revealed that these transverse or shear modes can also be transmitted through crystal plates and communicated to liquids in the form of consequential longitudinal strains. Associating such transmission maxima with thickness transverse frequencies, torsion constants for crystal plates can be calculated and the full set of elastic constants obtained by purely dynamical methods. This result has now been used for checking previous measurements on some crystals and to make new measurements on others. Full details and the numerical results are being published elsewhere.

It may be pointed out here that this observation is analogous to that of Bhagavantam and Suryanarayana[2], who have recently demonstrated that besides the usual longitudinal ones, shear modes also can be excited in piezo-electric crystal plates and transmitted to liquid media as corresponding longitudinal waves.

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[1] Bhagavantam, S., and Bhimasenachar, J., *Proc. Ind. Acad. Sci.*, A, **20**, 298 (1944).
[2] Bhagavantam, S., and Suryanarayana, D., *Nature*, **155**, 171 (1945).

COMBINED RAW MATERIALS BOARD

THE third annual report of the Combined Raw Materials Board covers the year ended January 26, 1945, and shows clearly that the international planning of the production and distribution of industrial raw materials, the world demand for which exceeds the supplies available, will long be required. The progress of the War during 1944, and the completion in large measure of the major planning tasks in the raw materials field in support of the war effort, permitted the two member Governments to review the Board's duties and terms of reference and to consider what modifications might be necessary in future.

The Board was designed as a war-time organization; but it is encouraging to learn that it has been decided, as a result of these discussions, that the Board shall continue in being for the duration of the War against Japan, and to operate under its existing terms of reference and with the increasing collaboration of the other United Nations most closely concerned. The text of a joint public announcement of January 19, 1945, which covers also the Combined Production and Resources Board and the Combined Food Board, is appended, and should remove the fear of any hasty jettisoning of the war-time machinery of economic partnership and control, and of the liberated countries of western Europe seeking to outbid each other or their more prosperous neighbours for scarce materials by independent buying in the markets of the world.

The report indicates a general improvement in 1944 in the raw materials position, and stringencies were arising less from shortages of raw materials than from other factors, particularly the shortage of labour for processing raw materials. The Board has been able to relax close control over certain grades of asbestos, balata, balsa wood, cobalt, mercury, mica, molybdenum, shellac, tantalite and tungsten, but on the other hand, sudden and unforeseen changes in the demand and supply position made it necessary to restore close control of antimony and zinc. Combined action was also necessary to deal with new shortages of jute, platinum, lead, casein, animal glue-making materials and goatskins, and the report refers to the way in which changes in military requirements and the needs of newly liberated countries prevent the guarantee of equilibrium. The acute dearth of natural rubber and of hard hemp persisted, and the Board urges that the conversion from the use of natural to the use of synthetic rubber should be vigorously pursued in all consuming countries. The situation with regard to hides and leather steadily worsened during 1944, and is likely to be one of the most serious facing the Board during 1945. Arrangements have already been made to bring the United Nations Relief and Rehabilitation Administration and the governments of Europe financing their own reconstruction requirements into close working arrangements with the Board to ensure that the orderly flow of hides may continue as new claimants against the world's supply enter the picture.

Particularly during the latter half of 1944, the governments of the liberated areas were in constant consultation with the Board regarding their requirements of essential raw materials, and although no substantial deliveries were possible before the end of the year, these claimants may cause new stringencies in raw materials available for civilian use in the United States, Great Britain and elsewhere during 1945. Within the narrower range of scarce commodities such as hides and leather, lumber, paper and pulp, cordage fibres, jute and lead, the legitimate needs of Europe will curtail the quantity available for others, although on the other hand the industrial output of western Europe should soon help to counteract the current deficits in such items as tyres and textiles.

