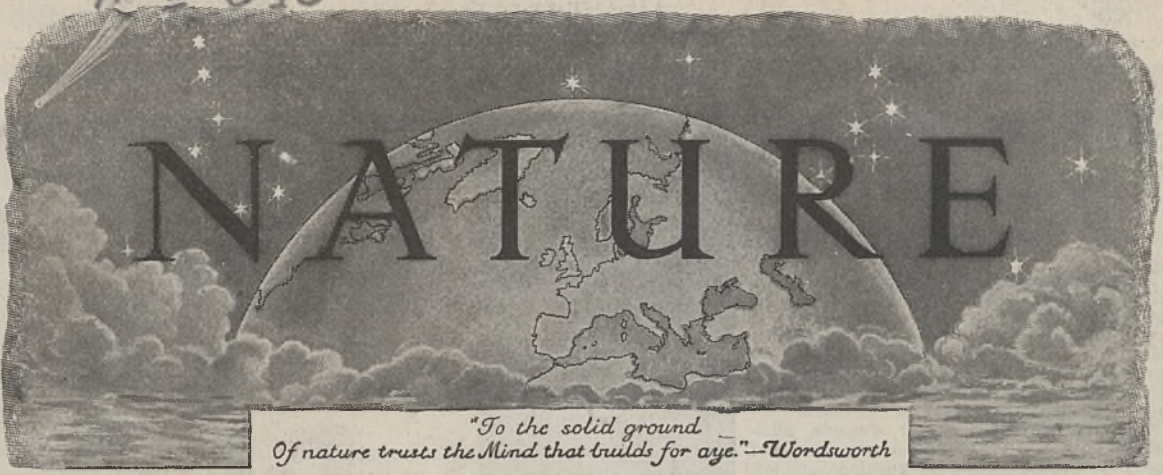


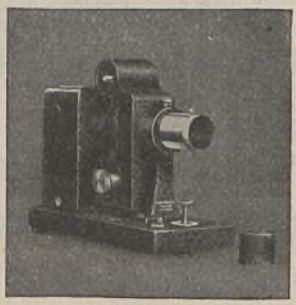
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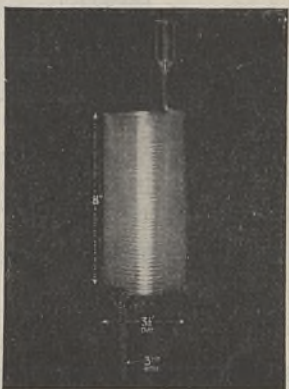
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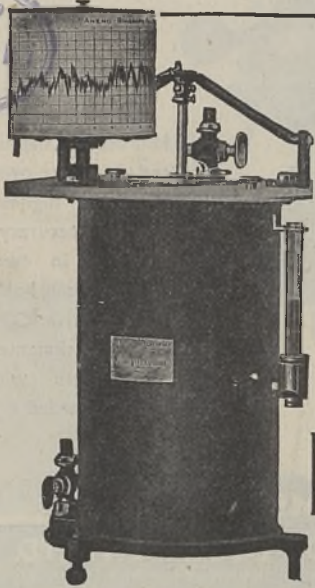
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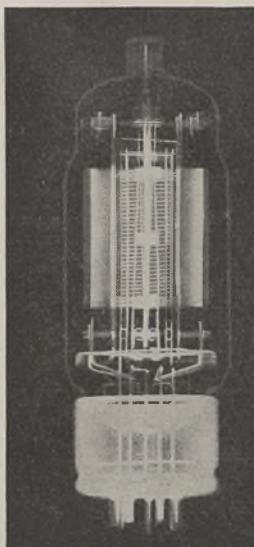
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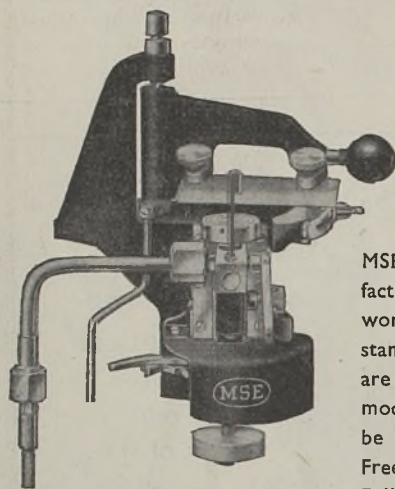
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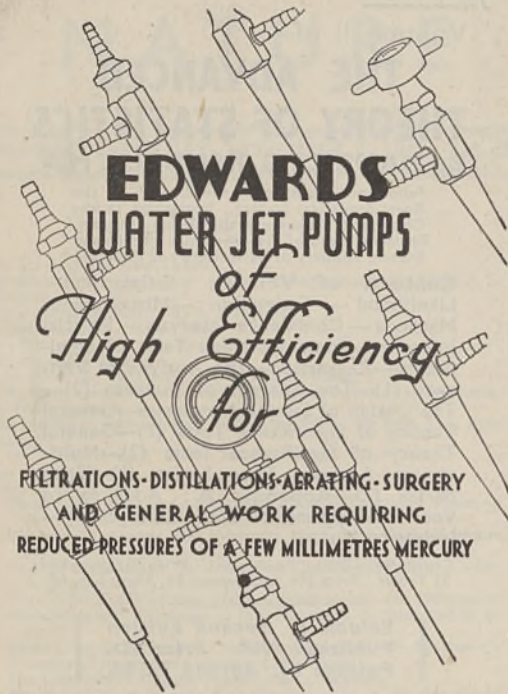
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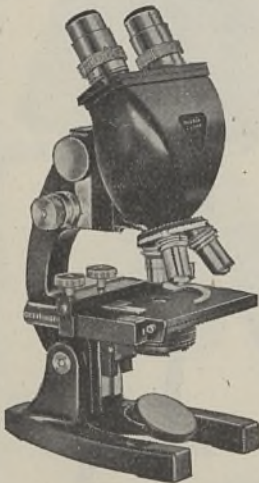
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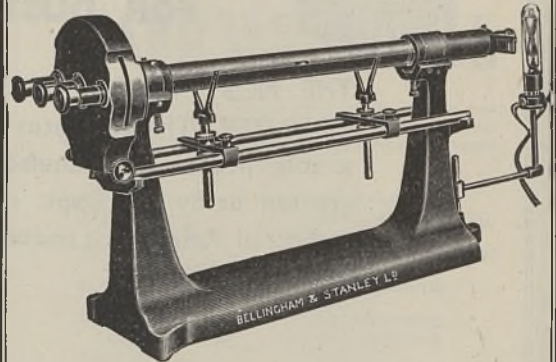
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## SOCIAL STRUCTURE IN NEW TOWNS

ALTHOUGH the daily and the technical press have given it little attention, the final report of the New Towns Committee, under the chairmanship of Lord Reith (London: H.M. Stationery Office, 1946. 1s. 3d. net), is a much more important document than the two interim reports. Whereas the interim reports were addressed primarily to the Minister of Town and Country Planning and the Secretary of State for Scotland, the final report is written also for the corporations which will promote new towns and for the general public. Summarizing the contents of the earlier reports, it deals both with the issues which are peculiar to new towns and with many which are common to all forms of new development. Some of the ideas and principles that it lays down for the guidance of those who will bear the responsibility of creating new towns may seem obvious, but the almost daily examples that are encountered of the neglect of the obvious by private developers, the planning authorities even of great cities, Government departments, and even such bodies as the National Trust, not only provide justification for the inclusion of such reminders but also indicate the wide audience whose attention the report can rightly claim.

It is this concern, not only with the physical tasks involved and with the devising of appropriate machinery to handle them, but also with the more complex and delicate problem of founding the social structure of a new town and fostering its corporate life, that gives the final report of the Reith Committee such general interest. The problem touches every citizen, for it is a social enterprise, demanding, if it is to be well done, not merely the exercise of techniques common to other forms of development and the co-operation of specialists in various fields, but also the close and continuous scrutiny and support of a really well-informed and vigilant public opinion.

Some of the Committee's recommendations relate to the establishment of towns on entirely new sites rather than the transformation of existing small communities; and the observations on the size and social structure of new towns, the qualifications of the chief officers of a corporation and the necessity for a central advisory commission, are at variance with the present practice of the Minister of Health. Not that the Committee's recommendations imply any one standardized pattern of physical or social structure: the Committee recognizes that, after standards have been adopted safeguarding the basic human needs of space, air and light, there is ample room for variations in local density and for meeting personal preferences. Satisfying such preferences, indeed, affords opportunity of avoiding architectural monotony and adding to the interest of a town. New ideas continually emerge, and the Committee urges that those responsible for new towns should never be afraid of experimenting, even at the cost of occasional mistakes.

In this final report the Reith Committee suggests a wide range of amenities that should be provided in





new towns. Even though all amenities cannot be provided at once or as soon as the local community is sufficient to support them, it is important to plan ahead for them, and to reserve sites for all amenities that will ultimately be required. Elsewhere in the report there is stressed the importance of the development authority refraining from the usual error of starting on important projects before the detailed plans are properly worked out. While there is no suggestion of over-planning in this report, the Committee emphasizes, and rightly, the necessity for methodical and careful planning before initiating projects, and for adherence to whatever long-term plan has been approved and initiated.

The principles to be considered in preparing such plans are clearly but concisely set out. They indicate the Committee's own preference for new towns on relatively undeveloped sites, and considerable force has since been lent to its view, that the difficulties which will arise in carrying out the major extension of a small town have not been fully appreciated, by what has already arisen over the Manchester proposals with regard to Mobberley, for example. Apart from the difficulties arising out of interference with existing interests and relationships, there is substance in the Committee's contention that there are regions in England, Wales and particularly Scotland, of low density and remote from any large centre, where a new town would confer great benefit, especially on the surrounding agricultural population, by affording alternative employment to some members of the family, and by bringing within easy reach the amenities and facilities of modern civilization. Omission of any such site from those already announced in Scotland has been strongly criticized, the Border counties being cited as providing the appropriate locality; and the dissatisfaction with the Minister's policy on this point will be the more general if, as now appears from Mr. Silkin's reported statement at the conference of the Institute of Housing on September 27, not more than seven and a half per cent of the population to be rehoused in the next ten years will be accommodated in new towns. If that proves to be true, the primary purpose of the New Towns Act will have been served only to an insignificant extent, and cities like Manchester will be driven to continued suburban sprawl.

Beyond this, it is at least open to question whether adequate weight has been given in the selection of the sites already named for new towns to the factors determining the size of a new town which are set forth in this final report, more particularly those governing its lower limit. Equally it would appear that there is real danger that the extent to which doctrinaire considerations influence, if they do not dominate, Mr. Bevan's building policy, will militate against the establishment of the balanced social structure advocated by the Reith Committee. If the community is to be truly balanced, so long as social classes exist, all must be represented in it. A contribution is needed from every type and class of the people; the community will be the poorer if all are not there, able and willing to make their contribution.

The Committee in this important passage of its report refers to the desirability of business and industries established in the new towns including not only factories, shops and services meeting local needs, but also administrative and research establishments, including sections of government departments. Directors and executives, for example, should live in the town and take part in its life. Professional men and women, writers, artists and others not tied to a particular location, as well as retired people, should find a new town a good place in which to live and work. To attract and retain all these groups, the character of the town as one of diverse and balanced social composition must be established at the start, and without mentioning the Government's present housing policy, the report indicates clearly enough how disastrous may be the consequences if all the dwellings built in the early years are of a minimum standard. Once the balanced character of the population is established, it will be relatively easy to maintain; but conscious and sustained policy to this end on the part of the agency itself and of the leaders of local industry and commerce and social activity will be as essential as a sympathetic and flexible policy and active support from the central Government itself, in ways that are indicated in what has already been said.

There are other matters on which some reassurance from the Government might well be forthcoming. In regard to the selection of sites, reference is again made to the importance of further research so that national considerations may be taken fully into account in formulating policy. Again, areas of exceptional natural beauty or great historic interest should be avoided if their character would be impaired by the siting of a town, though the Committee recognizes that a new town need not of itself destroy the beauty of the normal countryside—it may enhance it and bring more people within reach of enjoyment of it. Special care should be taken to safeguard features of particular beauty near new towns; and in regard to main zoning, while a disorderly mixture of land uses is anathema, in a town under unified land ownership it would be wrong to go to the other extreme and plan the land in advance too precisely. Factories, for example, should be segregated for technical reasons and for amenity; but they should be within easy walking or cycling distance of residential neighbourhoods. Similarly, the Committee points out that administration of the necessary control of design must not be oppressive; it requires a judicious blend of firmness and flexibility, but in its decisions the agency must be advised finally by one person; matters of taste cannot be determined by a team.

Throughout this admirable report, which forms a text-book on how to build a new town, there is a strong vein of common sense. There is vision as well, and the magnitude and the opportunity of the task which confronts a development corporation are clearly displayed. Some of the distinctive problems of the new towns policy might indeed have been discussed more fully. The methods by which a corporation could most effectively enlist the co-operation of the people of a new town in its work;



the problems of moulding a community in which there is no geographical or cultural segregation of social classes; and the relation of the building of new towns to a policy of urban decentralization—these are all problems needing attention and on which the Government itself has given as yet little guidance.

There is, it is true, little that is original in the report, though the review of the social, cultural and recreational facilities required in a new town contains food for thought for many concerned with such activities in existing towns also. It is the emphasis given to the factors that is so important, and the report should, moreover, dispel any illusions that the building of new towns offers any contribution to the alleviation of the immediate housing situation. It will be desirable to construct public utilities and build some factories and shops in advance of major housing developments. This means that, during the first three years, comparatively few permanent residents can move in; that heavy outlay will be necessary at first, yielding a delayed return; that initially it will be desirable to charge low rents for buildings such as shops, with powers to revise them upwards as the town develops; and that the provision of a large constructional force will require special and careful treatment.

It follows, therefore, that the success of a new towns policy will demand the support of an informed public opinion, fully understanding what is involved in the policy and able to resist pressure which sectional interests or those with short-term views may bring to bear on its orderly execution. The Government will rightly be expected to provide the first new towns with a reasonable share of labour, materials and other facilities, and to ensure that the broad trends of national policy promote their efforts. The development corporations will indeed have the means and the power to make the new towns a success, and that in turn will depend largely on the selection and training of men and women of the highest calibre both for membership of the corporations themselves and for the teams of executives to whom the development corporations entrust the preparation, administration and execution of their plans.

## MECHANISM OF THE BIOLOGICAL ACTION OF RADIATIONS

### Actions of Radiations on Living Cells

By Dr. D. E. Lea. Pp. xii+402+4 plates. (Cambridge: At the University Press, 1946.) 21s. net.

**T**HIS book is the most important and authoritative work now available dealing with the simplest and most fundamental actions of ionizing radiations on living cells. The scope is intentionally limited. In the preface the author states clearly that he "thought that a useful purpose would be served by giving a rather detailed discussion of the mechanism of those actions of radiation which are sufficiently well understood for such a treatment to be profitable at the present time".

Everyone working on the biological actions of radiations, including radiotherapists, should read and re-read this book. (The reviewer has read it four times.) Many people will find it difficult, but there can be no doubt as to the desirability of understanding the elementary principles which are examined critically and in great detail in this book.

The approach is biophysical. In the interpretation of the quantitative measurements of the actions of radiations on viruses, genes and chromosomes, the treatment is physical and the algebraic detail is wisely kept in the background. One of the most valuable features of the work is the large amount of relevant information summarized in tables and graphs. Radiobiologists should be grateful for accurate data such as these, applicable to liquid water and other tissue-like materials. At first glance, in some cases, the absolute values of the various physical quantities are not known to the accuracy which the tables suggest; but from the text it is evident that the author has taken great pains to avoid giving to the reader a false impression of accuracy. The tables are presented as a self-consistent set, and the justification for giving four significant figures where the absolute values may be in error by as much as 10 per cent is that the differences are usually very much more accurate than this, and spurious discontinuities are avoided.

The first chapter summarizes the physical properties and dosimetry of different radiations. Further details of some aspects of tissue dose and of the spatial distribution of ionization in tissues are given in the first part of an appendix. The discussion of radiochemistry in Chapter 2 summarizes a large amount of published information in a useful form. Of especial interest are the tabulations of ionic yields in dilute aqueous solution, and the discussion of direct and indirect actions of radiation.

Perhaps the most valuable part of the book is Chapter 3, on the target theory. Much of the treatment is original, including the calculations given in the appendix.

The single ionization type of action is characterized by an exponential survival-dose relationship, independence of time and intensity factors and decreasing efficiency per ion pair, with increasing specific ionization, that is, the dose required to produce the same effect with different radiations increases in the order gamma rays, hard X-rays, soft X-rays, fast neutrons and alpha particles. From the inactivation dose corresponding to 36.8 per cent ( $1/e$ ) survival, the target diameter can be calculated by a number of methods. For many of the macromolecular viruses and bacteriophages, the calculated target diameter for inactivation by a single ionization agrees with the size as measured by centrifugation and filtration methods. In the case of larger viruses such as vaccinia, the single spherical target theory is not applicable, and the radio-sensitive volume is only a small fraction of the total. In 1942, Lea and Salaman suggested that vaccinia virus should accordingly be regarded as a single-celled organism containing a number of discrete structural units analogous to genes, and shortly afterwards Green, Anderson and Smadel demonstrated internal structures within vaccinia virus particles by electron microscopy.

Genetical effects of radiations, including ultraviolet light, are discussed in Chapter 5, which includes a useful introduction to the aspects of genetics afterwards examined. The work of Lea and his



collaborators on enzyme and virus inactivation is discussed. Calculations of the target diameter for mutation are made, showing that the most probable value of the average gene diameter in *Drosophila* is 4–8  $\mu$ .

The production of structural changes in chromosomes by radiations is examined in great detail in Chapters 6 and 7. Again, much of the treatment is based on the investigations of the author and his colleagues. One point of great interest is the account of the prediction and experimental confirmation of the maximum of the number of primary chromatid breaks per cell per roentgen in the region of soft X-radiation near the wave-length 4 A.

The well-known phenomena of delayed division and lethal effects are considered in the last two chapters. The killing of bacteria and of large viruses can be regarded as lethal gene mutations. However, "in those organisms in which chromosome structural changes, as well as lethal actions, have been investigated, namely, *Drosophila* sperm and eggs, *Tradescantia* pollen and bean root tips, fairly strong evidence, though at present circumstantial evidence, has been presented for the view that the main cause of the lethal effect is the production of types of chromosome structural change which lead to bridges at division or genetic unbalance after division".

It is evident that the author has devoted great care and effort to the preparation of this book. The bibliography is especially valuable. Three minor printing errors have been detected.

It is to be noted that although this book was published in 1946, the preface is dated July 1944. It was not possible for the author to include references to more recent work such as the papers of C. D. Darlington and L. F. La Cour (*J. Genet.*, 46, 180; 1945), G. Hevesy (*Rev. Mod. Phys.*, 17, 102; 1945) and C. Auerbach and J. M. Robson (*Nature*, 157, 302; 1946). It is unfortunate that official secrecy prevented the author from commenting on the production of chromosome breakage by chemical agents. These inevitable omissions do not appreciably detract from the great value of this book, but suggest that progress will be made in the direction of cytogenetics.

J. S. MITCHELL

## SCIENCE OF MANAGEMENT

### An Approach to Management

By G. E. Milward. Pp. ix+82. (London: Macdonald and Evans, 1946.) 8s. 6d. net.

AN article on report writing in a recent issue of *Chemical and Metallurgical Engineering* tabulated a series of questions regarding the readers for whom the report is intended and the purpose in writing the report which it was suggested a writer would do well to consider before putting pen to paper. Looking at the growing mass of books on management in all its aspects, it is difficult to believe that some of the authors have honestly faced the questions listed in that article or that, if they have done so, would dare to publish the honest answers. For the most part, however, British publications in this field represent genuine contributions to the science or art of management and are less open to that charge of pot-boiling.

Mr. Milward's book is in that tradition, and he shows something of that skill in exposition which characterizes the writings of L. R. Urwick or M. P.

Follett. He is clear as to the readers for whom it is intended: those experienced in management who are still young enough to think in terms of the future, and young men who will themselves become managers. His justification for publication may be found in the comment of the Percy Report on the poor quality of the present literature of management in Great Britain and the absence of the intellectual quality of a sound mental discipline.

That remark is even more apposite of the American literature, which represents by far the great part of that available, and in presenting these notes, which he has used and developed in teaching the principles of management, Mr. Milward has largely succeeded in avoiding the platitudes and excrescences which have marred so many books on management and administration. It can be fairly claimed that in this short volume he has set the subject in a clear and true perspective in its relation to industrial and social efficiency, and indicated an approach to further study which gives full weight to the many factors which have now to be weighed. It represents a modest contribution towards that higher standard of literature on management which developments like the British Institute of Management and the Administrative Staff College are bound to stimulate, not to mention some frank comments in the Working Party reports.

Mr. Milward deals with his subject from two points of view: the management of people and the management of work. The first aspect, the human factor, which is the more prominent at the present time, he discusses in less than thirty pages, and the essential factors and principles are lucidly presented. Naturally, there are some omissions—the most important, perhaps, from the point of view of the further study the book is intended to assist being the absence of any reference to Dubreuil's work on the autonomous group. Compression has also spoiled the sequence in his third chapter. The transition of thought from the consideration of the place and functions of committees to the technique of interviewing is too abrupt and somewhat forced. For all that, Mr. Milward has packed into these pages a remarkable amount of sound common sense in a most readable form.

The four chapters which make up the second part of the book are not quite in the same high class of expression; yet they give a balanced but comprehensive survey of the principles and operations involved in the management of work, the preparation of work, the process of command and of the need for training. Without becoming trite the author emphasizes the right points in such matters as the line of authority, the planning of work and policy, the division of work, the choice of organisation and the co-ordination of activities and the issue of instructions, and it would not be easy to find another volume of eighty pages which covers the ground so comprehensively, soundly and suggestively. It is for that very reason to be regretted that Mr. Milward's bibliography is so restricted. While he has rightly omitted the great mass of second- and third-rate material with which the literature of management is cluttered, he has left out, too, some of the more important books as well as some of what might be termed the source material, such as reports of the Select Committee on National Expenditure or the report of the President's Committee on Administrative Management, which to the student are particularly valuable for the criticisms and analysis of administrative practice which they contain. The omission is the more serious as



his book will assuredly be criticized in some quarters because it does not give more guidance on practical aspects of management, and also because any contribution towards the establishment of a mental discipline should seek to facilitate the wider reading which assists the formation of independent judgment.

R. BRIGHTMAN

## THE ELECTRIC SPARK

### The Mechanism of the Electric Spark

By Prof. Leonard B. Loeb and John M. Meek. Pp. xiii+188. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1941.) 3.50 dollars.

**S**PARKING processes control the development of the lightning discharge, the minute gaseous discharges in solid dielectrics which can cause deterioration and ultimate failure, the breakdown of measuring and protective gaps, and the operation of many types of switchgear. The subject-matter of the book under notice is therefore of wide interest. The book is divided into three chapters, in the first of which the classical theory of Townsend is critically examined.

The common starting-point for all theories of the spark discharge is the formation of the electron avalanche. An electron in a gas in travelling a distance  $x$  in an electric field  $X$  creates  $e^{ax}$  new electrons by collision processes;  $\alpha$ , the ionization coefficient for electrons, is the number of electrons created in 1 cm. of travel and is a function of  $X$ . Before the spark can be established an additional supply of electrons is required in the volume swept by this so-called avalanche. Townsend assumed that the positive ions created during avalanche development produced new electrons by collision processes. When it was established that an inadequate supply of electrons was provided by this process, one involving the release of electrons from the cathode by positive ion bombardment was postulated. Theories in which secondary processes for the creation of electrons depended on movement of positive ions remained generally acceptable until it was shown experimentally that at atmospheric pressure the spark could be established in  $10^{-7}$  sec.; in this time there could be inappreciable movement of positive ions. Other secondary mechanisms dependent only on electron and photon movements would account for the very short interval between the formation of the avalanche and the establishment of the spark. A study of such mechanisms led the authors to formulate the streamer theory of the electric spark, to an exposition of which the second chapter is directed.

In addition to the intense ionization in the volume swept by the avalanche, large numbers of photons are produced which are absorbed in the gas and at the cathode, leading to considerable photo-ionization. The applied electric field near the anode is reinforced by the space charge field left when the original avalanche enters the anode. The photo-electrons in the enhanced field produce new avalanches, which with the original positive space charge form a 'conducting plasma' at the anode while the positive space charge left behind gives rise to a new region of increased field nearer the cathode. And so the process goes on until the 'conducting plasma' or streamer bridges the gap between the electrodes. If circuit conditions permit, there is a sudden rush of electrons up the channel and the spark is established. The velocities of the different processes are of the

order  $2 \times 10^7$  cm./sec. for the avalanche,  $10^8$  cm./sec. for the streamer, and  $10^9$ – $10^{10}$  cm./sec. for the intense wave of ionization.

The space charge field near the anode is calculated by assuming that the ions there are located in a sphere of radius  $r$  equal to the radius of the avalanche at the anode, and that the ionic density in the sphere is the same as that at the anode. By means of certain approximations, experimentally derived constants, and theoretical considerations the space charge field is expressed in terms of  $\alpha$ ,  $x$  the length of the avalanche and  $p$  the gas pressure. To complete the quantitative formulation of the theory, a relation is required between the space charge and the applied field. Meek, the junior author, supplied this by postulating that for streamer formation they should be equal. (Later, to secure better agreement between experimental and calculated values, he assumed that the ratio of space charge field to applied field is 0.1.) The quantitative theory has been used with considerable success to calculate the sparkover voltage of different electrode arrangements in air, and the third and final chapter of the book gives details of such calculations.

For low-pressure regions, and gaps greater than about 15 cm. at atmospheric pressure, calculations were not supported by experimental evidence. It was concluded that in spite of the adequate value of the space charge field there was a factor inhibiting streamer formation, namely, inadequate photon production near the head of the avalanche. In the low-pressure region sufficient photon activity could not be obtained and consequently a streamer mechanism for the spark discharge could not be invoked; in the large gap region it was necessary to increase the stress above that calculated, to provide the required photo-excitation. In this case, the avalanche-streamer mechanism is slightly modified from that in which the avalanche proceeds from cathode to anode and the streamer from anode to cathode. The streamer may start from the anode at the head of an avalanche which has originated in the mid-gap region, and then proceed to the cathode. Alternatively, it may begin at the head of an avalanche in the mid-gap region and proceed towards the cathode; meanwhile the avalanche moves on towards the anode a short distance when a new streamer forms at its head, and moves towards the cathode to join the first. The process is continued until the gap is bridged by the streamer. The authors describe this process as "avalanche-retrograde-streamer advance" and have modified the quantitative theory to cover it.

The streamer theory succeeds where the Townsend theory fails in explaining how the spark can be established in times of the order of  $10^{-7}$  sec., and it accounts satisfactorily for many of the characteristics of short sparks. It is inadequate to deal completely with long spark discharges, for example, the stepped leader of lightning. It is difficult to assess the value of the quantitative aspect of the theory. Good agreement between experimental and calculated values of sparkover voltage is obtained for a limited range of values of  $p\delta$  ( $\delta$  gap length), and the range is extended by modifying the theory; the authors themselves emphasize the danger of assessing the correctness of sparkover theories on the basis of such agreements. The assumptions underlying the quantitative theory are clearly stated, but the expedients necessary to make the development tractable, and the arbitrary or empirical choice for the value of  $k$



(ratio space charge field to applied field) are intellectually unsatisfying. The whole basis of the quantitative theory has been subjected to severe criticism (Zeleny, *J. App. Phys.*, 13, 444).

The book generally presents a complex argument clearly, but exception might be taken to the use of the terms 'retrograde streamer', 'positive streamer' and 'negative streamer', since all the streamers described contain negative and positive particles and the direction of growth is always towards the cathode. This contribution marks a step forward in our knowledge of sparking mechanisms; but the end of the story is not yet in sight.

R. DAVIS

## TRADE MARKS IN INDIA

The Law and Practice under the Trade Marks Act, 1940

(As amended by the Trade Marks (Amendment) Acts of 1941 and 1943); with a Full Collection of Statutes, Rules, Forms and Precedents, and a Guide to the Classification of Goods under the Trade Marks Act, 1940. By Dr. S. Venkateswaran. Pp. lxxvii+1,128. (Calcutta: Eastern Law House, Ltd., 1945.) 30 rupees.

AT a time when India is about to become self-governing and replace outside influences by Indian, it is not uninteresting to note that only so recently as 1940 India adopted, almost entirely, the English law relating to the registration of trade marks. It is, however, somewhat startling to realize that a country with such strong commercial interests as India should have managed without registered trade marks until that date, and that traders were obliged to rely on cumbersome and expensive passing-off actions to protect their name and goods. Apparently until after the First World War attempts at legislation in that direction met with only lukewarm encouragement, and it was not until the 'twenties that the matter received popular support from the Indian commercial public.

This delay has not been wholly unfavourable to India, as they have been able to avoid the trials and errors of the earlier English trade mark Acts and have adopted English trade mark law as it stands to-day. The Indian Trade Mark Act, 1940 (as amended by the Acts of 1941 and 1943), is based on the Trade Marks Act, 1938, and where it departs from English law is (with one or two exceptions) mainly for administrative purposes; and in fundamental legal principles it follows the English statute, adopting the innovations, such as registered users, defensive registration, assignment with or without the goodwill of a business, which were introduced by the Trade Marks Act of 1938.

The author of the present volume, Dr. S. Venkateswaran, has compiled what may well become a standard work on the subject, if the law remains substantially unaltered, and it is scarcely likely that registration of trade marks will be renounced so long as individual trading is protected. The form of the text consists in stating the sections of the Act, and following each section with exhaustive notes on the English case law dealing with the particular principle, and giving some history of the corresponding section of the English Act. These notes are possibly too detailed and elaborate, and a person unacquainted with the subject may find it difficult to use this book

as a reference book; but this is a minor fault, as the arrangement and indexing has been done with great care and, on the whole, admirable clarity. Notwithstanding that Dr. Venkateswaran says in the preface that the English cases cited "are of value only insofar as they lay down the principles of law and give guidance on the construction of the section", the quotations from English case law are encyclopaedic and as up-to-date as is possible in a book which must take some time in going through the press, and are an exceedingly valuable guide to the judicial interpretation of English trade mark law. It is to be hoped, however, that if in future editions notes of Indian judicial decisions are given in equal length, the author will not forbear to cut or condense some of his earlier notes, as this book (1,128 pages in all) is as large as is convenient for any text-book.

The book covers the whole of the Trade Marks Act and includes the substantive law and procedure relating to the registration of trade marks, the essential requirements for the registration of a trade mark, rectification and correction of the register, the duration and assignment of trade marks, the action for infringement and specialized types of registration, such as certification marks, for example.

The arrangement of the book has been well done, both as to text, appendixes and index; the appendixes, besides containing the Act and Rules, tables comparing the Indian Act with the English Acts of 1905 and 1938, have much useful information relating to pleadings and forms and orders used in English trade mark cases.

IRENE G. R. MOSES

## TRUTH AND ITS EXPRESSION

In Search of Truth

By Dr. Abel J. Jones. (Discussion Books, No. 79.) Pp. 208. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1945.) 3s. 6d. net.

DR. ABEL J. JONES'S volume rightly appears in a series of "Discussion Books". He never lays down the law, but offers an abundance—perhaps a superabundance—of material designed to set the reader thinking. His aim has been to give an account of the way in which men of science, historians, philosophers, artists, poets, moral and religious teachers and others have searched for truth and tried to express it. He admits that some readers may find the treatment too brief, but hopes they may find the book of interest as a conspectus of the whole subject. Indeed the reviewer, after an attentive perusal, has come to regard the book as a handy directory, written by a person of wide sympathies and encyclopaedic reading, and he proposes to give it a place among his reference books. Here he can only offer a few comments. The chapter on "The Liars in their Lairs" is both diverting and incisive. The author quotes to good effect the philosopher who said, "if you ask me what time is I cannot tell you, but I know what it is if you do not ask me". It will be news to many that Mussolini founded his morality on the pragmatism of William James. The sections on our habits of labelling and on "the bondage of consistency" are much to the point. The one chapter which the reviewer finds inadequate is that on historical truth, where no account is taken of the positions held by G. M. Trevelyan, J. B. Bury, J. Buchan, and others.



## DEVASTATION\*

By SIR JOHN L. MYRES, O.B.E., F.B.A.

## Physical Devastation

IN a recent essay I examined the mode of life known as *nomadism*<sup>1</sup>, where a human community is maintained by the produce of domesticated animals sustaining themselves in grassland without injury to its plant-covering: a mode of life, indeed, in which defacement of the plant-covering by ploughing or digging is the worst of economic offences. In another<sup>2</sup>, I presented the fundamental and elementary culture of the Mediterranean, based on a combination of cereal agriculture and tree-fruit crops, with subsidiary pasturage, hunting, and fishing, as an approximately stable regime, which presumes a cycle of soil-restoration, by fallow-grazing, and the rejuvenation of forests exploited for fuel or timber. There are, however, modes of subsistence for human communities which presume the destruction, or at all events the removal, of some irreplaceable part of the natural resources of their habitat; which exploit, that is, a wasting asset, or, in other words, live on their regional capital. What follows is an attempt to compare, classify, and interpret these forms of what collectively will be described as *devastation*, and to illustrate their economic and social consequences.

