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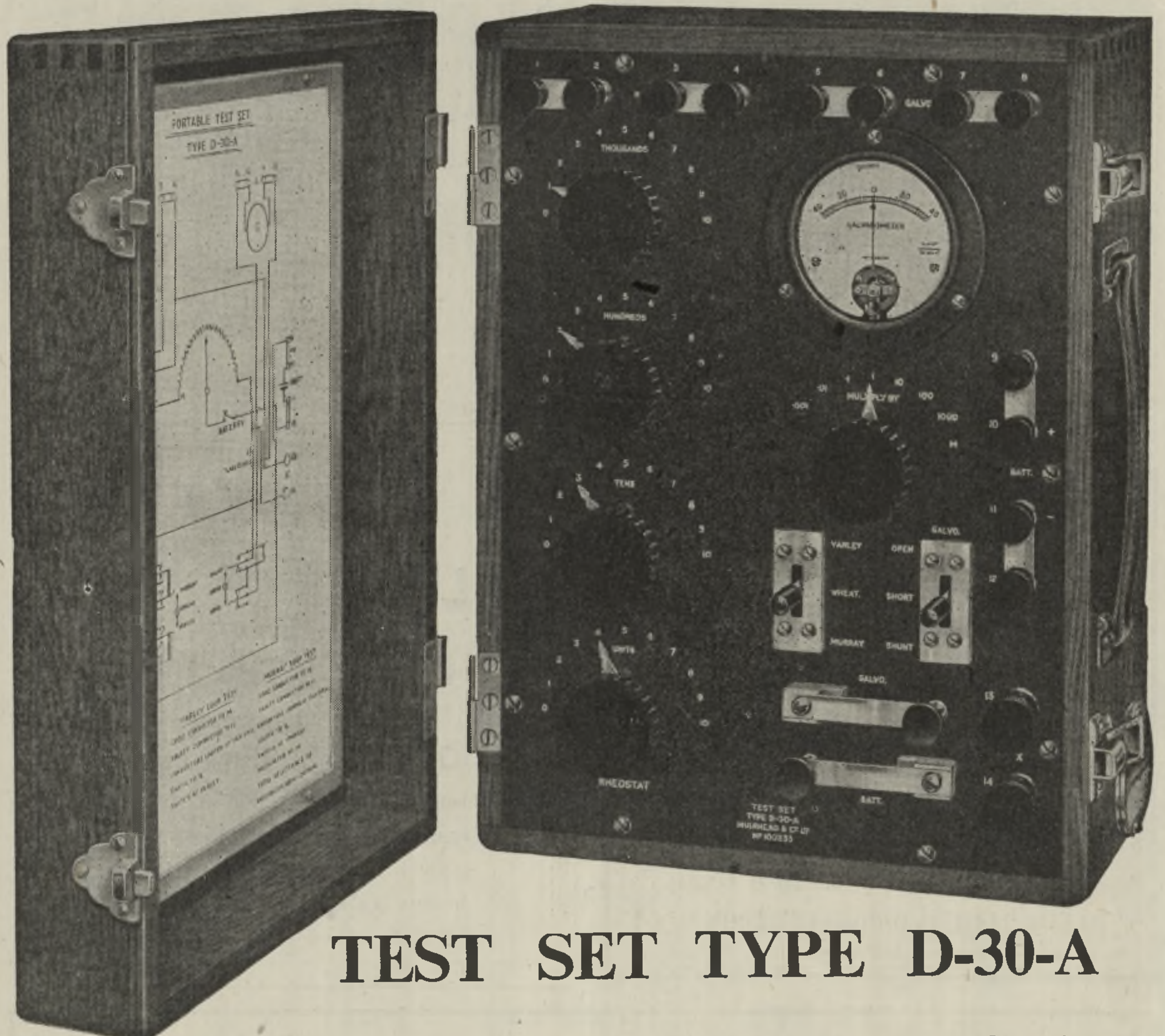


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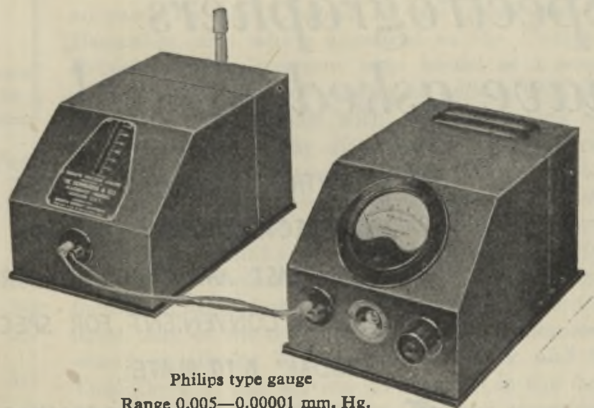

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# NATURE

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CONTENTS




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## UNIVERSITY DEVELOPMENTS

THE second report on "University Developments" issued by the Association of University Teachers, adopted by the Council of the Association last December, and which appeared in the *Universities Review* of May, has now been issued as a separate document. The report covers as wide a field as the first report, and deals with some questions which have been only briefly discussed in other reports on the expansion of the universities. Three broad subjects are covered : the place of research in the life of a university ; the relations of academic and industrial science ; and the university as a regional focus. The former includes a section on research in the faculty of arts ; but this would appear to be a fragment only of the document quoted and discussed so wisely by Bruce Truscot in "Redbrick and these Vital Days". The section on research in the faculty of science is even briefer, and beyond stressing the need for attention to such points as the improvement of the position of laboratory assistants, as well as in their number, and the place of group- or team-work in research at the universities, contributes little that is new. Criticism of research in the social studies is more searching and constructive ; and in urging that more and more adequate research in the social sciences is of the utmost importance because the progress of man in securing control over his material surroundings has not so far been accompanied by corresponding progress in controlling social and political organization and relationships, and in adapting human beings to their changing circumstances, the report suggests that much research on contemporary social conditions would be done better if initiated and directed by university departments. One reason for this is that it is difficult for an isolated group of persons to obtain access to, or command over, all the distinct disciplines and techniques required in the investigation, analysis and interpretation of complicated and many-sided social phenomena.

Social studies are very unevenly developed in the universities of Britain, and often there is little co-ordination between them. It is desirable that they should be further developed and brought into closer touch within each university and among universities. In her recent book on the training of the social servant, Elizabeth MacAdam referred to the place of the university in training such workers ; she pointed out that investigations into contemporary social conditions which arise out of such courses tend to stress social pathology. More studies of normal societies are needed ; for example, more knowledge of groups within society and of the relation of such groups to one another and to the whole ; of the problems of crowd and group psychology and of leadership ; of the relations of the sexes and the structure of the family ; of the social aspects of education ; and of the trends of change in all these. Moreover, since most social problems involve both facts and values, close relations must be developed between the social sciences and philosophy, and for some problems workers with a philosophical training as well as a knowledge and understanding of social facts will be required. This section of the report accordingly pleads for further encouragement of more thorough research and more co-operation in research, based on historical data, comparative studies of contemporary societies, correlation of different specialisms, and greater co-ordination in planning inquiries. As an example, attention is directed to the economic and psychological as well as biological issues involved in social medicine.

In these separate sections, as in the more general sections on research, the vital importance of research in the life of the university is adequately emphasized and also its intimate relation with the teaching aspect. The two aspects are inseparable and cannot be divorced, and if, as Mr. Truscot points out, caution is necessary in accepting some interpretations of the word 'research' in the arts field, there can be no dissatisfaction with the emphatic defence of the right of full freedom of investigation to be found in this report. Moreover, it is highly satisfactory to find that the Association of University Teachers has not missed the importance to research of such matters as adequate library facilities, the finance of publications, or the interchange of staff which are emphasized so strongly in the report of Dr. Bowman's Committee on Science and the Public Welfare recently published in the United States. An all-round development of library facilities, including books, periodicals, buildings and staff is overdue. Scientific and learned books and periodicals appearing in foreign countries are often poorly represented on university library shelves. The weakness of the scheme for inter-library loans receives pointed comment, and the importance of some portion of the research fund being available to meet the expenses of publication and of greater facilities for exchange of staff between universities and other research institutions is well stressed.

The section of the report on the university as a regional focus deals with large questions which have been ably discussed by Bruce Truscot in both his books as well as in an article in *The Political Quarterly*, and they are also the subject of a lecture by Prof. B. Dobrée delivered at King's College, Newcastle-on-Tyne last year. Here it need only be said that universities will, as the report notes, function as centres of information and ideas for their regions, partly by the independent activities of individual members of university staffs, and partly through the extra-mural departments, the building up of which on a sound and firm basis with adequate recognition from the governing bodies is recommended as a first step. To this end the report suggests the appointment as directors of such departments of persons of academic distinction, with adequate administrative staff; provision of working apparatus and sufficient staff with their own board of study. Scarcely less important is the need for premises, and it is significant that the plan for the development of Manchester at present on exhibition makes liberal provision for exactly the type of accommodation suggested.

Leaving for the present the further comments of the report as to the principal forms of activity and development of the university as a regional focus, we may note that such activities provide a further reason for closer co-operation with other bodies and for some attempt to formulate a national policy for Britain, particularly in view of the post-war developments imminent in adult education. One form of these activities at least is closely related to that major question of the relation of academic and industrial science considered in the second section of this report. The importance of general refresher courses, of short specialist and advanced courses and *ad hoc* conferences among scientific workers and other professional men is now widely recognized. The Association of University Teachers suggests that the provision of such courses may be one of the most important developments of post-war adult education. The universities are the institutions obviously qualified to help in giving the required instruction, and it will demand from them a new approach and much hard work and clear thinking if the best use is to be made of a great opportunity to make an outstanding contribution to the intellectual life of the community. These courses, suggests the report, should be conducted in such a way as to bring about contacts between the various professions and the general public, so that there may be a wider understanding in the community of the basic work of the different professions. They should also help to re-establish touch between the universities and many of their alumni; and their financing, which will not be easy, should be done in co-operation with the professional bodies concerned.