MICROFILM AND OTHER MEANS OF DOCUMENTARY REPRODUCTION

AT the nineteenth annual conference of the Association of Special Libraries and Information Bureaux held in December last, it was felt that justice could not be done to the photographic reproduction of documents by microfilm and other methods without a special conference on this subject alone. Such a conference was therefore held in London in the rooms of the Royal Society during June 1–2, under the auspices of the ASLIB Microfilm Service. Its three sessions drew a full gathering of some hundred and fifty librarians and other workers in bibliographical fields, including many from government departments, and a number of representatives of the photographic industry. The first two sessions were devoted largely to technical matters related to copying and reproduction processes, and the third and last session to the vexed question of copyright. At all three sessions the vigour of the discussions, quite as much as the high quality of the contributions of the principal speakers, provided a measure of the value of the conference; and if little was achieved in the way of proposals for that standardization which would do more than anything else to promote the use of this valuable new tool—a tool destined, some maintain, to transform research library practice—the conference did succeed in demonstrating the variety of purposes for which document-copying by photographic means is needed, and in suggesting some of the directions in which advances are likely to be most rapid.

After a brief speech of welcome had been made by Prof. A. V. Hill, who presided over the opening session, Mr. F. J. Tritton (of Ilford Limited) gave a clear and admirable survey of the principal photographic methods of document-copying and of the technical problems they involve, illustrating his remarks by reference to full-size paper reproductions, by the various processes, of a page of an ordinary journal comprising letterpress and illustrations in line, stipple and half-tone. For satisfactory reproduction of typographic matter, some overall gain in contrast is generally considered desirable, and while this does not affect the clarity of line and stipple illustrations, it gives poor reproduction of half-tone blocks. A compromise is therefore necessary, and since the greater bulk of material normally copied is purely typographic, materials of relatively high contrast are generally preferred; their development can, when necessary, be so modified as to reproduce half-tones satisfactorily. The processes can be classified as (*a*) those needing a camera, yielding records either substantially full-size (for example, photostat, using paper) or of reduced size (microfilm), and (*b*) those requiring no camera, but employing straight contact-printing to give a full-size copy, among these

being reflex processes, applicable to documents printed on both sides. Any of these processes can be made to yield a negative (the sole copy) or an unlimited number of positives (from a master negative). The choice of process depends much on the volume of work to be done, since gross costs are obviously affected by the cost of the apparatus needed in making the copy and in using it; it depends also on the purpose of the work, since evidently if reduced bulk is important, whether for storage or transport, some such method as microfilm is essential.

Other processes were mentioned in the course of an animated discussion, among them in particular being the 'micro-print' processes which have recently attracted considerable attention, especially in America. A case in point was the 'micro-card' system which has been described at length by Fremont Rider, librarian of the Wesleyan University Library, in "The Scholar and the Future of the Research Library" (see *Nature*, **154**, 655; 1944). Rider, impressed by the average rate of growth of American research libraries, which, he finds, double in size every sixteen years, has proposed that the back of the typical 5 in. × 3 in. library index card should carry a reduced image of up to one hundred pages of the text of the document catalogued; and thus, in short, that the research library of the future would be housed *on the back* of its catalogue cards, the cards themselves being produced at a cheap rate and in relatively large editions by central reproducing agencies. Mr. Tritton believes that a special difficulty of this and other micro-print systems using high degrees of reduction, quite apart from the present lack of satisfactory reading apparatus, is the obliterating effect of dust-particles settling during the copying of the original or in the course of printing. Other micro-print processes were mentioned in discussion, including one by Dr. Carl White of Columbia University, by which reduced copies of 25 pages of an original are offset-printed upon a single printed page of normal size.

Notwithstanding these developments, micro-film remains at present, in Great Britain and the United States, the medium most widely used for bulk reproduction work. A very pertinent discussion, therefore, was prompted by the second paper of the conference when Mrs. L. Moholy (director of the ASLIB Microfilm Service) reported on discussions she has had with Dr. L. A. Sayce on the important practical questions: whether perforated or unperforated film should be used, and whether a fixed frame-length should be adopted or a frame-length varying, at a fixed degree of reduction, with the length of the original document. Unperforated film offers greater economy in film area and therefore in weight, and has been employed by the ASLIB Microfilm Service, much of the output of which has been sent overseas. On most technical grounds it has much to commend it, but difficulties have arisen because unperforated film cannot be passed through the sprocket-driven apparatus which has for the most part been used in Britain.

An interesting discussion led to a suggestion that in future ASLIB should supply perforated film unless unperforated be specifically requested, since the former can be used in any reading apparatus. Similar divisions of opinion were clearly shown on the question of fixed frame *vs.* varying frame. The majority of speakers favoured the former, which simplifies apparatus problems (automatic selection of frames in reading and analysing machines) and makes for ease of filing and indexing of short lengths of film, though it can be somewhat wasteful of film when the page size of the originals varies.