The most incisive study of "Destructive Exploitation" hitherto is that of Jean Brunhes, in his "Human Geography" (1910), but there is something still to be said. Mineral devastation he regarded as a local and temporary derangement. Forest devastation on a great scale was only beginning; he noted, however, the destruction of seals, whales, and bison, and the practical difficulty of conserving fisheries. He emphasized the slave-trade as a gross form of devastation, and noted the reaction, already perceptible in 1910, towards a 'planned economy'. On the general issue, he regarded it as "the part assigned to living beings; to retard the degradation of energy in the world. . . ." (p. 350). The result of evolution (he held) "is definitely expressed by an increase in the energy utilized. But utilized energy must not be confounded with available energy."

In its simplest, most diagrammatic form, devastation removes something irreplaceable, and is consequently limited to chemical and physical destruction; all biological destruction being replaceable when natural processes are restored to normal activity. Game is conserved by a close season, deforestation by afforestation, without positive remedial interference of man. Minerals, on the other hand, whatever their origin, are not replaced in their lodes within any period that can be foreseen. The miner has no direct interest in remedying his spoliation.

With foresight, effort, and expense, disfigurement may be minimized. But more commonly the waste product of the mines is allowed to accumulate unutilized. This indifference to waste affects also the miner's estimate of his capital-expenditure in buildings and means of access; all that is not transferable to another scene of devastation is written off and left derelict; and this applies also to the labour-supply. The miner, like his shanty, is written off when he is paid off.

This prospect is, however, not always foreseen by the miners themselves, especially when the supply of

mineral has lasted long, and the occupation has become hereditary. In the tin mines of Cornwall, the collieries in South Wales, and elsewhere, a tragic aspect of devastation has been the inability of the mining population to realize what was unavoidable, even when it was imminent. If there were sinking-funds at all, they were for the replacement of capital, not of mineral. Where exhaustion has been foreseen, on the other hand, the miner's link with the locality has been weak, and his economy feckless.

Where a mining community has matured, on the other hand, its needs have brought into being supplementary activities—pastoral, agricultural, and industrial—which are parasitic on the mining population, and superfluous if mining comes to an end, unless like Swansea it can replace local minerals by imported, or maintain itself as an administrative or commercial centre, which would seem to be the prospect for Johannesburg. The outlook is still more grave on a larger scale, as Brunhes has illustrated in his analysis of the coal-mining culture of Western Europe.

Most mining is subterranean, and for reasons of safety must be carried on in narrow galleries and stalls, by artificial light, and in personal discomfort and risk. The effects on temper and outlook are well marked. Much that vitally concerns the miner must go on literally 'behind his back', and the strain on honesty and confidence is severer than in most kinds of organised work. Even when hours worked 'at the face' are reasonable, distances may be great, and they increase; the gross hours of absence from home become excessive; and night-shifts are habitual. The time available for any kind of study, discussion, or social intercourse is therefore severely limited, and the miner's outlook tends to be restricted. The physical strength and hardihood of a mining population may cause it to be feared and avoided, sometimes with reason. The mental reactions to habitual violent exertion have not been fully investigated, but should not be left out of account; and when a community of similarly qualified persons is inbred for long, it may be expected that congenial strains will become dominant.

In another respect, too, mining is a precarious enterprise. Some primitive mining is seasonal, by reason of altitude or water-supply. In Turkey, and other agricultural countries, men go to the mines in the slack season between seed-time and harvest; the mining-camp, like the fisherman's boat, is not their home. But maintenance must be provided for them at their work. Even in cultivable country, the concentration of many non-agricultural workers deranges the food supply.

Like the food supply, other natural resources are deranged by mining operations, especially the timber supply for props and for fuel. The ancient name of Thucydides' estate in Thrace—*Skapte Hyle*, the 'excavated wood'—reads like a glimpse of Montana, with the shafts and mine-dumps among the dragged pines.

The miner's dependence on his own strength and skill, and his precarious tenure of his workplace, lead to severe elimination of the unfit, and an austere competitive self-regarding outlook among those best qualified for a very abnormal mode of life. Among all backwoodsmen, the miner has the highest vogue in the literature of personal adventure, and, corresponding with his physical difficulties and uncertainties, the fabulous reward of a 'lucky strike' is proverbial. Personal friendship with your 'pal', less

\* Substance of a lecture before the Royal Anthropological Institute delivered on September 24. (London: Roy. Anthropol. Inst. 2s. 6d.)



uniform loyalty to your 'boss', only yield gradually to wider ties within gangs and unions, less affected by individual windfalls.

Where a mineral deposit has been worked for long, and on a large scale, and a permanent self-supplying community of professional miners has come into being, the special skill of its members becomes itself a valuable asset. In the Turkish province of Trabzon, at Gumush-Khané, 'the place of silver', not only is the ancient silver mine worked by a close-knit community of hereditary miners, who have their own farms and pastures, as well as their mineral wealth, but also the men of Gumush-Khané are in wide demand as skilled miners for all kinds of minerals, and find work in all parts of Anatolia. The Cornish miners are another instance.

In such circumstances, the mine, and related deposits of ore, are in communal ownership, like forests, pastures and streams. But where for any historical reason there is personal rule, and universally where there has been conquest, the *de facto* owner of territory is *de jure* owner of its natural resources, including its minerals. Historically this custom has led to abuses, as when a chief responsible to his community for customary obligations and outgoings has been induced to surrender his economic interest in his minerals for inadequate compensation, and public disapproval falls both on him and on the foreign adventurer who beguiled him.

All mining begins from the surface, or on surface indications recognizable by a prospector; but most mining requires capital expenditure on preparatory work, and usually, also, throughout the enterprise. This capitalist interest is all the more keen, because whatever the actual expenditure on development may be—and it is often great—it is at all events less than it would have been had there been any compulsion to make good all damage to the minefield, or (as in agriculture) to leave the land 'in good heart' for another crop. It is only in very exceptional circumstances that such a condition is imposed, and it is in any event difficult to enforce because the obligation does not mature until the mine has ceased to be remunerative, and then the mine-worker himself has no assets but idle mining-plant on which the landlord can distrain.

It is only recently that attention has been directed to this aspect of mineral exploitation, by actual shortages in the world supply of mineral products, especially the 'non-ferrous' metals; by the consequent scramble among financiers, and among States with positive financial policies, for the remaining resources of these kinds; and by the recent enunciation of a new principle of equitable participation in whatever mineral resources may remain unworked after the restoration of a rule of law in the world.

Theoretically, the exhaustion of the world supply of a particular mineral product may be compensated—or at least postponed—by 'salvage'. The alternative is a non-mineral substitute, such as the new 'plastic' substances, even for many metallic objects. These, however, are only palliatives and subterfuges. They do not affect the fact that all mining enterprises permanently and irretrievably reduce the economic resources available to mankind on this earth, and that, as at present conducted, they have economic and social effects which are as difficult to control as the processes of exploitation and devastation are to justify, except on the most individualistic and self-centred hypothesis of 'Man's place in Nature'.

Man is the only living being which has the will to

transform his habitat, and the skill and means to do so. The engineering work of ants, moles and beavers leaves no permanent disfigurement. Man is also the only being responsible for the effects of his changes, for he alone has the reason and imagination to foresee them, though often he does not. Sometimes his responsibility is brought home to him by physical disaster, more or less abrupt, as in the effects of deforestation, over-cropping or over-grazing. More often, hitherto, the disastrous process has been slow; but on the historical time-scale some such effects of devastation are obvious, and others are imminent, if not measurable.

### Biological Devastation

Before going further in search of a principle, economic or moral (and in *moral* we may include for this purpose *political*), it will help to clarify the whole matter, if we inquire what other forms of human exploitation of natural resources besides the search for minerals come within the same general category of devastation.

Quarrying, as a devastation subsidiary to agriculture or to industry, stands to independent mining as sedentary herding to nomadism. Salt mining is a special problem, because in brine-extraction the mineral is removed without regard for the stability of the overload, and the surface may be impaired, as at Nantwich, by subsidence. But in essentials these enterprises also (like mining) exploit wasting assets, and replacement is impossible.

Wood-cutting is a widespread mode of life, with its own simple economy. It emerges from mere forest-life as soon as the forester cuts trees not for his own needs, but for exchange with the products of non-forest communities, as in northern and south-western Anatolia. Here, too, much forestry is seasonal work, and fills intervals in the cultivator's routine. In many of these enterprises the aggression is on a single kind of tree or shrub. The forest complex is modified but not utterly deranged, and no perceptible damage is done to the humus or subsoil. What applies to this partial, specific, or selective destruction of trees applies also instructively to total deforestation by fire, however caused: for there is a cycle of recovery.

Quite different is deliberate and indiscriminate felling—whether accompanied by incendiarism or not—with the object of replacing forest by pasture or arable. If the pastoral cycle be arrested at this point, the herdsman's object is attained, probably without sacrificing eventual re-afforestation, should the flocks be withdrawn, provided only that natural nurseries of the appropriate forest trees have survived in sheltered places, from which their seeds may spread.

But there is also the risk of over-grazing, especially where the natural vegetation consists rather of shrubs and bushes than of turf, and the flocks—especially the omnivorous goats—mow off the new growth so close to the ground that the plants are stunted and perish, and rain denudes the humus and erodes the subsoil.

Similarly, trouble is only beginning for the cultivator when he strips the land of its forest covering, and continually breaks up its surface by ploughing. In many regions converted from forest or grassland to agriculture, the initial burning of the natural vegetation—which started the new cycle, unawares, with a top-dressing of wood ashes—falsified estimates of its productivity; and the large scale of prairie farming made the small holder's remedy of fallow-



grazing impracticable. Nothing, in fact, was returned to the soil, for the cereal crops were cut low so as to profit from the full length of the straw for winter fodder, thatching, and home-industries, if not for export. Even within the short historical span of prairie farming, therefore, much arable land has been devastated by over-cropping, and 'dust-bowl' areas have been formed, for which the remedy is not yet found.

Fortunately, where the devastation is not yet complete, it is possible to repair some, if not all, the damage, by spreading fertilizers, themselves usually quarry-products, and by restricting or rotating the crops; but the cumulative effects of more artificial farming are not yet fully explored.

In general, what has been learned by disastrous experience in a few extreme instances is that it is as possible to devastate land inconsiderately used in human economy as to exhaust a mine.

We may now turn to animal devastation. It is sufficient to refer to the recent instances of the American bison, the fur-seal, and the northern whale, to illustrate the rapid and unforeseen results of excessive hunting and fishing, and the difficulty of restoring a disturbed economy of this kind. The balance of biological factors is far too delicate and intricate to be regulated without greater knowledge and insight than man at present has. The whole problem is complicated by the disappearance, already noted, of large areas of woodland refuge for the larger game-animals. If man had known enough, and cared enough, about what he was doing, these irretrievable defacements of Nature would not have occurred.

It is convenient to summarize, at this point, the economic characteristics of devastatory communities. In the first place, they seek a wilderness, contribute nothing directly to their own maintenance in it, and have to be supplied with maintenance from elsewhere, so long as there is a demand elsewhere for the irreplaceable commodities they are there producing. Secondly, they tend to make a wilderness, by displacing and squandering the waste products of their quest, and usually without regard to reparation. Thirdly, the exceptional and marginal conditions of their occupation disorganise the normal social life of the devastators themselves; and, fourthly, they tend to mitigate these austerities by imposing the more arduous efforts on indigenous labourers. That they have been unaware of the further devastation thus effected is a measure of their own alienation from the outlook and practices of the communities from which they themselves originated.

Once again, as so often in human affairs, we find ourselves confronted with ancient Greek experience, and the practical wisdom embodied in the 'Two Commandments' of the Delphic Oracle: *Know thyself, and Nothing in excess*. To dominate Nature, man must stoop to conquer, by conformity with Nature's processes and conditions. He must 'look to the end', take long views and long resolutions, omitting no relevant circumstance from his calculations: the Greek word for *truth* means simply *not forgetting* any relevant fact. He must know his 'place in Nature', and for this he must also 'know himself'; estimate his needs and desires, and also his abilities and temptations to do this or that 'in excess'. The sole criterion of 'excess' between man and man is, once again, the golden rule: "to do unto others as we would they should do unto us"; or again, in Greek phrase, "to behave as similars and equals", limiting our own freedom lest it infringe

the freedom of our neighbour. Here is the sole and sure basis for man's use of Nature's resources, and for his own qualifications and ability to use them; the sole criterion of *value* and *rightness* between human cultures and modes of life.

Ethnology has gone on overlong without realizing that *behaviour* is a principal character of every tribe and people whom it studies, intimately related to breed and habitat and mode of maintenance and propagation; distinct from them all in its relation to man's self-conscious outlook on himself, and his world, but not, for that reason at all events, beyond the scope of ethnological study.

### The Devastation of Man

Of all the resources of Nature at the disposal of man's initiative and ingenuity, far the most abundantly rewarded is the energy and skill of other men. Aristotle's tentative but not final description of a slave is 'a tool in place of tools', an indefinite extension of a man's own capacity for action at a distance, or for acting in different ways at the same time. He illustrates his point by imagining an automatic loom or musical instrument—both very nearly attainable in our time. What he does not, however, at that stage in his examination of slavery attempt to prove, is that there actually *are* any such human beings as those he imagines for his argument.

It was known, moreover, even in slave-owning antiquity, that a slave was more than that. A slave, however docile and competent, *wore out*, as a loom or a lyre did not, and however well groomed, lodged, and fed, tended to wear out sooner than his master; also that he tended to wear out less soon, if he had a reasonable prospect of acquiring personal freedom while he still had the ability to make use of it. It was equally notorious, in antiquity, that the supply of slaves was not easily maintained: they came from farther and farther afield, and from stocks and breeds less amenable to servitude; and the slave trade was carried on with a degree of hardship and irresponsibility which classed the slave-raider with the pirate and bandit. In modern times, too, it was the atrocities, as much as the wrongfulness of the slave-trade, that roused public opinion and suppressed the traffic. Slave-raiders were exhausting a wasting asset, the chief export of tropical Africa.

There was, however, a principle at stake, a question of justice between man and man, the answer to which is inevitable, when the Golden Rule is applied: "Do unto others as you would they should do unto you". Philosophically it results, like the Golden Rule itself, from the fact that each individual man, whatever his place in Nature, is an end in himself, not a means to fulfil the end of any other man. Nothing precludes him from contributing what he can, and all that he can, to fulfil the ends of another, whether individual friend, or fellow-member of a society of men; but unless it is also all that he *will*, his *own* contribution, voluntary and deliberate, it is a diminution of his human freedom and a devastation of his personality. Like the utility of a mine or an oil-well, the potential, the literal *man-power* of each individual is a wasting asset. Like other such utilities, it can be economized, but not amplified, either by the man himself or by any other person. The abuse or misuse of another man's potential appears to fall into the same general category of devastation as the abuse or misuse of any other of Nature's utilities. The world will be a poorer place when he is no more: and in the infinite variety of human personality and



endowment, even the physical replacement of one generation of men by another only *replaces*; it does not restore.

This is what differentiates social or human individuality from biological—the separate existence of an animal or a plant; and it refutes analogy between the use or misuse of men, and of domestic animals.

### Ends and Means: The Conditions of Sacrifice or Total Surrender

We have now reached a point in our argument at which we may ask the general question, in terms applicable alike to a gold mine or coal mine, or to members of a human society: "In what circumstances, and for what objects, is the devastation of any of the resources of Nature, or of humanity, compensated by its consequences and results?" The question may be approached from two different points of view; but both, like the question itself, introduce the new notion of *value*, even if only in the minimal aspect—as stated here—of equivalence or compensation, of 'handing on undiminished' the resources of Nature which are at man's disposal. Brunhes demanded more: "to retard the degradation of energy" in a world which must go cold and dead some day.

If we had infinite knowledge of the course of Nature and of man's destiny, we could observe directly, or calculate, the cosmic result of any displacement—the removal of metallic ore, or the sending of a human messenger—and the cumulative effects of such acts on the planet or on humanity. If our estimate of values were commensurate with our knowledge of events, we could approve or condemn such an act accordingly. As we contemplate in imagination the withdrawal of this or that aspect of reality from our knowledge, we find our judgments in either category becoming more hypothetical. For many practical purposes, nevertheless, decisions are commonly taken which presume that something which we regard as 'benefit' accrues from obvious and immediate devastation, in the sense defined.

Mankind, however, is not thus replaceable, and it is that uniqueness of the human individuals that distinguishes them from individual animals or plants, which are members of a natural species and replaceable by others of their kind. It is indeed because they are thus replaceable that man's exploitation of flocks and crops is an essential element in this 'place in Nature'. No one, on the other hand, can replace a man. Each of them only lives once, making such use of his life as he can, and responsible to his own conscience—if to no one else—for his use of it. Each is also responsible, under the Golden Rule, for infringement of the liberty of every other so to live, as he does; and this liberty—his own and his neighbour's freedom alike—is a wasting asset; short of some transmigration or rejuvenation of souls, it cannot recur.

Whether in any circumstances—and if so, in what?—a man is required to limit or to surrender this freedom is, once again, for the Golden Rule to determine. It is sufficient for the present purpose to have formulated the question in terms which make it comparable with the question about other 'wasting assets', such as metallic ores, with which this inquiry began. But in the light of the whole argument, as it has developed, are we any nearer to a formula and criterion applicable to this whole group of human enterprises? I venture to suggest that we are.

It is a significant accident that among Athenian activities mining enterprises held a high place, and that many public as well as private achievements during the 'great age' of Athens were made possible by the public revenue from Attic silver. It was at all events the hypothesis on which Athenian policy as well as finance rested that this form, among others, of public wealth was fully accounted for, if it was spent—as Pericles himself claimed on a crucial occasion—for a necessary object; and in the last resort it was the citizens of Athens themselves, by direct vote, or by their selection and approval of their administrators, who decided what this was.

With fuller knowledge than theirs, and wider experience, sometimes we can approve their choice, sometimes not. Cumulatively, and, in the end, economically speaking, they failed to 'transmit undiminished' what their predecessors had held, including whatever it was for which they had won and expended their material 'wasting assets', their blood as well as their treasure. Is this, however, the whole of the account? Were there not, historically speaking—and 'history' is our judgment of other values, besides economic—other achievements of Athens, by which mankind remains enriched and ennobled, beyond question of loss or devastation? The argument is passing here out of the economic into another aspect of ethnology, and it will be observed that it does so precisely in respect of an economic commodity, a wasting asset, the mineral resources of Attica; whatever other factors, not economic, went to the invention of a justifiable use for that commodity, in the maintenance and enhancement of the mode of life, the culture, the well-being of the Athenian people.

Evidently there is to be made, once again, the distinction between wasting assets which are extinguished utterly and irreplaceably by destruction or removal of a natural commodity (such as an ore), and those which are indeed destroyed sooner or later by degradation or devastation, but where the process may be checked or even reversed by appropriate remedies. In the first alternative, there is indeed no remedy. All that can be done is to impose such restrictions as research and foresight may prescribe, so that the natural supply may meet necessary demands for as long as possible; and, in the respite so gained, to apply human ingenuity to discover or invent a substitute, in addition to obliterating the damage incidental to extraction.

In the second alternative, where devastation can be prevented by foresight and research, the 'more excellent way' is deliberate and voluntary reconstruction by the legal owner of the land himself. Every civilized farmer or forester, hunter or fisherman, recognizes this, and brings his own judgment, and that of public opinion, to bear on reckless or malicious owners. In civilized countries, uniformity of self-repression is enforced by public rules and penalties. This is indeed the fundamental attribute of civilized people, that they are mutually considerate, taking each other's situation or predicament into account, conforming to the Golden Rule by that longer view which reckons consequences as well as immediate advantage. It is, on the other hand, characteristic of barbarism—which, fundamentally, is inability to make oneself understood, or to understand what others mean—that it grasps at momentary advantage and opportunity, without regard to consequences or the convenience of other people.

Within any community it is the same: there are



*civil* persons, in the primary sense of that ancient word, and there are uncivil, for whom the Roman correlative was *hostis* (hostile, 'not of our sort'). Many simple societies are fully aware of the distinction; of where the boundary lies, and what the procedure is when it is transgressed.

More commonly, however, 'evil is wrought for want of thought', and especially for want of knowledge and experience; and there are sufficient instances of revolutionary changes resulting immediately from a fresh apprehension of the facts, and of public self-control in respect of the devastated asset of man-power. The thing can be done, if people want to do it. Where there's a will, there's a way.

It is indeed an obvious remedy, where devastation is unavoidable and irremediable, to seek for a substitute, the source of which is replaceable in the ordinary course of Nature. Most significant of all, the long vogue of slavery—the abuse of the most irreplaceable of 'wasting assets', human energy—was ended less by a moral revolution in regard to the 'natural rights' of man, than by the invention of sources of mechanical power, which made man-power uneconomic, as well as unobtainable, on the scale needed by mechanical industries.

It has been the constant claim of ethnologists that their method of functional analysis and of comparative study of modes of life not superficially similar, aids in understanding the doings of primitive and cultured men alike. If it be true, as Brunhes claimed, that the part assigned to living beings is to 'retard the degradation of energy' in the world, it is a paradox that the most disastrous devastations have resulted from the thoughtless activities of peoples whose cultures, however unbalanced, have achieved in some respects notable advancement. It is, however, some gain if the peoples themselves whose activities have been disastrous, because thoughtless, are brought, either by example, or by the first warnings of necessity, to review their own past and present doings, and take longer views into the future, and wider views of their 'place in Nature' and in a Society of Nations. It is some gain also if the practices of peoples, primitive and advanced alike, can be submitted to a test which is at the same time objective and a standard of value; applicable alike to economic commodities, and to the use and abuse of what must always be man's ultimate source of energy, the co-operation of his fellow-men.

<sup>1</sup> "Nomadism", *J. Roy. Anthropol. Inst.*, 71, 19 (1944).

<sup>2</sup> "Mediterranean Culture" (C.U.P., 1944).

## THE RUMEN PROCESS AS A FUNCTIONAL FIELD: AN ATTEMPT AT SYNTHESIS

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THE changes taking place in the rumen may be envisaged as a form of process organised with reference to the utilization of microbial products. Such an organisation in which a complex system of factors, internal and external<sup>1</sup>, converges upon the attainment of a final state may be termed a functional field<sup>2,3</sup>. Thus the efficiency of the process will devolve upon the intensity of the field established and will be exemplified in the degree of integration achieved

between the metabolism of the animal and the activities of an indigenous microbial population. Correlatively, the actual organisation of the gut will in part define in advance the working capacities of the system. A comparison of these features in ruminant and non-ruminant Herbivora, therefore, is essential to an understanding of the rumen process.

Now it is axiomatic that the utilization of microbial products presupposes the maintenance of a microbial population of high density. This requirement is met by the development of large diverticula—the rumen and caecum—which stand in a compensatory relation in ruminants and non-ruminants and in which extensive proliferation can occur. Again, the total output of microbial products will be determined, severally, by the volume of the organ, the period of retention and the extent to which, over this period, optimal conditions prevail. But a limit is imposed upon mere volume by the position of the organ in the *situs viscerum* and its relation to the overall dimensions of the animal. Again, in the caecum of non-ruminants a term is set to retention by the risk of impaction<sup>4</sup> and the insistence of peristalsis. In the ruminant, however, these obstacles are surmounted and an increased duration secured by the incorporation of a repetitive mechanism. Here are included exchanges occurring reciprocally between mouth and rumen and rumen and reticulum<sup>5,6</sup>. By the first an adequate trituration of solids is secured, which is perhaps completed in the omasum, while, by the second, fluids are retained in circulation and afford a permanent medium for microbial activity. Disengagement of gases is facilitated by the pulsations of the paunch and buffering promoted by the interaction of the carbon dioxide and gases liberated with the bicarbonates of the saliva<sup>7</sup>.

Thus the adoption of the ruminant habit is associated with the superposition of a cyclic upon an initially serial form of process and may be formally represented as the expansion in sphere of influence of a functional field. For the field has temporal as well as spatial dimensions, and in this way its duration as well as its extent is effectively augmented. That we are concerned, moreover, with a regulatory adjustment of internal to external factors is clear from the fact that the rumen is unconditionally, the caecum only conditionally, associated with the phytophagous habit<sup>8</sup>. Also, whereas the caecum is well developed *in utero*, the rumen attains completion *post natum* in direct response to the adoption of a vegetable diet<sup>9</sup>.

Now in Herbivora, generally, this epoch marks the development of a distinctive microbial association which may include: (a) a ciliate, (b) a fixed or free iodophile, and (c) an aniodophile population<sup>9</sup>. Since the types are constant for a given herbivore, the effects of diet may be represented by reference to its quantitative influence upon the relative densities attained<sup>10</sup>. Thus the maintenance of the field rests upon the dynamic equilibria established between the rates of multiplication of a mixed microbial population. Also, through the establishment of different stability maxima, potentialities for the development of alternative routes of decomposition and synthesis are prefigured the number and diversity of which will determine the regulatory capacities of the system. The release of these potentialities is conditioned by a wide range of factors the influence of which, as estimated by the actual densities of the iodophile and other populations, can in part be elucidated by *in vitro* incubations and counting methods<sup>10</sup>.



The natural habitat of this microbial association and the functional bond or link between it and the host animal is the ingested plant material. Cellulosic substrates, for example, are accessible to mammals only through microbial agencies. The relation, none the less, is more complex than at first appears; for the maintenance of the population is a direct consequence of proliferation, so that decomposition is throughout accompanied by synthesis. But for this synthesis a source of nitrogen is essential. The cytoclastic process, therefore, is bound up *ab initio* with the nitrogen requirements of the micro-organisms. Again, the substrate is heterogeneous and will include, as well as cellulose, other carbohydrates. Among these, starch and many sugars are accessible both to the micro-organisms and to their host; thus, with the development of the microbial population, a loss of independently accessible metabolites is potentially incurred by the animal. The micro-organisms responsible for this degradation may be represented as a commensal penumbra to a focus of symbionts. The maintenance of the field, then, presupposes that degradation is compensated by regradation through a progressive integration of the peripheral and central components of the system.

The mechanism by which this end is attained may next be considered. Now the respective value of the products of decomposition and synthesis to the host has been widely debated. Thus it is known that, as well as gases, fatty acids are produced. Also it is established that they are taken up by the portal circulation and that, among them, acetic acid can exert a glycogen-sparing action on the heart. From these data a metabolic schema for the utilization of microbial products can be elaborated<sup>11</sup>. That such a schema is, however, complete in itself it is legitimate to doubt. Thus the production of acid and gas may be accompanied by the formation of bacterial starch amounting to nearly 50 per cent dry weight of isolated bacterial substance<sup>12</sup>. But it is certain that the value of starch, taken as glucose, exceeds that of the lower carbon components produced—as, for example, is shown by the inability of the nervous system to metabolize acetic acid<sup>13</sup>. An alternative hypothesis would therefore be<sup>2</sup> that the development of the iodophile population represents a mechanism whereby glycolysis is arrested through removal of the soluble sugars initially present or afterwards liberated from further participation in the reactions taking place. In agreement, we find that (a) glucose, cellobiose and maltose are known decomposition products of cellulose and starch; (b) glucose disappears almost immediately from the rumen<sup>14</sup>; (c) synthesis of bacterial starch from sugars can be demonstrated *in vitro* within a period of 15–30 min.; (d) the energy values of starch and cellulose are almost equivalent, which “can only be explained if the end products resulting . . . are the same”<sup>15,16</sup>.

But, in addition, we have still to consider the inter-relationships which issue from the conjoint nitrogen requirements of the micro-organisms and their host. These requirements have secured attention largely through the now demonstrated<sup>17</sup> ability of ruminants to utilize non-protein nitrogen in the form of urea. Thus it is known: (1) that the micro-organisms concerned include the self-same iodophile and aniodophile species responsible for the decomposition of starch and sugars<sup>18</sup>; (2) that they are unable directly to utilize protein nitrogen<sup>19</sup>; (3) that urea is utilized as ammonia, through the action of rumen urease<sup>19</sup>; but (4) in the absence of carbohydrate intensive decom-

position of protein can also occur<sup>19</sup>. Thus we may suppose that the ability of ruminants to utilize urea is tributary to a process whereby *on normal diets* the nitrogen requirements of the micro-organisms responsible for the decomposition of carbohydrates are met from the products of proteolysis. We can therefore postulate, in addition to cycles of carbohydrate, cycles of protein synthesis and, with the extension in sphere of influence of the field, an ever closer integration of the latter with the former. Also, we must assume that in the ruminant a representative fraction of the available protein is normally assimilated, together with synthesized carbohydrate, as bacterial substance; the amounts being regulated, in accordance with the actual balance of diet components, through the establishment of stability maxima and alternative reaction systems in the manner indicated above. Further information regarding these reaction systems and cycles—which must include the interconversions of dietary, bacterial and protozoan protein, through the agency of ciliates—is therefore essential to a detailed understanding of the changes taking place.

With increasing intensity of the field the provision of an adequate mechanism of regradation becomes imperative precisely in such measure as the avenues of proteolysis are multiplied. But the efficacy of any such process presupposes the ability of the animal to utilize the substances synthesized. In non-ruminants, however, there is little to indicate that the large bowel can itself digest microbial products. Apart from supplementary mechanisms, therefore, this can be accomplished only by autolysis of the micro-organisms<sup>20</sup>. In ruminants, on the contrary, the situation of the diverticulum is such that the field now embraces in its sphere of influence the entire enzymatic equipment of the true stomach and small bowel. That in this way and through this extension an increased efficiency is secured is apparent, moreover, not only from the increased value of the digestive coefficients for starch and crude fibre, but also from the superior capacities displayed by ruminants in the synthesis and assimilation of vitamins<sup>21</sup>. From this point of view, coprophagy and refection become intelligible as devices through which a vicarious approximation to rumination is achieved. A case in point is the pseudo-rumination encountered in the rabbit, where the soft nocturnal faeces are removed by the animal from its own rectum, devoured and subsequently redigested<sup>22</sup>. Not only, however, are such supplementary mechanisms unable to function uninterruptedly, but also both feeding habits and the overall bodily architecture may prevent their adoption. Functional autonomy, therefore, is only achieved where, as in ruminants, the cyclic process is actually incorporated in the organisation of the digestive tract.

This brief reference to the habits of the animal may serve to point a concluding issue. In preceding paragraphs we have considered the organisation of the rumen process primarily as a molar-molecular mechanism. But the endurance of the process as a going concern presupposes, under natural conditions, an active search for and selection of appropriate fodder. Thus the habits of the species are integral to the character of the system. Again, among the indigenous micro-organisms are types incapable of survival outside the digestive tract<sup>5</sup>. The establishment of the field, therefore, presupposes *transmission* as well as *maintenance* of a microbial population—a process that will be determined by the conjoint characteristics of host and micro-organism. The



microbial population, for example, may be re-established variously by ingestion of infected fodder, by direct infection from mouth to mouth, or from anus to mouth. The more intimate bodily relationships established between the mother and her young, between the younger and older members of the herd, and between individuals of all ages and the enviroing pasture, are here in question. For, so regarded, the mechanism of transmission is tributary to an oral-anal instinctual complex, which, organised with reference to the ingestion of food and expulsion of faeces, is conspicuously ingredient in the social and sexual behaviour patterns of the species. But the canalization of these appetites is effected with reference to an environment disclosed to perception. The character of the process in its entirety, therefore, is in part prefigured in the actual modes of awareness of the animal which, as subjective factors, are real agents in the maintenance and perpetuation of the system as a functional field.

For the concepts set out in this article I am in great debt to Prof. F. G. Gregory. The responsibility for their application to this subject is my own.

- <sup>1</sup> Gregory, F. G., *Ann. Bot.*, **42**, 991 (1928).  
<sup>2</sup> Baker, F., and Martin, R., *Zbl. Bakt.*, **II**, **97**, 217 (1937).  
<sup>3</sup> Baker, F., and Martin, R., *Zbl. Bakt.*, **II**, **99**, 415 (1939).  
<sup>4</sup> Alvarez, "The Mechanics of the Digestive Tract" (Heinemann, 1928).  
<sup>5</sup> Mangold, E., "Handbuch d. Ernährung u. des Stoffwechsels", vol. 2 (Berlin, 1929).  
<sup>6</sup> McAnally, R. A., and Phillipson, A. T., *Biol. Rev.*, **19**, 41 (1944).  
<sup>7</sup> Mangold, E., "Handbuch d. Ernährung u. des Stoffwechsels" (Berlin, 1928).  
<sup>8</sup> Mitchell, P. C., *Proc. Zool. Soc.*, **27**, 522 (1905).  
<sup>9</sup> Baker, F., *Nature*, **150**, 479 (1942).  
<sup>10</sup> Baker, F., *Proc. Nutrition Soc.*, **3**, 199 (1945).  
<sup>11</sup> Marshall, R. A., Phillipson, A. T., Eldsen, S. R., and Barcroft, J., *Proc. Nutrition Soc.*, **3**, 238 (1945).  
<sup>12</sup> Smith, J. A. B., *Proc. Nutrition Soc.*, **3**, 203 (1945).  
<sup>13</sup> Quastel, J. H., *Proc. Roy. Soc. Med.*, **29**, 200 (1936).  
<sup>14</sup> Phillipson, A. T., and McAnally, R. A., *J. Exp. Biol.*, **19**, 199 (1942).  
<sup>15</sup> Marshall, F. H. A., and Halnan, E. T., "Physiology of Farm Animals", (Cambridge, 1945), 94.  
<sup>16</sup> Thaysen, A. C., *Proc. Nutrition Soc.*, **3**, 195 (1945).  
<sup>17</sup> Smith, J. A. B., *Proc. Nutrition Soc.*, **3**, 203, 195 (1945).  
<sup>18</sup> Smith, J. A. B., and Baker, F., *Biochem. J.*, **38**, 496 (1944).  
<sup>19</sup> Pearson, R. M., and Smith, J. A. B., *Biochem. J.*, **37**, 142, 148, 153 (1943).  
<sup>20</sup> Baker, F., *Nature*, **149**, 582 (1942).  
<sup>21</sup> Kon, S. K., *Proc. Nutrition Soc.*, **3**, 217 (1945).  
<sup>22</sup> Eden, A., *Proc. Nutrition Soc.*, **3**, 230 (1945).