It is to such co-operation between the universities and the professional bodies that we must also look, as the Nuffield College statement on problems of scientific and industrial research suggested last year, for the solution of some of the more difficult problems arising in the relations of academic and industrial science. That the Association's report should be concerned with these problems is the more welcome in view of the attention they have received in the United States by the able committee under Dr. Josiah Bowman as chairman, to which Dr. Vannebar Bush referred the consideration of questions relating to science and public welfare in preparing his report on a programme for post-war scientific research. The parallel in thought between the two reports is striking, and no one could wish for a more emphatic endorsement of the importance of the fundamental freedom of inquiry.

The universities, points out the Association of University Teachers, are the main sources of that fundamental research which, through subsequent development in the field of applied science, is one of the chief determinants of progress in a modern community; they are also the most effective institutions for ensuring that applied science is kept in full touch with expanding scientific knowledge. The Association claims that the highest standards of mental development and training in clear and critical thinking to which the university aspires to lead its students can be achieved through the teaching of technological subjects, as well as of the humanities or pure science, and urges that the development of the existing applied science departments is to be encouraged and new sections should be formed when sub-divisions have sufficiently increased in content and significance. In particular, the newer practical developments of biology should find full support in the expansion of teaching and of research; and special reference is made to the importance of genetics, ecology, and soil science.

Such developments represent one direction in which some measure of joint planning between the universities is desirable; and, again, in the establishment of new institutes for the application of fundamental research to the needs of industry, full consideration should be given to the arguments in favour of placing them near a university in the region most engaged in the industry concerned. Such institutions should maintain the closest touch with neighbouring laboratories engaged in fundamental research, and proper attention to this point should do much to close the gap between fundamental and applied science. The Joint Standing Council set up in Manchester last year by the University and the Chamber of Commerce is an example of the way in which such co-operation can be fostered.

The universities, however, must be the sole arbiters of the type of work which they shall undertake. There must be no suggestion that they should be in any way under the direction of the research institutes in this respect; and this freedom of fundamental research in the universities from external control is again stressed in connexion with the departments of applied science. In particular, the Association urges that the growing tendency of industries and individual firms to subsidize *ad hoc* research in universities on their own particular problems is in general to be resisted, as liable to lead to a form of commercial domination which is alien to the true university spirit and to the advancement of science itself. Effective contact with the industrial world can be maintained in other ways, and it is very desirable that assistance from non-industrial sources should be sufficient to ensure the independence of university research, especially on the technological side. In so far as applied research is carried out in university laboratories, the results should be immediately available to industry as a whole.

It is of course true that industrial research often discloses gaps in our more fundamental knowledge, and in this way industry may be able to indicate to the academic scientific worker problems which are worth investigation. Contacts between industry and the university such as are fostered by joint research councils of the type established at Manchester should encourage this cross-fertilization of ideas; and for this reason again the somewhat different problem of the engagement of professors or lecturers as consultants to firms or research associations requires careful handling. In principle, the intellectual resources of a university should be available to all in the community, and no restriction should be placed on the giving of advice by members of the academic staff, apart from the normal clause forbidding the acceptance of outside appointments without the consent of the university. So far as payment is concerned, the Association of University Teachers looks to the evolution of a code of professional conduct in such matters, as was suggested in the Nuffield College statement.

It will be seen, therefore, that the Association has covered the ground very thoroughly. Such questions as the relations between the universities and the technical colleges are also tentatively considered, and the importance of developing further links between them is recognized—for example, in addition to closer regional association, the setting up of joint standing committees by subjects, as well as between governing bodies, to investigate possibilities of mutual aid in the difficult post-war period is suggested. But what is most significant, however, is the extent to which the views urged by the Association find expression in the reports which have since appeared from Dr. Bowman's committee in the United States, already mentioned, and from the Commission on Higher Education in the Colonies. It would, in fact, be difficult to find a better brief exposition of the place of research in the life of the university than is contained in Chapter 6 of the latter report, and of the implications which arose from the acceptance of this conception of the place which the search for knowledge should hold in a university.

A university is not a continuation school in which the staff have time for research; it is an organ of higher learning inspired throughout by devotion to knowledge, and for the teaching staff the obligation to further knowledge in their special fields includes the duties of keeping constantly in touch with the results of research and of preserving a continual readiness to consider new ideas and to make the adjustments of outlook that follow from the acceptance of new data. For those who control universities, it means that the knowledge sought is desired for its own intrinsic value; the motive proper to a research worker is to extend the boundaries of charted knowledge in his own field wherever extension is intellectually most satisfying. Accordingly, utilitarian results must not be demanded from the research activities of members of the staff of a university, and their work must not be judged by its immediate bearing upon practical problems.

If these first principles are fully apprehended, and if those in control realize that in the long run universities will be judged by the contributions which they make to fundamental knowledge, there is little need to fear that some of the dangers to which Bruce Truscot and the Association of University Teachers direct attention will not be averted. It is not only in the Colonial universities that the choice of subjects for research is constrained by circumstances which make some desirable projects difficult or impossible to attempt, or that in the post-war world the necessary adjustment to new problems and new conditions may in itself provide a welcome and valuable stimulus. Again, in regard to the applied sciences, it is not the function of the universities directly to provide for the urgent application of science to improve health, agriculture or industry in the Colonies; to require the universities to do so would indicate a fundamental misapprehension of the place of research in universities. It is, on the other hand, an important duty of the university to train students to become applied scientists, and the abundance and attractiveness of local material, in the Colonies, as elsewhere, will not infrequently lead the university research worker, though untrammelled by the need to produce utilitarian results, to devote himself to inquiries which will have considerable practical significance. Equally, fidelity to such principles will be the surest guide in resolving the problems of relations and location between the institutes of applied science and the universities in the colonies as in Great Britain.

The Bowman Committee, in laying down similar general principles for the endowment of research in universities in the United States, has been influenced by the growing reliance of science departments of American universities upon industrial corporations for assistance. This, and the accompanying tendency to specify the projects for which grants to universities or to research institutions are to be used, have already been the subject of pointed comment. The Bowman Committee emphasizes the need for freedom in science, and refers to the need for guarding against the control of science by industry as well as against control of science by government. It points out, further, that reliance on industry in this manner may imply the distortion of university research in the direction of short-range problems at the expense of more fundamental research, as well as some decrease in the freedom of the university man of science.

The insistence in the Bowman Report on the necessity of devising ways and means of allocating funds in large measure without determining what particular problems are to be worked on and who is to execute them, and the importance of variety and decentralization of control in scientific work, where the fostering of novelty must be the first concern, is one way in which thought in the United States is clearly moving on similar lines to that in Great Britain. That in itself should help to overcome the complacency of which Bruce Truscot complains ; and it may well be that the increased contacts in certain fields during the War will have facilitated the further pooling of experience in dealing with some of these problems, and especially with the removal of those war-time obstacles which have hindered the free exchange both of information and ideas and scientific workers. The general desire of scientific men in Britain, the United States and the U.S.S.R. for more such contacts and for full freedom of communication is unmistakable ; but in the meantime this further report on university developments from the Association of University Teachers merits close study by all research workers. It is well to note that the Association, in consultation with the University members of Parliament, has drawn up a memorandum in which the more important needs of the universities are set forth in order of priority ; that memorandum, published in the *Universities Review* last May, also deserves attention by all concerned with education or research. The release of university staff and of students in Britain to complete their studies has received nothing like the priority that its importance for the new educational programme, the expansion of our research effort or industrial development demands.

# PSYCHOLOGY OF WAR

## Foundations of Human Conflicts

A Study in Group Psychology. By Dr. William A. Brend. Pp. viii+212. (London: Chapman and Hall, Ltd., 1944.) 15*s*. net.

THE psychology of conflict in human affairs, rising to an extreme of violence and cruelty in war between nations, is a subject of study second to no other at the present time. Although the great majority of educated and thinking people imagine that they can solve this problem in general terms by the light of common-sense and on the basis of ordinary experience, the mutually conflicting theories which they put forward indicate that no adequate solution can be reached in this way.

Dr. Brend's book may be regarded as the latest illustration of such a position. Although written by a sound physician with a legally trained mind and with a good working knowledge of medical psychology, it approaches the problem of human conflict along the lines of descriptive psychology, in which it is conscientiously precise and accurate, without probing more deeply into the fundamental springs of human activity.

Dr. Brend draws an important distinction between 'direct' and 'derived' emotions, and endeavours to explain the development of strife between groups, whether national or religious, between classes or ages, in terms of an artificial stimulation of derived emotions among the masses by the use of myths and symbols, by falsified history and irrelevant or outworn tradition, applied along the lines of the most up-to-date propaganda. He denies the existence of any instinct of pugnacity, or of the herd, or of religion, but considers that all these reactions are acquired by the individual after birth, under the influence of derived emotions which are, to say the least, inadequately controlled by reason and direct experience.

His ultimate solution would seem to be an extreme application of *rationalism* to the problem, whereby differences of nationality, of religion and of classes should be ultimately abolished. Nevertheless he shows little realization of the close and intimate relationship of the emotional and rational elements in the human soul, nor of the great importance of the 'spirited element' (τὸ θυμοειδές μέρος) as Plato saw it.

In spite of Dr. Brend's denial, there can be little doubt of the instinctive basis of pugnacity, gregariousness and the *general* religious attitude and outlook in man. There is an inborn tendency at the root of each of these mental reactions which is intimately related to a general instinct of self-preservation (*Selbsterhaltungstrieb*), even if we refrain from positing a more active tendency to aggression and to worship independently of individual experience. *Sublimation*, after release of repressions, is the only healthy result to be aimed at, and the only satisfactory solution of the problem of innate pugnacity.

Man is a fighting animal, and will at least defend himself when he is attacked. He will refuse to take unfavourable economic conditions lying down, and will combine and fight, both for his class and for his nation, when conditions become intolerable. In other words, he will fight to defend himself against objective enemies and difficulties.

But in his own individual development, onwards from infancy, he has had to contend with difficulties that were often too much for him, so that he has accumulated grievances and grudges, and, in general, *hates*, which continue to plague him from within, and their cumulative subconscious effect is to make him envious, spiteful and jealous, and unduly *suspicious* of his fellows, or some of them. He becomes on the defensive subjectively, and projects his stored-up hate and aggressiveness upon the people around him, considering them his enemies and putting himself on guard against them. In other words, he becomes *paranoid* in his mental attitude towards his environment.

As a member of a group, especially of a nation, with its sensitive national pride, his paranoid tendency is shared by his companions in relation to the common foe, and in their company he is ready to play his part in fighting the hostile nation by whatever means are available, sustained in his pugnacity by propaganda and by a consciousness of the rightness of his cause.