A similar diversity of present-day practice was seen in the field of reading apparatus, described by Mrs. L. Moholy in an illustrated lecture on "Projectors and Reading Machines" at the second session of the conference. The discussion showed, so far as a synthesis of the diverse needs of different classes of user is at all possible, that the ideal microfilm reader would probably be a relatively light and portable apparatus giving an easily readable image projected on a white reflecting surface (rather than on a diffusely transmitting screen), the apparatus being adapted to take a film bearing images either along or across its width and having conveniently operable means of changing from one frame to another and of selecting a desired frame as quickly as possible, and at the same time taking up so little space on a desk as to leave plenty of room for notebooks, etc. If we add that the apparatus would have to be produced cheaply because, it was urged, the average research user would want a reader on his desk and not merely in the central library of his department, we realize that no such reader exists as yet. Reference was made in discussion to a small cheap folding reader made of cardboard, adapted to take a few frames of film, which was used during the War for supplying information to the F.F.I. in France, the folded card reader and the microfilm being dropped from the air.

It was stated by some speakers that most users of microfilm services prefer to have prints which can be read direct, and while this may be due in part to the lack of really satisfactory readers, there is no doubt that a print which can be filed for easy reference has many advantages for the research worker. The storage of microfilm and its resistance to wear were also mentioned. Work carried out in the United States and elsewhere has shown, Mr. Tritton said, that provided the photographic processing has been properly carried out, the age of a microfilm record should be at least as great as that of the original document. Exposure to tropical atmospheric conditions should be avoided by air-conditioning film-storage compartments, but such steps are not necessary in temperate climates. As to wear in the course of handling, that appears to depend on the care taken by the user; but Mrs. Moholy emphasized that master copies should not be used in readers.

During this second session of the conference, at which Dr. C. H. Desch took the chair, Mr. G. R. Edwards (secretary of the Royal Society of Medicine) gave an account of the microfilm service which has been provided since the outbreak of war by that Society, as a means of providing its overseas members with information on request. It had been widely used, also, by the Director General of the Army Medical Services. Mr. Edwards pointed out that microfilms not only occupy a much smaller space than photostat copies, but also cost considerably less. It is certain that in future any library of standing will have a film reader and should be ready to use every type of technical device to disseminate its material. The use of such devices should, therefore, be taught in courses on librarianship.

The final session of the conference was in the form of a 'brains trust' on documentary reproduction and copyright, with Mr. G. S. W. Marlow, barrister-at-law (secretary of the Faraday Society), as chairman and question-master. The 'brains trust' consisted of

Prof. J. D. Bernal, Mr. E. J. Carter, Dr. Arundell Esdaile, Dr. C. H. Desch and Mr. R. A. Lochner. The chairman opened the proceedings with a summary of the relevant parts of the law of copyright. The making of a photographic copy is obviously "reproduction of the original" within the meaning of the Acts, but since the Acts permit "fair dealing" with an original for the purposes of private study and research, the problem raised by photographic reproduction is largely "When is dealing fair ?" In the course of the answers to this question, in which the audience shared freely, Prof. Bernal thought that scientific workers have long been breaking the law not only for study but also for criticism. To him, "fair dealing" implied the question : Was the photocopying service one for which money could reasonably be asked by the owner of the copyright ? If the copies were made for the use of one or two persons only, it would be very different from copies made for class-teaching on a large scale. Dr. Esdaile amplified this by saying that fair dealing ceased when the commercial interests of the owner were injured. Mr. A. G. Dance, of the Ministry of Education, said that the matter is one of great consequence, and some decision must soon be reached because the Ministry was hoping to see a very considerable increase in the use of film strip after the War. Several speakers urged the advertising value of photocopies. If production of photocopies, so far from reducing the demand for the original, stimulated such a demand (as has happened with the B.B.C. in the concert field), then injury to the owner of the copyright could scarcely be said to have occurred. Mr. Tritton went further, stating that the authors of much of the material now being microfilmed are individual scientific men and other professional workers whose greatest reward lies in the wide dissemination of their works, for which they rarely receive payment in money. Mr. Chilton added that the copying of individual articles in journals puts these articles at the disposal of research workers who only in rare instances could be expected to subscribe to the original journals, especially when account is taken of the widespread scatter of material on any one subject throughout the thousands of current scientific and professional periodicals. It was generally agreed, however, that since publishing bodies are inevitably business concerns, copyright problems cannot be got round in this way.