## PUBLIC HEALTH IN GREAT BRITAIN DURING THE WAR

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THE annual reports of the Ministry of Health were suspended during the period of the War. The Chief Medical Officer, with the assistance of his colleagues, has now issued a comprehensive report covering the period of hostilities between the years 1939-45\*. It is an important and inspiring document, and whether as a social, historical or scientific commentary is deserving of close study by all who have an interest in organised human achievement of a positive and constructive kind—an achievement carried through, in this instance, during a period of sustained hazard and unparalleled difficulty. We would differ slightly from its author when he says: "That, after these six years of unprecedented strain

alike upon the nation and upon the medical resources of the realm, the state of the public health should be as good as it is to-day is indeed a miracle". A miracle is strictly something due to supernatural agency. The state of the public health can be traced to the advancement of knowledge, to human planning and endeavour and to a number of natural causes which are now better understood than at any time in our previous history.

In the statistical sections we find that the birth-rate, rising after 1941, reached 17.7 in 1944, the highest figure since 1926, the effective reproduction-rate coming within 1 per cent of full replacement standard, although it has fallen since. The infant mortality for the country as a whole fell to its lowest level—45.4 per thousand live births in 1944 as compared with 50.6 in 1939, and 156 in 1896-1900. It also fell significantly in many large cities (from 74 to 58, for example, in Liverpool, and from 66 to 51 in Newcastle-on-Tyne), although Oxford's figures of 23 in 1939 and 25 in 1944 remind us how far we have yet to go elsewhere. Still-births, which again appear to reflect social and nutritional influences, have dropped from 40 per thousand of all births in 1928 to 28 in 1944.

There was a remarkable absence of serious epidemics. Cerebro-spinal fever alone, in the period 1940-41, had a very high incidence. With the new chemotherapies, its case mortality in the past five years was, however, greatly reduced, and it is calculated on the basis of earlier experience that some 15,000 lives were saved by these remedies. Infective jaundice, with a low mortality, gave much trouble in the civilian population and among the troops at home as well as among the armed forces abroad. Movements of population, destruction of water-mains and sewers by bombing and other adverse factors notwithstanding, the typhoidal infections were never a serious menace, and in 1944 were less prevalent than in any pre-war year. In 1944, diphtheria deaths were less than one-third of the pre-war average, largely as a consequence of the Ministry's immunization campaign. Nevertheless, several other countries are far ahead of us in respect of diphtheria control, and it is a sad commentary that during the War more children under fifteen were killed by this preventable disease than by bombs. Although propaganda and public education in health matters have made much headway during the War (largely through the joint activities of the Ministry of Health and the Central Council for Health Education) methods could clearly be much improved.

After an increase in deaths from pulmonary tuberculosis in the period 1939-41, the pre-war downward trend was later resumed and 1944 showed a new low figure. With pasteurization of milk still far from universal, bovine tuberculosis continues to claim among children in each year some 2,000 new cases with 600 deaths—all of which should be regarded as preventable. To offset the increases in tuberculosis, the officers of the Ministry mention in particular the contributions to its early detection of miniature mass radiography and to its treatment of the extension of tuberculosis benefit. On the other hand, they are compelled to regret the existing difficulties in the staffing of enough beds to ensure institutional treatment for all who require it. The venereal diseases, as always in times of war, increased considerably. As against their higher incidence are recorded the very great advances in treatment due to the sulphonamide drugs and penicillin, and the

\* On the State of the Public Health during Six Years of War. Report of the Chief Medical Officer of the Ministry of Health, 1939-1945. (London: H.M. Stationery Office, 1946). 58.



steady extension of contact-tracing and social service and the educational campaign.

Although morbidity studies of various kinds have lately been introduced, including a monthly sampling survey of sickness incidence in the population, it must be admitted that we still know too little of the incidence and trends of the diseases (lethal and non-lethal) outside the notifiable group. Nor can we say how far some of these may have been increased by war-time stress.

Perhaps the greatest and most favourably influential of all the public health undertakings of the war period was the maintenance of a high level of nutrition by rationing and fair distribution of foodstuffs throughout the population, together with the special advantages secured for expectant and nursing mothers and children. To this in large measure may be attributed the resistance to infection and strain of the people of Britain as a whole.

Passing to some of the special services created and maintained during the War, we find credit justly given to the Emergency Public Health Laboratory Service, organised by the Medical Research Council and now destined to remain as an integral part of the new health services. The Emergency Medical Service, with its vast hospital provisions for civil and military battle casualties and sick, and its first-class special hospital units for thoracic, facio-maxillary and head injuries, not only met the needs of many urgent situations, including the bombing offensives of the enemy and our own invasion of Europe, but resulted also in an upgrading of the hospital services of the country and helped to prepare the way for the unified hospital service which the new Health Bill envisages. Civil defence, shelter accommodation and shelter health provisions, the establishment of rest centres and the extension of day nurseries, were among the many other concerns of the Ministry of Health working alone or in conjunction with other ministries. Action in anticipation of introduced epidemic diseases from abroad, including typhus, smallpox and malaria, was taken at the ports and elsewhere. The care of the aged and infirm and of numerous children and other refugees from the Continent was a further responsibility. There were remarkable developments in therapeutics, especially in the use of penicillin and the sulphonamides, and of new protective insecticides such as D.D.T.

Sir Wilson Jameson pays tribute to the numerous expert advisers, specialists and general practitioners, to much generous American aid, and especially to the medical officers of health, who between them made this vast organisation and achievement possible.

The obvious comment is that if so much can be accomplished in face of the difficulties and under the impetus which war provides, what might not be achieved by similar 'combined operations' as between administrators, men of science, consultants, practitioners and the ancillary medical and social services, in times of peace. The sciences as a whole put more into destructive effort during these six years than had ever before been deemed possible, but the medical and allied sciences at least demonstrated by contrast and in comparable measure what a part they can play in the saving of life and limb and in the considered protection and improvement of a people's health.

In concert with the fuller descriptions which will later appear in the official medical history of the War, this report—with its sober, factual descriptions—will provide an enduring testimony to much wise prevision and to some very notable conquests.

## OBITUARIES

### Dr. Walter Arndt

It is with much regret that we learn of the death in 1944, at the hands of the Gestapo, of Dr. Walter Arndt, of the Museum für Naturkunde (section: Zoologisches Museum), Berlin.

Dr. Arndt was a prolific writer on sponges; beginning in 1912, then after a lapse of years due to the First World War, he contributed upwards of fifty publications between 1922 and the year of his death. There is only a comparatively small amount of original research to his credit; but this little is reliable and well done. His main contribution was as a compiler, and in this he was extremely thorough. A good example of his work is seen in the contribution "Schwämme" in "Die Rohstoffe des Tierreichs", Bd. 1, 2 Hälfte, 1937, p. 1,577. In this he has brought together an astonishing wealth of facts and statistics relating to bath sponges. But whether in the writing of a compilation of data, of a handbook, a dissertation on museum technique or a systematic paper, there is always conveyed an impression of painstaking attention to accuracy of detail, and of a desire to bring together any knowledge or obscure facts that might make the work more comprehensive.

Born in 1891, at Landeshut, Silesia, Dr. Arndt studied in Breslau under Kükenthal. He received doctorates both of medicine and philosophy (zoology), a fact which doubtless explains the broad field his writings usually contrived to cover.

A prisoner in Russian hands in the First World War, in the Second, Dr. Arndt appears to have been a staunch anti-Nazi. According to a letter written by his sister, he was arrested in his room at the Berlin Museum on January 12, 1944, as the result of a denunciation by a colleague and a friend of long standing. On May 11 he was condemned to death for 'defeatism' by the so-called Peoples' Court in Berlin. Several petitions were submitted for his pardon, all of which failed, because Arndt in the face of death would not retract the anti-Hitler and anti-war statements which formed the ground for his denunciation. He was executed on June 26 in the prison at Brandenburg.

It was never my privilege to meet Dr. Arndt, although I had often corresponded with him. My impression was of a kindly and courteous scholar, who spared no pains to be of the greatest assistance to a colleague. He freely responded to requests for advice, use of specimens or exchange of materials, and the rich collections of sponges in the British Museum have been enlarged to an appreciable extent by Dr. Arndt's friendly actions.

MAURICE BURTON

WE regret to announce the following deaths:

Prof. George Baborovský, professor of physical chemistry at the Technical College, Brno, on October 10, aged seventy-one.

Sir Louis Barnett, C.M.G., emeritus professor of surgery in the University of Otago, and a founder of the Royal Australasian College of Surgeons, on which he was president during 1937-39, aged eighty-one.

Mr. A. W. Lupton, senior lecturer in pharmacy and pharmaceutical chemistry in the University of Leeds.



## NEWS and VIEWS

Prof. A. W. Stewart

THE many friends of Prof. A. W. Stewart learned, with regret, of his retirement in 1944 from the chair of chemistry at Queen's University, Belfast, which he had held for twenty-five years. Educated at the University of Glasgow, the University of Marburg and University College, London, he in turn held the lectureship in organic chemistry at Belfast and the lectureship in physical chemistry and radioactivity at Glasgow, and in 1919 succeeded the late Prof. Letts as professor of chemistry at Belfast. Stewart did much to create the school from which many of his students at Belfast went to take up important

positions at home and abroad. Possessed of a fertile imagination, Stewart foresaw the dangers of early specialization, and was unceasing in his labours to provide a sound and fundamental training in all aspects of modern chemistry. Thus equipped, his students found themselves ready to undertake posts of responsibility in many spheres of academic and industrial chemistry. Stewart was catholic in his interests and was ever ready to give the benefit of his counsel and experience to the young research workers. Stimulated by his close association with Ramsay and Collie, he developed a keen interest in the application of physical chemistry to the elucidation of the structure and properties of organic compounds, and his work upon Tesla-luminescence spectra was especially noteworthy. By employing a fresh method of excitation, Stewart and his co-workers obtained a series of spectra, each of which is characteristic of the compound which emits it. Thus a new constitutional property was added to those previously known and a new field in spectroscopy was developed. His many books, notably his series on "Recent Advances"—which have now reached many editions—are testimony to his love of investigation and to his interest in the welfare of the undergraduate. It is of interest to note that Stewart suggested that elements which have identical atomic weights but differ in chemical properties should be named 'isobars'. He found pleasure in more recent years in detective fiction and, using the *nom de plume* of J. J. Connington, he has given pleasure to many all over the world. In spite of physical disabilities, Alfred W. Stewart never spared himself in the many interests of teaching, research and writing, and has won the admiration and sympathy of all.

Since February 23 of this year the "Letters to the Editors" of *Nature* have been printed in very small type. As was explained when the change was made, no other course was possible by which to accommodate the great number of "Letters" awaiting publication. However, it was never intended as more than a temporary measure, and it seems to have achieved its purpose in that arrears have been overtaken and it has become possible to publish communications more promptly. The number of "Letters" submitted by correspondents is still large, but the recent increased allowance of paper has made it possible to allocate additional space to this part of the journal without encroaching on the more general parts. It has therefore been decided to revert to the larger type for printing communications submitted as "Letters to the Editors". The additional space now available, however, will do no more than allow for the increase in size of type. It is, therefore, of the greatest importance that correspondents should restrict their communications to the minimum length consistent with clearness and accuracy; in the interests of prompt publication it is also desirable that manuscript or typescript submitted should be carefully read in order to avoid the need for extensive corrections on printed proofs.

Following the official suggestion that the additional allowance of paper might be used to increase both the size of the journal and also its circulation, more copies of *Nature* are being printed to meet the considerably increased demand from many parts of the world. Readers may like to know that, for the time being, it will be possible for the publishers to accept subscription orders once more.

Chemistry at University College, Hull: Prof. Brynmor Jones

DR. BRYNMOR JONES has been appointed to the chair of chemistry in University College, Hull. Dr. Jones took his B.Sc. degree with first-class honours in chemistry and his Ph.D. degree at Bangor. After a period of three years with the late Prof. T. M. Lowry at Cambridge, Dr. Jones went to Sheffield as assistant lecturer in chemistry in 1931 and was promoted lecturer and senior lecturer in 1934 and 1939 respectively. His researches have been mainly concerned with the kinetics of the halogenation of aromatic compounds; elegant and extensive developments from the earlier experiments of the late Prof. K. J. P. Orton and his school at Bangor

have been made, and the accurate velocity measurements have played an important part in the development of organic chemical theory. Dr. Jones has also published original work on a variety of topics including the rotary dispersion of organic compounds, liquid crystals, and aromatic substitution; during the War he carried out researches on behalf of the Ministry of Supply (Chemical Defence Research Department). As local representative at Sheffield and as a member of Council of the Chemical Society, Dr. Jones has given devoted services in the interests of chemistry in the Sheffield area. In addition, he has played an active part in numerous University activities, and recently he has compiled a valuable and interesting account of the University of Sheffield

contributions made by the University of Sheffield towards the war effort.

Botany at the University of Durham:

Prof. Meirion Thomas

MR. MEIRION THOMAS, who has just succeeded to the chair of botany, King's College, University of Durham (Newcastle upon Tyne), went directly from Cambridge to what was then Armstrong College, to a post as lecturer on botany. This post he held until 1944, when he was promoted to a readership in plant physiology in the same Department. Throughout his stay at King's College, he has conducted with marked vigour and success various researches on the catabolic processes in plants. Most of his results are embodied in a series of papers with the general title "Studies in Zymasis"; in general, theses proceeded from the pen of Prof. Thomas himself, but occasionally they were written in collaboration with research students. In



these were described the effects of oxygen, carbon dioxide and hydrocyanic acid in various gas mixtures on the zymasic breakdown of hexose. In addition to anaerobic zymasis, he has demonstrated that other types exist produced by the gases just named, and by injury and senescence. Having come to definite conclusions as to the conditions of the various forms of zymasis, he has examined the relations between the phenomenon and the incidence of physiological diseases. Naturally, during the War, the whole of these researches were suspended, or at least slowed down, by Prof. Thomas's activities in the O.T.C., in which he held the rank of captain. However, during the past year, they have been recommenced along some of the more promising lines, so that there is every probability that his tenure of the professorship will be marked by a steady flow of research papers continuing the investigations which have been so productive of results in the past.

### Patterson Medal in Meteorology

THE inauguration has been announced of a Patterson Medal to be awarded annually to a resident of Canada or Newfoundland for achievement in meteorology. The Medal has been founded by the friends and professional associates of Dr. John Patterson, the retiring controller of the Meteorological Service of Canada and honorary professor of meteorology in the University of Toronto. After graduating from the University of Toronto in 1900, Dr. Patterson went to the Cavendish Laboratory, Cambridge, with an 1851 Exhibition Science Research Scholarship. In 1902 he became professor of physics at the University of Allahabad, and soon afterwards he was appointed Imperial meteorologist to the Government of India. He joined the Meteorological Service of Canada in 1910 and became director in 1929. During the First World War, Dr. Patterson worked with the British Admiralty to develop a commercial process for the extraction of helium from natural gas. After the War, to meet the demands of aviation, he trained young graduates for the Canadian Meteorological Service, and when the Second World War broke out, he had already laid the foundation of a great meteorological service which was able to meet the demands of the British Commonwealth Air Training Plan. He is best known for his pioneering work in the exploration of the upper atmosphere by means of balloon meteorographs and for improvements to the cup anemometer and mercury barometer.

The announcement of the Patterson Medal was made by the Hon. C. D. Howe, Minister of Reconstruction and Supply in Canada, at a reception and dinner given to Dr. Patterson on September 28. Commander C. P. Edwards, Deputy Minister of Transport, presented him with a portrait which Dr. Patterson requested should be hung at the headquarters of the Meteorological Office along with the portraits of the six preceding directors. Commander Edwards then presented a silver platter with an inscription expressing the esteem in which Dr. Patterson is held by colleagues and other friends. In reply, Dr. Patterson said he was deeply gratified that his friends had chosen to honour him by the foundation of the Medal, since it would foster the advancement of meteorological science. Nations have founded great institutions for the development of other sciences, and scholarships and awards have been set up, yet this science, which bears upon the

life of every human being, had not received the attention it merited. This was the first time in Canada that there had been any award for meteorology. The building of a good meteorological service depends, he said, on two essentials: the obtaining of basic data and the provision of technical staff capable of making the most of the data. Surface meteorological observations are only obtainable regularly from one fifth of the surface of the globe. The augmentation of basic data is taking place to-day from the upper air. This data has become very expensive, by pre-war standards. The provision of a technical staff competent to make the most of this data would only add a few per cent to the total cost of the service; failure to provide this staff would be false economy.

### Principles of Rheological Measurement

A CONFERENCE and exhibition of rheological research apparatus were arranged by the British Rheologists' Club during October 3-5 at Bedford College, University of London. Prof. E. N. da C. Andrade, in a presidential address, gave a survey of modern theory with special reference to metals and hard materials in general. Three sessions were devoted to the principles of rheological measurement for (a) soft materials under conditions of large strain, (b) materials of intermediate consistency, such as doughs, pastes, rubber, etc., and (c) steel and hard materials. Dr. L. R. G. Treloar spoke on "Technical Terms and Definitions". Mr. E. G. Ellis, chairman of the Grease Rheology Panel of the Institute of Petroleum, spoke on the measurement of the consistency of lubricating greases. Dr. K. Weissenberg with Mr. G. M. Freeman, of the British Cotton Industry Research Association, dealt with the geometry of rheological phenomena and demonstrated the practical application of the Weissenberg rheogoniometer. Dr. G. W. Scott Blair read a paper on the consistency of doughs and pastes, and Mr. J. M. Buist on the hardness testing of rubbers. In the session on hard materials, Dr. W. W. Barkas discussed the anisotropic elastic properties of wood, and Dr. E. Orowan dealt with steel and metals. The discussions were lively and well sustained: new views and an interchange of ideas were rendered possible by the presence of distinguished overseas rheologists.

The research apparatus used by members were exhibited and demonstrated during the conference. Models and graphs, such as, for example, a model illustrating tractions and composition of stress and strain tensors in a unit cube, graphs showing the flow characteristics of a grease at medium rates of shear (plunger viscometer) and at high rates of shear (pendulum viscometer) were displayed. Apparatus developed for special industrial purposes were shown: these included instruments for the measurement of creep of dielectrics, the consistency of curd in cheese-making, a rotational viscometer for fabric-printing thickeners, oil viscometer with a high range of shear rate, etc. On October 5 visits were made to the science laboratory of Mr. F. I. G. Rawlins at the National Gallery, to the G. E. C.-Osram glass works, Wembley, and the Building Research Station, Garsston, where members were able to observe how rheological methods are being used in the arts and industry. Publication of the proceedings of the conference is being arranged, and it is hoped that copies also of "Essays in Rheology" (Oxford Conference) will be available in the new year.



### Developments in Agricultural Machinery

At the fourth annual inspection by the Agricultural Machinery Development Board held at the National Institute of Agricultural Engineering, Askham Bryan, on October 2, a number of interesting demonstrations were arranged to illustrate the work in progress at the Institute. The new sugar beet harvester on view incorporated several improvements on the model shown last year, notably the 'topper-picker' and 'sweeping wheel' which had undergone successful trials late in the previous season. The beet is topped while still in the ground, and beet and tops are delivered into separate windrows. No elevator chains or rollers are used, thus considerably reducing the wear from soil abrasion. Work in progress for the production of a simple machine for assisting in the harvesting of a variety of root crops such as swedes, mangolds, carrots or potatoes was also demonstrated, while the provision of an efficient potato digger suitable for the small grower was a further proposition undergoing investigation. The main exhibit in the plough section was a mounted one-way 3-furrow plough designed and built at the Institute. This 'reversible' type requires less skill in operation, leaves a level field without ridges or open furrows, and when direct-mounted should effect considerable saving in time and fuel. Combine harvesters have introduced problems of handling, drying and storing grain in bulk, and much research work at the Institute has been devoted to their solution. Among the range of machinery shown for use in conjunction with a small combine, were installations for the drying of grain by ventilation with slightly heated air during storage, and a modified form of the automatic drier that was a feature of the exhibit of last year.

### Additions to the Irish Flora, 1939-45

SINCE the publication by Lloyd Praeger of "Irish Topographical Botany" in 1901, there have been seven supplementary papers which have kept our knowledge of the distribution of higher plants in Ireland up to date; the eighth of these (*Proc. Roy. Irish Acad.*, 51 B, (3), 27; 1946) is, as Dr. Praeger says, probably the last which will be published under his own name. Nevertheless, the number of records bearing a sign indicating that the author himself had seen either a plant in its locality or a specimen from there, is a remarkable tribute to the energy and capability of a botanist who has passed his eightieth year. The present paper contains first records for the forty vice-counties together with extensions and diminutions in the areas of interesting species. Unlike earlier lists, 'introduced' species are included. Of especial interest are the remarks concerning the North American *Myriophyllum alterniflorum* var. *americanum* and the South American *Margyricarpus setosus*, while the known ranges of such species as *Erica vagans*, *Sisyrinchium angustifolium*, *Naias flexilis*, *Eriocaulon septangulare* and several others show interesting extensions. The difficult species of *Allium* are elucidated, and the nomenclature of those species of *Hieracium* and *Euphrasia* which occur in Ireland are revised according to the schemes of Pugsley. The paper is concerned, too, with suggestions as to areas in which certain species and hybrids should be sought, indicating that the author, although a veteran, is still alive to future possibilities. This is shown, too, by his continued emphasis on the necessity for a *biological* survey by geologists, botanists and zoologists

of the extremely interesting Lough Neagh, where he is convinced that such a team would reap a rich harvest.

### The Indian Forest Research Institute

THE annual report of the Forest Research Institute, Dehra Dun, for 1942-43 increasingly shows how the work continued to be interrupted by the War and its demands (*For. Res. Inst. Public.*, Vasant Press, Dehra Dun, 1945). The report, it is of interest to mention, is printed on paper made in the Paper Pulp Section of the Forest Research Institute from saplings of *Pinus longifolia* from forests not so very far distant. The first chapter of the report summarizes the work of the different branches, the remaining chapters giving the reports of the year's work by each branch. Most of the branches had to suspend all their ordinary work to deal with urgent demands of the Fighting and Civil Forces, the exceptions being botany and silviculture, though the rubber scarcity and search for supplies provided work for both of them. It is a curious fact that the individual 'branches' of a research institute acquire the habit of working in water-tight compartments. Dehra Dun was no exception. The president, Sir Herbert Howard, writer of this report, deplors this fact of the past and says that the War has forced co-operation upon the branches and sections, with valuable results, which it may be hoped will be maintained to the benefit of the Institute. Where all branches have been more or less closely engaged upon war-time research, reference to the report must be made for details.

It is remarkable that the so-called minor forest products of India have never received their recognition in the Institute as a separate branch with an officer in charge. Their importance and effect on India and its commerce can still be only suspected. For example, during the year 1942-43, among other things, a source of pectin from tamarind seeds which had previously been wasted was developed. This pectin gives excellent material for jellies, and its further development has given a gum of the tragacanth type which is the only material at present available for creaming rubber latex, for which it is entirely suitable. It has also been successful as a sizing material for textiles. The commercial possibilities of this are said to be very great. Suitable species for producer gas, and an investigation into various species as sources of rubber production has also occupied the activities of the branch.

### Archæology of the Illinois River Valley

A REPORT, upon work done under the auspices of the University of Illinois in 1928, deals with the archæology of a small part of that State (*Trans. Amer. Phil. Soc.*, 32, Part 1: "Contributions to the Archæology of the Illinois River Valley". By Frank C. Baker, James B. Griffin, Richard G. Morgan, Georg K. Neumann and Jay L. B. Taylor. Edited by James B. Griffin and Richard G. Morgan. Pp. iv + 208 + 68 plates. Philadelphia: American Philological Society, 1941). Excavations were made in a number of mound-groups, and a village site was reconnoitred. Most of the mounds belong to the comparatively well-known Hopewell mound-building culture, a single mound-group belongs to a later phase, the Middle Mississippi, and the village site and one mound are ascribed to the Woodland-culture pattern, probably later still. The second part of the



report is devoted to a study of the fauna associated with the sites, and the third to some skulls from the Woodland-culture mound. The value of the report lies in supplementing our information about the distribution of the cultures found, and is enhanced by a map and classified list of archaeological sites in Illinois at the beginning. It would have been easier to follow had the descriptions of sites been arranged in some intelligible kind of order, segregating those of various cultures. The introduction says that it was impossible to include the maps and diagrams of the sites; the inclusion of at least some of them would undoubtedly have been an advantage.

### Mineral-insulated Metal-sheathed Conductors

IN a recently published paper (*J. Inst. Elec. Eng.*, 93, Part 2, No. 34, Aug. 1946), Messrs. F. W. Tomlinson and H. M. Wright discuss the development and uses of metal-sheathed conductors employing as insulating medium highly compressed magnesium oxide powder. In consequence of the high-temperature stability and the good insulating properties of this material, these conductors have found wide application as electrical heating elements in radiant boiler-plates and as power supply cables in circumstances where the avoidance of fire-risk is of special importance, or where the ambient temperature or atmospheric conditions are too severe for other types of electric cable. The low dielectric loss exhibited by magnesium oxide at very high frequencies, combined with the other advantageous characteristics mentioned, has enabled specially designed cables to be used for certain important radar purposes.

### Status of Translations and Translators

IN his pamphlet "On Translations", reprinted from *Life and Letters*, Sir Stanley Unwin directs attention to some of the problems arising in translation from one language to another, and to inadequacies and inaccuracies still encountered, although during the past forty years the quality of translations into English and the status of translators have steadily improved (London: Allen and Unwin, Ltd. Pp. 8. 6d. net). Sir Stanley emphasizes that first and foremost the translator should be adequately paid, and payment for translation should be a first charge, taking precedence over the author's remuneration. The translator's name should always be given, provided it is his (or her) exclusive work, and it should be a universal practice to print, on the back of the title-page of any translation, the title of the original work. The best remedy for mistranslation and for deliberate tampering with the text is informed criticism; bad translations should be denounced. Authors should help by giving preference to publishers who take pride in the quality of their translations and maintain a high standard; but while the publication of translations is in general more speculative than the issue of original work, Sir Stanley does not agree that the publication of translations should be financed by governments. If, however, for commercial reasons any work of outstanding importance had remained untranslated for, say, five years, governments would be well advised to offer to bear the cost of translation, if a publisher was willing in that event to produce the work at his own risk and expense. The pamphlet also includes some notes on "Our Universal Language", which stress the importance of the new demand for British books.

### Museums of To-morrow

DR. D. A. ALLAN'S presidential address on the occasion of the Museums Association's annual conference at Brighton this year is reported in full in the *Museums Journal* of August. Under the title, "Museums—*Mutatis Mutandis*", Dr. Allan advocates more teaching in the museum and less congestion of exhibits, and he is of the opinion that museums should not strive to increase already immense collections. "To perform its function adequately," he says, "each museum, large or small, must adopt a plan and work it out. It is not enough merely to tidy-up a museum; it must be put into working order; it must show less and teach more." He also appeals for the establishment of special museums to demonstrate the history and applications of British mechanical invention and engineering, mining and agriculture, and looks for the further development of folk museums so that there may be one to each distinctive region of the British Isles.

### Economics of International Trade

IN Pamphlet No. 7, "International Trade", in the "Looking Forward" series issued by the Royal Institute of International Affairs, G. A. Duncan points out first that international trade between two countries really means a multitude of independent transactions linked by nothing more serious than the accident that their participants happen to live in two politically defined areas; hence, while all the problems, spurious as well as real, would still be there if the world was politically unified, they would not be linked up with political units and political power. He then attempts to set out the nature of the principal questions that arise on the assumption that one State, one supreme political government, embraces the whole earth. The complications introduced by the existence of sixty-odd sovereign and independent States are then considered, and the conditions precedent to the revival and growth of international trade in the post-war world are indicated. International trade, Mr. Duncan argues, consists of an economic substratum overlaid by a political scum. The economic reality is that the real welfare of the world's human population is a function of the optimum use of its diversified resources—mineral, vegetable, animal and human—under contemporary conditions of technical knowledge.

The optimum pattern, according to Mr. Duncan, is not a matter of merely technical comparison, but of economic balancing, taking into account differing valuations of resources in differing areas, and the correct distribution can only be determined by the empirical method of competition, which continually presents the dilemma of choice between immediate, localized and vocal loss, and more distant, diffused and inarticulate gain. The competitive process can only yield its dividends when it is allowed to proceed so far as possible on economic grounds. The political scum consists of the arbitrary importance attached to trade crossing political frontiers and to the significance of partial calculations about its component elements; the tendency to think of international trade as trade between definable political entities instead of an arithmetical accident; and the invasion of economic problems by notions of political power and prestige. The problem for economic statesmanship in the next few years, he concludes, is that of working out by common agreement a form and extent of political impositions upon international



trade that will inhibit its growth as little as possible, while satisfying all reasonable political desires.

### Bibliography of Seismology

THIS valuable bibliography is being continued by Dr. Ernest A. Hodgson; *Pub. Dominion Observ., Ottawa*, 13, Nos. 16, 17 and 18, comprise items 5788-6046. The bibliography is concerned with publications in pure and applied seismology and other subjects having a direct bearing on seismological problems. It is pleasing to see notes of Russian work, much of which was done during the War. One such is by E. E. Petrenko, "A Net of Co-ordinates for Determining the Epicentre of an Earthquake" (*Akademiia Nauk, U.S.S.R., Trudy Seismolog. Inst.*, No. 106, 12-16, Moscow, 1941). This is in Russian, but it has been translated by W. Ayvazoglu and V. Skitsky for *Geophysical Abstracts*. Greek work is largely centred on the collected papers of Prof. N. A. Critikos, published by his colleagues on the occasion of the thirty-fifth anniversary of his scientific work (Item 5901). An especially important piece of American work is listed as Item 5956, by D. S. Carder, "Seismic Investigations in the Boulder Dam Area 1940-41, and the Influence of Reservoir Loading on Local Earthquake Activity" (*Bull. Seis. Soc. Amer.*, 35, No. 4, 175-192, Oct. 1945). This work has been particularly successful in locating epicentres of small shocks and associating them with fault planes. It may easily have far-reaching results on reservoir engineering. Considerable useful work has been done in New Zealand; for example, Item 5980, by W. M. Jones, refers to three papers, including "Determination of Epicentres in the South Pacific from Differences in the Arrival Times of ScS" (*N.Z. J. Sci. and Tech.*, 26, No. 6B, 366-369). This paper shows that there is less ambiguity in epicentral determination using ScS pulses than when using P pulses in certain cases owing to less variation caused by the depth of focus. British work is mentioned, including Item 5862, Prof. H. H. Plaskett's tribute to the seismological work of Miss E. F. Bellamy; Item 5880, Sir George Simpson's tribute to the work of the late Dr. F. J. W. Whipple; and Item 5930, by Dr. R. Stoneley, "Earthquakes" (*Observ.*, 66, No. 824). There is also a list of references published in *Nature*.

### University of London: Appointments

THE following appointments have been made: Dr. C. A. Hart, to the University chair of surveying and photogrammetry tenable at University College as from October 1; in 1927 he became assistant lecturer in the Department of Municipal Engineering and Hygiene at University College, and during 1942-46 he was officer in charge of research, Directorate of Military Survey, War Office; Dr. C. V. Harrison, to the University readership in morbid anatomy tenable at the British Postgraduate Medical School as from October 1, 1946; Dr. Harrison was formerly lecturer in pathology in the University of Liverpool, and since 1944 has been chief pathologist to the Ministry of Supply and chief consultant in pathology to the Admiralty.

The following doctorates have been conferred: *D.Sc.*: Mr. W. E. Duncanson, recognized teacher of University College; *D.Sc.(Eng.)*: Dr. Harold Heywood, Imperial College of Science and Technology; *D.Sc.(Econ.)*: Mr. K. H. L. Key, Institute of Education.