Once battle is joined, as in a dog-fight, he will not desist until he has destroyed the enemy or the enemy has destroyed him. The time to stop a war is before it starts. If nations were fully informed by their leaders of the facts of the international situation an outbreak of war might be delayed, but it would not necessarily be prevented. Nations and their leaders may be self-deceived at a deeper psychological level, and it is here that the psychological roots of war are to be found—in addition to the more obvious economic causes.

In other words, only by deep mental analysis—along the lines of Freud's method of psycho-analysis, but without prejudice as to the special sexual theory which he and his followers have developed in their study of both normal and psychopathological cases—can the full psychological meaning and causation of human conflicts, both individual and group, be revealed. Many investigators are now at work along these lines, and they have incomparable material in the latest war with Germany, if they know German and are prepared to make a *direct* study of the minds of Germans as well as those of their own countrymen, not omitting *themselves*. The end is self-knowledge, free from illusion or self-righteousness.

William Brown.

## HUMAN EMBRYOLOGY

**Human Embryology**

(Prenatal Development of Form and Function). By Prof. W. J. Hamilton, Prof. J. D. Boyd and Prof. H. W. Mossman. Pp. viii+366. (Cambridge: W. Heffer and Sons, Ltd., 1945.) 31*s*. 6*d*. net.

ADVANCES in the field of human embryology during the present century have been dependent chiefly upon the acquisition of more abundant human material, particularly in the earlier stages of development, and upon its accurate observation and interpretation in the light of comparative and, to a lesser degree, experimental embryology. Undoubtedly the most notable recent advances have been in the study of early human and primate material, which is now becoming available in steadily increasing quantities. In this new text-book, the authors have attempted "a presentation of the subject of human embryology in the light of the advances which have been made in it during the past twenty years". They have, in general, succeeded in working into existing knowledge many facts which have been collected during the past twenty years.

The text follows the customary order, dealing in turn with the germ cells, accessory sexual organs, fertilization, implantation, early developmental stages, including the fœtal membranes and organogeny. Chapters are also included on some elementary and fundamental concepts of experimental embryology and on comparative embryology. Each chapter is provided with a list of references which are described as 'full'. It is regrettable that no mention has been made of the life-work of three great English anatomists, namely, Elliot Smith on the nervous system, Fawcett on the skull and Wood Jones on the urogenital system. There are detailed references to that great American publication "Contributions to Embryology", and its influence is much in evidence throughout the book both in the text and figures.

The illustrations are numerous, many being in colour. Original figures are in a minority, and do not attain the high standard of accuracy found in most of the copied or modified figures. It is a pity that there are inaccuracies in these figures, as in a textbook for students accuracy should come before all else. To mention some, in Fig. 136 the vertebral artery is labelled as a precostal anastomosis; Fig. 150 is that of a sagittal section of a fœtal head and conveys an entirely false impression as to the form and dimensions of the nasal cavity at this stage. In another figure the chorda tympani is shown passing above the first pharyngeal pouch. The vitelline artery and vein are shown in Fig. 176 passing to their destination outside the mesentery of the small gut, while the relations of the Wolffian duct to the ureter differ in Figs. 207 and 212. Indeed, the error in Fig. 207 would make the transformation which is shown in the succeeding figures impossible to understand. The changing relations of the suspensory ligament of the gonad to the metanephros shown in figures dealing with the urogenital system can do little but confuse the observant reader. In Fig. 330, based on Macklin's diagrams, the tympanic bone is indicated as a cartilage bone, while in the succeeding figure it is correctly depicted as a membrane bone. Correlation between the figures and the text is in many places unsatisfactory. Structures such as the paracondyloid process, ala hypochiasmata, alicochlear commissure and polar cartilages are figured and labelled but receive no mention in the text and fail to appear in the index.

The account of early human developmental stages is excellent and constitutes one of the most valuable features of the book. Many details of known early human embryos are tabulated and recorded. This is a field in which at least one of the authors can speak with considerable authority and gives a valuable summary of the formation of the germ layers and implantation as it is now known. The sections on the lymphatic system and on teeth could with great advantage be enlarged and elaborated. The development of the heart is clear and well written; but it is a little surprising to note the omission of the term infundibulum of the right ventricle both in the text and index. Speaking of this part, Keith said, "The importance of recognizing the bulbus cordis as a separate constituent of the heart will be realized when it is remembered that 95% of the cases of congenital malformation are the result of its imperfect transformation to form the infundibulum of the right ventricle of the heart". It would appear that it is impossible to lay too much stress on this part.

Congenital abnormalities and disease are considered briefly, while the possible mechanisms of malformation, twinning and monstrosities are discussed.

The choice of epiloia as an example of a purely ectodermal disease is misleading, both on account of its rarity and of the mesodermal tumours in the dermis, heart and kidney which seem to co-exist in a great majority of the cases.

Most text-books of human embryology suffer from one serious defect, namely, the inadequate picture which is conveyed of that most interesting of all newborns, the human babe at birth. This book is no exception. Ballantyne's account in that infrequently read book "Antenatal Pathology and Hygiene" still remains one of the best and most concise. Embryology should not only help the student to understand adult anatomy but also neonatal anatomy and physiology, upon which so much depends. The fact that the fœtal and newborn kidney is lobulated is not mentioned in the text of this book, though it is frequently so depicted in the figures, while the term fontanelle does not appear within its covers.

The book is beautifully produced. Typographical errors are few and the photographs and figures are well reproduced. It is a credit to the publishers that they find themselves able to offer such a profusely illustrated volume at so reasonable a price. The student will undoubtedly appreciate the excellency of the production, as well as the concise presentation of the many and important aspects of human embryology now made available to him.

D. V. DAVIES.

## FRANÇOIS MAGENDIE (1783–1855)

**François Magendie**

Pioneer in Experimental Physiology and Scientific Medicine in Nineteenth Century France. By J. M. D. Olmsted. Pp. xvi+290+1 plate. (New York: Schuman's, 1944.) 5 dollars.

PROF. J. M. D. OLMSTED has followed up his excellent life of Claude Bernard with one of François Magendie, Bernard's teacher and one of the great figures in the rise of scientific medicine. Trained in Paris during the period of the Napoleonic Wars, Magendie worked in a period when medicine began to discard the traditions of the eighteenth century and to depend on more critical and exact observation and experiment. Bichat, Laennec and Corvisart were his seniors, and Flourens and Le Gallois his contemporaries. French medicine was in the ascendant, and Magendie, professor at the Collège de France from 1831, contributed to its development by his work in physiology and pharmacology and by his uncompromising criticism.

Magendie was before all things an experimental physiologist, and his name survives in the 'Bell-Magendie law' of conduction in the spinal roots and in the 'foramen of Magendie', the opening through which the cerebro-spinal fluid passes from the interior to the exterior of the brain. Probably the Bell-Magendie law is rightly named, for Charles Bell, the brilliant Scottish anatomist, and François Magendie both had a hand in its discovery; but Magendie always felt that the main credit was his and did not hesitate to say so. Prof. Olmsted's critical account of the long controversy shows that he had some reason for his claim, since his were the decisive experiments. But his contemporaries favoured Bell, and Magendie's quarrelsome habits may have made them glad to do so.

In medicine Magendie remained the experimental physiologist. With his lack of respect for tradition, he found much to overthrow though he had little to put in its place. He had no use for copious bleeding and purging, the established treatment of the time, though his internes were so distressed at this neglect of his patients that they sometimes bled them without his knowledge. His studies of the effects of drugs on animals (the beginnings of experimental pharmacology) did not encourage him to use more than a few well-tried medicines, and he was often content to leave the disease to run its course. Flourens wrote of him: "To young doctors he was fond of saying 'You have not tried doing nothing yet. . . . More often than not we cannot discover the cause of a disease. Our only function is to assist Nature, which always tries to restore the normal state, by refusing to hinder her; we can hope only sometimes to be skilful enough to aid her'." But his patients relied on him none the less, and he was far kinder to them than to most of his scientific colleagues.

Nor did Magendie neglect to look for the causes of disease. He made a special journey to Sunderland in 1831 to report on the outbreak of cholera there. He was appalled at the wretchedness, filth and poverty of the houses, but argued that the disease was not contagious. His views on contagion seem, in fact, to have been based on the belief that a disease could not be contagious if he himself had been exposed to it and had not been infected. He had certainly exposed himself, in Sunderland and afterwards in the Paris epidemic of 1832, where he worked day and night at the Hotel Dieu with a small band of internes and nurses.

Magendie's views were certainly wrong sometimes, and he would not admit that they were until he had seen the experiment which disproved them. He was intolerant, resented criticism, made enemies and was regarded by many as a monster of cruelty for his vivisection of animals. But he was fearless and honest, and medical science owes a great deal to his deliberately sceptical attitude, forcibly maintained and upheld by his great authority as a physiologist. Prof. Olmsted's biography is careful, well-balanced and interesting. It is to be hoped that he will write more of this period which he knows so well.

E. D. ADRIAN.

## HAY-FEVER PLANTS

**Hay-fever Plants**

Their Appearance, Distribution, Time of Flowering and their Role in Hay-fever, with special reference to North America. (Plant Science Book, Vol. 15.) By Roger P. Wodehouse. Pp. xxvi+245. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1945.) 4.75 dollars.

FOR a plant to be an important cause of hay-fever it must shed its pollen freely, must produce large amounts of pollen, must grow in great abundance, and must have active allergens in the pollen grains. Most wind-pollinated plants satisfy the first condition, but anemophily and entomophily offer little guide to the second. Relative abundance is of immense importance as a distinguishing factor between species of great and small importance in hay-fever; thus only about thirty-five species of grasses out of the thousand or so in the North American flora are important hay-fever plants. Lastly, the allergic qualities of species also differ widely, appearing with fair constancy in the following families : Gramineæ, Compositæ, Chenopodiaceæ, Amaranthaceæ, Plantaginaceæ, Polygonaceæ, Betulaceæ, Fagaceæ, Ulmaceæ, Moraceæ, Juglandaceæ, Salicaceæ, Aceraceæ and Oleaceæ.