Dr. R. S. Hutton and Mrs. Moholy pointed the way to a solution of the problem, first referring to present U.S. practice whereby the purchaser of a photocopy declares that he will not use the copy other than for the purpose of private study, and secondly calling for a less cumbersome arrangement with the owners of copyright than the present one, which requires that in cases of doubt the copying agency has to make contact with the owner before proceeding with the copying. Time-saving being one of the greatest advantages of photocopying methods, it is desirable to have an automatic arrangement with copyright owners concerning the terms under which they are prepared to permit photocopying. It would then be possible for a copying agency like ASLIB to carry out its work without specific reference to publisher or author in any particular case.

It has been impossible in the course of a brief review to cover the many interesting points arising from this conference, but it is understood that the proceedings will be available in due course.

L. V. Chilton.

BRITISH MUSEUMS DURING THE WAR YEARS

"THE great task of museums and art galleries in this country during the War is to help preserve the basic sanity of our peoples and anything that can be done in this respect will be of greater ultimate value than most of us perhaps can now realize." These words are quoted from a message from Major S. F. Markham to members of the Museums Association in 1940. How the museums and art galleries have endeavoured to carry out this task is the subject of the leading article entitled "Endeavour and Achievement", appearing in the *Museums Journal* of April 1945. The information contained therein is based upon the many museum and art gallery reports received regularly at the offices of the Museums Association in London.

The author states that the large majority of these institutions have not only continued their activities throughout the war period, but also that they have considerably risen in public appreciation ; that their development, far from being curtailed by war conditions, has been greatly accelerated ; and that "the support of museum and art gallery activities is now accepted as a normal service in any progressive city or town". Some of the causes leading to this satisfactory position are to be looked for in the popular short-term exhibitions of material supplied by government departments, the Council for the Encouragement of Music and the Arts, and many other organizations ; the co-operation of the museums and art galleries with government departments and the various Services in the provision of instruction for men and women in the Forces, and of loan-exhibits to camps, canteens and clubs ; the arrangements made for discussion groups, concerts and art exhibitions ; the many informative exhibits and talks dealing with the need for fuel economy, paper salvage, food production and so on ; and the special catering for the needs of leisure and thought by careful presentation of artistic, historical and scientific material.

That the need for such amenities is very real is proved by the overwhelming response of the public wherever they are provided, and the results fully demonstrate that where the service is well rendered, there will it be well received—indeed, even demanded. Nevertheless, the high attainments of even a majority of institutions must not be allowed to mask the fact that there are still far too many areas in Great Britain where the museum service is static, in decay, or even non-existent. Further, reports from even the larger museums continue to stress the need for expansion, better staffing, better working facilities, and more adequate expenditure ; and there has been much criticism from not unimportant quarters. Even the writer of the article outlined above is aware of such matters, for he writes, ". . . it is of paramount importance that museums and art galleries should turn their present proud position to good account when peace returns. Directors and curators should take their rightful place in the circle of leading professional men and women who render notable service to the community". And again, "The Museums Association is staking a general claim for the advancement of museums and art galleries throughout the country, but local authorities must adapt this according to their individual needs". At this point, however, one may doubt whether *all* local authorities

are sufficiently interested in, or informed of, this particular public service, and hence whether they are qualified to come to any conclusion at all about such 'needs'. One more statement from the article under consideration is worth quoting for the light it throws upon a not uncommon official attitude towards museums: "Museums have been the Cinderellas of the services for too long a time". It is evident, therefore, that many of these institutions are at present in a state of suppression, and that the cause may be ill-informed, ungenerous, or timid rule. It is evident, also, that various authorities, whether they are responsible for the conduct of a museum service or not, have yet to be convinced of the value of the museum in the fields of education and research, and in the intelligent and constructive use of leisure.