### Re-opening of the British Museum (Natural History)

THOSE portions of the British Museum (Natural History) that have been restored have been re-opened to the public. The hours of opening are 10 a.m.-6 p.m. on weekdays, and 2.30 p.m.-6 p.m. on Sundays. The Museum suffered considerably from bomb-blast and fires resulting from air raids during the War. Little or no irreplaceable material was lost, as all the most valuable specimens had been evacuated to places of safety. But the Botanical and Shell Galleries were destroyed (the latter fortunately being empty at the time), and in many of the galleries exhibits were damaged, notably those of birds and mammals in the Western Wing. The Museum has been re-opened as soon as the minimum of essential repairs could be completed, but as yet the public can be admitted to only a few of the galleries on the ground floor, namely, the Central and North Halls, the Fish Gallery, the Insect Gallery, the Reptile Gallery and the Whale Hall. Selections of specimens from the more seriously damaged parts of the exhibition are on view temporarily in these galleries. As the work of repair and reconstruction proceeds, more galleries will become available for exhibition purposes and will be re-opened.

### Announcements

PROF. C. H. LANDER, who has just retired from the chair of mechanical engineering at the City and Guilds College, University of London (see *Nature*, August 10, p. 191), has been appointed dean of the Military College of Science.

DR. JACOB BAKKER, of the Netherlands State Coal-mines, has joined the National Coal Board in Great Britain as adviser to the chief mining engineer. He is widely recognized throughout the coal-fields of Europe as a leading expert on 'horizon mining', that is, driving main roadways straight out from the pit-bottom and working the coal wherever it is struck.

DR. FRANK BELL, principal of Lancaster Technical College since 1941, has been appointed professor of chemistry at the Belfast College of Technology in succession to Dr. Henry Wren. Dr. Bell has held previous appointments at the Wellcome Chemical Research Laboratories, Blackburn Technical College and Battersea Polytechnic.

A David Anderson-Berry Silver-Gilt Medal, together with a sum of money amounting to about £100, will be awarded during 1947 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the therapeutical effect of X-rays on human diseases. Applications for this prize are invited. They may be based on both published and unpublished work and should be accompanied by copies of the relevant papers. Applications must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, not later than January 31, 1947. It should be noted that an extension of the period allowed for the receipt of papers has been made.

ERRATUM. The "wonderful one-hoss shay" referred to in *Nature* of October 19, p. 537, was wrongly attributed to Longfellow; the phrase comes from Oliver Wendell Holmes' "The Deacon's Master-piece".



## LETTERS TO THE EDITORS

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

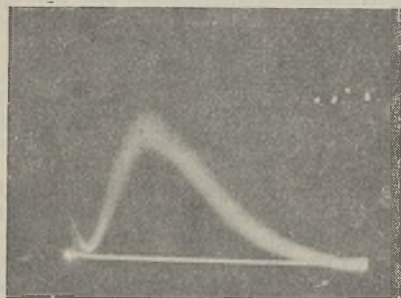
## Observation of Spectral Lines with Electron Multiplier Tubes

CONSIDERABLE interest has been shown within the last two or three years in technical developments relating to spectroscopic analysis. Since the advent of several new controlled sources<sup>1,2</sup>, including a circuit devised by Mr. C. J. Braudo, in this Laboratory and recently described briefly<sup>3</sup> (a full communication has been prepared), great importance has become attached to observations of any residual fluctuations in spectral-line intensities, because the irregularities in breakdown voltage of the test gap have been almost entirely eliminated by these new circuits.

A descriptive paper, giving details of multiplier observations of certain dynamic gas discharge effects, has recently appeared<sup>4</sup>, and was followed by details of a multiplier technique for spectroscopic analysis<sup>5</sup>. It is therefore considered worth while to give a short summary of the experiments carried out in this Laboratory since 1943.

The development of reliable sealed-off triggered spark gaps<sup>6</sup> enabled us to use controlled spark sources for spectroscopic and other experiments some three years ago. Despite the accurate repetition of breakdown voltage and current (observed oscillographically) in the spark discharges then used, it was noticed that considerable fluctuations in light emission from argon spark discharges occurred<sup>7,8</sup>.

This work led to several developments: among them were (a) the more refined spectroscopic source unit<sup>3</sup>, (b) work on the accurate determination of ion concentrations in hydrogen spark discharges<sup>9,10</sup>, and (c) some new observations of the excitation of metal electrode vapour in spark discharges.



The accompanying typical record for the Cd line 5085 Å. is a photographic reproduction of the oscillograph screen. The vertical axis gives line intensity, using the amplified current from an electron multiplier excited from the sparks via a spectrometer, while the time axis is horizontal. The pulse is about 4 microsec. long, and is therefore that of a pure spark source. The circuit<sup>3</sup> mentioned above provides, if required, a follow current to give a discharge of arc type. Some preliminary multiplier measurements with this compound source were made early in 1946 and are to be extended.

We have observed fluctuations in the intensities of electrode vapour spectral lines (the thickness of the trace in the trace reproduced compared with that of

the zero line is illustrative) which do not appear to be explicable on the grounds of circuit variations from spark to spark, and it appears possible that these fluctuations (now being studied) are linked with those observed in 1943<sup>7</sup> for purely gaseous (argon) discharges.

J. D. CRAGGS  
W. HOPWOOD

High Voltage Laboratory,  
Research Department,  
Metropolitan-Vickers Electrical Co., Ltd.,  
Manchester, 17.  
Sept. 11.

<sup>1</sup> Hasler, M. F., and Dietert, H. W., *J. Opt. Soc. Amer.*, 33, 218 (1943), and references there cited.

<sup>2</sup> Walsh, A., *Bull. British Non-Ferrous Metals Res. Assoc.*, No. 201, 60 (March 1946).

<sup>3</sup> Braudo, C. J., and Clayton, H. R., *Nature*, 157, 622 (1946).

<sup>4</sup> Dieke, G. H., Loh, H. Y., and Crosswhite, H. M., *J. Opt. Soc. Amer.*, 36, 185 (1946).

<sup>5</sup> Dieke, G. H., and Crosswhite, H. M., *J. Opt. Soc. Amer.*, 36, 192 (1946).

<sup>6</sup> Craggs, J. D., Haine, M. E., and Meek, J. M., *J. Inst. Elec. Eng.*, in the press.

<sup>7</sup> Meek, J. M., and Craggs, J. D., *Nature*, 152, 538 (1943).

<sup>8</sup> Craggs, J. D., and Meek, J. M., *Proc. Roy. Soc., A*, 193, 241 (1946).

<sup>9</sup> Craggs, J. D., and Meek, J. M., *Nature*, 153, 21 (1945).

<sup>10</sup> Craggs, J. D., and Hopwood, W., to be published shortly.

## Changes in Cosmic Ray Intensity Associated with Magnetic Storms

It is usually supposed that the world-wide changes in cosmic ray intensity associated with a magnetic storm are due to variations in the earth's magnetic field produced during the storm. This seems to be excluded, however, by recent observations by Lange and Forbush<sup>1</sup>, who have found that the intensity varies (decreases and increases) even at Godhavn, which is situated at so high a geomagnetic latitude (80°) that the earth's magnetic field cannot possibly affect the intensity. Further, the variations cannot be due to changes in the solar magnetic field, because they are observed even at Huancaayo, which has a low geomagnetic latitude (0.6°) so that it is reached only by the high-energy particles which are certainly not influenced by the solar magnetic field. Then the only possible explanation seems to be that the variations in cosmic radiation are due to changes in the earth's electrostatic potential.

There are strong arguments in favour of the view that magnetic storms are caused by ionized clouds emitted from the sun. As the time of travel from the sun to the earth is about one day, their average velocity is of the order of  $1.5 \times 10^{13} / 0.864 \times 10^5 = 2 \times 10^8$  cm./sec. The solar magnetic field at the distance of the earth is likely to be  $3 \times 10^{-6}$  gauss (assuming a dipole field with about 50 gauss at the pole). Any electrical conductor (and the ion cloud is certainly conducting), which moves in a magnetic field, becomes polarized, the electric field strength being  $E = vH/c$ , which in our case gives  $3 \times 10^{-6} \times 2 \times 10^8 / 3 \times 10^{10} = 2 \times 10^{-8}$  E.S.U. = 6 μvolt/cm. As storms often endure for, say, two days, the breadth of an ion stream emitted from the sun (and sharing the solar rotation, as shown by the 25-day recurrence of storms) should be  $2/25 \times 2\pi \times 1.5 \times 10^{13}$  cm. at the distance of the earth ( $1.5 \times 10^{13}$  cm.). This means that there must be a difference in potential between the two sides of the stream of  $6 \times 10^{-8} \times 8 \times 10^{12} = 50 \times 10^6$  volts, the east (advancing) side being negative. As indicated by a



theory of magnetic storms<sup>2</sup> proposed some years ago and by recent model experiments by Malmfors<sup>3</sup>, the electric field strength during a storm may be considerably greater, so that potential differences of some hundred megavolts, in exceptional cases still more, would be possible. But even the above value (50 MV.) is no doubt enough to affect the cosmic radiation appreciably. As the earth quickly attains about the potential of the stream, it would be negative in the beginning and positive at the end of a storm, resulting in an increase and later a decrease of cosmic radiation. This seems to be in general accord with what is observed.

Near other stars the same mechanism may give rise to still higher differences in potential. This is of interest with regard to the point of view<sup>4</sup> according to which the cosmic radiation may be generated in electric fields produced by magnetic induction.

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Sept. 28.

<sup>1</sup> Lange and Forbush, *Terr. Mag.*, 47, 331 (1942).

<sup>2</sup> Alfven, H., *Kungl. Svenska Vet. Akad.*, Handlingar III, Bd. 18, No. 3 (1939); No. 9 (1940).

<sup>3</sup> Malmfors, K. G., *Arkiv. för mat. astr. fysik.*, Bd. 34, B, No. 1 (1946).

<sup>4</sup> Alfven, H., *Z. Phys.*, 107, 579 (1937); *Nature*, 143, 435 (1939).

### Dielectric Dispersion in Crystalline Di-isopropyl Ketone

DIPOLAR rotation is well known to occur in a number of organic crystals, for example, *d*-camphor<sup>1</sup> and cyclopentanol<sup>2</sup>, and in ice<sup>3,4</sup> far below the melting point. The dielectric behaviour of these substances is remarkable in that solidification is only shown as a minor discontinuity of the polarization curve, and it may be said that such compounds do not freeze dielectrically at their macroscopic freezing point. In some cases, dipolar rotation stops at a transition taking place at a lower temperature. Whether or not dispersion is observed in the crystalline state should depend on the frequency used.

It appears to be interesting that the dipolar rotation in crystalline di-isopropyl ketone, found in the course of another investigation, presents a different picture. Fig. 1 gives its dielectric constant  $\epsilon'$  at two frequencies, and Fig. 2 the loss factor  $\epsilon''$  at three frequencies, measured by a resonance method, details of which have been given elsewhere<sup>5</sup>. The sample was fractionated under nitrogen, b.p. + 123° C.,  $n_D^{17.5} = 1.4107$ , but it was found that its dielectric properties were little different from the untreated commercial product. The substance melts between -72.5° and -73.5° C. When approaching this point from higher temperatures,  $\epsilon'$  and  $\epsilon''$  increase, the rise of  $\epsilon''$  indicating incipient anomalous dispersion. The liquid supercools generally to about -80°, and crystallization is accompanied by a sharp drop of the dielectric constants; but  $\epsilon'$  falls to a value appreciably higher than is expected in a crystalline solid (that is, about  $n^2$ ) and depends on the frequency. The reason for this frequency dependence is the occurrence of anomalous dispersion in the crystalline state shown by the peaks of  $\epsilon''$  in Fig. 2 and by the sigmoid shape of the  $\epsilon'$ -curves in Fig. 1. The dielectric constant  $\epsilon'$  assumes its final value of about 2.4 on the low-temperature side of the dispersion range.

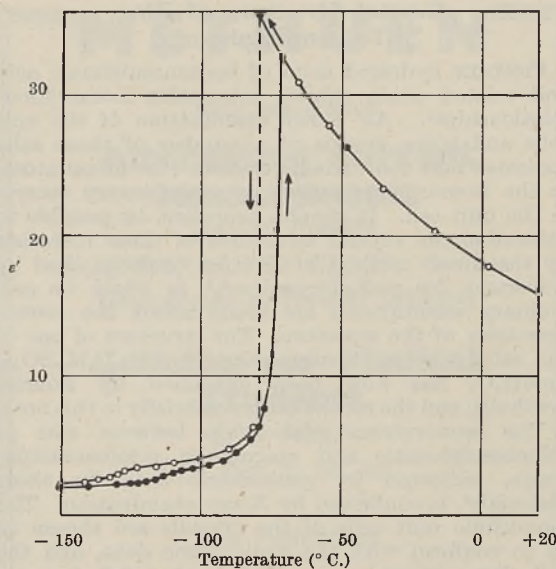


Fig. 1. DIELECTRIC CONSTANT,  $\epsilon'$ , OF DI-ISOPROPYL KETONE: —○—, at 1.12 Mc/s.; —●—, at 20.4 Mc/s.

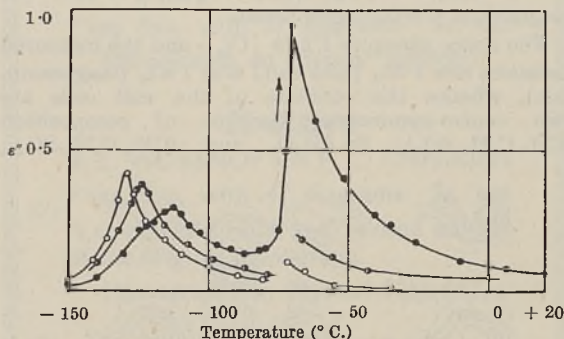


Fig. 2. LOSS FACTOR,  $\epsilon''$ , OF DI-ISOPROPYL KETONE: —○—, at 1.12 Mc/s.; —●—, at 4.4 Mc/s.; and —●—, at 20.4 Mc/s.

Measurements made at rising temperature give a gradual increase both of  $\epsilon'$  and  $\epsilon''$  just below the melting point until the points coincide with those taken at falling temperature. Müller<sup>6</sup> found this pre-melting effect on  $\epsilon'$  in two straight ketones of higher molecular weight but no dispersion in the crystalline material.

In contradistinction to the substances mentioned above, the crystallization of di-isopropyl ketone has a profound influence on the polarization, and there is no sign of another transition below the melting point. It is tentatively suggested that branching of the molecule causes a crystal lattice somewhat looser than that of straight ketones and reduces the intramolecular forces sufficiently to allow restricted molecular rotation.

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Herts. Sept. 30.

<sup>1</sup> White and Morgan, *J. Amer. Chem. Soc.*, 57, 2079 (1935).

<sup>2</sup> White and Bishop, *J. Amer. Chem. Soc.*, 62, 8 (1940).

<sup>3</sup> Smyth and Hitchcock, *J. Amer. Chem. Soc.*, 54, 4631 (1932).

<sup>4</sup> Wintch, *Helv. Phys. Acta*, 5, 126 (1932).

<sup>5</sup> Schallamach, *Trans. Farad. Soc.*, 42, 495 (1946).

<sup>6</sup> Müller, *Proc. Roy. Soc., A*, 158, 403 (1937).



### Crystal Structure of Zinc *p*-Toluenesulphonate

CERTAIN hydrated salts of benzenesulphonic acid and related acids exhibit interesting isomorphous relationships<sup>1</sup>. An X-ray examination of the unit cells and space groups of a number of these salts indicates that the variable element (the metal atom) in the isomorphous series lies at symmetry centres in the unit cell. It should, therefore, be possible to determine the crystal structures of these materials by the direct method of Fourier synthesis used by Robertson for phthalocyanines<sup>2,3</sup>, in which no preliminary assumptions are made about the stereochemistry of the structure. The structure of one of the salts, zinc *p*-toluenesulphonate,  $(\text{CH}_3\cdot\text{C}_6\text{H}_4\cdot\text{SO}_3)_2\text{Zn}\cdot 6\text{H}_2\text{O}$ , has now been examined by Fourier synthesis, and the results are given briefly in this note.

The isomorphous relationship between zinc *p*-toluenesulphonate and magnesium *p*-toluenesulphonate, indicated by goniometric data for these materials<sup>4</sup>, is confirmed by X-ray examination. The monoclinic unit cells of the crystals are chosen so as to conform with the goniometric data, and the cell dimensions are  $a = 25.3 \text{ \AA}$ ,  $b = 6.2 \text{ \AA}$ ,  $c = 6.9 \text{ \AA}$ ,  $\beta = 88.5^\circ$  for zinc *p*-toluenesulphonate, and  $a = 25.2 \text{ \AA}$ ,  $b = 6.2 \text{ \AA}$ ,  $c = 6.9 \text{ \AA}$ ,  $\beta = 88.1^\circ$  for magnesium *p*-toluenesulphonate.

The space group is  $P2_1/n$  ( $C_{2h}^2$ ), and the measured densities are 1.55<sub>1</sub> (zinc salt) and 1.42<sub>0</sub> (magnesium salt), whence the contents of the unit cells are two centro-symmetrical groups of composition  $(\text{CH}_3\cdot\text{C}_6\text{H}_4\cdot\text{SO}_3)_2\text{Zn}\cdot 6\text{H}_2\text{O}$ , and  $(\text{CH}_3\cdot\text{C}_6\text{H}_4\cdot\text{SO}_3)_2$

$\text{Mg}\cdot 6\text{H}_2\text{O}$ , respectively, with the metal atoms situated at symmetry centres.

Fig. 1 is a contour map showing the projection of the electron density of zinc *p*-toluenesulphonate along the direction of the *b* axis. Fig. 2 is deduced from Fig. 1 and represents the structure of zinc *p*-toluenesulphonate projected along the *b* axis [010]. The projected electron density has been calculated by the summation of a two-dimensional Fourier series of 165 terms. The relative phases of the Fourier terms have been determined experimentally<sup>2</sup>, by comparing the measured structure amplitudes for corresponding reflexions from zinc *p*-toluenesulphonate and magnesium *p*-toluenesulphonate.

All the atoms in zinc *p*-toluenesulphonate can be clearly identified in Fig. 1, with the exception of one oxygen atom, ( $\text{O}_I$ ), of the sulphonate group. The peak identified as the sulphur atom is nearly circular, but rises to a considerably greater height than may be expected for a sulphur atom alone, suggesting that the oxygen atom  $\text{O}_I$  is directly superimposed on the sulphur atom. This interpretation is supported by the observation that the projected positions of the atoms  $\text{O}_I$ ,  $\text{O}_{II}$ ,  $\text{O}_{III}$ ,  $\text{C}_I$  are consistent with a regular tetrahedral distribution of these atoms about the sulphur atom. It is noted also that the distribution of water molecules in Fig. 1 is consistent with a regular octahedral grouping of six water molecules about each zinc atom.

It is necessary to determine the third co-ordinate of each atom before precise details of the stereochemistry of the structure can be given, and work is now proceeding with this end in view.

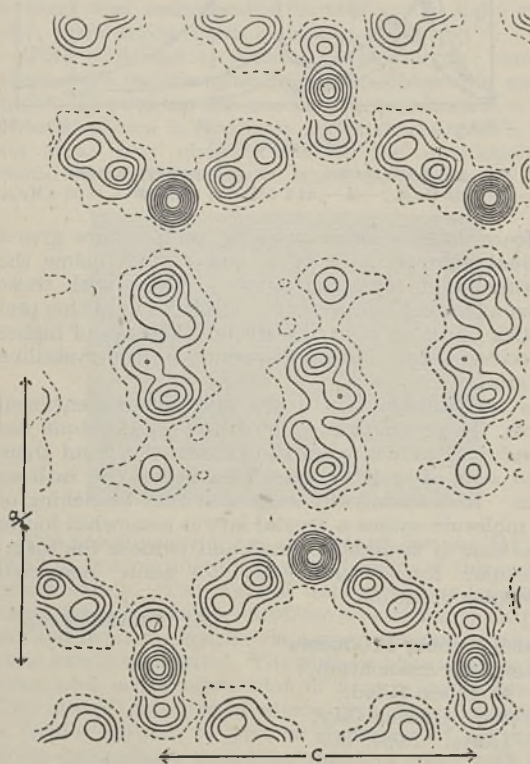


Fig. 1. ELECTRON DENSITY IN ZINC *p*-TOLUENESULPHONATE PROJECTED ALONG THE *b*-AXIS [010]

The contour lines enclosing the zinc atom and the (sulphur + oxygen I) group are drawn at intervals of 8 electrons per  $\text{\AA}^3$  and 4 electrons per  $\text{\AA}^3$  respectively; the remaining contours are drawn at intervals of 2 electrons per  $\text{\AA}^3$ , and the 2-electron line is dotted

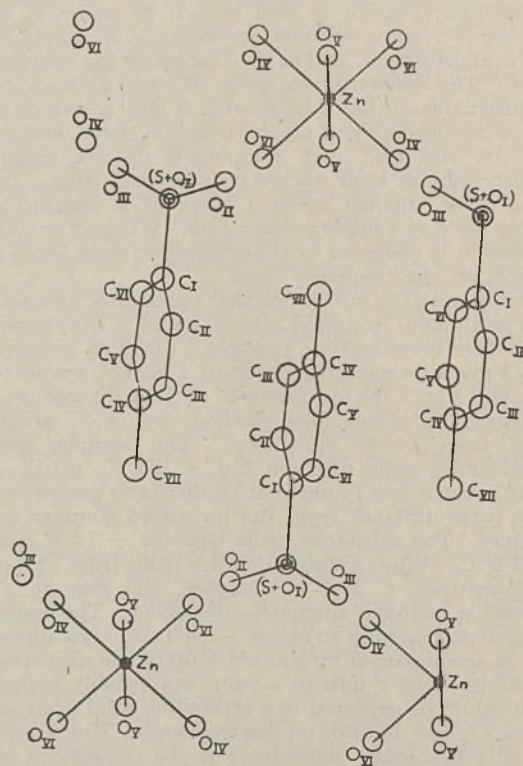


Fig. 2. THE PROJECTION, OVER THE AREA COVERED BY FIG. 1, OF THE STRUCTURE OF ZINC *p*-TOLUENESULPHONATE ALONG THE *b*-AXIS [010]





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Applications are invited for a post as Lecturer in Chemistry. The Lecturer will be required to be specially qualified in Physical Chemistry. Salary £550, rising by £25 every year to £650 and then, if the appointment is renewed, £700, with superannuation provision under the Federated Superannuation Scheme for Universities, and family allowance.

Applications (four copies), including the names and addresses of referees, and, if desired, copies of testimonials, should reach the undersigned (from whom further particulars may be obtained) by November 16, 1946.

A. W. CHAPMAN,  
Registrar.

**THE UNIVERSITY OF SHEFFIELD**

Applications are invited for a post of senior Lecturer in Physiology. Salary £750, rising by £50 every two years to £1,000, with superannuation provision under the Federated Superannuation Scheme for Universities, and family allowance.

Applications (four copies), including the names and addresses of referees, and, if desired, copies of testimonials, should reach the undersigned (from whom further particulars may be obtained) by November 16, 1946.

A. W. CHAPMAN,  
Registrar.

**UNIVERSITY OF CAPE TOWN  
SENIOR LECTURER IN PHYSIOLOGY**

Applications are invited for the post of senior lecturer in the Department of Physiology. The salary scale is £675 × £25-£775 per annum. The lecturer will be required to teach in practical classes of human and experimental physiology, and to take part in the routine lecturing of the department. He will also be expected to do research work. He must have scientific qualifications in Physiology. A medical qualification would be a recommendation. Applications from serving personnel and ex-volunteers will receive special consideration and applicants are advised to give details of their military and other national service.

Write quoting G.83 to Ministry of Labour and National Service, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for application forms which must be returned completed by December 12, 1946.

**HUDDERSFIELD TECHNICAL  
COLLEGE**

Principal: Dr. W. E. SCOTT, M.B.E.  
RESEARCH SCHOLARSHIPS

Applications are invited from graduates or candidates with equivalent qualifications for Research Scholarships tenable for two or more years. The Scholarships vary in value from £100 to £150 per annum and are tenable in the Department of Coal Tar Colour Chemistry and/or other Departments of the College. The Scholarships are open to candidates of either sex.

Further particulars may be obtained from the Principal.

H. KAY,  
Director of Education.

**UNIVERSITY COLLEGE OF HULL**

Four Research Assistants required for routine analysis, etc., as members of a team studying plankton ecology in relation to the fisheries. The appointments will be in the scale approved by H.M. Treasury for Assistant Experimental Officers (£140-£320 plus bonus, according to age, with degree allowance), and candidates should at least have obtained Higher School Certificate (or its equivalent) with biological qualifications. Application, with two references or testimonials, should be made within 14 days of this date to the Head of the Department of Oceanography, University College, Hull.

**ROYAL VETERINARY COLLEGE  
AND HOSPITAL**

Demonstrator in Biology required for Department of Anatomy. The appointment will be in the first place for one year, renewable yearly for a maximum of three years subject to satisfactory service. Salary range £300 × £20 to £500 p.a. Initial salary according to qualifications and experience. Applications with not more than three recent testimonials to the Bursar, Royal Veterinary College and Hospital, Royal College Street, London, N.W.1, as soon as possible.

**THE UNIVERSITY OF LEEDS**

Applications are invited for the following posts in the Department of Inorganic and Physical Chemistry, viz.: Lecturer, on the scale £550-£900 a year; Assistant Lecturer, on the scale £400-£450-£25-£500. Preference will be given to candidates with a knowledge of, or interest in, X-ray structure analysis and/or the chemistry of the solid state. Further particulars on application to the Registrar, University, Leeds 2. The last date for the receipt of applications is November 30, 1946.

**UNIVERSITY OF LONDON**

A lecture entitled "Some Aspects of the Pathology of the Pneumococcosis" will be given at the London School of Hygiene and Tropical Medicine (Keppel Street, Gower Street, W.C.1) at 5.30 p.m. on Friday, November 8, 1946, by Professor A. Pollicard (Professor in the Faculty of Medicine of Lyons). The Chair will be taken by Professor E. J. King, Ph.D., M.A. (Professor of Chemical Pathology in the University of London). Admission Free, without ticket.

JAMES HENDERSON,  
Academic Registrar.

**ROYAL HOLLOWAY COLLEGE  
(UNIVERSITY OF LONDON)**

Principal: Miss E. C. BATHO, M.A., D.Lit.  
The Lent Term commences on Wednesday, January 15, 1947. The College prepares women students for the London degrees in Arts and Science. Entrance Scholarships, varying in value from £40 to £80 a year, and several Exhibitions, all tenable for three years, will be offered for competition in January 1947. The last date for the receipt of entry forms is November 23, 1946. For further particulars apply to the Registrar, Royal Holloway College, Englefield Green, Surrey.

**THE UNIVERSITY OF LIVERPOOL**

Applications are invited for the following posts in the Department of Geography:—

- (i) Lecturer (Grade II);
- (ii) Assistant Lecturer (Grade III).

Applications stating age, academic qualifications, and experience, together with the names of three referees, should be received not later than November 22, 1946, by the undersigned, from whom further particulars of the conditions of appointment and salary scales may be obtained.

STANLEY DUMBELL,  
Registrar.

**KING'S COLLEGE OF  
HOUSEHOLD & SOCIAL SCIENCE  
(UNIVERSITY OF LONDON)**

CAMPDEN HILL ROAD, LONDON, W.8  
The College Council invites applications for the appointment of Principal, to take office in October 1947.

Further particulars may be obtained from the Secretary at the above address.

Completed applications should be received on or before January 1, 1947.

**UNIVERSITY OF LONDON**

A course of three lectures on Marine Geology will be given by Dr. Philip Kuenen (Professor of Geology, University of Groningen) at 5 p.m. on November 4, 5 and 6, in the Department of Geology of the Royal School of Mines (Imperial College, Prince Consort Road, S.W.7). Lecture I, Submarine Canyons. Lecture II, Atolls and Barrier Reefs. Lecture III, Rate and Mass of Deep Sea Sedimentation. Admission Free, without ticket.

JAMES HENDERSON,  
Academic Registrar.

**ANTI-LOCUST RESEARCH  
CENTRE**

Applications urgently invited for following vacancies:

1. Scientific Officer to run locust breeding laboratory with possibility of research. B.Sc. (honours in Zoology), and/or suitable experience. Commencing salary £353 (man), £338 (woman), or more according to age.
2. Technical Assistant in the locust laboratory. Higher School Certificate, or an equivalent, or suitable experience. Commencing salary £228 (man), £213 (woman), or more according to age.
3. Technical Secretary. Knowledge of general secretarial work (accounting not essential, clerical help provided); experience in bibliography and abstracting; working knowledge of some European languages; biological qualification desirable. Commencing salary £490 (man), £392 (woman).

All appointments on incremental scale and subject to F.S.S.U. Applications by letter to the Director, Anti-Locust Research Centre, British Museum (Natural History), London, S.W.7.

**HERIOT-WATT COLLEGE,  
EDINBURGH**

The Governors invite applications from British Subjects for appointments in the Chemistry Department, viz.: (1) Lectureship in Inorganic Chemistry, Salary Scale £400-£15-£595, (2) Lectureship in Fuel Technology, Salary Scale £450-£15-£685. A degree or equivalent qualification is essential and some teaching experience desirable. Candidates may be placed on the scale according to qualifications and experience. Further particulars and application form may be obtained from the Principal to whom applications must be submitted not later than November 15, 1946.

J. CAMERON SMAIL,  
Principal.

**CITY OF MANCHESTER  
EDUCATION COMMITTEE**

NEWTON HEATH TECHNICAL SCHOOLS  
PRINCIPAL: ARTHUR M. PARKINSON, B.Sc.(ENG.),  
M.I.E.E., M.I.Mech.E.

Applications are invited for the post of Assistant Teacher of Physics, mainly in the Secondary Technical School. Candidates should be graduates and should be prepared to undertake classes in elementary electricity and chemistry in addition to general physics. Salary will be in accordance with the Burnham Scale.

Application forms and conditions of appointment may be obtained (stamped, addressed foolscap envelope) from the Chief Education Officer, Education Offices, Deansgate, Manchester 3, to whom the completed forms should be returned by not later than November 9, 1946.

**THE ROYAL INSTITUTE OF  
CHEMISTRY OF GREAT BRITAIN  
AND 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 Organizations 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 Sq., London, W.C.1.

**CHELSEA POLYTECHNIC,  
LONDON, S.W.3**

DEPARTMENT OF MATHEMATICS

HEAD OF DEPARTMENT: A. E. LUDLAM, M.Sc.  
The Governing Body invite applications for the post of Senior Lecturer in Mathematics. Special qualifications in Applied Mathematics or Mathematical Physics are expected and the post offers considerable scope for advanced University work in these subjects. Research qualifications which will secure recognition as a Teacher of the University of London are required. Salary in accordance with the London Burnham (Technical) Scale for Senior Assistants, viz., £600-£25-£750 with London allowance and training additions.

Further particulars may be obtained from the Principal, Dr. F. J. Harlow, M.B.E. (stamped addressed foolscap envelope necessary), to whom applications should be submitted not later than Saturday, November 9.

**UNIVERSITY OF LONDON**

The Senate invite applications for the Readership in Mathematical Statistics tenable at Imperial College of Science and Technology (salary not less than £800). Applications must be received not later than November 26, 1946, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

**UNIVERSITY OF ABERDEEN**

ASSISTANTSHIP IN CHEMISTRY

Applications are invited for the post of Assistant in the Department of Chemistry with special qualifications in Physical or Organic Chemistry. Salary £400 or £450 according to qualifications and experience. Applications should reach the Secretary of the University (from whom further particulars may be obtained) not later than November 8, 1946.

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

**UNIVERSITY COLLEGE OF  
NORTH WALES, BANGOR**

A Laboratory Assistant is required as soon as possible in the Department of Botany. Salary £160 to £380 p.a. plus superannuation, according to qualifications and experience. For further particulars, apply to the undersigned.

F. P. G. HUNTER,  
Bursar.

**MEDICAL RESEARCH COUNCIL**

The National Institute for Medical Research, Hampstead, has a vacancy for a junior technician (age 21-26) in an organic chemical research laboratory. Salary scale £140-£15-£215 plus consolidated addition of £78 per annum for males and £62 for females. Apply, stating age and experience, to Administrative Officer, National Institute for Medical Research, Hampstead, London, N.W.3.

(Continued on page clvi)



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I am indebted to Messrs. Imperial Chemical Industries Limited (Dyestuffs Group) for supplying the crystals used in this investigation.

A. HARGREAVES

Physics Department,  
College of Technology,  
Manchester, 1.

<sup>1</sup> Groth, P. H., "Chemische Krystallographie", vol. 4, p. 297.

<sup>2</sup> Robertson, J. M., *J. Chem. Soc.*, 1195 (1936).

<sup>3</sup> Robertson, J. M., *J. Chem. Soc.*, 219 (1937).

<sup>4</sup> Weibull, M., *Z. Krist.*, 15, 234 (1889).