If to these considerations we add the differential susceptibilities of patients to various types of air-borne pollen, the immense variation in local occurrence of the species concerned, and their various times of flowering, it will be apparent how large and complex a field of botanical inquiry lies behind the scientific study of the causes of hay-fever. Such study has of recent years made great progress in the United States, and one of the foremost research workers on pollen characterization and identification, Dr. R. P. Wodehouse, has now published a useful and timely summary of present knowledge of hay-fever conditions in that country.

An introductory chapter explains the origin of air-borne pollen and describes the chief methods now employed in estimating the pollen content of the air, filtration, the air-centrifuge, and gravitational settling, combined with microscopic identification. It is interesting to have the first tentative estimates of the minimal pollen doses which will produce hay-fever symptoms. For the ragweed (*Ambrosia* spp.) this appears to correspond with a pollen frequency of about 200 grains per cubic yard of air, or a daily inhalation of about 4,000 grains.

Subsequent chapters give brief descriptions of all the species now recognized as concerned, or possibly concerned, with hay-fever in the United States, with accounts of form, habitat and flowering season, illustrations of the plants, and full description and illustration of the pollen grains.

Lastly there follows a valuable analysis of all the recorded data for the United States treated on a basis of twelve geographical regions, for each of which there is given a comprehensive chart illustrating the frequency and flowering season of all the hay-fever plants. From this information both clinician and botanist will derive much help. We can see at a glance how in the north-eastern States there are three phases of hay-fever in the year—the unimportant early spring phase of tree pollen, the important early summer grass pollen phase, and the very important late summer ragweed pollen phase. This contrasts strongly with conditions in the southern States, where the long growing season gives many continuous months of hay-fever conditions to which many pollen types contribute. In this section we find also discussed how the weediness of undeveloped building estates makes for bad hay-fever conditions, and how forest cover and maritime situation offer good conditions suitable for hay-fever resorts.

It is very striking to the English botanist to observe that most of the grasses which are serious causes of hay-fever in the United States are those introduced from Europe, such as *Anthoxanthum odoratum*, *Poa pratensis*, *Phleum pratense*, *Agrostis alba* and *Dactylis glomerata*, while with them is associated *Plantago lanceolata*. Presumably the reason for this is that these are all weeds or cultivated grasses now abundant around the big population centres which are comparatively out of reach of pollen borne by the wind from the prairies. Otherwise one would not expect the native prairie grasses to be so overweighted in effect.

It is to be hoped that this book will encourage much similar work, not only in the United States, but also in Great Britain, where hitherto only Hyde and Williams have made significant headway in this direction. H. GODWIN.

# METHODS IN CLIMATOLOGY

## Methods in Climatology

By Victor Conrad. Pp. xx+228. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1944.) 21s. 6d. net.

IN this book, Dr. Victor Conrad, formerly head of the Austrian Meteorological Service, and now research associate in climatology in Harvard University, gives an outline of methods of treatment of observations, as distinguished from results of the treatment.

The book is in four parts, the first dealing with the general methods of statistical discussion, including the evaluation of frequency distributions, the mean, median, mode, etc., the fitting of curves to numerical data, the smoothing of data, and the essential formulæ of harmonic analysis.

The second part deals with the representation of characteristic features of different elements. Thus under the heading of temperature we find the discussion of the relation of the mean of two or three observations made at standard times to the 'true mean', which is the mean of 24-hourly observations, and the evaluation of spells of weather which satisfy certain conditions. Rather similar technique is applied later to rainfall measurements. The methods of evaluating resultant wind velocity from records of the velocity and direction, and the resultant wind direction from the frequencies of the directions alone, are discussed in a separate chapter. All these topics are relatively simple and could perhaps have been treated more briefly.

While there are frequent references to original papers, the author now and again fails to explain an important point. For example, on p. 111 he gives formulæ for the evaluation of the drying power of the air, the effect of the wind speed, $v$, being represented by a factor $F(v)$. A table of values of $F(v)$ is given for a wide range of values of $v$, presumably from a paper by Knoche. The reader would have profited from a hint as to the form of the function $F(v)$, particularly in view of the fact that a few pages later, in discussing cooling power of the air over a wet surface, the author gives a very different function of $v$ in his equations.

The third part of the book deals with methods of spatial comparison. Methods of testing relative homogeneity of observations, and of the reduction of climatological averages to a uniform period, are briefly treated. Formulæ for computation of the coefficient of correlation, and of the regression coefficients, are given later. Here the reviewer felt that emphasis should have been laid on the practical forms for computation, which are $r = \Sigma xy/\{\Sigma x^2.\Sigma y^2\}^{\frac{1}{2}}$ and $b = \Sigma xy/\Sigma x^2$ respectively, and not $r = \Sigma xy/n\sigma_x\sigma_y$ and $b = r\sigma_y/\sigma_x$. The methods of anomalies, the use of wind roses and stream-lines are briefly discussed.

The fourth part deals with climatography, or the presentation of a complete picture of the climate of a region. This part is of interest in that it brings into prominence a number of features of climate which are frequently overlooked ; but it does not sufficiently emphasize the fact that a satisfying description of a climate should deal, not only with the monthly means over a period, but also with the variability from the mean.

This book, which is in general simple in its treatment of the questions discussed, will be a help to many a beginner in the subject.

## Post-War Educational Reconstruction in the United Nations

21st Educational Year Book of International Institute of Teachers College, Columbia University. Edited by I. L. Kandel. Pp. ix+341. (New York: Bureau of Publications, Teachers College, Columbia University, New York City, 1944.) 3.70 dollars.

THIS book is of special interest at the present time, when attention is being directed to the future of education, and to the prospects of a new start, based upon the ideals for which the War has been, and still is being, fought. The havoc wrought by the aggressors on educational systems in the occupied countries is here described; the problems that confront each of the countries are discussed; and the programme for reconstruction in the years following the final victory of the United Nations is presented. The book contains articles on Australia, Belgium, Canada, China, Czechoslovakia, England, France, Greece, Italy, the Netherlands, New Zealand, Norway, Poland, Scotland, the Union of South Africa and the United States. The omission of an article on Soviet Russia is due to circumstances over which the editor had no control; and the absence of an article on Yugoslavia reflects the uncertain political situation in that country when plans for this volume were being made.

This is the twenty-first volume of the Educational Yearbook of the International Institute of Teachers College, Columbia University. During the whole period the Yearbook has been edited by Prof. I. L. Kandel, who now has to make the melancholy announcement that this volume will be the last in the series. The news will be received with great regret by students of education in many lands who have derived both pleasure and profit from the Yearbook. The editor places on record his indebtedness to the Rockefeller Foundation and the Carnegie Corporation of New York, which made publication possible, to the willing co-operation of contributors, and to his able secretary, Miss Gilroy. To all these must be added Prof. Kandel himself, the moving spirit of the whole enterprise.

## The Blackbird

A Contribution to the Study of a Single Avian Species. By A. F. C. Hillstead. Pp. 104+19 plates. (London: Faber and Faber, Ltd., 1945.) 8*s*. 6*d*. net.

IT is wrong, to my mind, to tell a child not to be cruel to animals; it puts the very idea of cruelty into his mind, and the living creatures remain animals, or even beasts, for him. He had better grow up among the mouse-people and the sparrow-people and the pussy-cat-people, and all the other friendly people who share the world with each other and with him. This is the wholesome spirit in which Mr. A. F. C. Hillstead writes about the blackbird, in the company of which he has lived for years, until he knows him body and soul. There is not a thing in his little life which Mr. Hillstead has not studied and described: his song, his 'territory' or law of landed property, his courtship and nest-building and care of his young, his migrations on holiday jaunts, his general intelligence, and all the diverse occupations of his livelong day. Mr. Hillstead has much to tell under all these heads, and more besides. The blackbird is no world-wanderer, like stork or swallow, but he does love a change of air; he likes to 'go places', like civilized man. He comes across the Channel to share our milder, insular winter; he is partial to Ireland; he cares little for Devon, and openly dislikes Cornwall, strange to say. His song is described with full sympathy and comprehension; "by and large, it has no equal; there is nothing to touch the rich flute-like tones which are so essentially British".

The whole story is illustrated with photographs by bird-loving friends. These are wonderfully beautiful; they show all sorts of situations of the nest, and all sorts of occupations of the bird. In short, we have here, to the life, our old friend "so black of hue, with orange-tawny bill"; and his wife and children, and his house and home, and everything which is his. D'ARCY W. THOMPSON.

## Sun Compass

By Francis Chichester. Pp. 10+Compass. (London: George Allen and Unwin, Ltd., 1944.) 5*s*. net.

THE sun compass is designed for use anywhere in a belt round the world within two hundred miles north and south of a line from Birmingham to Berlin. Knowing the date and the local time, a simple setting of the sun compass enables one to take the sun's bearings to an accuracy of about 2°, and with practice an accuracy of 1° is possible. A rotating disk has the months marked with dates which vary from six to twenty days. Thus September 16–22 is included in one date, June 1–21 in another, and so on, and a 'model sun' for each of these periods is marked on the disk. On a transparent graticule are marked the hours from 4 to 20 and also curves showing the sun's bearings from 50° to 300°. The bearings are given for every 10°; but it is easy to interpolate to an accuracy of about 1°.

On the back of the card there is a compass rose by which bearings other than those of the sun can be obtained. This involves nothing more formidable than setting up a pencil on a degree circle, so that the shadow of the sun falls on the centre of the compass rose, which is then rotated until the shadow cuts the degree scale at the desired division. The maximum error that can occur at places 3° north or south of the Birmingham-Berlin line is 3°, but this takes place only at midsummer and even then only at certain times in the day. It seems possible that there may be a demand for this very convenient instrument (it measures 5½ in. by 5 in.) for other latitudes. Having checked some of the results, using rigorous formulæ and four-figure tables, it is surprising to find the high degree of accuracy obtained over the range of latitudes. M. D.

## The Science of Nutrition

By Prof. Henry C. Sherman. Pp. xi+253. (London: Oxford University Press, 1944.) 15*s*. net.

THIS is a book about nutrition for the layman. Prof. Sherman describes the three main functions of food as first, provision of energy; secondly, supply of structural material for the growth and maintenance of tissue; and thirdly, the provision of substances which maintain the body's self-regulatory system and physico-chemical balance in tissue.