HISTORICAL LIBRARY OF YALE UNIVERSITY SCHOOL OF MEDICINE

THE difficulties of scientific libraries, the meagre funds sometimes allocated to them and the devoted labours of those who work obscurely in them for the benefit of science are often not adequately appreciated by those who would be the first to maintain that libraries are essential tools of research. It would, indeed, do most undergraduates and research workers in science departments no harm to work for a month or two in a library; for only those who have sufficient imagination can realize, without this practical experience, all the labour and organization which goes to the making of an efficient library service. One record of this kind of service is given in the reports for the years 1941–44 of the Historical Library of Yale University School of Medicine (Sterling Hall of Medicine, New Haven, Connecticut).

During the first year (1941–42) this Library, which was endowed by Harvey Cushing and dedicated on June 15, 1941, made vigorous efforts to build up its collections, especially those relating to the medical history of the War of 1914–18; the Library is also associated with the work of the National Research Council's Subcommittee on Historical Records of the medical history of the present War. The same Council financed the publication of a classified bibliography of aviation medicine prepared by the Yale Historical Medical Library, supplements to which have been requested by the National Research Council's Sub-committee. The problems which occupied this busy year are discussed in these reports. One of the Library's most useful decisions was that books should be available on loan without restriction, and many scholars outside Yale have benefited from this. Another valuable service is the opening of the Library for seven days a week.

The Library's outstanding treasures are the collection bequeathed to it by Harvey Cushing himself and the other one bequeathed by Dr. Arnold Klebs, who died in 1943 in Switzerland, where his books await transportation to Yale. These collections will place Yale in the forefront of libraries concentrating on fifteenth-century literature. To them the Library can add, among its other treasures, the collection of Prof. J. F. Fulton relating largely to the seventeenth century. Prof. Fulton's other devoted services to the management and general policy of the Library as chairman of its Advisory Board are evident throughout these reports. He is also consultant to the Army Medical Library, the system of classification of which the Yale Library now follows. Another feature of the Library's work has been the lectures and demonstrations given each year by Dr. Arturo Castiglioni. The Library has issued the catalogue of Harvey Cushing's collection, which has been considered the finest gift of books by a medical man since William Hunter left his library to the University of Glasgow. Cushing's collection is rich in documents on the anatomy of the Renaissance, the surgery of Tudor England and Vesalius' books. The great historical Library now being formed at Yale is a fine memorial to Cushing, and under the care of Prof. John Fulton and his colleagues it will fare well. G. LAPAGE.

MARINE ECOLOGY IN SOUTH AFRICA*

PROF. T. A. STEPHENSON and his assistants have studied intensively the intertidal fauna and flora of South Africa for many years, and the result is a valuable series of ecological memoirs. In Part 1 (1939) of this paper, an account was given of zonation in the intertidal belt surrounding South Africa, to which were added details of the distribution of the Patellidæ. The present part describes the distribution on the South African coasts of the more important intertidal species, and defines the geographical components of the fauna and flora. A third part is to be published later which will include, among other items, a comparison of results with those of other workers.

A very large amount of work is entailed in this survey, and the results are of great interest. Altogether a coast-line of about 1,820 miles has been surveyed and about 1,200 species identified. The most important forms on which attention has been concentrated number 318 (202 animals and 116 algæ).

The intertidal fauna and flora comprise four components—a very large warm-water component supreme in the east but dying down westward; a smaller, but important, cold-water component, paramount westward but diminishing eastwards; a component centred about the south coast, disappearing to the eastward and westward, and a component consisting of species which occur around the entire coast from Durban to Port Nolloth. In addition there appear to be components of more local range centred about different parts of the coast.

Two very large elements are included; one endemic or indigenous to South Africa, the other consisting of species with an East African, Indic or Indo-Pacific range. Apart from these, other elements (Atlantic, sub-antarctic, cosmopolitan, etc.) are represented in relatively small proportions. The number of species rises steadily from west to east.

A comparison of the zonation of these coasts brings out roughly a *Littorina* zone, recognizable throughout although the species of *Littorina* change from east to west; a Balanoid zone throughout, everywhere inhabited by *Patella granularis* as well as by barnacles, but westward the barnacles diminish leaving the Patella dominant; a zone of *Patella cochlear* throughout the greater part of the coast; but at both the eastern and western ends complications appear due to the diminution of that species

* The Constitution of the Intertidal Fauna and Flora of South Africa. Part 2. By T. A. Stephenson. With Plates XII–XIV and 13 text-figures. *Ann. Natal Mus.*, **10**, Part 3 (Dec. 28, 1944).

and the consequent dominance of other forms; and the lowest zone, the sub-littoral fringe, is also demonstrable throughout though its population changes and it becomes rather vague to westward, where it represents the fringe of the (mainly sub-littoral) Laminarian zone.