### Measurement of Thickness of Thin Films

TOLANSKY has shown in a recent series of papers<sup>1</sup> that interference fringes formed by multiple reflexion between highly reflecting surfaces can be applied with great effectiveness to the study of surface topography. Thus Tolansky has been able to detect abrupt changes of only 20 Å. in level in cleavage surfaces of mica. We have recently applied this technique to the determination of thickness of thin layers of gold, silica, collodion and 'Formvar', which are widely used for supporting and other purposes in electron microscopy.

A typical sample of the appropriate thin film is, in preference, prepared in contact with a smooth glass surface. The film is arranged to cover only a part of the plate so that an abrupt step of depth equal to the thickness of the film is present at some position on the surface. Such a step may be formed by any appropriate method, for example, by shading part of the glass plate in the case of films formed by evaporation or by using the natural boundary of a portion of film in the case of plastic films. The composite surface thus formed is coated with a thin layer (300–400 Å. say) of silver by evaporation *in vacuo*, and the silvered film placed in substantial contact with a similarly silvered second glass plate. Fizeau fringes are formed by the plates by using a collimated, filtered beam ( $\lambda = 5460$ ) from a high-pressure mercury-vapour lamp (Metrovick ME 250). The localized fringes are viewed in transmission with a low-power microscope and show in general smooth contours broken by an abrupt shift occurring at the film boundary. Fringe shifts of 1/200 of an order can be detected (that is, about 15 Å. in film thickness), and thus the method is suitable for the measurement of films of thickness 100 Å. and above.

The nature of the glass plates used in the apparatus merits some attention. Good quality sheet glass (for example, a lantern slide cover) proves particularly suitable, and indeed for smoothness of contour shape is superior to good quality optically worked glass. The reason for the superiority of sheet glass in this respect is presumably due to a small-scale smoothness of surface in 'fire-polished' glass that, as was anticipated, was absent in mechanically polished glass.

A typical photograph is reproduced of the fringe shift associated with a collodion film 390 Å. thick. We have successfully applied a similar technique to the measurement of evaporated films of silica and gold

(using reflected fringes in the latter case), and we have also measured the optical thickness and consequently the refractive index of silica and collodion films.

A. F. GUNN  
R. A. SCOTT

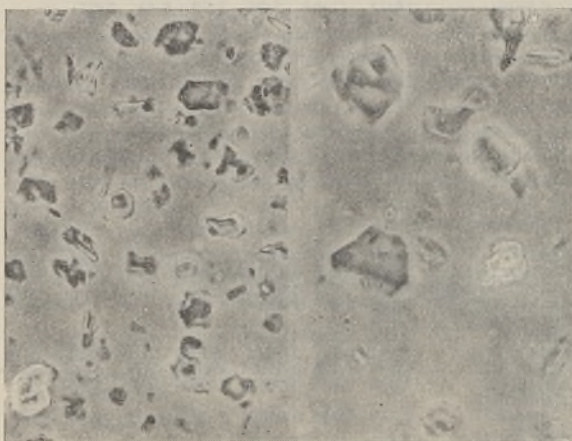
High Voltage Laboratories,  
Metropolitan-Vickers Electrical Co.,  
Manchester.

<sup>1</sup> Tolansky, *Proc. Roy. Soc.*, 184, 41 (1945); 186, 261 (1946) and earlier papers.

### Phase-Contrast Microscopy for Mineralogy

PHASE-CONTRAST microscopy has in recent years been applied to a number of biological problems<sup>1,2,3</sup>, but up to the present no results of its application to mineral substances appear to have been published. I recently suggested to Messrs. Cooke, Troughton and Simms, Ltd., that as they were preparing phase-contrast equipment for biological work, it would be of interest to determine whether the same methods would be of value in micro-mineralogy. As a test, they kindly allowed me to examine by this method some of my mineralogical slides, and from some they prepared photomicrographs.

In thin sections, the structures of rocks containing colourless minerals of similar refractive indices (for example, quartz and the feldspars) showed up very clearly with phase contrast; in these cases a further improvement in the image sometimes resulted from the use of a single 'Polaroid' filter placed in the beam. In Canada balsam mounts of china clays, the shapes of the larger particles were clearly seen. The photomicrographs reproduced here are sufficient indication that the technique represents a development which the mineralogist ought not to neglect.



× 90    × 180  
CRYSTALS OF KAOLIN, CORNWALL, PHOTOGRAPHED BY MEANS OF  
THE PHASE-CONTRAST MICROSCOPE

The phase-contrast equipment used in the above work consisted of a special condenser with annular diaphragms and a set of four objectives, giving magnifications of 10, 20, 40 and 95, each with its integral phase plate. The photographs reproduced above were taken with the lower-power objectives and a 12× eyepiece.

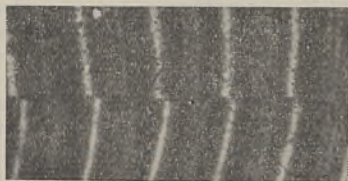
F. SMITHSON

20 Queens Road, Hartshill,  
Stoke-on-Trent.

<sup>1</sup> Burch, C. R., and Stock, J. P. P., *J. Sci. Instr.*, 19, 71 (1942).

<sup>2</sup> Richards, O. W., *Nature*, 151, 872 (1944).

<sup>3</sup> Brice, A. T., Jones, R. P., and Smyth, J. D., *Nature*, 157, 553 (1946).





### Viscosity of Associated Liquids

AN equation representing the temperature variation of the viscosity ( $\eta$ ) of water and lime soda glass has just been published by Douglas<sup>1</sup>, namely,

$$\eta = T (A'e^{B/T} + C'e^{D/T}), \quad (1)$$

where  $A'$ ,  $B'$ ,  $C'$  and  $D'$  are constants, and  $T$  the absolute temperature.

I have recently shown<sup>2</sup> that for non-associated liquids we may write:

$$\eta \sqrt{v} = Ae^{B/T}, \quad (2)$$

where  $v$  is the specific volume.

(2) differs from the well-known Andrade-Guzmán equation by the occurrence of  $\sqrt{v}$  in the variable  $\eta$ , a difference which, although not affecting the accuracy of the equation (for within any temperature range the variation in viscosity is many times greater than the corresponding change in  $\sqrt{v}$ ), leads to a tolerably constant value of  $\eta_c \sqrt{v_c}$ , the value of  $\eta \sqrt{v}$  at the critical temperature.

For associated liquids, I found that the addition of a second exponential term to (2) gives an equation which is in good agreement with the experimental data:

$$\eta \sqrt{v} = Ae^{B/T} + Ce^{D/T}. \quad (3)$$

(3) is, of course, a modification of (1) and has been fitted to the experimental results for a number of substances. A typical case is that of 2·2 dimethyl butanol I:

Temperature ° C.	5	15	25	35	45	55	65
$\eta \sqrt{v}$ calc. ( $\eta$ in $10^3$ poise)	352·7	177·5	98·2	59·3	38·7	26·95	19·76
$\eta \sqrt{v}$ expt.	350·2	176·9	99·6	60·0	39·2	27·27	19·94
Temperature ° C.	75	85	95	105	115	125	
$\eta \sqrt{v}$ calc. ( $\eta$ in $10^3$ poise)	15·10	11·90	9·62	7·93	6·64	5·635	
$\eta \sqrt{v}$ expt.	15·11	11·84	9·52	7·89	6·64	5·670	

Values of the constants  $A$ ,  $B$ ,  $C$  (as  $-\log_{10} C$ ) and  $D$  for a number of alcohols which are known to give a markedly non-linear relationship between  $\log \eta \sqrt{v}$  and  $1/T$  are tabulated below, together with the average percentage deviations between the observed and calculated values of the viscosity. The observers are indicated by references to footnotes.

Substance	$B$	$D$	$A$	$-\log_{10} C$	Mean % error	Viscosity range
Water <sup>a</sup>	1,247	3,777	0·09464	5·0652	0·2	2·84—17·9
Ethylene glycol <sup>a</sup>	2,234	5,570	0·04445	6·2535	1·0	10·4—119
Terl. butyl alcohol <sup>a</sup>	2,250	7,411	0·01121	9·3206	1·1	6·00—33·5
Terl. amyl alcohol <sup>a</sup>	2,199	5,947	0·01351	7·3949	1·7	4·34—142
'Active' amyl alcohol <sup>a</sup>	2,030	3,742	0·02050	4·0044	0·5	5·05—111
Hexanol 1 <sup>a</sup>	108·2	2,777	0·9817	2·3526	0·4	3·45—89·2
Hexanol 2 <sup>a</sup>	1,540	4,468	0·07927	4·9910	0·4	3·83—108
Heptanol 1 <sup>a</sup>	1,437	3,035	0·09070	2·8233	0·3	4·50—100
2,2-dimethyl butanol 1 <sup>a</sup>	2,319	6,452	0·01584	7·6227	0·7	4·86—321
2-methyl pentanol 5 <sup>a</sup>	1,127	2,925	0·1120	2·6009	0·7	3·74—90·9
2-ethyl butanol 1 <sup>a</sup>	1,670	4,378	0·06250	4·7077	1·7	3·61—146
3-methyl pentanol 1 <sup>a</sup>	1,094	3,088	0·1540	2·8441	0·9	3·74—96·2
2-methyl pentanol 3 <sup>a</sup>	1,926	5,735	0·02713	7·0086	1·8	3·15—102
3-methyl pentanol 3 <sup>a</sup>	1,418	4,380	0·09482	4·0246	1·1	3·66—73·4

L. H. THOMAS

Department of Chemical Engineering,  
School of Mines and Technology,  
Treforest. Sept. 27.

<sup>1</sup> *Nature*, 153, 415 (1946).

<sup>2</sup> Thomas, *J. Chem. Soc.*, 573 (1946).

<sup>3</sup> "International Critical Tables."

<sup>4</sup> Bingham and Fornwalt, *J. Rheol.*, 1, 372 (1930).

<sup>5</sup> Thorpe and Rodger, *Phil. Trans.*, 185, 397 (1894).

<sup>6</sup> Hovorka, Lankelma et al., *J. Amer. Chem. Soc.*, 55, 4820 (1933); 60, 820 (1938); 62, 187, 1096, 2372 (1940); 63, 1097 (1941).

### The Logarithmic Transformation

IN a recent communication, Dr. H. V. Musham<sup>1</sup> directs attention to the fact that a logarithmic transformation of a variable may not only make the distribution more normal but will often stabilize the standard deviation, that is, make it more or less independent of the mean in those cases where the standard deviation of the original variable is roughly proportional to the mean. He is, perhaps, mistaken when he suggests that the latter effect has not previously been appreciated. In cases where the logarithmic transformation is used as a preparatory step to an analysis of variance, its main purpose is to ensure that the standard deviation, as calculated from a residual sum of squares, shall be applicable to the various 'treatment' means, even when these differ considerably from each other. The lack of normality of the distribution of the residual error is not in itself of any great practical consequence.

There is yet another useful property of the logarithmic transformation which is often not appreciated. If natural logarithms are used, we have

$$y = \log x \\ dy = dx/x.$$

If variations in  $x$  are not too large, we may put  $x = \mu$ , its mean value. Then

$$dy = dx/\mu,$$

∴ standard deviation ( $y$ ) = standard deviation ( $x$ )/ $\mu$   
= coefficient of variation ( $x$ ).

Hence, the coefficient of variation of  $x$  is given directly by the standard deviation of  $y = \log x$ , which can be estimated by the usual method from

$$s = \sqrt{\{\sum(y-\bar{y})^2/(n-1)\}}.$$

If common instead of natural logarithms are used, the standard deviation of  $y$  must be multiplied by 2·30259 to give the coefficient of variation of  $x$ .

W. L. STEVENS

Research Department,  
Imperial Chemical Industries, Ltd.,  
Billingham, Co. Durham.

<sup>1</sup> *Nature*, 153, 453 (1946).

### Activity of 'Vitamin A-Acid' in the Rat

IT is a well-known fact that  $\beta$ -carotene is converted by mammals into vitamin A, which is stored in the liver. As vitamin A-acid is biologically active<sup>1</sup>, it seemed possible that this substance might also be converted into vitamin A. To investigate this question the following experiments were carried out.

Young rats were grown on a diet freed of vitamin A. After signs of deficiency had appeared, the rats were divided into groups of five animals. From one group the vitamin A content of the livers was determined after saponification. (The vitamin A determinations were carried out by the Analytical Department using the Carr and Price reaction and the Lovibond colorimeter.) This proved to be zero. The rats of a second group each received subcutaneously 10 mgm. of vitamin A-acid as sodium salt dissolved in 2 c.c. phosphate buffer (pH 10·5). These injections caused no serious damage. After three days the vitamin A content of the livers was determined. It proved to be zero.



The rats of a third group each received subcutaneously on seven successive days 1 mgm. of 'vitamin A-acid' dissolved in 0.2 c.c. of the same buffer. On the ninth day the vitamin A content of the livers was zero.

The rats of a fourth group received orally on three successive days 3 mgm. of vitamin A-acid as sodium salt dissolved in 0.3 c.c. phosphate buffer pH 10.5. On the fifth day the vitamin A content of the livers proved to be zero.

From the above experiments we may conclude that the sodium salt of vitamin A-acid, whether administered orally or subcutaneously, is not converted into vitamin A, and probably itself exerts its biological activity.

J. F. ARENS  
D. A. VAN DORP

Laboratory of N. V. Organon,  
Oss, Holland.  
Aug. 23.

<sup>1</sup> *Nature*, 157, 190 (1946); 158, 60 (1946). *Rec. Trav. Chim.*, 65, 338 (1946).

### Use of Water Purified by Synthetic Resin Ion-Exchange Methods for the Study of Mineral Deficiencies in Plants

AN adequate supply of highly purified water is an essential requirement for the study of plant nutrition problems, particularly those relating to mineral deficiencies, when experiments are carried out on a large scale. Liebig, Vanselow and Chapman<sup>1</sup> in California found that tap water purified by the synthetic resin ion-exchange principle was satisfactory for maintaining healthy growth in citrus and sweet lemon without any toxic effects. They did not, however, report any experiments using demineralized water in deficiency cultures, although they published analytical results indicating that considerable removal of certain of the major and trace elements was effected by the treatment. Schroeder, Davis and Schafer<sup>2</sup> have recently published a note in which they conclude that demineralized tap water is unsuitable as a substitute for distilled water for boron-deficiency cultures. Using the latter, symptoms of this deficiency developed in canning beet in five weeks, whereas, in parallel cultures with the demineralized water, no symptoms were observed.

I have previously reported<sup>3</sup> the use of demineralized water at Long Ashton, using the 'Permutit' method, for large-scale sand culture work, using both a hard tap water and rain water, but in view of the unfavourable results obtained for boron by Schroeder *et al.*, it is of interest to refer to results obtained at Long Ashton for both boron and other nutrient elements.

In deficiency experiments with plants, the ultimate test of any point of technique must be that of biological analysis, and using such a criterion a number of indicator crops have been grown under deficiency conditions to test a demineralizing apparatus during the 1945 and 1946 seasons. The effectiveness of the technique was judged by the method of visual diagnosis, and the purity of the treated water was also checked by chemical analysis.

Using tap water, the following deficiencies were produced in acute forms: nitrogen, phosphorus, calcium, magnesium, potassium and manganese in

tomato (Market King); calcium in sugar beet and hungry gap kale; iron in oats (Star); boron in cauliflower (Majestic), sugar beet and celery.

Using rain water, in extensive experiments with a large variety of crops, the following deficiencies were observed: iron in tomato, potato, sugar beet, red clover, marrowstem kale, flax, wheat, oats; manganese in tomato and globe beet; boron in tomato, potato, sugar beet, globe beet, red and alsike clover, lucerne, dwarf, broad and runner bean, pea, flax, parsnip. The severity of calcium deficiency symptoms, in crops like alsike clover, parsnip, flax and cereals, was greatly accentuated over that produced by the use of untreated rain water.

The effectiveness of the removal of specific inorganic ions depends on the total concentration of other ions present; for example, efficiency of removal of a small quantity of iron increases as the amounts of calcium and magnesium decrease. Considerable increase in efficiency, and improvement in pH reaction and sodium elimination has been obtained by the use of a secondary cation exchanger to reduce further the cation level in the water, although the anion content is not changed.

The analytical results of Liebig *et al.* do not show appreciable reduction in boron content, and experience at Long Ashton shows that boron is less readily removed than some ions; but with rain water having an initial boron content of about 0.01 p.p.m., the boron level can be reduced to as little as 0.0025 p.p.m.

The apparatus in use at present has delivered more than 1,000 gallons of purified rain water without regeneration, and the figures for iron content are representative of its efficiency: April storage rain water 0.03 p.p.m., purified 0.0017 p.p.m.; August storage rain water 0.50 p.p.m., purified 0.003 p.p.m.

The use of demineralized water holds considerable possibilities for large-scale trace element research, and further experiments in this direction are in progress. Full details of technique and analyses will be published later.

This work has been carried out under the Agricultural Research Council's scheme for plant nutrition with the aid of special grants for which grateful acknowledgment is made. I wish to thank the Permutit Co., London, for their interest and helpful co-operation in the design of suitable equipment and for making the apparatus available for use in the experimental sand cultures at Long Ashton.

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Sept. 16.

<sup>1</sup> Liebig, G. F., jun., Vanselow, A. P., and Chapman, H. D., *Soil Science*, 55, 371 (1943).

<sup>2</sup> Schroeder, W. T., Davis, J. F., and Schafer, J., jun., *J. Amer. Soc. Agron.*, 38, 754 (1946).

<sup>3</sup> Hewitt, E. J., Long Ashton Res. Stn. Ann. Rep. (1945), 44.

### Adsorption on Carbon of Rare Earth Organic Complexes

ALTHOUGH Botti<sup>1</sup> studied the adsorption on activated carbon of members of the rare earth group, and Croatta<sup>2</sup> and others<sup>3</sup> have examined chromatographical methods of their separation, the investigations of these workers have been confined to rare earth ions as such.



The adsorption on charcoal of organic compounds is, as is well known, much higher than that of inorganic ions, and consequently it was considered that an examination of the adsorption of rare earth organic complexes might yield interesting results, particularly if such complexes were coloured.

Several colour tests for the rare earths, individually and collectively, have been variously proposed; but for the initial work indicated here the violet *p*-phenetidine cerium complex of Wenger, Rusconi and Duckert<sup>4</sup> was employed. To a solution containing a few milligrams of cerium in the tetravalent state, saturated aqueous *p*-phenetidine was added and a small amount of decolorizing charcoal shaken with the violet-coloured solution produced; adsorption of the colour was immediate and complete, and after filtration the complex could be recovered from the charcoal by extraction with chloroform. To obtain the data indicated in the table below, the chloroformic extract was evaporated to dryness, ignited, and the residual oxide weighed.

Cerium oxide taken (mgm.)	Carbon used	Cerium oxide recovered (mgm.)
3.15	0.1 gm.	3.0
6.30	0.1 "	6.1
9.45	0.1 "	9.2
12.60	0.1 "	12.4
10 gm. La <sub>2</sub> O <sub>3</sub> + 0.1% CeO <sub>2</sub>	0.1 "	9.5
Control 10.0	0.1 "	nil

The applicability of this separation only being to the removal of small amounts of cerium from solution, a lanthanum nitrate solution containing 0.1 per cent Ce was treated by this method for removal of the cerium. Although actual recovery by this method is not exceptionally near theoretical, the efficiency as a method of removing traces of cerium occurring as impurities is excellent, as spectrographic examination showed complete absence of that element in the aqueous filtrates obtained in the first instances and in the lanthanum oxide produced in the final cases. As Botti has shown that adsorption of the rare earths on charcoal, although small, does occur, a control experiment was conducted in which the adsorption of tetravalent cerium ion was determined in the absence of the organic complex.

A more comprehensive study of this separation has been prepared, and will be published elsewhere, in which the efficiency of this procedure is confirmed and the application of the technique to other rare earths indicated.

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Sept. 24.

<sup>1</sup> *Atti X<sup>e</sup> Congr. Intern. Chim.*, 3, 406 (1939).

<sup>2</sup> *Ricerca Sci.*, 12, 157 (1941).

<sup>3</sup> *Erametso et al.*, *Chem. Zentr.*, 1, 2387 (1943); 1, 2568 (1942).

<sup>4</sup> *Helv. Chimica Acta*, 27, 1479 (1944).

### Adenosine Triphosphate in Mammalian Spermatozoa

THE presence of adenosine triphosphoric acid (that is, of readily hydrolysable phosphorus) in mammalian spermatozoa has been established by Ivanov and Kanygina<sup>1</sup> and by Lardy, Hansen and Phillips<sup>2</sup>.

According to the findings of Ivanov and Kanygina<sup>1</sup> the content of adenosine triphosphate in sheep spermatozoa, obtained from the epididymis, varies

within the limits of 12–30 mgm. of adenosine triphosphate phosphorus per 100 gm. of the contents of the cauda epididymis. The adenosine triphosphate content decreases under anaerobic conditions parallel with the decrease of motility of the spermatozoa. If aerobic conditions are provided for, or if glucose is added, the adenosine triphosphate content of the sperm cells returns to its initial value; simultaneously the spermatozoa resume their movements. Mann<sup>3</sup> has isolated adenosine triphosphate from sheep sperm and determined a number of constants characterizing this preparation.

We have studied the biological effect produced by adenosine triphosphate isolated from spermatozoa on actomyosin threads prepared according to Szent-Györgyi<sup>4</sup>. It was found that adenosine triphosphate isolated from pig spermatozoa provokes a marked contraction (by 40–60 per cent) of the actomyosin thread in a saline medium. It follows that adenosine triphosphate from sperm cells seems not to differ, in respect of its ability to react with actomyosin in the presence of potassium and magnesium salts, from adenosine triphosphate isolated from muscle.

It should be noted, however, that if a solution of muscle adenosine triphosphate is added to spermatozoa obtained from the epididymis which have lost their motility under anaerobic conditions, no resumption of the movements of the spermatozoa is observed. The last-mentioned experiments were usually made in the presence of monobromacetate, which does not interfere with the dephosphorylation of adenosine triphosphate but blocks the anaerobic decomposition of carbohydrates with the formation of lactic acid.

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<sup>1</sup> Ivanov, I. I., and Kanygina, K. Y., *C.R. Acad. Sci. U.S.S.R.*, 50, 361 (1945). See also Ivanov, I. I., *Human Fertility*, 13, 83 (1945); *Progress of Modern Biology*, 13, 627 (1943); 21, 99 (1945).

<sup>2</sup> Lardy, H. A., Hansen, R. G., and Phillips, P. H., *Arch. Biochem.*, 6, 41 (1945).

<sup>3</sup> Mann, T., *Biochem. J.*, 39, 451 (1945).

<sup>4</sup> Szent-Györgyi, A., *Acta physiol. Scand.*, Supp. 9, 25 (1945).

### Action of Prostatic Secretion on the Motility and Metabolism of Spermatozoa

WE know<sup>1,2</sup> that the secretion of the prostate possesses a pronounced ability to activate the motility of spermatozoa isolated from the epididymis. The effect of the prostatic secretion of the dog on the motion and respiration of canine spermatozoa has been studied by Ivanov<sup>3</sup>. We have now investigated the effect of the prostatic secretion of the dog on the motion of spermatozoa both under aerobic and anaerobic conditions.

It was shown that prostatic secretion activates markedly the motility of spermatozoa both in the case of a free access of oxygen and under anaerobic conditions (in the presence of cyanide). In the latter case, however, to obtain a prolonged effect, it is necessary to add to the sperm some carbohydrate which can be utilized as a substrate for glycolysis. Consequently, prostatic secretion activates to a high degree the utilization by spermatozoa of the energy of both aerobic and anaerobic energy-producing pro-



cesses. This capacity of the secretion is lost by it after it has been heated to 100° C. This effect of the prostatic secretion is species specific. Thus, for example, the secretion of the prostate of a dog is unable to activate the movements of bull or sheep spermatozoa.

We are at present attempting to find out whether prostatic secretion contains a protein capable of activating the contractile protein of the spermatozoan tail.

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<sup>1</sup> Ivanov, I. I., *Human Fertility*, 17, No. 2, 33 (1945).

<sup>2</sup> Huggins, *Phys. Rev.*, 15, No. 2, 281 (1945).

<sup>3</sup> Ivanov, I. I., *C.R. Soc. Biol.*, 193, 57 (1930).

### Inhibiting Action of Fluorophosphonates on Cholinesterase

IN connexion with the interesting report<sup>1</sup> by Dr. M. Dixon and Dr. D. M. Needham on "Biochemical Research on Chemical Warfare Agents", we should like to mention that the first observations on the cholinesterase-inhibiting action of fluorophosphonates were made in 1941<sup>2</sup>. At that time the dimethyl and diethyl fluorophosphonates only were known; these compounds are somewhat less toxic than the di-isopropyl fluorophosphonate, but otherwise have similar effects. The long-lasting constriction of the pupil produced by dimethyl fluorophosphonate suggested a mode of action like that of eserine, and we found that, like eserine, it strongly inhibited the cholinesterase activity of human plasma. When the more toxic di-isopropyl fluorophosphonate was prepared, we found that it had a more potent inhibiting action on cholinesterase<sup>3</sup>.

An account of these early observations will be published in the *Journal of Pharmacology*.

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<sup>1</sup> *Nature*, 158, 432 (1946).

<sup>2</sup> Report XZ.71 to the Min. of Supply, October 1941.

<sup>3</sup> Report XZ.111 to the Min. of Supply, November 1942.

### A Medium for Investigating the Breakdown of Pectin by Bacteria

DURING the course of an investigation on the bacteria associated with the rotting of potatoes in storage, carried out on behalf of the Agricultural Research Council, a large number of isolates was tested for ability to break down pectin.

Previous investigators have used one of the following methods in the examination of the breakdown of pectin: (1) observation of the growth of an organism in a medium with pectin as the sole source of carbon; (2) testing of enzyme preparations of cultures for ability to cause loss of coherence in strips of plant tissue, or changes in viscosity of a pectin solution; (3) measurement of the rate of utilization of a particular pectic substrate by progressive chemical analysis. While the above methods would be satisfactory, it

seemed that a more suitable method, for a rapid qualitative test, would be to grow the organisms on a pectin gel. Organisms which were able to break down pectin would cause liquefaction of the medium. In the past, it has only been possible to prepare pectin gels with high sugar concentrations, and under acid or alkaline conditions<sup>1</sup> which would not support the growth of bacteria. Low methoxylated pectin gels<sup>2,3</sup> can now be prepared with a low sugar content and with an increased range of pH, and it is possible that they might be used in the present investigation, but they have not been available to me.

Through the courtesy of the A.S.P. Chemical Co. Ltd., of Gerrards Cross, a sodium pectate powder was obtained which would form a gel at a neutral pH and in the absence of sugar. The medium is prepared as follows: a basal solution is made up containing NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub> 1 gm., KCl 0.2 gm. and MgSO<sub>4</sub> 0.2 gm. per litre of distilled water. To this solution is added 50 ml. per litre of buffer solution (McIlvaine's phosphate-citrate buffer, 0.2M NaH<sub>2</sub>PO<sub>4</sub>, 0.1M citric acid). The mixture is heated to 70° C. and sufficient of the powder added to give a 1 per cent concentration. The mixture is further heated almost to boiling and held at this temperature for about five minutes. From the time of the addition of the pectate powder, the mixture must be thoroughly stirred. It has been found helpful to add Bromo Thymol-Blue to the medium as an indicator. The medium is tubed and sterilized by bringing momentarily to 120° C. in an autoclave, turning off the gas and allowing to cool. This method of sterilization<sup>4</sup> reduces breakdown of the pectate.

The setting of the medium is brought about by a certain concentration of calcium ions (approximately 3.2 per cent of the powder), which convert some of the sodium pectate to calcium pectate on cooling. The addition of a small proportion of a 10 per cent solution of calcium chloride increases the structural viscosity of the gel.

Tubes, inoculated by needle stabs from broth cultures, of *Bact. phytophthorum*, *B. carotovorum*, *B. aroideae* and *Bacillus polymyxa* showed slight liquefaction after two days at 25° C., and the liquefaction was almost complete after a week. *Bs. subtilis* produced a slight liquefaction after four days. *Bact. cerogenes*, *Bs. mesentericus* and *Pseudomonas fluorescens* did not liquefy the medium after twenty days. No extensive examination of cultures of fungi has been undertaken; but *Botrytis cinerea* and *Sclerotinia minor* produce a liquefaction of the medium.

Liquefaction of this medium indicates the splitting of the pectate unit and is not necessarily the same as loss of coherence in plant tissues. Comparative tests, however, have shown that liquefaction of a pectate gel and loss of coherence of plant tissue appear to be correlated.

I am much indebted to Dr. W. J. Dowson and Dr. N. A. Burges for their advice in this work. This brief account is published as it is considered that the medium may have applications in other directions.

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Oct. 1.

<sup>1</sup> Spencer, G., *J. Phys. Chem.*, 33, 1987 (1929).

<sup>2</sup> Baker, G. L., and Goodwin, M. W., *Del. Agric. Exp. Sta. Bull.* No. 234 (1941).

<sup>3</sup> Baker, G. L., and Goodwin, M. W., *Del. Agric. Exp. Sta. Bull.* No. 246 (1944).

<sup>4</sup> Davis, J. G., and Rogers, H. J., *Abs. Proc. Soc. Agric. Bacterio.*, 41 (1938).



## Mitotic Disturbances Induced in Yeast by Chemicals, and their Significance for the Interpretation of the Normal Chromosome Conditions of Yeast

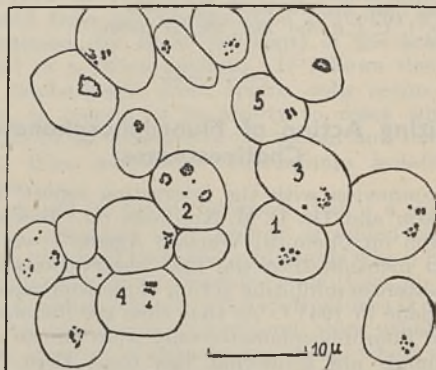
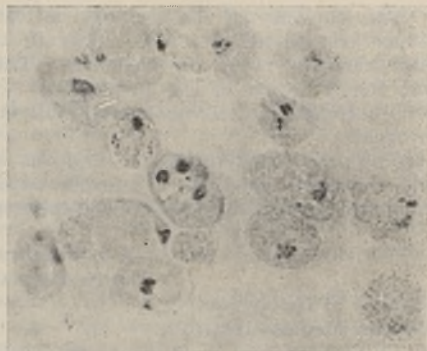
THE camphor reaction of yeast, described by Bauch<sup>1</sup>, was interpreted by me<sup>2</sup> as a narcosis affecting the normal growth of the yeast cell. Instead of budding normally, the yeast, under the influence of many chemicals of the same type as the narcotics, grows out into associations of cells, which show an irregular, tube-like, bottle-shaped or vesicular form. Their cell volume is often enlarged. In 1938 and 1939, Segal<sup>3</sup> induced this reaction by treatment with the higher aliphatic alcohols and fusel oil. The so-called involution forms of yeast, often observed in ageing cultures in connexion with the autolysis, seems to be a phenomenon of the same nature, the yeast cells narcotizing themselves with their own metabolic products.

Segal noticed the occurrence of abnormal nuclei in yeast cells treated with the higher alcohols. No detailed study of the nuclear conditions of the 'camphor cells' has been made, however, although supposed chromosome-doubled types of yeast have been produced by chemical treatments several times<sup>1,4,5</sup>. In the present communication a few data will be given concerning the nuclear behaviour of 'camphor cells' induced by camphor, butyric alcohol and benzene.

During the first days of treatment, most nuclei in the 'camphor cells' divide normally, each daughter cell obtaining one normally shaped nucleus. After a somewhat longer treatment, certain mitotic disturbances appear, and after a fortnight there may be a large number in some slides. The accompanying photomicrograph, which has been made from a Feulgen-stained slide of cells treated for sixteen days with 0.012 mol. benzene, shows some typical deviations from normal mitosis. In cell 1 a fairly normal metaphase is seen in polar view. About ten separate bodies may be counted, six of them being larger. In cell 2 three nuclei are present, and in addition two solitary bodies which I interpret as single chromosomes. This configuration is suggestive of the action of a multipolar spindle. 3 and 4 show instances of one larger nucleus and one small body outside the nucleus, presumably one vagabond chromosome. In other cases I have found pairs of chromosomes lying free in the plasma, single chromosomes having evidently divided in their abnormal position.

The mitotic disturbances here described are of special interest, since they furnish an opportunity to estimate the size of single yeast chromosomes, which is seldom possible in untreated cells, where the chromosomes usually appear in dense groups; and it is found that the chromosome size varies from 0.1  $\mu$  to, perhaps, 0.5  $\mu$ . Thus, the chromosome size lies near the limit of what can be seen in the microscope.