On this basis is built an excellent survey of the recent developments in the science of nutrition in its personal and economic aspects and applications. Purely scientific terms and descriptions are kept to a minimum, but a selected bibliography is provided for those readers whose interests go beyond mere broad information. The wide scope of this work is indicated by the inclusion of a summary of work on 'tagged' atoms in the study of metabolism.

# RADAR IN WAR AND IN PEACE

By Sir ROBERT WATSON-WATT, C.B., F.R.S.

It is customary, but not invariably wise, to preface an account of a new subject with some attempt at a definition. There being no part of the problem more difficult than accurate and condensed definition, this custom makes the whole subject look more difficult than it really is. For this reason the immediately following section of these notes on radar might well be annotated, as in some prescribed text-books, with the remark "May be omitted at a first reading".

## On Defining 'Radar'

To devise, and to interpret, an adequate definition of 'Radar' would be more laborious than profitable. The group of varied and flexible but intimately related techniques which have grown from a common stem of R.D.F. or radiolocation in Great Britain and radar in the U.S.A. have it in common that they involve essentially a measurement of distance, inferred from a relative time-delay and an assumed or known speed of travel of radio waves. But they have much more in common, and they are far from being merely radio range-finding systems. They might not have been achieved without Appleton's classical range measurement on the ionosphere; they would not have been practically useful without Breit and Tuve's powerful tool of the radio pulse, which carried Fizeau's method out of the optical laboratory into the upper air.

At the least, a radar system must provide an unambiguously associated pair from the three co-ordinates required to specify the position in space of the material object to be located by radio means, and must present these co-ordinates in a form convenient to the user. It should and normally does measure the third co-ordinate (usually stated as flying height) in the case of aircraft, and it frequently gives additional information about identity, numbers, speed in line of sight, and so on.

It would be pedantic, unrealistic and unhelpful to restrict 'radar' to the "location of an object without active co-operation from that object". The radiolocation of friends will, happily, be a far more general practice than the search for enemies, and active co-operation from the friend should not be ruled out as 'not cricket'. Nor should the emphasis be on 'an' object. The very essence of radiolocation, alike for war and for peace, is that it began with a determination to achieve something more practical than one of several possible systems which could locate 'an' aircraft alone in space, or could continue to locate an aircraft once an initial position was known, to the neglect of all the other aircraft in the sky and of the initial pick-up problems.

It would be artificial and misleading to confine the adjective 'radar' to systems involving the reflexion of radio energy from the object to be located, or even to the return of energy from the object towards the primary radiator. The most generally installed radar equipment of all was the 'Gee' receiver, which enabled the air navigator to determine his position by measuring the relative times of arrival of radio pulses emitted synchronously from three ground stations. The techniques involved in this 'one-way traffic' system of pulses, travelling from ground to aircraft or from shore to ship but not back, are quite inseparable from the techniques used in the 'H' and 'Oboe' systems, in which the primary radio pulses 'interrogating' the mobile craft automatically release from it a series of reinforced, coded, and conveniently frequency-displaced reply pulses, which travel back towards the primary radiator. And the techniques of all these, and of the I.F.F. system from which 'H', 'Oboe' and radar beacons grew, are in turn quite inseparable in general conception and broad execution from those which are used to extract somewhat lower accuracies at somewhat shorter ranges from the somewhat less informative radio echoes returned from a non-co-operative aircraft.

So in practical life radar is a group of techniques which enable the position of one object among many to be measured by radio means, involving essentially the measurement of relative time-delays and thence the total paths or difference of paths, in the travel of suitably labelled radio waves between the object to be located and the radio station or stations (which may be transmitting, receiving or receiving-and-re-transmitting stations) which provide reference points for the location. The 'labels' attached to the radio waves may be a controlled change of frequency, as in the Appleton foundation experiment in radio range-finding, or a controlled change in amplitude, of which Breit and Tuve's pulse technique is the almost universal application.

## The Pulse Technique

The pulse technique has attained this universality because it satisfies a number of special needs simultaneously. The beginning or 'leading edge' of the pulse marks a packet of energy which can be re-identified after the vicissitudes of travel, thus permitting accurate measurement of time of travel, and the end or 'trailing edge' marks the beginning of an invaluable clear period in which the radar echoes or response signals can be received free from the overlaying and interfering effect of the primary signal. In modern pulse technique, pulses which may be very brief indeed are sent out at a very accurately controlled recurrence frequency, and displayed on the equally accurately synchronized time-base of a cathode-ray oscillograph. This gives a cumulative preference to the slowly changing pulse-responses over the random noises occurring along with them, since the successive responses are more or less accurately superposed while the noise is spread more or less evenly over the background. The interval between primary pulses is preferably made just greater than the time-delay of the response from the greatest distance to be sounded. The time base then becomes a range-scale, with its zero at the leading edge of the primary pulses, and it can be made linear in time and range. Care must, however, be taken that echoes or responses received after a time-delay greater than that between primary pulses are not read as coming from a distance less by one or more whole pulse-periods than their true path. Finally there is a considerable advantage in discrimination to be attained by using the pulse-recurrency frequency as a coding characteristic of the stations concerned, and by additional coding by pulse-width or multiple pulse-spacing, or both. These advantages of the pulse system are bought at that price in increased width of frequency channel occupied which is the inescapable price of high information-carrying capacity.

The superposed successive pulses returned from any one reflecting or responding object can be treated as a continuing signal coming from that object, unmixed with others of different time-delay, and can thus be subjected to standard processes of direction-finding, in azimuth and elevation, independently of the corresponding series of responses from more or less adjacent objects. And if the responses come from closely spaced objects, such as a tight formation of aircraft, the beating which results from their incomplete separation can be used as a means of estimating the number of objects thus incompletely resolved.

## The First Steps

When it became distressingly obvious that it would be important to detect and locate enemy aircraft while they were still far from our shores, the high probability that a single aircraft could be located at a hundred miles, and the possibility that it could be detected at two hundred miles, was readily demonstrated by simple arithmetical process, supported by a crude experimental demonstration at short range. The arithmetic was easier than the consequent decision, for it pointed to an engineering efficiency, in a single determination, of the order of one in $10^{17}$. The joint operational and technical decision that it was alike worth while and practicable to utilize this low-efficiency process transformed an idle dream, often conceived and always dismissed, into a decisive weapon of war.

But there were many technical difficulties in the transformation. No distances less than thirty miles had ever been measured by radio range-finding; targets separated by less than fifteen or twenty miles would not be resolved by the then existing technique. These two profound and indeed prohibitive limitations must be removed by a very drastic shortening of the emitted pulse, from the then current durations of about half a millisecond to durations of five or ten microseconds. This shortening must be accompanied by a great increase in the peak power emitted, and by a 'squaring' of the pulse shape. A sharp leading edge was vital to accurate range-finding; a long trailing edge was fatal to echo separation. The receiver and its associated aerials must give good response over the wide frequency band occupied by such short steep pulses, and it must also be immune from paralysis by the enormously powerful impulses from a transmitter a few yards away; many other defects in senders and receivers had to be cured. No direction-finder of adequate sensitivity existed; it had to be developed. The effective measurement of flying height depended on specially favourable topography; sites with a favourable foreground must be combined with accessibility and bearing capacity for heavy towers. Even on the most suitable sites the resulting data had to be corrected against calibration flights and had, after correction, to be put in a form convenient for immediate communication to the user. How the technical problems were solved must be told in detail elsewhere; the broad operational results have already been outlined in the daily Press. Here it is important to emphasize the milestones in radar technique, and how they were set up.

## Milestones

When the more obvious of the difficulties just enumerated had been surmounted there remained those due to interference between the rays propagated directly between ground station and aircraft, and those reflected, with an almost complete reversal of phase, from the ground. It was the presence of the reflected ray that made height-finding practicable; but this one convenience was a part compensation for great inconveniences. The phase reversal meant that the interference pattern between direct and ground-reflected ray had a minimum in the horizontal direction, so that low-flying aircraft could come close inshore before detection. The only cure for this was the adoption of much shorter wave-lengths, so that the bottom lobe of the vertical polar diagram could be pushed lower without the use of prohibitively tall aerial systems.

The higher minima in the interference pattern were still at such angles that there were inclined lanes down, or to some extent across, which aircraft could fly unlocated, and these gaps in coverage had to be filled by the use of aerials of different height, with a non-coincident interference pattern, and by switching frequently from one aerial height to the other.

The attainment of high powers and adequate receiver gain on one-and-a-half metre wave-lengths allowed low cover to be established; but it permitted also the setting up of the third milestone in radar. The aerial system for such wave-lengths could now be rotated mechanically, and gave a comparatively narrow beam. By electrical beam-swinging the beam could be moved by a few degrees, and by matching amplitudes of response with the beam in its two positions the target could be located in azimuth with an accuracy some twenty times greater than by the previous methods. The inaccuracy of bearing fell from one or two degrees to five or ten minutes of arc. This was indeed a landmark in the history of precision measurement by radio.

Concurrent work on improved accuracy in the time-delay measurement was in train, and it was soon (in fact in 1938) established that the operational range-accuracy of the monostatic radio range-finder was, against quick-moving aircraft targets at least, higher than that of the monostatic optical range-finder. Errors of about twenty-five yards at heavy anti-aircraft gunnery ranges became standard.

One of the greatest steps in radar technique was the development of the Plan Position Indicator. Initially the time-base of the cathode ray oscillograph had been a fixed diameter of the tube-face, and the radio response or echo made an indentation (or 'blip' !) transverse to this line. But when the rotating antenna was introduced, and the radiation was confined to a comparatively narrow rotating beam, it became practicable to make the time-base a radial one, with its zero at the centre of the tube-face, and to rotate it synchronously with the antenna. If now the received signal were used to give brightness modulation of the cathode-ray beam, a response was displayed as a bright, though not very small, sector of a circle, the inner edge of this sector measuring the range and the mid-angular point of the sector the bearing; the width of the sector was of course governed by the sharpness of the radio beam. Thus automatically the rotating radial time-base gave in map form a plan display (with slant range used instead of horizontal range) of the positions of responding objects. This device, first used in the controlling from the ground of night-fighters, was of the utmost importance in the airborne and shipborne radar of the war against the U-boat, and in the aids to the bombing of invisible targets which were variously called 'H2S', the 'gen-box', 'Mickey' and the 'Magic Eye'.