The replacement of certain forms is interesting. Thus the polychæte *Gunnarea capensis* drives out *Patella cochlear* in places, and mussels replace limpets in others. Also algæ replace other algæ or limpets. The illustrations of the zoning, in many cases coloured, are very attractive and informing.

Such a survey as this can only be done by steady team-work, and the difficulties overcome are very large. Prof. Stephenson is to be congratulated on the large amount of valuable work accomplished, and it is hoped that it may continue on the same lines.

FORTHCOMING EVENTS

Saturday, July 7

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at the Rothamsted Experimental Station, Harpenden), at 9.30 a.m.—Fiftieth Annual Congress. Prof. W. G. Ogg: "Some Aspects of the Work at Rothamsted".

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (in the Physics Department, Imperial College of Science and Technology, South Kensington, London, S.W.7), at 2 p.m.—Discussion on "The Corrosion of Metals".

Tuesday, July 10

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

Wednesday, July 11

GEOLOGICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Prof. W. W. Watts, F.R.S.: First William Smith Lecture.

Wednesday, July 11—Thursday, July 12

IRON AND STEEL INSTITUTE (at the Institution of Civil Engineers, Great George Street, London, S.W.1)—Annual General Meeting.

Wednesday, July 11

At 10.30 a.m. and 2.30 p.m.

Thursday, July 12

At 9.45 a.m.

Thursday, July 12

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1).—Dr. W. T. Astbury, F.R.S.: "The Structure of Biological Fibres and the Problem of Muscle" (Croonian Lecture).

Thursday, July 12—Friday, July 13

SOCIETY OF CHEMICAL INDUSTRY—Sixty-fourth Annual Meeting.

Thursday, July 12

(At the Chemical Society, Burlington House, Piccadilly, London, W.1), at 10.30 a.m.

Friday, July 13

(At the Royal Institution, Albemarle Street, Piccadilly, London, W.1), at 10.30 a.m.—Business; at 11.30 a.m.—Presidential Address; at 3 p.m.—Presentation of the Society's Medal to the Rt. Hon. Viscount Leverhulme, and Medallist's Address.

Friday, July 13

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Discussion on "The Origin of the Solar System" (Speakers: Prof. W. H. McCrea, Dr. A. Hunter, Dr. R. A. Lyttleton and/or Mr. F. Hoyle).

APPOINTMENTS VACANT

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

WOMAN ABSTRACTOR (Ref. F.4217.XA) with experience in scientific and technical abstracting; a GRADUATE PHYSICAL CHEMIST (Ref. F.4218.XA) with research experience in Rheology or Surface Chemistry; and a PHYSICAL CHEMIST (Ref. F.4219.XA) with Honours Degree and aptitude for research, by a Research Association—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting the appropriate Reference No. (July 12).

QUALIFIED DEVELOPMENT ENGINEER to take charge of Design, Testing and Development of range of Hydraulic Pumps (location, Gloucestershire)—The Ministry of Labour and National Service, Appointments Department A.9, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting C.2403.XA (July 13).

LECTURER IN THE DEPARTMENT OF PHYSICS—The Secretary, The University, Edmund Street, Birmingham 3 (July 14).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Bradford Technical College—The Director of Education, Town Hall, Bradford (July 14).

DEPUTY BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Town Hall, Great Yarmouth (July 16).

AGRICULTURAL CHEMIST, and a BIOLOGIST—Acting Director of Agriculture, School of Agriculture, Houghall, Durham (July 18).

CIVIL ENGINEERS for service on a railway extension in Iraq—(*a*) Assistant Civil Engineer (Ref. E.1740.XA) capable of taking charge of setting out for railway construction, measuring up work, taking out quantities, and preparing certificates for payment; (*b*) Junior Civil Engineers (Ref. E.1705.XA) with good experience of instrument work for setting out earthworks for railway work, cross sectioning, measurements, etc.—The Ministry of Labour and National Service, Appointments Department A.9, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting the appropriate Reference No. (July 20).