In my best fixations of untreated yeast I have found the nuclei to contain a number of distinct bodies of a size similar to that of single chromosomes of these treated cells. At metaphase these bodies may be seen clearly and have the same appearance as cell 1 of the present picture. They are often distributed on a hollow spindle. At normal anaphase their tendency to stick together may easily give an impression of one or two bodies, just as has happened in cell 5 of the reproduction. In my opinion this is the cause



*Saccharomyces cerevisiae* TREATED FOR SIXTEEN DAYS WITH 0.012 MOL. BENZENE, 1, NORMAL METAPHASE; 2, EFFECT OF MULTIPOLAR SPINDLE; 3, 4, VAGABOND CHROMOSOMES; 5, LUMPING OF CHROMOSOMES INTO TWO BODIES.  $\times 1,200$

both of the assumption of amitosis in yeast and of the low chromosome number reported by many workers (for example, Badian<sup>6</sup>, Sinoto and Yuasa<sup>7</sup>). After having been able to study the size of single chromosomes in treated yeast, I do not doubt that the normal chromosome number of yeast is higher. Ten separate elements are often counted in untreated material, and it is quite probable that several very small chromosomes are then concealed. I accordingly consider ten a minimum number. Neither can I agree with Lindegren<sup>8</sup> that the Feulgen-positive constituent of the yeast cell is a centriole without further interior organisation.

The nuclear disturbances of the 'camphor cells' of yeast are evidently not identical with full colchicine-mitosis of higher plants. Even after long treatment, the spindle apparatus functions at least partially. The disturbances observed may very well give rise to cells with altered chromosome number; in fact, cells with doubled number have been actually seen in my slides. If a similar condition occurs also in the normally occurring involution forms of ageing cultures, it may be important not to use old cultures as mother cultures in practical brewery.

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<sup>1</sup> *Naturwiss.*, 29 (1941).

<sup>2</sup> *Hereditas*, 30 (1944).

<sup>3</sup> *Microbiologija*, 7 (1938), 8 (1939).

<sup>4</sup> *Nature*, 152 (1945).

<sup>5</sup> *Curr. Sci.*, 14 (1945).

<sup>6</sup> *Bull. Int. Acad. Polon.*, B, 61 (1937).

<sup>7</sup> *Cytologia*, 11 (1941).

<sup>8</sup> *Mykologia*, 37 (1945).



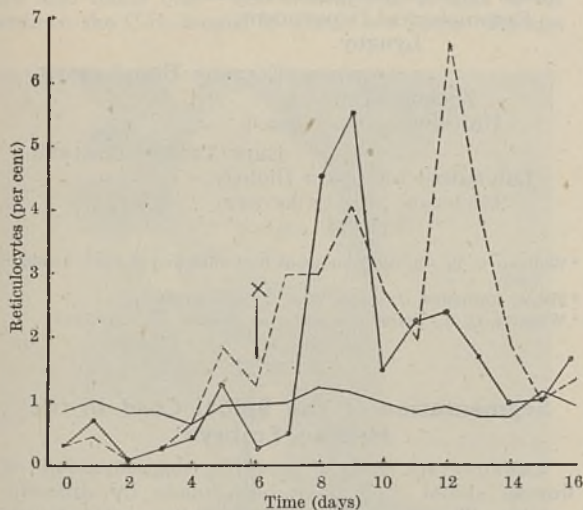
### Reticulocytosis following the Administration of Thymine to Splenectomized Rabbits

Jacobson and Williams<sup>1,2</sup> have reported that splenectomized rabbits show a reticulocytosis after intramuscular injections of liver extract, and have suggested that this observation could form the basis for a method of bio-assay of liver extracts.

Following Jacobson's report, we have carried out a number of experiments on a series of eighteen splenectomized rabbits and have confirmed, qualitatively, the response of these animals to an injection of liver extract. We are not in a position at this stage to comment on the quantitative nature of the response, except as noted below. The appearance of a series of papers by Spies and his collaborators<sup>3,4,5,6</sup> on the value of thymine (5-methyl uracil) in the treatment of sprue and pernicious anæmia suggested the investigation of the action of thymine in splenectomized rabbits.

We have now shown that intramuscular and intravenous injections of thymine produce a marked reticulocytosis in these animals. With intramuscular injections, a latent period of 2-4 days is usually observed, but using the intravenous route, a more rapid response is obtained. This effect is marked in doses varying from 50 mgm. to 250 mgm., and was still apparent in one animal on a dose of 5 mgm.

The smaller doses of thymine were usually given in warm aqueous solution (1-3 mgm./ml.) and the larger doses in suspension in the same medium. The accompanying graph shows the result of administering 100 mgm. and 20 mgm. to splenectomized rabbits. It also shows the absence of effect due to the administration of distilled water alone.



---, 100 mgm. thymine intramuscularly; —, 5 ml. distilled water intramuscularly; —○—, 20 mgm. thymine intravenously. Injections were made at X.

All the rabbits used in these experiments showed a normal reticulocyte level of 1.0-2.0 per cent, and a response was considered positive only if a level of 2.0-3.0 per cent or more was observed. Two or three weeks prior to being treated with thymine, each rabbit was given an intramuscular injection of 1.0 ml. of purified liver extract ('Examen'), and any animal not showing a positive response was rejected from further experimental work. Although the responses of different rabbits to an equal dose of thymine

showed considerable variation, it was observed that a dose of 100 mgm. or more of thymine usually resulted in a higher reticulocyte peak than that obtained with 1.0 ml. of 'Examen'.

The foregoing results supply further evidence that splenectomized rabbits respond to materials active in pernicious anæmia, and the fact that the height of the reticulocyte peak appears to run roughly parallel with the size of the dose of thymine suggests that the response may be more or less quantitative. The results also lend support to the view that thymine or some substance of similar structure may play an important part in hæmopoiesis.

Further work is in progress with related compounds to determine whether they have an action similar to that of thymine.

We are indebted to Dr. J. F. Martin for supplies of thymine and to the directors of Genatosan, Ltd., for permission to publish this note.

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<sup>1</sup> Jacobson, W., and Williams, S. M., *J. Path. Bact.*, 67, 101 (1945).

<sup>2</sup> Jacobson, W., and Williams, S. M., *J. Path. Bact.*, 67, 423 (1945).

<sup>3</sup> Spies, T. D., Vilter, C. F., and Cline, J. K., *South. M. J.*, 39, 289 (1946).

<sup>4</sup> Spies, T. D., Frommeyer, W. B., Vilter, C. F., and English, A. *Blood*, 1, 185 (1946).

<sup>5</sup> Spies, T. D., Frommeyer, W. B., Lopez, G. G., Toca, R. L., and Gwinner, G., *Lancet*, 1, 883 (1946).

<sup>6</sup> Frommeyer, W. B., Spies, T. D., Vilter, C. F., and English, A. *J. Lab. Clin. Med.*, 31, 643 (1946).

### Carbohydrate Metabolism in Alloxan-diabetic Rats

Mering and Minkowski<sup>1</sup> and also Hédon<sup>2</sup> have already found that the glycogen content of the liver and of the skeletal muscles, during experimental pancreas-diabetes, is being very much decreased. This was always confirmed by later authors and led to various hypotheses concerning the action of insulin on carbohydrate metabolism. By means of their mode of experimental procedure, Major and Mann<sup>3</sup> were able to show that the formation of glycogen in pancreatectomized dogs is not suppressed in the case of permanent glucose infusion. Concerning the glycogen content of liver and skeletal muscles, Lackey, Bunde, Gill and Harris<sup>4</sup> obtained the same results in alloxan-diabetic rats as Mering and Minkowski in pancreatectomized dogs. The investigations of Laszt<sup>5</sup> and Laszt and Vogel<sup>6</sup> on the carbohydrate metabolism in alloxan-diabetic rats make it probable that the formation of glycogen cannot be lowered. We were, therefore, induced to verify this point. The rats were made diabetic by the method suggested by Laszt<sup>5</sup>. There was no steatosis of the liver to be observed, neither macroscopically nor microscopically. This fact is of importance, as the formation of glycogen and its deposition is suppressed in fatty liver<sup>7</sup>.

As the accompanying table shows (average rates), the glycogen content of the liver after 24 hr. fasting is higher in alloxan-diabetic rats than in normal ones, whereas the glycogen content of the muscles is lower. One hour after glucose feeding (1 gm.) the liver glycogen, as well as the



	Liver				Skeletal muscle
	Glycogen (%)	In-organic P. (mgm. %)	Total acid-soluble P. (mgm. %)	Organic P. (mgm. %)	Glycogen (%)
Normal animals :					
After 24 hr. fasting	0.136	31.70	94.70	63.00	0.328
1 hr. after 1 gm. glucose feeding	0.500	22.12	87.87	67.75	0.380
Diabetic animals :					
After 24 hr. fasting	0.913	28.40	95.00	66.60	0.247
1 hr. after 1 gm. glucose feeding	1.729	21.50	97.75	76.25	0.390
Diab.-adrenalectomized animals :					
After 24 hr. fasting	0.058	46.62	100.65	54.03	0.266
1 hr. after 1 gm. glucose feeding	0.296	33.10	93.30	60.20	0.259

skeletal muscle glycogen, rise more in diabetic animals than in normal ones. Alloxan-diabetic rats in which glycosuria and hyperglycaemia have been completely suppressed by adrenalectomy show, when young and when fed, a lower glycogen content of liver as well as of skeletal muscle than normal ones. Further, the organic phosphate in the liver was also higher in alloxan-diabetic rats than in normal rats.

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- <sup>1</sup> Mering, v. J., and Minkowski, *Arch. exp. Path. u. Pharm.*, 23, 371 (1890).  
<sup>2</sup> Hédon, E., *Arch. méd. exper.*, 3, 1 (1891). *Arch. de Physiol.*, (5), 4, 245 (1892).  
<sup>3</sup> Major, S. J., and Mann, F. C., *Amer. J. Physiol.*, 102, 409 (1932).  
<sup>4</sup> Lackey, R. W., Bunde, C. A., Gill, A. J., and Harris, L. C., *Proc. Soc. Exp. Biol. Med.*, 57, 191 (1944).  
<sup>5</sup> Laszt, L., *Experientia*, 1 (1945). *Bull. Soc. fribourgeoise Sciences nat.*, 38 (1946).  
<sup>6</sup> Laszt, L., and Vogel, H., *Nature*, 157, 551 (1946). *Nature*, [158, 588 (1946)].  
<sup>7</sup> Rosenfeld, G., *Berliner klin. Wchsft.*, 976 (1906).

## Observations on the Moth *Plusia gamma* in Denmark in 1946

THIS year the noctuid *Plusia gamma* has been more abundant in Denmark than at any time since 1905. It is likely that the swarms arrived here in June; the first report of damage caused by the larvæ came from the southern part of Denmark, and was followed by similar reports from more northern parts, thus closely corresponding to the seasonal progression recorded in England<sup>1</sup>. The adults appeared about August 1.

The main results of the observations in the field, confirmed by experiments in the laboratory, are as follows. *Plusia gamma* has two different activity patterns, one for seeking food on plants, another one for migrating. The first is correlated with the temperature, maximum activity being found at temperatures between 25° and 30° C., with a lower limit at 18–20° C.; accordingly, the feeding takes place in the day-time, especially on bright and warm days.

We have only observed the migrating activity during the night. The temperature limit is much lower, about 12°–14° C. The moths were not found to feed during migration, except on a few very warm nights. Migratory individuals seem to be less attracted by light than other moths. The flight takes place at heights of 5–20 m. above the ground, and the direction of the flight is very nearly the same for all individuals observed during a certain period. But, unlike previous investigators<sup>2,3</sup>, we have found that the migrations are in the direction of the wind. This is not only the result of general observations, but out of 440 individuals actually counted during ten observations lasting for 10 minutes, 73 per cent moved exactly in the main direction of the wind and only 6 per cent deviated by more than 45° from this direction. The directions of the wind were north, north-west, west, south-east and east. These observations were made by means of a searchlight.

In Denmark, sunset in August is at about 8 p.m. (M.E.T., one hour after G.M.T.); the migrations start one or two hours later, and last for about three–four hours, with a maximum in the hour before midnight.

Towards the end of August, the number of individuals decreased. Copulation was never observed, and only about one per thousand of the females had developed eggs in the ovaries. As no evidence of a return flight has so far been recorded from Denmark, it is possible that this generation will die out entirely.

A detailed report of the observations and experiments will appear in the near future in *Entomologiske Meddelelser* (Copenhagen).

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<sup>1</sup> Williams, C. B., "British Immigrant Butterflies and Moths" (London, 1935).

<sup>2</sup> Fisher, Katherine, *J. Anim. Ecol.*, 7, 230 (1938).

<sup>3</sup> Williams, C. B., *Trans. Roy. Ent. Soc. London*, 92, 101 (1942).

## Segmentation of the Spinal Cord in the Human Embryo

VARYING statements regarding segmentation of human spinal cord have been made by different writers. They range from "No definite segmentation can, however, be effectively demonstrated. The obvious segmentation of the tube is through the nerve roots which arise in regular sequence from its walls"<sup>1</sup> of Paterson to that of Sir Arthur Keith, who states that "Dr. Watt observed in a human embryo in which there are 18 body somites that 11 segments were to be noted in the spinal cord"<sup>2</sup>.

In the course of study of "The Neuraxis in South Indian Fœtuses and Neonati", clear segmentation of the spinal cord has been noted in some specimens. Actual photographs of two embryos are reproduced here. The first one is that of an embryo the C.R. length of which is 5.1 cm. Its age will be between



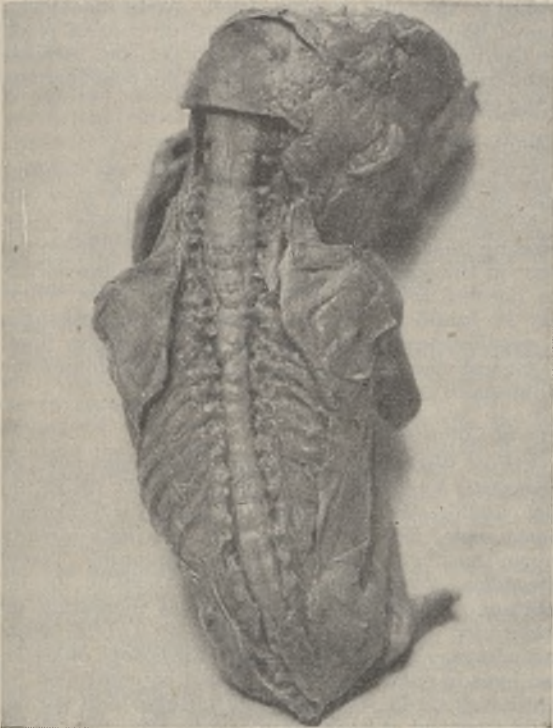


Fig. 1

ten and eleven weeks. The spinal cord shows twenty-five segments; and cervical and lumbar enlargements are also made out. The second one is that of an embryo the C.R. length of which is 6.2 cm. Its age

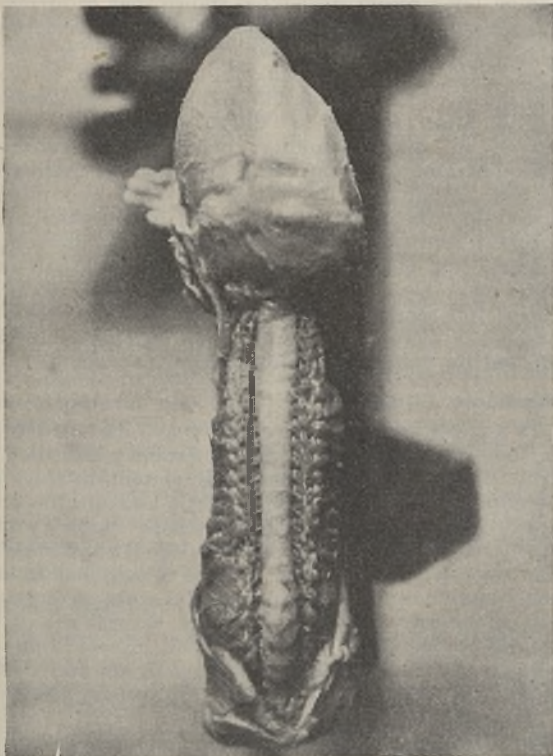


Fig. 2

will be between eleven and twelve weeks. It is slightly older than the first one. The spinal cord shows clearly the cervical and lumbar enlargements and twenty-six segments. That the segmentation is a regular one and not caused by pressure of the vertebræ can be seen by the position of the nerves that emerge out from each segment (Fig. 2).

Further work is in progress.

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<sup>1</sup> Paterson, A. M., "Manual of Embryology" (1915), 88.

<sup>2</sup> Keith, Sir Arthur, "Human Embryology and Morphology" (fifth edition) (1933), 101.

### Blood Groups of Burmese

THERE does not appear to be any record in the literature of blood-group tests made on Burmese subjects; we therefore took a recent opportunity of testing the blood of a number of subjects with regard to ABO and Rh groups. We had intended to group many hundreds, but owing to unforeseen circumstances had to abandon the work after only about two hundred persons had been tested. However, in view of the absence of other published data and the present interest in the racial distribution of the Rh factor, we are publishing this brief report on the results.

229 subjects were tested against anti-A, anti-B and anti-Rh sera. The anti-Rh serum was a potent sample that had been dried in small ampoules by Dr. R. I. N. Greaves. A sample has recently been submitted to Dr. R. R. Race, who reports that the serum contains anti-C + anti-D<sup>1</sup> agglutinins with a very little anti-D<sup>u</sup><sup>2</sup>.

The results were as follows:

Total no. tested	O	A	B	AB	Rh+	Rh-
229	83	60	68	18	229	0
	(36.2%)	(26.2%)	(29.7%)	(7.9%)	(100%)	nil

A few bloods failed to react with the anti-Rh serum on first testing, but on being re-tested with the same serum they gave positive results. These same few bloods were also tested against at least one other dried anti-Rh serum, and all gave positive results. All these anti-Rh sera gave consistently clear-cut negative reactions with known Rh-negative cells.

Of the 229 subjects tested, 155 claimed to be 'pure Burmese' (Anglo-Burmese and Anglo-Indian-Burmese were excluded), 57 were Karens, 13 Chins and the remaining 4 Kachins.

The absence (or certainly very low incidence) of the Rh-negative type in Burmese is not unexpected in view of previous reports<sup>3</sup> of a very low incidence in Chinese.

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<sup>1</sup> Race, R. R., *Nature*, 153, 771 (1944).

<sup>2</sup> Stratton, F., *Nature*, 158, 25 (1916).

<sup>3</sup> Levine, P., and Wong, H., *Amer. J. Obstet. Gynec.*, 45, 832 (1943).



## RESEARCH ITEMS

## Choline and Phospholipid Synthesis

THE action of dietary choline in preventing and curing certain types of fatty liver in rats is well known. There is now considerable evidence, reviewed by E. W. McHenry and J. M. Patterson (*Phys. Rev.*, 24, 128; 1944), that this 'lipotropic' action is due to the part which choline plays in the formation of phospholipids. It is believed that fat is normally transported from the liver in the form of phospholipid and that choline, being a constituent of certain phospholipids, is necessary for their synthesis and therefore for fat transport. In choline deficiency, the normal transport of fat from the liver is interrupted and fat accumulates therein; while administration of choline can accelerate the removal of fat from various types of experimentally produced fatty livers. More recently, W. H. Griffith and N. J. Wade (*Proc. Soc. Exp. Biol. Med.*, 41, 188; 1939) described another result of choline deficiency, hæmorrhagic degeneration of the kidneys. This lesion was produced much more readily in young growing rats than in adults. J. M. Patterson and E. W. McHenry (*J. Biol. Chem.*, 145, 207; 1942) found in such cases that the phospholipid content of the kidneys (both percentage and absolute) was below normal and suggested that the lesion resulted from a failure of phospholipid synthesis at a period when phospholipid was required as a protoplasmic constituent for the development of the growing kidney. J. M. Patterson, N. B. Keevil and E. W. McHenry (*J. Biol. Chem.*, 153, 489; 1944), using radioactive phosphorus, have shown that the rate of phospholipid turnover in the rat's kidney is greatest at the time (sixth day of life) when the kidney is most susceptible to choline deficiency, and that the turnover is greatly reduced in choline-deficient animals. It seems, therefore, that both the liver and kidney lesions of choline deficiency can be ascribed to a failure of phospholipid synthesis.

## Control of Pear Midge

S. H. Bennett and H. G. H. Kearns (*J. Pom. and Hort. Sci.*, 22, 38; 1946) report the successful control of *Contarinia pyrivora* by the application of tar oil and dinitro-ortho-cresol washes to the soil. The larvæ pupate in the surface soil and the midges emerge in the spring to lay their eggs on the flower buds and open flowers. On hatching, the larvæ bore into the developing fruitlets, which become malformed and fall to the ground. Some control has been effected hitherto by repeated cultivations of arable soil after the fruit has fallen, by digging calcium cyanide into the soil, or by nicotine washes applied to the blossom when the midges are on the wing. Trials were made with 3 per cent high boiling neutral tar oil, and 0.1 per cent D.N.C. with 5 per cent petroleum oil, sprayed on the soil at low pressure, both as sulphite lye emulsions. A plantation of Williams' Bon Chrétien and Fertility pear trees was used and the treatments randomized to find the effects of the washes when applied at the time of bud burst (March 1, 1944) and 4-5 days before the 'white bud' stage (March 27, 1944) respectively. 900-1,200 gallons of wash per acre were applied over the surface, the top soil being dry enough to absorb it. Examination of random samples of fruitlets and comparison of crop weights at picking time showed that a high degree of control was obtained. No significant differences were obtained between the two

washes or the time of application. With an infestation of 64 per cent of fruitlets on the control plots, the treatments gave from 46 to 101 per cent increase in the fruits harvested, and 31 to 53 per cent increase in the crop weights.

## Genetics and Plant Breeding

D. U. GERSTEL (*J. Hered.*, 36, 197; 1945) shows that by back-crossing *Nicotiana tabacum* ( $n = 24$ )  $\times$  *N. glutinosa* ( $n = 12$ ) with *N. tabacum*, true-breeding lines with 25 and 26 pairs of chromosomes occur in the progeny. The extra chromosomes which are derived from *N. glutinosa* carry genes which may be useful in tobacco. For example, resistance to mosaic disease was incorporated in the new lines. A general account is given of single chromosome additions in evolution.

## Pests of Cotoneaster

G. FOX WILSON has described nine insect pests of *Cotoneaster horizontalis* (*J. Roy. Hort. Soc.*, 70, Pt. 9; Sept. 1945). Woolly aphis, and peach or European brown scale, *Lecanium corni*, are two pests already known on fruit trees. The web-spinning Tineid caterpillar, *Scythropia crataegella*, is usually an inhabitant of hawthorn bushes, but is increasing on *Cotoneaster*. It can be controlled by D.D.T. dusts and sprays. The Pyralid moth, *Eurhodope suavella*, also lives in silken galleries. It can be controlled by nicotine dusts in warm days of autumn and spring, while arsenical washes afford preventive treatment. The four major pests here mentioned appear to be most prevalent in the south-eastern counties of England.

## Dry Rot of Potatoes

*Phytophthora infestans* and *Fusarium cœruleum* are the principal causes of fungal wastage of potatoes in clamps, but a recent survey has shown that *Fusarium avenaceum* also causes loss, especially in the varieties King Edward and Doon Star (F. Joan Moore, *Ann. Appl. Biol.*, 32, 304; 1945). A comparison of the two species of *Fusarium* showed that *F. avenaceum* caused most rotting at 20-25°C., and in conditions of high humidity, while *F. cœruleum* caused maximum loss at 15°C. and was less sensitive to low humidities; it was noted that the more susceptible the potato variety the higher was the optimum temperature for both species of *Fusarium*. Rotting was much more severe in clamps than in stores or in open trays held at the same temperature. This is apparently due to the higher humidity obtaining in the clamp; the amount of rotting is little affected by volatile excretions from the tubers.

## Recession of Glaciers

IN a paper on researches on snow and ice, 1918-40, in the *Geographical Journal* of January-February, Prof. H. W. Ahlman outlines his contention that a climatological improvement in arctic latitudes began slowly in the middle of the nineteenth century and has increased rapidly in recent decades. His investigation on certain Norwegian glaciers shows that from being stationary they have reached a state of retreat and, if the rate of retreat continues, several will disappear in a few more decades. Work in west Spitsbergen and in North-East Land again showed that ablation exceeded accumulation. On Iceland glaciers comparable results were obtained. Lastly, in North-East Greenland regression was noted and, as elsewhere, at an increasing rate. Prof. Ahlman points



also to the results of Russian researches north of Siberia, which indicate a vast reduction since 1924 of the sea area covered with pack-ice, a reduction in the average thickness of floes, an increase in temperature of the Kara and other seas, and a northward shift of the southern limit of permanently frozen ground. The meteorological causes of these changes lie in increased flow of warm air to the regions around the North Atlantic and the northward movement of the Icelandic low-pressure area. Prof. Ahlman stresses the need of comparable quantitative researches in the Antarctic and elsewhere.

#### Space Charge in the Magnetron

THE method employed by L. Page and N. I. Adams, jun. (*Phys. Rev.*, 68, 126; 1945) to solve the space charge equation of the cylindrical diode has been applied by the same authors to solve the similar equation for the plane magnetron, consisting of two infinite parallel plane electrodes (*Phys. Rev.*, 69, 492; 1946), and for the cylindrical magnetron, consisting of two coaxial cylindrical electrodes (*Phys. Rev.*, 69, 494; 1946). The relationship between the current and the magnetic field is determined in both cases, as also the effect of the magnetic field on the distribution of potential and charge. An interesting feature of the plane magnetron, as shown by one of the curves, is that the current decreases only slightly with increasing magnetic field strength until quite close to the cut-off. The corresponding curve for the cylindrical magnetron is in accord with A. W. Hull's experimental values (*Phys. Rev.*, 18, 31; 1921).

#### Telephone Interference Arising from Power Systems

IN a recently published paper (*J. Inst. Elec. Eng.*, 93, Part 1, No. 66, June 1946), Messrs. P. B. Frost and E. F. H. Gould review the investigations on telephone interference which have been carried out in Great Britain between 1934 and 1944. Under the heading of electromagnetic induction at fundamental frequency, they discuss the precautionary measures available for power and telephone systems to avoid damage to equipment and injury to personnel from high induced voltages, and under interference at audio-frequency the serious effects which may arise from faulty power lines which are maintained in operation through the use of arc-suppression coils, and the possibilities of interference from power lines supplying large rectifier units. The paper enumerates the conditions under which it is permissible to employ multiple earthing in high-voltage systems, and gives evidence to show that the inter-connexion of low-voltage systems, each earthed at one point, is unlikely to cause interference. Recent apparatus developments affecting the problem, such as gas discharge tubes, noise-eliminating filters and noise-measuring instruments, are reviewed. The paper is supported by a lengthy discussion, several contributors to which emphasize the need for closer co-operation between the power supply undertakings and the telephone authorities, particularly in respect of new installations.

#### Raman Spectra of Mixed Crystals

SODIUM and potassium nitrates form a continuous series of mixed crystals above 130° when the two lattices unite to form a unique lattice. M. Kanaka Raju (*Proc. Indian Acad. Sci.*, 22A, 150; 1945) has examined the Raman spectra of this system and finds frequency shifts which are regarded as corresponding with the lattice and with internal oscillations.

With mixed crystals containing 25–75 per cent of potassium nitrate, there was a gradual change of frequency from that of pure sodium nitrate to that of pure potassium nitrate, and this fact, and the result that there is a unique line representing the total symmetric vibration in the mixed crystals (a mixture of the same composition showing the two lines of  $\text{NaNO}_3$  and  $\text{KNO}_3$  separately), confirm the formation of a unique lattice in the mixed crystal, the vicarious elements replacing one another atom for atom. This result is in agreement with many other investigations on mixed crystals and confirms the structure suggested for them by Vegard.

#### Purification of Benzene and Toluene

THE separation of thiophene and methylthiophene from benzene and toluene is not easy, and the usual methods are either tedious, or expensive and unsuitable for large amounts. J. Bougault, E. Cattelain, and P. Chabrier have described in a paper only recently available in Britain (*Bull. Soc. Chim.*, 7, 780; 1940) a very simple process by which large amounts of the two hydrocarbons can be freed from thiophene and its derivatives so as to give no indophenene reaction. The liquid is shaken for a short time at the ordinary temperature with Raney nickel, previously washed with alcohol and ether. The preparation of the nickel was described by the same authors in an earlier paper (*Bull. Soc. Chim.*, 5, 1699; 1938). In another paper (*Bull. Soc. Chim.*, 7, 781; 1940) they show that Raney nickel when introduced into solutions or suspensions of many inorganic and organic sulphur compounds leads to an evolution of hydrogen, and the sulphur is completely removed in combination with nickel as sulphide. Tetrathionate and thiosulphate are rapidly converted into sulphite, and the latter then slowly converted into alkali hydroxide. Carbon disulphide in alcohol evolves a mixture of hydrogen and methane. Raney nickel is thus a valuable desulphurizing agent.

#### Synthesis of Methanol

THE reactions of hydrogen and carbon monoxide over a great range of experimental conditions have been studied, and one of the products is methanol (methyl alcohol,  $\text{CH}_3\text{OH}$ ). The reactions of hydrogen and carbon dioxide have received little attention. V. N. Ipatieff and G. S. Monroe (*J. Amer. Chem. Soc.*, 67, 2168; 1945) have studied this latter reaction in presence of copper-alumina catalysts over a temperature range of 282–487° and a pressure range of 117–410 atm. Copper and alumina separately had no catalytic effect. The most active catalyst had a copper content of 8–28 per cent and gave conversions of 94 per cent at 410 atm. and 285°. Similar experiments with carbon monoxide and hydrogen gave much smaller conversions of 39–43 per cent, with as much as 15 per cent and 41 per cent of the carbon monoxide charge reacting to give methane and dimethyl ether, respectively. When carbon dioxide was added to the carbon monoxide in the mole ratio  $\text{CO} : \text{CO}_2 = 3.1 : 1.0$ , the methanol conversion was raised to 64 per cent and the formation of dimethyl ether reduced to about 1 per cent. Other experiments indicate that the reaction with carbon dioxide and hydrogen follows two paths: after reduction to formaldehyde, part of the methanol is formed by direct hydrogenation of formaldehyde and part by a Cannizzaro reaction.



# TEMPERATURE RADIATION FROM THE QUIET SUN IN THE RADIO SPECTRUM

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THE radio-frequency emissivity of the sun considered as a black body is proportional to  $T\lambda^{-2}$  per unit frequency increment, where  $T$  is the temperature of the radiating region, and  $\lambda$  is the wave-length of the radiation. The sensitivity of radio equipment is now such that it is possible to detect this radiation on the shorter wave-lengths in the radio spectrum. In particular, Reber<sup>1</sup> and Southworth<sup>2</sup> have measured it on short radio wave-lengths, using highly directive aerial systems. Appleton<sup>3</sup> has pointed out that it should be impossible to detect this temperature radiation at the longer radio wave-lengths, owing to the rapid falling off of solar emissivity, combined with the impracticability of using highly directive aeri-als on these wave-lengths. He and others<sup>4</sup> suggest that the radiations which are observed on the longer wave-lengths, and which appear to be correlated with sun-spots, cannot be thermal in origin, since such an explanation would require solar temperatures of the order one million degrees and upwards. There is little doubt that these views, so far as they refer to temperatures upwards of  $10^6$  degrees, must be correct, especially in the light of recent evidence<sup>5,6</sup> showing that at such times the radiation comes from restricted areas in the immediate vicinity of sunspots. It is the purpose of this note to point out, however, that at such wave-lengths we should expect thermal radiation corresponding to values of  $T$  downwards from  $10^6$  degrees to the familiar surface temperature of order  $10^4$  degrees.

having a normal (quiet sun) intensity corresponding nearly to  $T = 10^4$ .

We may proceed to investigate the effective values of  $T$  at other wave-lengths by using Milne's criterion that the observed radiation comes from an average optical depth  $\tau = 1$ , where  $\tau = -\int \kappa_1 dr$ ,  $\kappa_1$  being the absorption coefficient and  $r$  the distance from the sun's centre. When we apply this criterion for wave-lengths shorter than 1 metre it is found that, as  $\lambda$  decreases, the radiation begins to emanate from the chromosphere, which is at a much lower temperature than  $10^6$  degrees, so that the solar emissivity falls off rapidly in this region of the spectrum.

On the long-wave side of 1 metre the corona becomes a reflector and  $\tau$  is less than unity. This happens because of the exponential decrease of electron density and collision frequency in the corona as  $r$  increases. Assuming local thermodynamic equilibrium, we may apply Kirchhoff's law, so that the effective temperature now becomes  $\kappa_1 T$ . As  $\lambda$  increases,  $\kappa_1$  decreases and the effective temperature falls off. There is thus a maximum in effective  $T$  in the vicinity of  $\lambda = 1$  m. The results of detailed calculations of this kind are shown in Fig. 1 (full line). It will be noticed that the curve descends steeply on the short wave-length side of the maximum, and comparatively gradually on the long wave-length side. In the latter region the effective size of the solar disk will be considerably increased, since it is the corona which is responsible for the observed radiation. In practice, however, it will not usually be necessary to take account of this, because of pronounced 'limb-darkening', which we now consider.