The greatest revolution of all, however, was the success of the campaign for centimetric wave-lengths. It had long been clear that the major defects of airborne radar, and many of those of ground radar, were curable only by the use of an extremely fine pencil of radiation scanning the area to be explored. Such a pencil could only be formed by an antenna and reflector system having an aperture of many wave-lengths, and this could only be fitted in aircraft if the linear dimensions and weight were kept down by the use of wave-lengths less than ten centimetres. The precision with which individual targets could be located, the clarity of display, the separation of responses from two or more targets, and the reduction of the very serious overlaying effect of responses from fixed objects were all immediately dependent on the attainment of centimetric working. There were some associated advantages in reduction of the enemy's power to interfere with the full enjoyment of radar facilities.

How centimetric radar came is so closely associated with the general story of the organization of scientific effort on radar that it is desirable to look next at that story.

## The Spiritual Ingredients

The most important thing about the British development of radiolocation as an instrument of war is not that it happened, but that it happened at the right time. The essential difference between the British effort and the most nearly corresponding effort in other countries is to be sought in those intangible factors which assured to us, at each stage in development, an adequate (though often a no more than adequate) margin of time for meeting the successive crises of the War.

It cannot be too often or too firmly stated that the victory over Germany was essentially a victory of the spirit. No technical devices can turn the scale of war save as tools of the spirit. Nor is there, indeed, any real gap between spirit and material, though the very mechanical perfection of our new technical devices may hide the vital fact that they are not only the tools but also the products of the spirit. Radiolocation is perhaps the best of all examples of the interaction of spirit and technique in the forging of a decisive weapon of war. But its origins in the spirit of science may be temporarily lost to view behind its successes. The curiosity-value of its devices, the wealth of its applications to all forms of warfare, and its spectacular victories may dazzle the casual observer.

Radiolocation was the direct, but in no wise the predestined and inevitable, fruit of pure research. Its beginnings lay in the work of those who laboured to understand more of the things that happened in the earth's atmosphere. Its later developments, and much of its technique at all times, were due to those who sought the inner secrets of the structure of matter.

Britain was a prominent leader in those pure researches into the physical processes of the ionosphere and of the lightning flash which were, indeed, directed towards the improvement of radio communications, but which were of an enlightened width and depth, not closely trimmed to immediate practical ends. These researches were State-aided, but most generously and most lightly State-controlled. The Department of Scientific and Industrial Research had, through the vision of its first Minister, A. J. Balfour, and of its successive administrative heads, Sir Frank Heath, Sir Henry Tizard and Sir Frank Smith, established a unique position for its Radio Research Board, founded and nurtured by the gentle wisdom of Admiral of the Fleet Sir Henry Jackson. Among the Board's contributions to the international stock of fundamental knowledge and to the international store of radio technique, none was more important than those due to Dr. E. V. Appleton, whose radio researches it supported from its foundation until the time when he succeeded Sir Frank Smith (himself a dominant figure in the scientific work of the Board) as Secretary of the D.S.I.R., and became Sir Edward Appleton. It is morally certain that without the peaceful pursuits of the Board in general, and of Appleton and his colleagues in ionospheric research in particular, radiolocation would have come too late to have any decisive influence in the War.

The Radio Research Board had trained a team of young research workers encouraged to see and explore the wide open spaces between the Morse key and the loud-speaker. They were to remember the needs of the radio user, but to probe to the heart of the processes rather than to apply palliative dressings. They were to be pathologists rather than physicians ; to be physiologists and even morphologists rather than pathologists. Their vision and imagination were to be turned in the general direction of application, but they were to take neither narrow nor short views.

The scientific staff of the Air Ministry reviewed in 1934 the prospects of aerial warfare. They were profoundly disturbed by the lack of any effective means of defence against the fast military aircraft of the day. On their advice, the Secretary of State for Air sought the counsel of three distinguished 'outside' scientific workers of deep knowledge and wide experience. They in turn suggested that one aspect of the problem should be discussed with a member of the Radio Research Board's team.

As an official document has recently said : "This contact between a user Department with a great need, and a Department which had fostered scientific discovery not wholly directed towards specific needs, was perhaps one of the most important events in our history, and illustrates the need for fostering scientific research in all fields and for making the needs of the State known to those who are engaged on scientific research".

It was a characteristic and natural step in this train of enlightened reviews of general needs rather than particular prescriptions, that the radio researcher brushed aside the problem directly posed, replacing it by a quite different and far from novel problem, for which he proposed a novel solution. The solution was novel, not because it had not been glanced at qualitatively on other occasions, not because it contained any intrinsically novel element, but because it was a quantitative synthesis, a judicious mixture of old ingredients, each ingredient to be modified and refined for the new purpose, and adapted to the complexities of an operational problem far more involved than those of the laboratories—even of the open air laboratories—in which the ingredients had been evolved.

But again it must be said that the basic ingredients of radiolocation were in fact the spiritual ingredients, the wisdom that integrated the scientific advisers into the Air Staff in the handling of its day-to-day worries, the judgment that assessed the relative priority of these worries, the courage of all the participants—courage in the small band of "good but not first rank" (the description is their own) men of science who made firm promises out of their exact knowledge and their imaginative enthusiasm; courage in the men of science who recognized the scientific and operational validity of promises made on a one in $10^{17}$ basis, courage in the officers who staked some millions of pounds of public money and revised the air defence system of the country on the paper promises of a "bunch of scientists", the exploits of a "rather ancient lorry" near Daventry and the not unqualified successes attained in a few tentative air exercises.

That success—a success which even in the first trial of strength in 1940 made the difference between a free and an invaded Britain—was achieved was due to those same influences which governed the acceptance of the gamble. The most significant factor in the story of radiolocation was not the technical skill packed into its boxes, was not the operational skill with which they were used. It was the unprecedented and unprecedentedly productive interplay between scientific and operational minds, which carried the basic technique from its first defensive application in an early warning system through more actively defensive phases to a wealth of offensive applications which had a decisive effect in every major phase of the War.

When radiolocation has taken second or third place to future novelties in the military art, this intimate co-operation of scientific and military minds will remain as the real secret weapon in the British armoury, as something which grew to full vigour with radiolocation, at once a source and a product of that successful development. Nowhere in the councils of the United Nations or of their enemies—and those concerned in developing radiolocation have been at some pains in recent months to verify this last point—has there been a parallel to the practice followed from the first days of radiolocation research. The Air Marshal took advice from the junior scientific officer on how to make war, and the laboratory assistant was told by the Admiral why physics has sometimes to give way to psychology in the planning and conduct of operations. The soothing fiction of an operational requirement stated by an all-wise staff, and unquestioningly satisfied by a docile and technically expert developer, has no place in the history of the most versatile technique of the War. The proud and affectionate title of "Boffin" conferred on the scientific developer by his military colleagues and co-workers is earned only by a man in whom technical expertize is matched by operational understanding and indomitable zeal, allied to the peculiarly scientific virtues of inquisitiveness, impatience, intolerance and insubordination.

The fruitful co-operation was not confined to the origination and development of technical equipments and systems. It extended to the selection and training of personnel to operate and maintain the systems, to the evolution and practising of tactical methods based on the systems, and to the whole complex of technical, tactical and logistic problems involved in introducing new scientific devices into heavily engaged operational formations.

The over-riding demands of secrecy limited the size of the team and the facilities that could be devoted to radiolocation in the 1935–39 period. Not the least of the merits of that limited team were their technical restraint and their ruthless objectivity, their refusal to explore at once the innumerable avenues of development opened by the new art, their insistence on the sacrifice of refinements, elegances and versatilities to the one desperate need for "something to be going on with". They never turned aside from their cult of the third best—"the best never comes, the second best comes too late".

Easter 1939 saw the opening of a continuous watch—sustained unbroken for the next six years—by the radar stations of the east and south coast; it saw also the reinforcement of the research and development teams by the cream of the physical research laboratories of the country. The ninety physicists who spent the spring and summer of 1939 in the coastal stations devoted their first war-time efforts to meeting the needs and exploiting the possibilities which suggested themselves in their first scrutiny of radar at work. Further strengthened by transfers from other groups, the greatly augmented team brought to the work intellectual qualifications, research experience, depth of fundamental physical knowledge, imagination, initiative, versatility, enterprise and enthusiasm, inquiring and critical faculties, of quite unique order. The dreams and aspirations of the 'founder members' were rapidly fulfilled and surpassed, new dreams were converted to achievements, and the traditions of constructive debate between General and junior scientific worker and of inextricable interweaving of contributions from operational officer and boffin were cherished, maintained and extended.

The newcomers, knit into a large and powerful organization, with facilities better proportioned to their needs than ever before in research for military purposes, came from other fields besides pure physics. Chemists, physiologists, general biologists, dons and schoolmasters were united by certain basic characteristics common to all branches of science. The habit of measurement, classification, comparison, and orientation in the light of defined principles, the isolation of those changes in behaviour which are due to the variation of one identified factor from those due to other factors, the stringent assessment of statistical validity in measurements, are of the creed of all men of science in all fields. A sturdy refusal to take refuge behind chance and accident, a firm hatred of the creed of the 'magic box', make the boffin the sworn enemy of the 'gremlin'. A stern exclusion of emotion from the method of science is allied with a fierce flame of emotion as the motive power behind the application of that method. Above all, a religious conviction that all facts are good facts, that suppression of the known and measurable truth is the supreme sin, governs and explains the determination of the man of science to drag every strategic and tactical skeleton out of the cupboards of the Commands, so that it may either be reclothed and revivified or be decently interred.

From this fervent objectivity, backed by the highest technical skill ever organized into a single team, and by a remarkable organization for quick production, came the successive devices that turned the tide of battle in successive phases of the War. They were vital to the defeat of the day bomber and the night bomber attacking London and other British cities and towns. They drove the enemy surface ship from the Straits, the North Sea and the oceans of both hemispheres. They beat the U-boat in the Bay of Biscay and in the Atlantic. They foiled the 'flak' gunner in the Ruhr. They penetrated the fog and cloud cover that was the best anti-aircraft aircraft defence the German cities ever had. They baffled the night fighter which strove to make good these lost defences. They silenced the coastal gunner on the

Normandy shore. And, by aiding the airborne forces and the tactical air forces supporting the armies of liberation, they contributed to the defeat of the last Panzer and infantry defences of the crumbling Reich.