LECTURER IN INDUSTRIAL ADMINISTRATION and an ASSISTANT LECTURER IN INDUSTRIAL ADMINISTRATION—The Registrar, College of Technology, Manchester 1 (July 20).

LECTURER IN CHEMISTRY in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (July 21).

RESEARCH OFFICER FOR X-RAY CRYSTALLOGRAPHY, Division of Industrial Chemistry, Council for Scientific and Industrial Research, Melbourne—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (July 23).

ASSISTANT LECTURER IN THE DEPARTMENT OF ENGINEERING—The Registrar, University College, Singleton Park, Swansea (July 30).

PROFESSOR OF GEOGRAPHY, and a LECTURER IN GEOGRAPHY, in the University of Ceylon—The Vice-Chancellor (Dr. W. Ivor Jennings), 23 Grange Road, Cambridge (July 31).

LECTURER IN FORENSIC MEDICINE AND TOXICOLOGY—The Secretary, School of Medicine Committee, Westminster Hospital Medical School, 17 Horseferry Road, London, S.W.1 (July 31).

SECRETARY—The Director, School of Oriental and African Studies, University of London, London, W.C.1 (August 15).

PROFESSOR OF CHEMISTRY—The Secretary, Royal Technical College, Glasgow (August 31).

LUCAS CHAIR IN THE PRINCIPLES OF ENGINEERING PRODUCTION (applicants should have high qualifications in Engineering and experience in industry)—The Secretary, The University, Birmingham 3 (September 1).

LECTURER IN SOCIAL ANTHROPOLOGY—The Secretary, The University, Edinburgh (September 30).

ASSISTANT LECTURER, or LECTURER, IN THE DEPARTMENT OF GEOGRAPHY (with good qualifications in Geomorphology)—The Registrar, University College, Southampton.

HEADMASTER, Grade III (Honours Graduate, with interest in Technical Education) of the Technical High School—The Director of Education, Education Offices, Library Street, Blackburn.

GRADUATE TEACHER OF GENERAL SCIENCE, especially Chemistry, in the Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent (endorsed 'T').

PRINCIPAL of the Cardiff Technical College—The Director of Education, City Hall, Cardiff.

TEACHER (full-time) OF MECHANICAL ENGINEERING SUBJECTS, in the Technical Institute and Junior Technical School—The Clerk to the Education Committee, Education Offices, Trafalgar Road, Great Yarmouth.

TEACHER (part-time, evening) IN PHYSIOLOGY—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1.

ASSISTANT MASTER TO TEACH ENGINEERING SCIENCE, PRACTICAL GEOMETRY AND MACHINE DRAWING in the Heaton Technical School—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne 2.

ASSISTANT MASTER TO TEACH SCIENCE AND MATHEMATICS in the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham.

ASSISTANT LECTURER IN AGRICULTURAL ECONOMICS—The Registrar, University College of Wales, Aberystwyth.

LECTURER IN CHEMISTRY, with qualifications in Organic Chemistry—The Registrar, University College, Exeter.

TEACHER OF ENGINEERING DRAWING, ENGINEERING SCIENCE, Practical Mathematics, Workshop Technology, Jig and Tool Drawing, and Design, to Ordinary National Certificate standard in the Redditch Technical School—Mr. G. Brodrick, Education Office, Church Green West, Redditch, Worcestershire.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Imperial Bureau of Animal Breeding and Genetics. Technical Communication: The Semen of Animals and its Use for Artificial Insemination. By Dr. James Anderson. Pp. viii+151+9 plates. (Aberystwyth: Imperial Agricultural Bureaux, 1945.) 7*s*. 6*d*. [26

Empire Cotton Growing Corporation. Annual Report of the Administrative Council for the Season 1943–1944, submitted to the Twenty-fourth Annual General Meeting on June 5th, 1945. Pp. 18. (London: Empire Cotton Growing Corporation, 1945.) [96

Catalogue

A Catalogue of Books and Periodicals on Arithmetic, Astronomy, Chemistry, Electricity, Engineering, Mining, Navigation, Physics, etc. (No. 630.) Pp. 32. (London: Bernard Quaritch, Ltd., 1945.) 6*d*.

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