So far, we have confined our attention to the effective values of  $T$  averaged over the whole disk. It is of considerable interest to examine the variation of  $T$  (the brightness) within the disk. Fig. 2 (curves a-d) shows this variation for a range of the longer wave-lengths. It will be noticed that there is a considerable falling off in brightness as the limb of the sun is approached. This effect is superficially similar to the 'limb-darkening' familiar to solar physicists in visible light. The causes, however, are fundamentally different. Limb-darkening in the visible spectrum is due to the fact that a rising temperature is encountered as we penetrate the photosphere. The light we see from the centre of the disk comes from lower and hotter regions than that which comes to us at the more nearly glancing angles on the limb. In the radio case the effect of temperature gradient in the corona is negligible compared with the falling off in  $\kappa_1$  at the shallower angles of emergence as the limb is approached. For wave-lengths shorter than about 1 metre (Fig. 2, curves d-g) the solar atmosphere becomes optically thick over most of the limb, and a treatment more strictly analogous to that used by solar physicists may be applied. Since the temperature decreases rapidly as we pass from the corona to the chromosphere, it follows, however, that limb brightening should be observed in the radio case. This phenomenon should be very marked at wave-lengths of 60 cm. downwards. It should be capable of direct experimental test either by the use of highly directive aeri-als on centimetre wave-lengths, or at eclipses.

The discussion so far has neglected the effect of the sun's general magnetic field. Account can be taken of this factor by making a solar application of Appleton's magneto-ionic theory of the ionosphere. The total radiation now divides into two parts, the 'ordinary' and 'extraordinary', each with character-

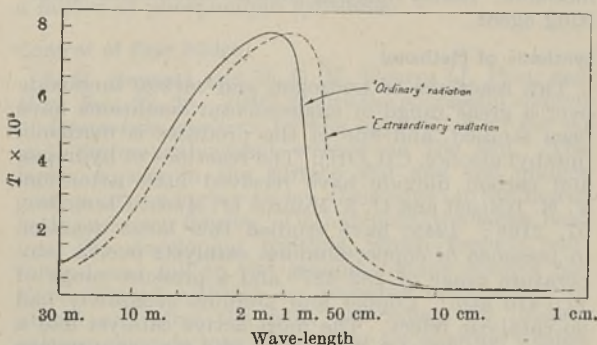


Fig. 1. EFFECTIVE TEMPERATURE OF SUN CONSIDERED AS A BLACK-BODY RADIATOR IN THE RADIO SPECTRUM

Studies by Baumbach<sup>7</sup> of the light scattering by electrons in the solar corona give reliable estimates of the electron densities in this region. Since the corona must be completely ionized, the electron collision frequencies may be calculated by the method of Chapman and Cowling<sup>8</sup>. It is then easy, by application of Milne's concept of optical depth, to show that solar radiations the wave-length of which is longer than about 1 metre must emanate from the corona. Now, Edlén's recent work<sup>9</sup>, together with other spectroscopic evidence, shows that the coronal matter is normally at a temperature approaching  $10^6$  degrees. We should therefore expect to find black-body radiation of about 1 metre wave-length



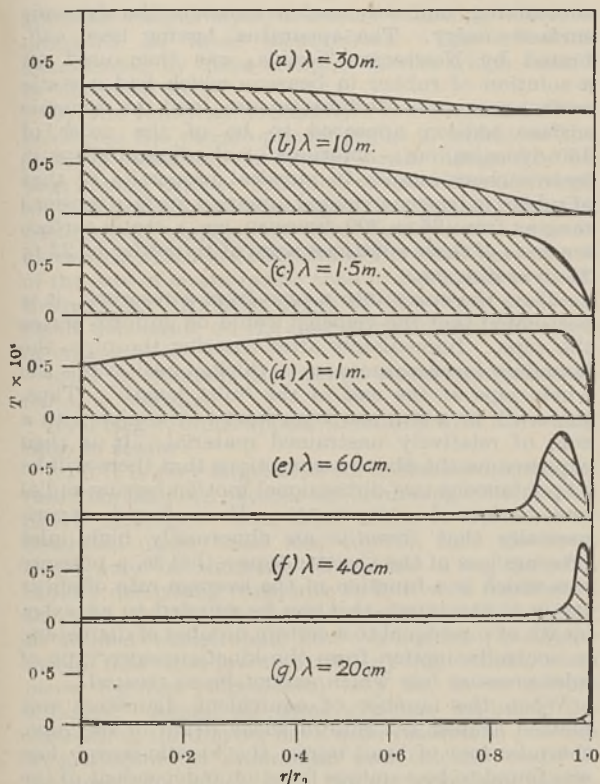


FIG. 2. VARIATION OF RADIO 'BRIGHTNESS' ACROSS THE SOLAR DISK AT VARIOUS WAVE-LENGTHS ( $r = r_{\odot}$ , AT L.L.B.)

istic elliptical polarization of opposite senses of rotation. The discussion above may be taken with sufficient accuracy as applying to the 'ordinary' radiation. The distribution of 'extraordinary' radiation over the spectrum is shown by the dashed line in Fig. 1. It is seen that the intensities of these two characteristic radiations are markedly different over a wide range of wave-lengths. At first sight it might seem that this conclusion could be simply tested by the use of aerial systems alternately disposed to receive right- or left-handed radiations. Unfortunately, however, while the 'ordinary' radiation from the northern solar hemisphere is right-handed, the same radiation from the southern hemisphere is left-handed. For testing the above conclusion we must rely on statistical observations of the quiet sun over a period of time during which the solar axis is tilted markedly towards or away from the earth. Alternatively, observations could be made at eclipses or in regions providing a suitable horizon at sunrise or sunset.

As yet, few published observations exist which can be compared quantitatively with our conclusions. However, Southworth's original observations, which appeared to give  $T = 6,000^{\circ}$  in the region  $\lambda = 10$  cm., have since been corrected by him<sup>10</sup> to give  $T = 20,000^{\circ}$ , agreeing with the curve in Fig. 1.

The complete exploration of quiet sun solar radiation over the radio spectrum is probably beyond the resources of a single organisation, owing to the comparative inflexibility of the necessary equipment with respect to wave-length. It is hoped that the above conclusions, which appear to rest on well-established solar data and physical principles, may be of service to those planning regular observations in this field.

A full description of this work, which is part of the research programme of the Council for Scientific and Industrial Research, will be published elsewhere. I am indebted to Drs. R. Woolley and C. W. Allen for much advice on solar data.

- <sup>1</sup> Reber, *Astrophys. J.*, 100, 279 (1944).
- <sup>2</sup> Southworth, *J. Franklin Inst.*, 289, 285 (1944).
- <sup>3</sup> Appleton, *Nature*, 156, 534 (1945).
- <sup>4</sup> Pawsey, Payne-Scott and McCready, *Nature*, 157, 158 (1946).
- <sup>5</sup> Pawsey, Payne-Scott and McCready, in the press.
- <sup>6</sup> Martyn, *Nature*, 153, 308 (1946).
- <sup>7</sup> Baumbach, *Ast. Nach.*, 263, 121 (1937).
- <sup>8</sup> Chapman and Cowling, "Mathematical Theory of Non-Uniform Gases" (Camb. Univ. Press, 1939), 177.
- <sup>9</sup> Edlen, *Ark. f. mat. Ast. Fys.*, 28 B, No. 1 (1942).
- <sup>10</sup> Southworth, *J. Franklin Inst.*, 2-1 (March 1946).

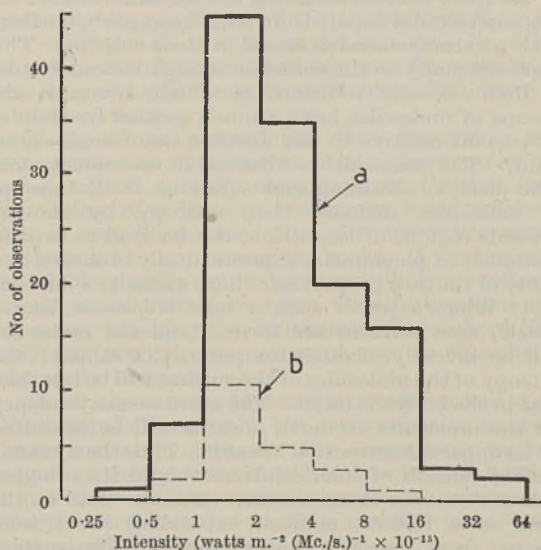
## OBSERVATION OF MILLION DEGREE THERMAL RADIATION FROM THE SUN AT A WAVE-LENGTH OF 1.5 METRES

By DR. J. L. PAWSEY

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IN the preceding communication, Martyn has shown that at wave-lengths of a few metres, thermal radiation corresponding to a temperature of about a million degrees should be radiated from the sun. The detection of this radiation is complicated by the presence of a further source, which is highly variable and is associated in some way with sunspots. This source can, on occasion, yield radiation up to 100 times the expected thermal intensity. If we confine ourselves to intensity measurements, it would in fact be detectable only if the intensity due to the variable source, not infrequently fell below that of the thermal one.

Daily measurements of intensity on a wave-length of 1.5 metres over a period of about six months



HISTOGRAMS SHOWING DISTRIBUTION OF DAILY VALUES OF SOLAR RADIATION INTENSITY AT 1.5 METRES WAVE-LENGTH (INCREASES OF A FEW SECONDS ARE NEGLECTED). (a) DAILY: OCT. 5, 1945-DEC. 12, 1945; JAN. 1, 1946-MARCH 15, 1946 (R.A.A.F. OBSERVERS). (b) SUNDRY DAYS, MARCH TO MAY 1946 (LABORATORY OBSERVERS)



indicate that this condition is satisfied in this part of the spectrum. The distribution of observed intensities is shown in the accompanying histograms. This distribution is markedly skew, having a sharp cut-off on the low side at the intensity range  $0.5-1.0 \times 10^{-15}$  watt  $m^{-2}$   $(Mc./s.)^{-1}$ , corresponding to effective temperatures between  $0.6$  and  $1.2 \times 10^6$  degrees Kelvin. This distribution is consistent with the co-existence of a steady source, of intensity equal to the cut-off value, and a symmetrically distributed highly variable source, which, on this wave-length, exceeds the steady value for about 60 per cent of the observations.

The agreement between the observed cut-off intensity, which corresponds to a temperature of about one million degrees Kelvin, and the effective temperature derived by Martyn,  $0.8 \times 10^6$  degrees Kelvin, leaves little doubt that million degree thermal radiation is being observed at this wave-length.

I am indebted to Dr. D. F. Martyn for pointing out to me the probable existence of high-level thermal radiation, and to members of the Royal Australian Air Force and of the Radiophysics Laboratory who took the observations.

This work is part of the research programme of the Radiophysics Laboratory, Commonwealth Council for Scientific and Industrial Research.

## RHEOLOGICAL PROPERTIES OF HIGH-VISCOSITY SOLUTIONS OF LONG MOLECULES

By PROF. F. H. GARNER

AND

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IN the kinetic theory of the elasticity of rubber, it is assumed that on straining at constant volume, the macromolecules depart from their most probable form with a consequential decrease in their entropy. This applies equally to the coiled or zigzag macromolecules in high-viscosity solutions in which, however, the groups of molecules have a much greater freedom of movement relative to one another than in an elastic solid. The assumption that such movement does take place on straining such solutions, in that groups of molecules increase their entropy by moving towards regions of less strain, can be used to explain a number of phenomena experimentally observed in a study of the flow properties of high viscosity solutions.

(1) When a jet of such a solution issues from a nozzle, new surfaces are formed and the molecules will be severely, though temporarily, strained; the entropy of the molecules at the surface will be less than that in the body of the jet. The spontaneous tendency for the molecules to move inwards will be exhibited by an apparent attraction inwards. Thus the dynamic surface tension of such solutions should show higher values than the static surface tension. Jets in the form of a hollow, conical, expanding sheet were ejected from specially shaped nozzles. The surface energy of the jets tended to contract them into cylindrical form, whereas the kinetic energy forced them to expand. The kinetic energy of the jet was adjusted until just sufficient to prevent the jet

contracting, and was used to measure the dynamic surface energy. The apparatus, having been calibrated by Newtonian liquids, was then used on a solution of rubber in benzene which had a static surface tension of 29 dynes/sq. cm., and the dynamic surface tension appeared to be of the order of 150 dynes/sq. cm. Solutions of aluminium soaps in hydrocarbons similar in physical properties to that of rubber in benzene yielded apparent surface tensions ranging from 26 to 300 dynes/sq. cm.; static surface tensions of these solutions were of the order of 22 to 25 dynes/sq. cm.

(2) At the entry into a pipe from a reservoir, it is postulated that the velocity would be uniform across the pipe. Immediately after entering the pipe, the boundary layer commences to thicken until it fills the whole pipe at the end of the 'inlet length'. Thus, there will be a strained layer next to the pipe with a core of relatively unstrained material. It is then expected on the above assumptions that there will be a spontaneous two-dimensional motion having radial and backward components. It is found experimentally that there is an abnormally high inlet pressure loss of the Couette type—that is, a pressure loss which is a function of the average rate of shear strain in the pipe; this can be equated to an extra length of pipe equal to a certain number of diameters, in contradistinction from the kinetic-energy type of inlet-pressure loss which cannot be so treated.

When the number of equivalent diameters was plotted against the rate of shear strain in the pipe, the inlet loss of head minus the kinetic-energy loss was found to be a unique function independent of the dimensions of the apparatus. The number of diameters increased with the rate of shear strain up to a maximum of 60 diameters, after which it decreased to an asymptote approaching zero diameters at very high rates of shear strain. In Newtonian liquids, the number of diameters is of the order of 0.6-1 due to Couette loss.

(3) In the main body of a pipe, the outer layers of a flowing solution of long molecules are at a higher rate of shear strain than in the centre. Relaxation by macroscopic radial flow inward cannot be achieved without straining other molecules by outward radial flow, therefore relaxation will take place in flow in a pipe on the molecular scale displacing the solvent molecules. This process implies a decrease in the concentration of the solute in the layer next to the pipe from the average. Diffusion of the solvent and interfacial phenomena will, however, restore the average concentration. This continuous interchange of energy between the solute and solvent molecules results in a certain amount of loss. As the rate of shear strain increases with the radius of the pipe, it follows that this extra loss of energy will be greater in the layers near the walls of the pipe than in those near the centre. In other words, the fluid will flow as if it were made of layers of increasing viscosities with increasing distance from the centre.

It will be appreciated that where the normal breakdown in viscosity with rate of shear strain exceeds this thickening, the overall effect of the two is a reduction in viscosity with increasing radial distance. However, where this relaxation process is strong enough, a phenomenon similar, but opposite in sign, to the 'sigma-phenomenon' exhibited by clay slips which flow with an apparent 'slip' should be expected. It is found that solutions of aluminium soaps in hydrocarbons on flowing in pipes, after correcting fully for end-effects, do reveal this



apparent viscous layer, or surface-retarding effect, as predicted on these assumptions. This effect is complicated by other complex factors which cannot be discussed here.

(4) The solutions discussed in this communication belong to the pseudo-plastic group in which, as the stress is increased, the rate of strain increases to an even greater extent. The form of relaxation discussed implies an extra loss of energy on flow to that normally encountered, namely, the fluid should show a type of hardening which is a function of the space derivatives of the rate of strain rather than of the strain or stress themselves. Different types of flow in a pipe can result depending on the magnitude of this extra loss of energy:

(a) if it is small, the normal stress rate of strain curve is obtained;

(b) if larger, fluids appear to harden with increasing rates of strain;

(c) if it is very large, after an initial hardening, the rate of breakdown exceeds the hardening effect (which has a maximum value after which it decreases as described under 'inlet loss' above), then the total effect may be suddenly to initiate a regime of a rapidly decreasing resistance to flow with increase in the rate of flow. This would result in what can only be termed 'catastrophic flow'—a sudden rise in the rate of flow from low to extremely high values, when other regimes (turbulence) may set in to restore stability. Again, all these systems, including the interesting third type, have been realized in practice with systems of aluminium and calcium soaps in hydrocarbons which give rapidly relaxing, elastic, colloidal structures due to formations of macromolecules.

(5) Finally, this secondary flow can be observed visually as it takes place on a macroscopic scale in certain circumstances. A flat disk may be fixed parallel to the flat bottom of a glass beaker, and at, say,  $\frac{1}{2}$ -cm. distance from it. The beaker is then filled with a solution of rubber in benzene (or soap in hydrocarbon) of fairly high viscosity. On rotation it will be observed that there is secondary radial flow from the periphery of the stationary disk inwards both above and below the disk. Small coloured particles will reveal the flow readily. Similarly, on rotating a rod partially immersed in such solutions, the liquid will be observed to climb up the rod from the line of strain to the regions of no strain where the adhering solution rotates with the rod.

It is hoped that an extended account of these experiments will be published elsewhere.

## WAVE ENERGY: SIDWAYS FLOW AND LOSSES BY THE SHORE

By P. J. H. UNNA

WHEN sea waves leave the open and enter a channel, they at once start to spend some of their energy along its shores, so that longshore strips of water, with low energy values, start near the actual points of entrance. This sets up energy gradients athwart the channel; and such gradients induce sideways flow of energy. The general effect is a drain of energy from mid-channel towards the shores; so that, well up channel, the strips of low energy will widen, and ultimately join, while the gradients will extend to correspond.

The results are that a sea running up channel should not be so heavy close inshore, and that the ratio of mileage to width of channel acts as a metaphorical though quite effective breakwater. Experience seems to confirm the first conclusion, provided that stream does not exert a disturbing influence; but the second of the two results is far more marked, and is the one which it is proposed to consider here.

Let  $E$  be energy in ft.-lb./sq. ft.,  $M$  be mileage, and  $W$  be width of channel. There is difficulty in estimating how much protection  $M/W$  can be expected to give, for there do not seem to be any data, theoretical or otherwise, for co-ordinating sideways flow with gradient. Assuming, however, that in given circumstances such as wave length or whatever may affect the issue, the ratio  $A$ , of wave power intercepted per mile of shore to wave power per mile width of channel, can be regarded as constant,  $E_M$  at  $M$  miles from the entrance should be given by  $E_0(1 - 2A/W)^M$ . That makes  $E$  subject to the law of compound discount,  $2A/W$  being the rate. Strictly speaking, of course,  $A$  will not be constant, especially for small values of  $M/W$ ; but it should become nearly so where the conditions are stabilized well up channel. In any event, the expression helps to show the sort of thing that happens, and to afford a basis for rough calculation.

To take the English Channel as an example,  $W = 90$  for the first 140 miles measured from the Lizard-Ushant line, and it is then suddenly reduced to 55, and stays at that figure up to Beachy Head, where  $M = 235$ . Owing to the sudden contraction in width that is caused by the Cherbourg peninsula, all the energy that enters by the southern half of the fairway must inevitably be trapped in the Gulf of St. Malo. So only the northern half of the Channel need be considered; and off St. Albans, where  $M = 140$ ,  $E_{140} = E_0(1 - A/45)^{140}$ . This shows that  $4\frac{1}{2}$  or 21 per cent of  $E_0$  survives off St. Albans, according as to whether  $A = 1.0$  or  $0.5$ . If  $A = 0.5$ , the expression explains the heavy ocean swell of 20-sec. period occasionally noticed by Dr. Vaughan Cornish<sup>1</sup> as far up-channel as Christchurch Bay.

On the other hand,  $E$  at Beachy Head would be given by  $E_{235} = E_{140}(1 - 2A/55)^{95}$ , making  $E_{235}$  only 0.1 or  $3\frac{3}{4}$  per cent of  $E_0$ , as the case may be. That shows that if Atlantic swell can ever be regarded as reaching Beachy Head, it must have died down to almost nothing.

It should be pointed out that the above considerations are independent of the character of the coast. With a rocky steep-to coast there is some possibility of a little of the energy being reflected; but it may be assumed that the waves are almost entirely broken up among the rocks. If, on the other hand, shoaling is gradual, there will be no reflexion at all of wind-formed waves. The third case is that of a bay breaking the continuity of the shore line; and any energy, once embayed, can be regarded as definitely trapped.

In all three cases the energy gradient will cause the general alignment of the wave crests to be somewhat curved in plan, for the crests have to keep square to the direction in which the energy is flowing; but with gradual shoaling there will also be the much sharper curvature due to the waves slowing down as they shoal their water.

The general circumstances should be much the same if the shores converge gently, as in a bell-mouthed estuary, but disperses on will not be entirely dependent on shoreward flow of energy. All the



energy would ultimately reach the shore, even if it were not diverted by a shoreward gradient, so losses by the shore arise from twofold action.

All the foregoing relates to ocean swell; but from what has been explained it should be clear that shore dispersion must also place definite and quite restrictive limits to the development of wind-forced waves within a narrow channel, say wherever  $W/M$  is less than 1. This shows the futility of investigating wave formation by taking measurements on a narrow lake.

Another common instance of sideways flow affecting  $E$  occurs when wave energy leaves the storm area of its origin. It must spread out sideways, whether or not there is a shore in the vicinity for it to reach.

Lastly, there is the case of seas rounding the head of a breakwater. Air photographs show that the wave crests just under the lee of a breakwater are circular in plan, and centre on its head; but here again, the law according to which the energy fans out does not seem to have been explained. Farther up the harbour, of course, the energy becomes uniformly spread across the channel.

It is unfortunate that these notes are so inconclusive, but they will serve their purpose if they lead someone to explain how sideways flow co-ordinates with gradient; for that seems to be a basic question in the theory of wind-formed waves.

<sup>1</sup> "Waves of the Sea", pp. 87-90.

## APPLICATION OF 'GAMMEXANE' TO ARTHROPODS OF VETERINARY IMPORTANCE

By J. S. STEWARD

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SINCE the announcement by Slade<sup>1</sup> of the discovery of 'Gammexane', several references have been made in the Press to its use in the control of pests of animals. As a considerable amount of work on this subject is being done in our own laboratories and by independent collaborators, it is felt that a brief résumé of the results so far achieved will be of interest. In this communication, 'Gammexane' refers to the gamma ( $\gamma$ ) isomer of benzene hexachloride, and references to other authors' work are interpreted in terms of the gamma isomer so far as that is possible. The experimental preparation used was (except where otherwise stated) a dilution in water prepared from a 5 per cent solution of 'Gammexane' in a mixture of sulphonated castor oil and an organic solvent in proportions to give an easily pourable, miscible oil.

*Diptera.* The value of 'Gammexane' for the control of flies generally has been widely recognized. Against the sheep blowfly (*Lucilia* spp.), Harbour and Watt<sup>2</sup> found that good protection up to six weeks was obtained using a spray containing 0.5 per cent 'Gammexane'.

We have found that a spray deposit of approximately 40 mgm./sq. ft. produced lethal effects on the adult stable fly (*Stomoxys*), the residual activity lasting up to three weeks. With the sheep ked (*Melophagus ovinus*) this residual activity persists in

long-woolled sheep for a similar period after treatment with dilutions of 1 in 25,000. The larvæ of *Hypoderma* in the back of infested cattle and *Gastrophilus in vitro* are relatively insusceptible. Excellent results have been reported on the treatment of wounds infested with the screw worm (*Cochliomyia hominivorax*), and the application of 'Gammexane' to open wounds was found harmless.

Against the orthorrhaphous Diptera, 'Gammexane' shows a high degree of activity, producing complete mortality of the aquatic larvæ of *Culicoides nubiculosus* after 24 hours contact with a concentration so low as 1 in 5,000,000; while *Simulium* larvæ succumbed to even greater dilutions (1 in 8,000,000) after an exposure of 1 hour followed by a change of water.

*Anoplura.* Both biting and sucking lice are highly susceptible to 'Gammexane' either as dusts or emulsions. Dilutions up to 1 in 15,000-30,000 in single applications give complete control of *Bovicola bovis*. With *H. eurysternus* somewhat higher concentrations were necessary, probably because these lice are found in places where the hair is short and sparse. The pig louse (*H. suis*) was destroyed by a single application of a castor oil - spirit lotion (equal parts by weight) containing 1 in 20,000 'Gammexane', which remained effective up to at least 27 days. *Trichodectes canis* and *Linognathus setosus* were eradicated from dogs bathed with 'Gammexane' emulsions as dilute as 1 in 40,000.

*Siphonaptera.* One application of 0.5 per cent 'Gammexane' dust has been generally found to rid dogs and cats of fleas and prevent re-infestation for some time. The breeding places of fleas require treatment as well as the infested animals. As a bath for infested animals, dilutions of up to 1 in 15,000 were effective.

*Acarina.* 'Gammexane' has proved effective against several genera of ticks (*Argas*, *Ornithodoros*, *Boophilus*). Hocking<sup>3</sup> eradicated *Ornithodoros moubata* from barrack huts by spraying the floor twice at intervals of three weeks (150 mgm./sq. ft.). Whitnall<sup>4</sup> has found that complete inhibition of egg laying of *Boophilus decoloratus* is obtained by 0.008 per cent, whereas for the same effect the concentrations of arsenic trioxide and D.D.T. require to be 0.32 per cent (as sodium arsenite in water) and 4 per cent respectively. The arsenic-resistant tick was found highly susceptible to 'Gammexane'. Taylor<sup>5</sup> found two applications of 0.1 per cent 'Gammexane' in liquid paraffin more effective in rat mange (*Notædres muris*) than D.D.T. In these laboratories the same infection has been cured by dipping affected rats once for 30 sec. in dilutions so high as 0.01 per cent. Single-spray treatment of chorioptic mange of horses (legs) and cattle (neck and rump) has resulted in destruction of most of the acari and great clinical improvement for several weeks. Complete cure may have been obtained by single sprayings of 1 in 6-8,000 'Gammexane' dilutions.

Exact data on *Sarcoptes* spp. are not available, though promising results have been reported.

*Dermanyssus gallinæ* (red mite) has been considerably reduced by sprays of 1 in 5,000, and heavy infestations almost eliminated from hen houses sprayed with a 1 in 2,500 dilution. Elimination has been claimed by the use of 0.5 per cent dusts on perches and other harbourages combined with dusting of the birds.

Among the synthetic insecticides, 'Gammexane' is outstanding in acaricidal activity, and this important



veterinary use is being investigated further. A fuller account of the results obtained is being prepared for publication.

<sup>1</sup> Slade, R., *Chemistry and Industry*, 314 (Oct. 13, 1945).

<sup>2</sup> Harbour, J. E., and Watt, J. A., *Vet. Rec.*, 52, 685 (1945).

<sup>3</sup> Hocking, K. S., *E. African Med. J.*, 23, 50 (1946).

<sup>4</sup> Whitnall, A. B. M., private communication (1945-46).

<sup>5</sup> Taylor, E. L., *Vet. Rec.*, 57, 210 (1945).

## RECENT ADDITIONS TO THE LONDON ZOO

By DR. EDWARD HINDLE, F.R.S.

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THE replacement of the collections of animals in the care of the Zoological Society of London at Regent's Park and Whipsnade has progressed much more rapidly than could have been anticipated, and the recent arrival of the largest single consignment of animals ever to reach Great Britain will go far to complete the representation of the larger African mammals.

Contrary to general belief, very few animals at Regent's Park were killed as a direct result of enemy action, for although most of the buildings were damaged and some completely destroyed as a result of bombing, the inmates, as a rule, escaped any serious injury. However, during six years of war the number of animals has naturally become reduced, owing to normal mortality, accentuated by difficulties of feeding and shortage of staff. Very few replacements have been possible during these years, and by 1945 the collections were reduced in number, and not so widely representative as in normal times.

With the end of the War the replacement of gaps in the collection presented a very difficult problem, as, apart from the question of transport, it was no longer possible to obtain animals through dealers, many of whom had gone out of business, and all of whom were short of supplies.

The Society, as in the past, has been fortunate in receiving donations from Governments, public institutions, and private individuals, two of the most notable recent gifts being the giant panda, presented by the Szech-Wan Provincial Government, and two Kodiak bears and two Ceylon elephants, presented by Mr. Alfred Ezra, vice-president of the Society. Private gifts, however, are scarcely adequate to provide the requirements of such a large institution as the London Zoo.

The appointment, in 1945, of Mr. C. S. Webb as curator-collector of the Society has helped to solve this difficulty. Mr. Webb, an experienced and widely travelled collector, went out to East Africa towards the end of last year, and during the past few months has been successful in getting together a very large collection of mammals, birds, and a few reptiles, which have now reached Regent's Park.

The most valuable arrivals are probably the six young giraffes, belonging to three sub-species, including two Baringo, *Giraffa camelopardalis rothschildi*, three reticulated, *G. c. reticulata*, and an intermediate form, *G. c. cottoni*. The two latter have never been seen alive in Britain previously.

Other ungulates of interest include a lesser kudu, *Strepsiceros imberbis*, which has not been exhibited since 1886; a second Thomson's gazelle (the first arrived only last year), impala, duiker, water buck, bush buck, and two oribi. Last, but by no means

least, a young black rhinoceros, *R. bicornis*, will provide an example of a family that has not been seen at Regent's Park since the War.

The primates include chimpanzees, Gelada baboons, guerezas, *Colobus abyssinicus*, and a very fine series of Brazza's monkey, *Cercopithecus brazzae*. Of special interest are the melanic forms of a Galago (*G. crassicaudatus argentatus*), collected from a small area around Sotik, at the west end of the Mau escarpment of western Uganda. The typical silvery-grey form, which occurs in all the surrounding country, was never seen by Mr. Webb within this area, every specimen belonging to the black race.

The carnivores include three lions, four cheetahs, a leopard, and a lynx; six genets, two of which are melanic forms; and four species of mongoose, one of which, *Myonax sanguineus*, a black-tailed species, is new to the collection.

Edentates are represented by three armadillos, *Orycteropus capensis*, a weird-looking animal of considerable interest in view of its many peculiar anatomical features.

The birds include ostriches, crested cranes, yellow-necked francolins, and two examples of the secretary bird, famous for its habit of destroying reptiles, a species which has long been absent from Regent's Park. Two beautiful species of crested guinea fowl, *Guttera pucherani*, from Mt. Kenya, and *G. edouardi seth-smithi*, from Lake Victoria, are already on view in the Pheasantries. There are four examples of the ground horn-bill, *Bucorvus cafer*, and the many smaller birds include at least four species new to the collection: two weaver-birds, *Pseudonigrita arnaudi* and *Ploceus rubiginosus*, a seed-eater, *Poliospiza striolata*, and several examples of crimson-rumped waxbills, *Estrilda rhodopyga*.

The reptiles include two African pythons, *P. sebae*, and a hawk-billed turtle.

Some of the animals in this collection, including the giraffes, are already on view at Regent's Park, but others will have to undergo a period of quarantine before being exhibited.

## ACHEULEAN CULTURE IN KENYA

ON the eve of his return to Kenya, Dr. L. S. B. Leakey recorded (*The Times*, October 4) a further remarkable discovery made by himself and his wife in the course of such archaeological explorations as they were able to carry out during brief periods of leave from war duties. In April 1942, they found an outstanding site of the Acheulean culture of the early stone age at Olorgesailie, forty-two miles from Nairobi. While examining systematically a region of well-exposed ancient lake beds, they came upon an area thickly strewn with Acheulean hand-axes and cleavers. Further search revealed a number of distinct and different strata from which these specimens were being derived by sub-aerial erosion.

In 1943, further evidence was obtained pointing to the conclusion that on this site, now known as Olorgesailie site 10, there was a series of actual living-floors or camp sites of Acheulean man such as had never been found anywhere. The floors are interbedded between layers of lake sediment (clays and silts) on ancient land surfaces. It was evident that in the Middle Pleistocene period Acheulean man had lived on the shore of a lake of which the water-level was not constant, but had fluctuated over a long period of time. When the waters rose, the camp was



flooded, and had to be abandoned; when the water receded the old camp had been sealed by layers of clay and a new camp was made. The same sequence of events recurred again and again, but on each occasion the returning stone industry represents a later phase of the culture. A sequence of Acheulean culture "such as exists nowhere else" is thus made available for study. Fossilized remains of extinct mammals found here include many genera and species similar to those from Oldoway Gorge, Tanganyika—*Elephas antiquus*, the straight-tusked elephant, *Hippopotamus gorgops*, the hippopotamus with periscopic eyes, etc. All the bones which could contain marrow have been split to extract it, but there are no signs of fire.

Dr. Leakey's discovery would appear to open up a new vista in the study of the early stone age and will, with the discovery of the Rusinga jaw recently announced, prove of high importance in the annals of the study of primitive man. It may be pointed out, however, that a discovery very similar to that now recorded by Dr. Leakey, and also showing the cultural sequence, was made at Whitlingham, near Norwich, in 1926-27, when J. E. Sainty and H. Halls recovered from such parts of the site as they were able to excavate 543 specimens, ranging from Chellean to Mousterian, of which 173 were hand-axes or choppers, the majority Acheulean. Prof. P. G. H. Boswell, after examining the site, in reporting on the geological evidence, concluded that probably primitive man had camped and established his workshops here on gravel banks adjoining the old channel of the River Yare. Lest the reported statement that "the Acheulean or great hand-axe culture was first found in England by Sir John Frere in 1750" should be a trap for the unwary, it should be noted that it was in 1797 that John Frere, F.R.S. (1740-1807), the famous antiquary—he was neither knighted nor a baronet—discovered flints "evidently weapons of war" but now identified as Acheulean at Hoxne in Suffolk. The first recorded hand-axe found in Britain came from Gray's Inn Lane, London, in 1690 and is now in the British Museum.