## The Centimetric Revolution

The demands for adequate transmitter power and receiver sensitivity on centimetric wave-lengths had grown more and more insistent from the time they were first voiced by the radar team of 1935, and the ninety 'scientific observers' on the chain in 1939 included those best qualified to perceive the intensity of the need and to devise the means for meeting it.

Under the inspiration of Prof. M. L. Oliphant a team at the University of Birmingham provided the essential element in the solution. Dr. J. T. Randall applied the resonant-cavity technique to the relatively ineffective magnetron of pre-war days, and made of it a radically new and immensely powerful device which remains the heart of every modern radar equipment. Dr. R. W. Sutton, of the Admiralty Signals Establishment, matched it with an equally novel receiving valve, the Clarendon Laboratory team made a vital contribution to the efficient use of a common aerial system for transmission and reception of radar pulse signals, and centimetric radar for ground, ship and airborne use was at hand. Floodlighting and wide-beam systems remained an essential part of the whole radar complex ; but the fine pencil scanning systematically and point by point the whole area of search alone sufficed to paint the fine detail of target areas, to avoid the smudging over of each element by the response from adjacent or more remote elements, to give adequate 'illumination' of the extremely low flier or the surface ship by coast-watching stations. And apart from permitting fine-beam formation, the very high frequency permitted a corresponding improvement of discrimination in depth, by allowing pulses of duration much under one microsecond to be formed by the transmitter and reproduced comparatively faithfully by the receiver. Only at frequencies of, or above, three thousand megacycles per second does the band-width occupied by such short pulses constitute a sufficiently small percentage of the central frequency for good pulse-shaping at sender and receiver to be attained.

These were the foundations of the techniques which gave the night fighter an A.I. set in which the returns from the ground no longer overlaid those from the bomber under pursuit whenever its range from the fighter exceeded that of the nearest ground, so that the maximum effective range of the A.I. set was no longer, as before, the flying height of the fighter. They gave the searcher for the surfaced U-boat, in destroyer, corvette and aircraft, the means of locating a periscope at several miles and a normally surfaced U-boat at tens of miles, and prevented the U-boat from getting, before he was driven from the sea, that early warning of pursuit which he derived from listening sets on metric wave-lengths. They gave the anti-aircraft gunner a higher precision and an almost complete release from the limitations of site and obscuration by 'ground-clutter' which had crippled his tactical freedom in using metric-wave GL sets. They were applied by our American collaborators in ground installations of considerable elegance and high adaptability which made great contributions to the defeat of the flying bomb and to the close air support of ground forces in the liberation of Europe.

## Bombing by Radar

Perhaps the most picturesque, and certainly one of the most valuable, of the centimetric radar devices is the 'H2S' airborne aid to the bombing of invisible targets. The 'P.P.I.' picture in which seas, lakes and waterways remain black because they give substantially specular reflexion of the scanning pencil away from the aircraft projecting it ; in which coast-lines, with their cliffs, bays and inlets, show up clearly as outline map features because they scatter radiation back towards its source ; in which the inland landscape is of a nondescript intermediate tone ; and in which the 'works of man'—camps, hangars, and above all towns and cities—stand out brightly, the towns reasonably clearly defined in outline at tens of miles and in some detail at ten miles and under ; this fascinates everyone at first acquaintance and never ceases to impress even the hardened boffin.

It has no competitor in this grip on the imagination, save perhaps the other blind-bombing device, of higher precision but limited coverage, called 'Oboe'. That two controllers sitting in vans on English soil should each know with an accuracy of a few yards each way—certainly within fifty yards—the position of an aircraft over Essen is a surprising thing, no more and no less surprising when one reflects that they know it much better than do the occupants of the craft. Yet in principle it is ridiculously simple ; one ground station, *A*, knows the deviations of the craft from a circular track of constant distance from *A* ; the other, *B*, knows when the craft flying a circle about *A* is at any desired distance, including zero distance, from the intersection of that circle with another of known radius about *B*. And this point of intersection was selected, in the relative comfort of the English ground stations, to be the bomb-release point, arrived at by applying up-to-the-last-moment corrections for the local wind conditions over the German target. *A* and *B* are pulse-interrogator stations, the aircraft has a responder of constant and accurately known delay-time, and meticulous calibration and adjustment assure an accuracy in radar range finding of one in ten thousand or so at some two hundred miles.

## Radar in Peace

Radar in war fell into three convenient categories, each of which has come to stay in the peace.

Primary radar is that form of radar which "does not require the co-operation of the object to be located". It is useful against icebergs and enemies generally ; it is an extravagance when used against friends.

Secondary radar requires that small measure of co-operation which is involved in the fitting and switching on of an otherwise automatic responder. The responder sends back, when interrogated by radar pulses, reply pulses on a different wave-length —so that 'ground clutter' disappears from secondary radar—coded with information about the 'personal identity' of the craft carrying the responder, and about its flying height if it is an aircraft.

Radar navigation does not depend essentially on the return of an echo, amplified or unaltered, from the craft to be located. It may in some special cases like 'Oboe' find that convenient ; in some other and more frequency cases like 'G-H' and 'Babs' (Blind Approach Beacon System) and 'Rebecca-Eureka' utilize coded responses sent back by a ground responder-beacon in reply to pulses from an airborne or shipborne interrogator. And in 'Gee' and 'Loran' and related systems it will depend on a measurement in the craft of the time-difference of arrival of primary pulses from synchronized ground stations in accurately surveyed positions.

In a well-ordered world—which includes, but goes beyond, a world at peace—primary radar would have no place in aviation save as an airborne means of avoiding dangerous high ground and dangerous clouds and as a 'last resort' ground system for locating aircraft whose responders had failed, as they may on occasion do even in a well-ordered world. In the shipping world it would have a corresponding role, save that all ground is then dangerous high ground and the iceberg is the equivalent of dangerous cloud. In land transport primary radar should have no place at all; but primary radar on the ground will help the meteorologist in his still difficult task of forecasting. The world has still some way to go before even an optimist will regard it as well-ordered, and so ships will sail and aircraft fly with primary radar performing other duties which will ultimately be better confided to secondary radar.

The aim of the radar aids to civil aviation which were discussed at the recent Third Commonwealth and Empire Conference on Radio for Civil Aviation (C.E.R.C.A.) in London is to give from a generous provision of ground installations and the minimum of equipment in the aircraft, sufficient information (without the intervention of communications from ground controllers) for the pilot to know at every moment where he is, how to fly to his destination by the shortest or safest route, and how to land safely whatever the visibility. These provisions will be supplemented by radar aids which will keep the air traffic controller fully informed of the traffic pattern around his airport and on his designated routes. It will not be done cheaply, but independence of the weather has never been cheaply bought.

The simpler problems of marine transport find simpler radar solutions, and the sea and air transport without which our great Commonwealth and Empire cannot hold together in its service to civilization need radar services with an urgency second only to that which produced radar services in war.

Of railroad radar no one will at this date speak with equal confidence. But it is surely reasonable to believe that the simple elements of secondary radar in cab, cabin and caboose will at last banish the primitive detonator from this fog-girt isle! Romance cannot wholly dispense with radar in its noble task of bringing up the eight-fifteen—especially in the not infrequent conditions in which it is not romance alone that is 'all unseen'.

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# SCIENCE IN THE U.S.S.R.*

## ASTRONOMY AND TERRESTRIAL MAGNETISM

By Sir HAROLD SPENCER JONES, F.R.S.
Astronomer Royal

RUSSIA has played an important part in the development of astronomy since the foundation of the Pulkova Observatory by Czar Nicholas in 1839. Under the direction of F. G. W. Struve, this observatory was built regardless of expense. It has made notable contributions to fundamental astronomy, its instrumental equipment for such observations being more varied and complete than that of any other observatory. The Pulkova observations have always been characterized by their great accuracy. At the beginning of the present century, the work was expanded to include astrometry and astrophysics. Its great refractor, of 30-inches aperture and 45-feet focal length, was one of the finest in the world. In 1908 an astrophysical observatory was established at Simeis in the Crimea. There were, at the time I visited Russia in 1914, several other observatories, but for the most part their equipment was modest and their staffs were small. Since the Revolution a great expansion in astronomical work has occurred. Additional instrumental equipment has been installed, including the 40-inch reflector at Simeis: new observatories have been constructed in Abastumani (Georgia), Stalinabad (Tajikistan), Yerevan (Armenia), Poltava (Ukraine) and Alma Ata (Kazakhstan), the last of these during the war years. Astronomical institutes have been established in Moscow and Leningrad, for computational and theoretical work in the fields both of astrophysics and of celestial mechanics. The total staffs have been increased about ten-fold.

* Continued from page 285.

In the pre-Revolution days, each observatory worked alone, and its resources were generally insufficient to enable large programmes of observation to be undertaken. In the Soviet years an Astronomical Council has been constituted by the Academy of Sciences which co-ordinates the work of the various observatories, including both those which come directly under the Academy and those which are attached to universities. Thus, it has been possible, by pooling of effort, to undertake fields of work which are beyond the scope of any single observatory and also to avoid unnecessary duplication. For example, observations of selected minor planets and of the positions of some 16,000 red giant stars have been undertaken at several observatories for the improvement of the fundamental system of star places. Special attention has been given to solar phenomena and their terrestrial relationships. The paths of totality of the total solar eclipses of 1927, 1936, 1941 and 1945 have crossed Soviet territory and extensive programmes of observation were planned. For the last three of these eclipses some fifteen to twenty expeditions were organized and were distributed along the line of totality—valuable results being obtained.

The time service has been extended, and its accuracy considerably improved. A Nautical Almanac is published to meet the needs of navigators and surveyors as well as astronomers. The computations for its production are made at the Astronomical Institution in Leningrad.

Soviet astronomers have made important contributions to the theory of the structure of comet tails and heads, to the problems of the variation of latitude, to the study of the atmospheres of stars (including the discovery of heavy isotopes of carbon), to the problems of novæ, and to cosmogony.