Archaeologists attending the forthcoming Pan-African Congress on Prehistory at Nairobi in January next (*Nature*, April 20, p. 548) will have the advantage of discussing the evidence of Dr. Leakey's war-time discoveries, including the Rusinga jaw, on the actual ground. No doubt argument there will clarify the issues in the recent tendency of opinion on the place of man's origin to swing back from Asia to Africa. It should certainly serve to integrate the problems of African prehistory, and in particular to place recent discoveries in both East and South Africa in true perspective.

## RESEARCH AND THE SMALLER FIRM IN BRITAIN

A CONFERENCE arranged by the Manchester Joint Research Council on "Research and the Smaller Firm" at the Albert Hall, Manchester, on October 16, at which Dr. P. Dunsheath and Sir Edward Appleton presided over the morning and afternoon sessions, respectively, was remarkable for a disinclination, as revealed in the discussion following the papers, to rely on large research organisations either of the type of the Mellon Institute or the Battelle Institute, on the ground that it is better

for individual officers of small concerns to make themselves responsible for research. Opposition to institutions such as the Mellon Institute with its system of industrial fellowships sponsored by individual firms was brought to a focus in Dr. F. C. Toy's address at the afternoon session on "Existing and Potential Facilities for Research". In so far as the Mellon Institute is largely supported by the large firms, the soundness of the conception and the general confidence in the foundation can scarcely be questioned; nevertheless, Dr. Toy's paper indicated concern as to the future of the research association in Great Britain and its ability to win the confidence of the industry it served.

Mr. C. G. Renold's paper at the morning session, which was opened by Mr. A. H. S. Hinchcliffe, dealt with internal organisation for the application of research, and discussed more particularly the management factor which is involved, as well as a scientific attitude of mind on the part of the leaders of industry and adequate facilities for the prosecution of research, to enable industry in Britain to be more responsive to the discoveries of science. The management problem involves three phases—recognition, investigation and application—and the responsibility for pursuing such work in all phases should rest on one individual, designated by Mr. Renold as the 'development officer'. That officer's duties as regards recognition and investigation present no great difficulty from the point of view of organisation, though even here it is open to doubt whether he can be really effective unless he has the status of a director. His duties in regard to application involve relations with the manufacturing side of the business and call for special techniques and practices of management. Mr. Renold had mainly the engineering industry in mind, but what he had to say about a foundation of authoritative specifications for raw materials, products and processes based on consultation with all concerned would apply to other industries as well. Mr. Renold would vest in the development officer the custody and upkeep of such specifications and the chairmanship of consultations in either formulation or revision.

Dr. C. J. T. Cronshaw's paper, "Technical Service—the Vital Link between the Producer and the Consumer", developed further some ideas implicit in his Mather Lecture to the Textile Institute last year, and he insisted that technical service has as its essential function the experimental investigation of the application of certain products within a consuming industry; its real value arises out of the unique knowledge acquired by research and experiment in its own laboratories. It is an abiding process of acquiring new knowledge, and it is not the function of technical service merely to provide a knowledge of the general science of chemistry, physics or engineering to a section of industry needing it. Dr. Cronshaw asserted that the function of technical service is to supply precise, specific and unique knowledge, and he then passed on to the quality of expertness. In doing so, he paid tribute to the skill and experience of the textile industry in Great Britain, and said that the only sure method of determining whether or not a new synthetic fibre would be a worthwhile addition to the range of fibres used by the textile industry is to put an appropriate quantity at the disposal of the industry and seek the initiative as well as the diversity of skill and talent of the firms within the industry. Sustained systematic search for novel products designed for some specific



purpose involves inevitably a technical service department for the purpose of evaluating new products and serving as a link between the potential consumer and producer. While, however, a technical service can help and collaborate in the industrial use of new products, it cannot unaided solve completely the problems arising in different fields of industrial effort. The small firm can utilize technical service just as readily as the larger firm.

Sir Edward Appleton, speaking at the afternoon session, said that the Department of Scientific and Industrial Research has given much thought to the problems of research and the smaller firm. He suggested that the industrial research associations should form the main reservoirs of knowledge on which the smaller firms should draw, stressing particularly the importance of efficient distribution of knowledge, supplemented by personal contacts, and the value of membership of more than one research association. He referred in general terms to the universities and technical colleges as the main source of new knowledge and fundamental research, and stressed the importance of having within the smallest firm those competent to assess the bearing of new knowledge on the products, processes or purposes of that industry. When facilities and staff are available, the Department of Scientific and Industrial Research will be prepared to assist a small firm by arranging to carry out special investigations into specific problems, although it is not possible to offer the same facilities as the Mellon Institute or the Battelle Institute—a statement which appears to conflict with Dr. Toy's remark that the research associations themselves are not encouraged to undertake work at cost for an individual firm.

## SCIENCE IN RELATION TO THE COMMUNITY

THE Imperial College of Science and Technology has established an Inaugural Lecture to be delivered annually, and with no limitation of subject. The first of these lectures was delivered on October 25 by Prof. A. D. Ritchie, professor of logic and metaphysics in the University of Edinburgh. The following is an abstract of Prof. Ritchie's remarks:

To begin with, it is necessary to distinguish between science and technology. In popular use, the term science covers both. Though one man's activities may be such as to count as both science and technology, this does not happen often. Even so, the aims of the two are always distinct. The man of science is trying to understand. His practical activities are practice for the sake of understanding. The technologist is concerned with doing something useful. Though he must understand first, his understanding is for the sake of practice. However closely connected, the two have very different social responsibilities.

The final result of scientific investigation is a body of systematic thought. The scientific worker's responsibility is towards his fellow men of science, those who are capable of judging the value of his work; as to whether it contributes to their common system of thought. Nowadays, when science has become expensive, the man of science must count himself lucky, if those who pay for his piping let him call his own tune. If ever he is not allowed to, science will die

out, and after that technology will petrify into routine and superstition.

The technologist is the servant of the public, directly or indirectly. His business is to plan or produce things which are useful and not harmful. His best efforts may sometimes be misused by other people through no fault of his own, but he has no right to assume that misuse is never his fault. An architect planning a new housing estate, who designs a built-in cocktail bar for the houses but no accommodation suitable for children, has a great deal of responsibility for the social habits of the inhabitants. He may put forward two schemes, one with cocktail bar, the other with nursery and playroom, saying both cannot be had at the price, and leaving the choice to the politicians. But in the modern world, social problems are more and more tied up with technical matters, so that the technologist can and does force the hand of the politician far more than he used to.

The social conduct of those technologists we call medical men has been governed by a definite moral code—the Hippocratic Oath—as a result of which they have on the whole used their immense prestige for the good of the community. It has been suggested that all technologists should be bound by a kind of Hippocratic Oath. The man who has to draw up such an oath is not to be envied his task. It was easy for Hippocrates, as he dealt only with the relations between individual physician and individual patient, which are always much the same and for which a general rule can be laid down. Nowadays the technologist is concerned far more with large-scale collective relations. Each new problem is different from the last; general rules may do more harm than good. Still, there is one great danger ahead, which if seen may be avoided. The tendency now is for men to become the servants of their machines, instead of the machines the servants of men. The engineer's formula of efficiency may be merely an excuse to further this tendency, unless he remembers that people come first and machines second.

## FORTHCOMING EVENTS

(Meetings marked with an asterisk \* are open to the public)

### Monday, November 4

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—Mr. J. G. Stewart: "Protein Food Production".

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. A. E. Bingham: "Modern Methods of Testing".

SOCIETY OF CHEMICAL INDUSTRY, LONDON SECTION (joint meeting with the INSTITUTE OF FUEL, at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Dr. C. C. Hall: "The Operation and Development of the Fischer-Tropsch and related Processes in Germany".

### Tuesday, November 5

CHADWICK PUBLIC LECTURE (in the Livingstone Hall, London Missionary Society, 42 Broadway, Westminster, London, S.W.1), at 2.30 p.m.—Mr. Asa Briggs: "Public Opinion and Public Health in the Age of Chadwick".\*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S.: "Locomotor Mechanisms in Vertebrate Animals, 2. Transition from Water to Land; Origin of the Limb with Five Digits; Its Development for Propulsion and Support".\*

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. W. F. Carey: "The Effect of Using Hot Air in Grinding Systems".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5.30 p.m.—Saw Tha Din: "The Karen People".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Princes' Gate, London, S.W.7), at 7 p.m.—Symposium on "How Accurate is a Photograph?" (Contributions by Dr. J. L. Tearle, Mr. A. A. Ray and others).



## Wednesday, November 6

SOCIETY OF DAIRY TECHNOLOGY, MIDLAND SECTION (at the Imperial Hotel, Birmingham), at 2.15 p.m.—Mr. F. R. Pattison: "The Relation of Metals to Milk".

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. D. C. Easley, Mr. E. C. Cherry and Mr. M. M. Levy: "The Pulse Testing of Wide-Band Networks".

## Thursday, November 7

INSTITUTE OF FUEL, EAST MIDLAND SECTION (at the Gas Demonstration Theatre, Nottingham), at 3 p.m.—Dr. A. L. Roberts: "Radiant Heating—its Principles and some Applications".

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. J. B. S. Haldane, F.R.S.: "The Formal Genetics of Man" (Croonian Lecture).

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr John Chear: "Birds and Man" (a colour film); Dr. V. van Straelen: "The Belgian National Park, Congo Belge".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. R. Partington: "History of Alchemy and Early Chemistry, 2".\*

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. Allan and Mr. D. F. Amer: "The Extinction of Arcs in Air-Blast Circuit-Breakers"; Mr. H. E. Cox and Mr. T. W. Wilcox: "The Performance of High-Voltage Oil Circuit-Breakers".

SOCIETY OF DYERS AND COLOURISTS, MIDLANDS SECTION (joint meeting with the SOCIETY OF CHEMICAL INDUSTRY, in Room 104, College of Art and Technology, Leicester), at 7 p.m.—Prof. J. B. Speakman: "The Promotion and Prevention of Milling Shrinkage".

TEXTILE INSTITUTE, LANCASHIRE SECTION (at the Chamber of Commerce, Richmond Terrace, Blackburn), at 7.15 p.m.—Mr. F. L. Barrett: "New Finishes".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Discussion on "Nitration" (arranged by Dr. G. M. Bennett).

TEXTILE INSTITUTE, BELFAST BRANCH (at the College of Technology, Belfast), at 7.30 p.m.—Mr. D. T. Flodd: "The Uses of Starch in Textiles".

## Friday, November 8

TEXTILE INSTITUTE (at 16 St. Mary's Parsonage, Manchester), at 1 p.m.—Mr. J. Chirnside: "Colour and Texture in Textile Design".

ASSOCIATION OF APPLIED BIOLOGISTS (in the Botanical Lecture Theatre, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7), at 2 p.m.—Mr. S. A. Barnett: "Rodent Control in Towns".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. R. d'E. Atkinson: "A Proposed 'Mirror Transit Circle'"; Mr. H. W. Newton: "'Sudden Commencements' in the Greenwich Magnetic Records (1879-1944) and related Sunspot Data".

CHEMICAL SOCIETY, SHEFFIELD SECTION (joint meeting with the SHEFFIELD UNIVERSITY CHEMICAL SOCIETY, in the Chemistry Lecture Theatre, The University, Sheffield), at 5.30 p.m.—Dr. H. W. Thompson, F.R.S.: "Some Applications of Infra-Red Measurements".

INSTITUTE OF FUEL, SOUTH WALES SECTION (joint meeting with local branches of CHEMICAL SOCIETIES, at the Royal Institution, Swansea), at 5.30 p.m.—Mr. H. E. Crossley: "The Inorganic Constituents of Coal".

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Current and Voltage Transformers for Protective Gear Purposes" (to be opened by Mr. J. G. Wellings and Mr. F. J. Lane).

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. H. Hillier: "Feed Distribution and Hunting in Marine Water-Tube Boilers".

OIL AND COLOUR CHEMISTS' ASSOCIATION, MANCHESTER SECTION (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Discussion on "Testing Methods for (a) Pigments, (b) Media, (c) Paints".

ROYAL STATISTICAL SOCIETY, LONDON GROUP OF THE INDUSTRIAL APPLICATIONS SECTION (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 6.30 p.m.—Mr. K. A. Brownlee, Dr. B. P. Dudding and Mr. D. J. Desmond: "Some Applications of Multiple Correlation".

INSTITUTE OF PHYSICS, ELECTRONICS GROUP (joint meeting with the MANCHESTER AND DISTRICT BRANCH OF THE INSTITUTE OF PHYSICS, in the New Physics Theatre, The University, Oxford Road, Manchester), at 7 p.m.—Dr. F. A. Vick: "Contact Potentials".

SOCIETY OF DYERS AND COLOURISTS, SCOTTISH SECTION (joint meeting with the GUILD OF CALICO PRINTERS, BLEACHERS, DYERS AND FINISHERS FOREMEN, at St. Enoch Hotel, Glasgow), at 7 p.m.—"The Importance of Adequate Shrinkage in the Dyeing and Finishing of Fibre".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Sir D'Arcy W. Thompson, F.R.S.: "The Anatomist and the Engineer, a Study in the Mechanism of a Bird".

TEXTILE INSTITUTE, BOLTON BRANCH (at the Municipal Technical College, Bolton).—Mr. W. Barker: "Weaving of the Future".

## Saturday, November 9

INSTITUTE OF PHYSICS, MIDLAND BRANCH (at the University, Edgbaston, Birmingham).—Dr. H. A. A. Boot: "The Cavity Magnetron".

## Friday, November 8—Saturday, November 9

INSTITUTE OF PHYSICS, X-RAY ANALYSIS GROUP (in the Conference Hall of the Royal Victoria Hotel, Sheffield).\*

Friday, November 8

At 2.30 p.m.—Dr. A. J. Bradley, F.R.S.: "The Intensity Relations of Debye-Scherrer Powder Diffraction Lines"; Dr. W. A. Wood: "The Application of X-Rays to the Study of Stresses in Metals".

Saturday, November 9

At 9.30 a.m.—Prof. G. I. Finch, F.R.S.: "The Surface Structure of Metals"; Mr. H. J. Goldschmidt: "An X-Ray Investigation of Electro-deposited Chromium"; Dr. A. H. Jay: "Some Successes and Failures in the Application of X-Rays to Industrial Problems".

## APPOINTMENTS VACANT

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

LECTURER AND INSTRUCTOR IN HORTICULTURE, a LECTURER AND INSTRUCTOR IN AGRICULTURE, and a SUPERINTENDENT for the Buntingham Horticultural Station—The Chief Education Officer, Norfolk Education Committee, County Education Offices, Stracey Road, Norwich, endorsed 'Agricultural Staff' (November 6).

SENIOR SCIENTIFIC OFFICER in the Directorate of Telecommunications Research and Development, London, of the Ministry of Supply—The Director of Scientific and Technical Administration (D), Ivybridge House, Adam Street, Strand, London, W.C.2 (November 7).

SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS (temporary), and EXPERIMENTAL OFFICERS and ASSISTANT EXPERIMENTAL OFFICERS (temporary), at the Guided Projectiles Establishment, Westcott, Berks.—The Director of Scientific and Technical Administration (D), Ivybridge House, Adam Street, Strand, London, W.C.2 (November 9).

LECTURER IN ELECTRICAL ENGINEERING—The Principal, Handsworth Technical College, Golds Hill Road, Handsworth, Birmingham (November 9).

LECTURERS (2) to teach (a) subjects in MECHANICAL AND AERONAUTICAL ENGINEERING, or (b) subjects in PRODUCTION ENGINEERING including PATTERN-MAKING, in the Mechanical Engineering Department of the Coventry Technical College—The Director of Education, Education Offices, Coventry (November 9).

LECTURER IN CHEMISTRY at the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (November 9).

TUTOR for women students, with qualifications in CHEMISTRY, PHYSICS or MATHEMATICS, at the Bradford Technical College—The Director of Education, Town Hall, Bradford (November 9).

LECTURER IN MATHEMATICS—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3 (November 9).

ASSISTANT LECTURER IN PLANT PHYSIOLOGY—The Principal, Royal Holloway College, Englefield Green, Surrey (November 9).

ASSISTANT (male) at the Bodleian Library (Radcliffe Science Library), Oxford—The Librarian, Bodleian Library, Oxford (November 9).

MATHEMATICAL PHYSICIST as Head of the Theoretical Physics Section in the Laboratory at Battersea—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1 (November 11).

SENIOR ASSISTANT IN THE DEPARTMENT OF MECHANICAL AND MARINE ENGINEERING at the City of Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool 1 (November 11).

ASSISTANT LECTURER IN AGRICULTURAL CHEMISTRY at the Essex Institute of Agriculture, Writtle—The Chief Education Officer, County Offices, Chelmsford (November 13).

CHAIR OF AGRICULTURE at Wye College—The Academic Registrar, University of London, Senate House, London, W.C.1 (November 13).

SENIOR LECTURER IN PHYSIOLOGY, and a LECTURER IN CHEMISTRY—The Registrar, The University, Sheffield (November 16).

MECHANICAL ENGINEERS (2) for service in the Sudan on the installation and maintenance of plant and machinery, including Diesel engine pumps, cotton ginning factories and sawmills—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Agricultural Engineer'.

ENGINEER to assist in the planning and erection of an electrically driven cotton spinning and weaving mill and power station—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Cotton'.

TECHNICAL DIRECTOR to co-ordinate and control the work of all technical departments, including a new Development Research Station—The Director, Cement and Concrete Association, 52 Grosvenor Gardens, London, S.W.1, endorsed 'Technical Director'.

LECTURER (grade II) in the DEPARTMENT OF PHYSIOLOGY—The Secretary, University College, Gower Street, London, W.C.1.

RESEARCH ASSISTANT to work in the Information Section—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

GRADUATE (young, with degree in Zoology) for research in Anthropometric studies—The Secretary, The University, Edmund Street, Birmingham 3.

METALLURGIST or PHYSICAL CHEMIST preferably with some experience in the metallography and general metallurgy of non-ferrous alloys, and a METALLURGIST with industrial or research experience in non-ferrous foundry work—The Secretary, British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1.

DEMONSTRATOR IN PHYSIOLOGY—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1.

SENIOR LECTURERS IN PHYSICS AND MATHEMATICAL PHYSICS, LECTURERS IN PHILOSOPHY AND ZOOLOGY, and ASSISTANT LECTURERS IN HISTORY, PHYSICS, AND MATHEMATICS, at the University of Otago, Dunedin, New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.





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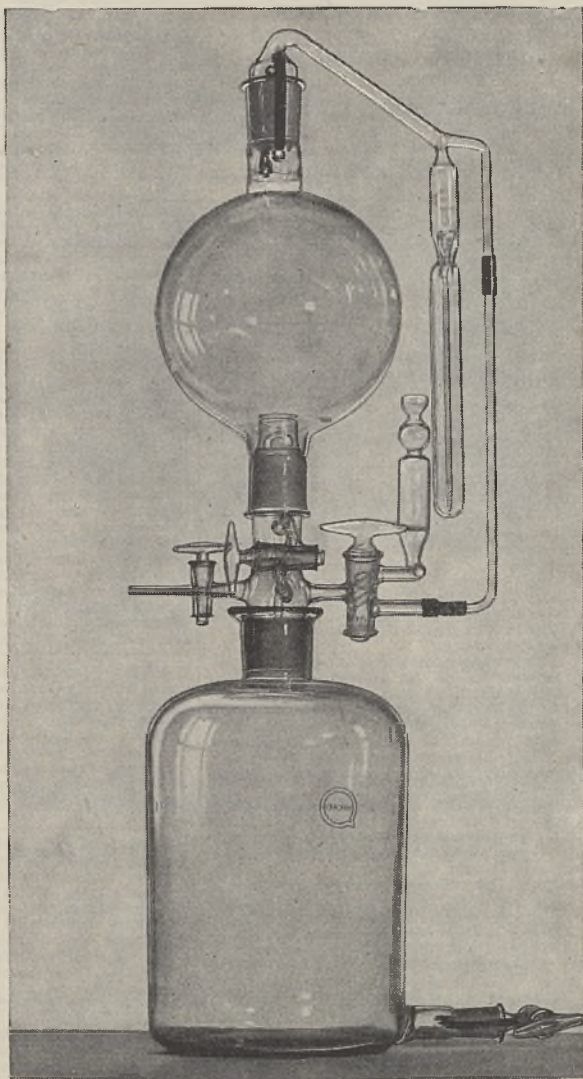
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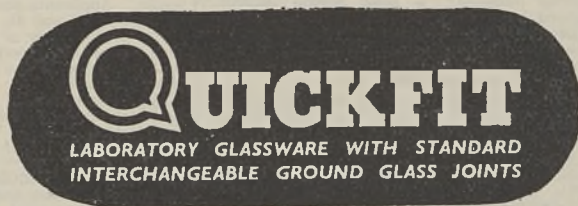


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(Continued from page iii of Supplement.)

## THE INSTITUTION OF CHEMICAL ENGINEERS

EXAMINATION, 1947

Application forms (returnable December 2, 1946) and particulars of the Associate-Membership Examination for 1947 may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56 Victoria Street, Westminster, London, S.W.1.

## UNIVERSITY OF LONDON

The Senate invite applications for the Readership in Geography tenable at Queen Mary College (salary not less than £800). Applications must be received not later than November 19, 1946, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

## UNIVERSITY OF LONDON

The Senate invite applications for the Readership in Geology tenable at Queen Mary College (salary not less than £700). Applications must be received not later than November 19, 1946, by the Academic Registrar, University of London, Senate House, W.C.1 from whom further particulars should be obtained.

The Civil Service Commissioners invite applications for two posts of Principal Scientific Officer for Research and Development work on flutter, aero-elasticity and general airframe vibration at the Royal Aircraft Establishment, South Farnborough, Hants. The successful candidates should have a first or second class honours degree, or the equivalent, in engineering, mathematics or science, and have either research experience supported by original papers, or aircraft design experience related to aero-elastic theory.

One Principal Scientific Officer is required to assist a Superintendent in the general supervision of flutter research and its application to existing aircraft and new designs, and especially to control and to guide experimental vibration work on actual aircraft, both in flight and on the ground. Some experience in flight testing, instrumentation and general engineering is necessary, and some knowledge of aerodynamics is desirable.

The second Principal Scientific Officer is required to specialise in the aerodynamic aspects of flutter. He must be prepared to give technical supervision in the design of a new high-speed flutter wind-tunnel, and to take charge of its operation when completed. For this post extensive experience of wind-tunnel testing, and knowledge of flutter theory and general aerodynamics, are essential.

The salary scale for these appointments is £750 × 30-£1,020 (men) and £660 × 30-£880 (women). The salary will be increased by a consolidation addition (in place of War Bonus) which ranges from £90 at the minimum of the scale to £105 at the maximum for men and from £79 at the minimum of the scale to £84 at the maximum for women.

Candidates must be of British nationality and have been born on or before August 1, 1915 and be under 50 years of age on September 1, 1946. They must possess the stipulated qualifications and experience. The posts carry Superannuation benefits under the Federated Superannuation System for Universities.

Forms of application are obtainable from the Civil Service Commission, 6, Burlington Gardens, London, W.1, quoting No. 1659, to whom completed applications must be returned not later than November 18, 1946.

A large manufacturing firm with works in Lancashire and elsewhere has vacancies for several young technical men between the ages of 24 and 30 years, either straight from university or after having had industrial experience or service with H.M. Forces, preferably in a technical capacity. Qualifications required: a good general education followed by a University Degree in Engineering, Physics or Chemistry.

In general terms the intention is to employ these young men as Technical Assistants in process departments and if successful they can look forward to promotion to positions of responsibility on the Management Staff in control of manufacturing processes.

The commencing remuneration offered would be between £350 and £600, depending upon age, qualifications and experience. Box 731, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Young energetic chemist, B.Sc., Ph.D., age 29, requires position of responsibility in research or analytical laboratory offering scope for initiative. Experience of research, general analytical chemistry, biochemistry, electrochemistry, chemical process control. Used to control of staff. London area preferred. Box P.210, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## Engineer Designer.—An Assistant

Chief Engineer Designer is required by a large Industrial Organisation in the North of England. The Chief Engineer Designer, with an adequate staff, is responsible for the design and development of production machinery and the preparation of estimates for plant and building extensions; he is not responsible for the installation of new plant and the maintenance of existing plant, which is carried out by a separate department.

Applications are invited from engineers with a flair for the mechanical design of heavy precision machinery who can produce evidence of their ability to do original design and development work. They should be between 35 and 40 years of age, have a good general education and University Degree, or equivalent in Mechanical Engineering, and workshop experience. The commencing remuneration will be of the order of £1,000 per annum. Box 732, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Director of Research required immediately for recently established Research Laboratory in London attached to well-known Company manufacturing Antiseptics, etc. Primary qualification a wide experience in Bacteriology. Applicant should also have interest in, and some knowledge of, cognate subjects, especially Chemistry. Adequate equipment and assistance are provided, and duties will involve short and long term investigation in Bacteriological Department, and the planning and direction of Bio-Chemistry and Chemistry Sections of the Laboratory. The salary offered will be commensurate with qualifications and experience. Pension Scheme is in operation. Applications, with full details of qualifications, experience, age, and the names of three referees to whom confidential enquiries can be addressed, should be sent to Box 735, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Physicist, Chemist or Metallurgist required for X-ray Crystallograph and Spectrochemical analysis for research and routine work on light metals. Training to B.Sc. (or equivalent standard) necessary, but men with higher qualifications will be considered. Salary according to training and experience but not less than £400 per annum. Write giving full details of experience and qualifications. Box 743, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Qualified Engineer required as deputy to Chief Engineer for large Chemical Works in East London. Salary between £600 and £900 according to qualifications. A post offering excellent prospects for progressive and energetic applicant B.Sc. or equivalent degree with not less than five years engineering and electrical experience in chemical work. The position offers scope and advancement. Box 741, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Factory situated East London requires a Research Chemist with experience in industrial organic chemistry and all-round training and knowledge of physico-chemical methods desirable. Salary £600-£700 per annum, according to qualifications. Box 742, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Bacteriologist (man) required immediately to initiate investigations in the Research Laboratory in London of a Company manufacturing Antiseptics, etc. Wide experience in Bacteriology primary qualifications. Salary will be in accordance with qualifications and experience. Pension Scheme is in operation. Apply with full particulars of qualifications and experience, together with names of two referees, to Box 734, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Manager required to take charge of a Fine Chemical Manufacturing Unit employing 220 people. Applicants should preferably be between the ages of 35 and 45, must be graduates with a degree in Chemistry or Chemical Engineering, and have had sound experience of a similar type of work. The post is one of responsibility carrying a four figure salary.

Applications, which must give full details of qualifications, experience and salary required, should be addressed to the Works Director, Wellcome Chemical Works, Dartford, Kent.

Rubber Technologist required to take full charge of rubber research and testing laboratory carrying out physical and technological research and technical service work. Applicants must be University Honours graduates. Factory as well as laboratory experience would be an advantage, but is not essential. Good prospects of wider responsibility for a man with the ability and initiative. Salary from £700 to £1,000 according to qualifications and experience. Box 740, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Senior Assistant to Patent Manager required by long established Radio and Television Manufacturers. Qualifications must include a degree or equivalent and a sound knowledge, both practical and technical, of radio and electronics with a real interest in technical correspondence and specifications. Salary between £550 and £700 p.a. according to qualifications and experience. Apply, giving necessary particulars to Box 745, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Junior Clinical Laboratory Technician required, grade C (I.M.L.T.) or similar partly trained status. Salary according to I.M.L.T. scale plus bonus. Apply for interview to Clinical Director, Hosa Research Laboratories, Sunbury-on-Thames, Middlesex.

Scientific Assistant. Vacancy for Science Graduate (Zoology) for bureau literary work. £354 × 18 - £570 inclusive. Good knowledge of German desirable.—Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture, New Haw, Weybridge, Surrey.

Technical Assistant. Vacancy for Arts Graduate for bureau literary work. Knowledge of a Scandinavian language desirable. £204 × 15 - £384 inclusive. Suitable applicant would start at appropriate grade.—Imperial Bureau of Animal Health, Veterinary Laboratory, New Haw, Weybridge, Surrey.

Analyst required. Applicants should be honours graduates in chemistry or A.R.I.C. and should preferably have had several years industrial experience in the analysis of medicinal preparations and fine chemicals. Commencing salary £400-£450 per annum. Apply to the Technical Director, Genatosan, Ltd., Loughborough, Leics.

Research Assistant required for London area. Candidates should have experience of research allied to industry, and preferably some knowledge of magnetic materials and their use in electrical instruments. Applicants should give details of experience, age and salary required. Box 736, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Technical Assistant (Senior) required, fully qualified man preferably with M.Sc. or Ph.D. in Chemistry or Physics, to conduct research and development. Experience in textiles advantageous. Age: 25-35. Apply: Personnel Dept. (Ref. PM/LVG/77), Fort Dunlop, Birmingham, 24.

A vacancy exists with an old-established Company for a first-class Ceramic Chemist in a senior position. Applicants must have had practical experience with ceramic insulating material of exceptionally high alumina content and be capable of supervising control of processes and constituent materials. Apply Box 698, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Graduate Chemist required by Research Association. Candidates aged 25-35 with research experience preferred. Salary £400 to £500 according to qualifications and experience. Apply in writing to the Secretary, B.C.U.R.A., 13, Grosvenor Gardens, S.W.1.

Technical Assistants, Graduates in Chemistry or Physics for research and development work, preferably with industrial experience. Age: 22-30. Apply: Personnel Dept. (ref. PM/LVG/78), Fort Dunlop, Birmingham, 24.

Research Chemist required by a large firm in the Manchester district. Honours degree or A.R.I.C. Candidates should have knowledge of the preparation, testing and uses of plastics. Permanent position with good prospects. Box 744, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Gresham College, Basinghall Street, London, E.C.2. Four Lectures by Professor H. Hartridge, M.A., M.D., Sc.D., M.R.C.P., F.R.S. (Gresham Professor in Physics) on "Physiology of Vision" on Mon. to Thurs. Nov. 4 to 7. The Lectures are Free and begin at 5.30 p.m.

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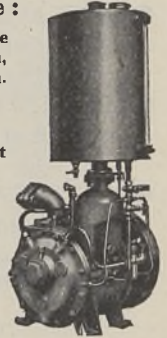
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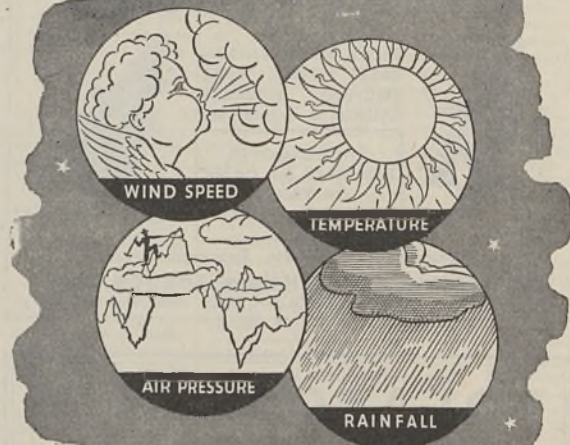
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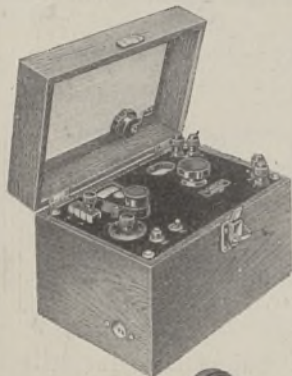
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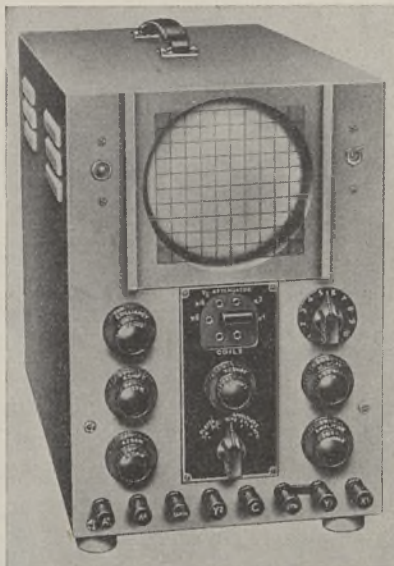
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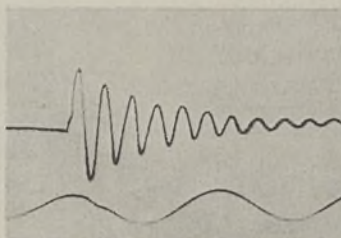
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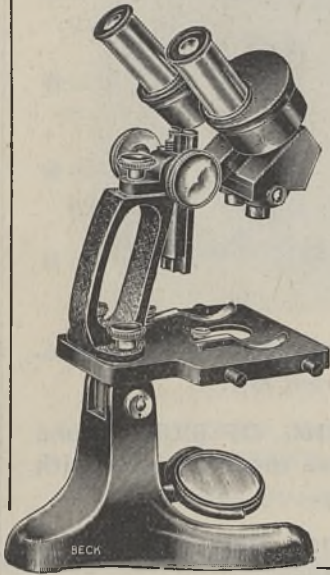
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