Astronomy in the U.S.S.R. has suffered a serious setback through the destruction of, or damage to, various observatories. The Pulkova Observatory was in the front line for two and a half years in the fighting around Leningrad and has been completely destroyed by German shelling and bombing, though some of the instruments were saved. Most of its valuable astronomical library, probably the most complete in the world, has been lost; some of its treasures, including the manuscripts of Kepler, were fortunately saved. Its destruction was no doubt inevitable in the circumstances. But it was otherwise in the case of the Simeis Observatory, for no fighting took place in its vicinity. The Germans removed the telescopes (which have since been found in Potsdam, but in a state unfit for use), most of the library and most of the astronomical negatives; they then deliberately set fire to and destroyed the Observatory. The Observatories at Odessa, Kiev, Nikolaiev, Kharkov and Poltava were all badly damaged. Many of the observational records have been removed or destroyed, so that some of the co-operative programmes of observation, on which much work had been done, will have to be commenced anew. Many of the astronomers and some of their instruments were evacuated far into the interior. Some of the Pulkova astronomers were moved from Leningrad by aeroplane during the siege. Throughout the War a considerable amount of research in astronomy was continued in spite of the difficulties of the conditions.

The reconstruction of some of the damaged observatories has already been commenced. Plans have been prepared for the rebuilding of the Pulkova Observatory according to its original plan; the telescopes which were saved will be replaced in their original positions. But new additional instruments will be installed. Plans are under consideration for the establishment of a large astrophysical observatory in the Crimea, provided with powerful reflecting telescopes and with instruments of modern types; there may be also a subsidiary station somewhere in the southern hemisphere.

Mention may be made of the invention by Dr. Maksutov during the War of the new system of meniscus lens telescopes which, because only spherical surfaces are employed, are simple to manufacture. These telescopes are powerful and extremely compact. The largest meniscus telescope as yet constructed is of nine inches aperture; but telescopes of this type and of greater aperture are to be constructed for astronomical observation.

It is certain that the U.S.S.R. is destined to play a prominent part in the development of astronomy in the post-war years.

The Institute of Terrestrial Magnetism, established in Leningrad in 1940, embraces a wide field of work. It comprises sections for land magnetic surveys, sea magnetic surveys, magnetic observatories, magnetic cartography, ionospheric and cosmic ray observations, and theoretical investigations. Nineteen permanent magnetic observatories, including some high-latitude stations, were in operation when the War started. Six of these at Yanov, Stepanovka, Novgorod, Amvrossievka, Nizhnedevitsk and Pavlovsk were occupied by the Germans in 1941–42: same of the staffs were evacuated and some were made prisoners. When the Germans retreated they burned or blew up the observatory buildings in Pavlovsk, Novgorod and Nizhnedevitsk. Observational records and instruments were removed or destroyed. The magnetograms of the Second Polar Year stations have disappeared. Profs. Weinberg and Trubyatchinsky died of famine during the siege of Leningrad. Magnetic survey work has been continued during the War, and some expeditions were sent to the north of Siberia. Observations are made at regular intervals at a number of repeat stations for the determinations of secular changes. Magnetic anomalies associated with possibly useful mineral deposits have been studied. Solar, magnetic and ionospheric data are collected and summaries are published in ten-day cosmic bulletins.

The Institute is to be moved to a site near Moscow, where special buildings are to be erected, and the magnetic observatories destroyed by the Germans are to be re-established. Theoretical investigations in terrestrial magnetism and allied subjects are also carried out at the Institute for Theoretical Physics in Moscow, where Prof. Frenkel has recently developed new theories of atmospheric electricity and of the earth's magnetism. Among other work undertaken at this Institute are theoretical investigations of the scattering of light in the earth's atmosphere and of atmospheric transparency, and the study of the light of the night sky.

## THEORETICAL PHYSICS

By Prof. M. BORN, F.R.S.
University of Edinburgh

In the original group of British delegates to the Moscow conference, theoretical physics was well represented (Darwin, Dirac, Mott and myself); but I was the only one allowed by the Government to proceed. The following account is therefore based only on the observations of one pair of eyes and ears, which had to absorb a multitude of impressions vastly more interesting and important than even the most fascinating scientific things: a new and strange type of civilization in its various activities, social, economic, military, scientific, artistic, etc.

Theoretical physics can scarcely be separated from physics in general, on which Andrade has reported in a previous number of *Nature* (August 25, p. 223). I shall add a few remarks to his excellent account, but speak mainly about the more abstract branches of my subject. As the Soviet State is based on a definite philosophical system, the question arises whether this fact has any influence on the development of fundamental ideas in physics. I have found scarcely any traces of such an influence, and certainly no restrictions of research. The Russian physicist interprets the facts of observation in the same spirit of intellectual freedom as his Western colleague, and indulges in any speculation on cosmology, relativity or quantum theory without being censored. Nor does the question of the practical applicability play a great part, as many of the reports on other subjects have already stressed. Fundamental research is acknowledged as the basis for a sound growth of science, and a theoretical physicist is no more expected to produce results of economical importance than the roots of an apple tree to bear fruit; but if the roots are allowed to spread freely the branches carry a good crop.

The theory of relativity has a powerful representative in V. A. Fock (Moscow). A most important paper of his which appeared just before the War (February 1939) is little known in Britain. It contains the solution of the fundamental problem, also treated by Einstein (and collaborators), whether the field equations of gravitation are sufficient to determine the orbits of planets, or whether separate equations of motions are necessary. Fock's answer is that no such assumptions need to be made; he obtains Newton's laws as a first approximation for small bodies separated by large distances and develops the relativistic correction terms. I had a short discussion with Fock on Mises' foundation of the theory of probability and found him very sceptical: to define probability as the limit of relative frequencies in an actual series of trials seems to be a vicious circle, for there is no certainty of the existence of such a limit, but only a probability. I think Fock is right. He is also a great expert in quantum mechanics. I found him and the other Russian physicists perfectly acquainted with the newest developments, in particular of the theory of quantized fields and its application to radiation and mesons. J. Tamm (Moscow) and J. Frenkel (Leningrad) are working on these problems; their attitude to the well-known difficulties and perplexities is not much different from my own. To mention only one point, they are not satisfied by Eddington's ingenious theory of ultimate particles. Among the many other questions we discussed, I wish to direct attention to Frenkel's dynamic theory of atmospheric electricity, which has just appeared and seems to me very promising. As Andrade has already pointed out, Frenkel is attached to Joffe's laboratory in Leningrad and takes an active part in the interpretation of the experiments on semi-conductors and other things.

In an account of theoretical physics, the theoretical part of physico-chemistry cannot be excluded. In Moscow it is brilliantly represented by Frumkin, in whose laboratory well-planned work is done on the chemistry and physics of surface layers.

Russian physics suffered a great loss last year by the death of Mandelstam who, together with Landsberg, discovered almost simultaneously with Raman and independently the phenomenon since called the Raman effect. Mandelstam's optical school is continued under Landsberg's leadership. Another member of it is E. Gross, who discovered the splitting of spectral lines in a beam of light which is scattered by a liquid or a crystal, an effect due to the Doppler effect produced by the reflexion of the light waves on sound waves.

Russian physicists were very keen to learn something about work done in Britain, and I had to give several lectures. One of these was in the Lebedev Institute of Physics, the director of which, S. Vavilov, has just been elected president of the Academy of Sciences of the U.S.S.R. This visit gave me the opportunity of a glimpse of the celebrated laboratory and a discussion with its workers on diverse problems.

The limits of this article do not allow me to give an account of new discoveries in crystal physics and their explanation. I must, however, add a few remarks to Andrade's description of Kapitza's Institute for Physical Problems and the work done there. For this Institute contains a separate group of theoretical physicists under Landau's leadership who have made essential contributions to the low-temperature work going on. Kapitza himself is an expert in thermo-dynamics, which he applies as an engineer to the technical problems of the liquefaction of air, and as a physicist to research on liquid helium. It is most remarkable and characteristic of Russian science how applied and pure physics, experiment and theory, are here combined. Andrade has mentioned Landau's theory of superfluidity which was published in 1941, but has been improved by him and his collaborators. It will cause the theorists some 'headaches'; for though it is most successful in predicting experimental results, for example, the existence of two different velocities of sound (the normal one of about 220 m./sec. and a slow one of about 20 m./sec.), it also contains many obscurities. The first part deals with the quantization of the hydrodynamical equations for ideal liquids. The second part describes helium II as a mixture of two phases, or interpenetrating liquids, one having viscosity, the other not. This new and surprising idea is clear in itself but scarcely connected with the first part. The link is a consideration about the quantization of vortex motion, which leads to the conclusion that the range of energy states (of the whole liquid) consists of two parts separated by a gap $\Delta$, one part representing the irrotational, the other the vortex motion. The existence of this finite energy $\Delta$ prohibits, for slow motions of the liquid, the excitation of quanta, therefore the transfer of momentum from the walls, and this means lack of viscosity. Landau gives an expression for $\Delta$ in terms of density $\rho$, mass of the atom $m$ and Quantum constant $\hbar$; the formula as published is wrong, but the idea is right. One has simply to remember the well-known expression for the so-called degeneration parameter from the Einstein-Bose or Fermi-Dirac statistics, $A = n\hbar^3/(m\Delta)^{3/2}$ where $n = \rho/m$ is the number of particles per unit volume. If $\Delta$ is expressed in terms of a critical temperature $T_c$, $\Delta = kT_c$, then for $T_c = 1°$ K. the dimensionless quantity $A$ is very small for a gas, but of the order unity for a liquid*. Hence quantum effects can be expected for every liquid at temperatures of the order 1° K., but are only observable in helium as all other substances become solid at such low temperatures. Landau shows how the actual value of $\Delta$ can be determined from measurements of specific heat and finds that it is 8–9° K. This value is then used for further calculations, for example, of the two velocities of sound.

There are many other interesting investigations which I should like to discuss; but I have first to digest the reprints which were given to me in considerable numbers.

I cannot close this report without expressing my thanks to the Russian colleagues for the kind reception and hospitality we found in their midst.

* Landau's formula should read

$$\hbar^2 \rho^{2/3} m^{-5/3} = \hbar^2 n^{2/3} m^{-2/3} = A^{2/3} \Delta.$$

*(To be continued.)*

# OBITUARIES

## Colonel C. H. D. Ryder, C.B., C.I.E.

Colonel Charles Henry Dudley Ryder died on July 13 at Bognor Regis at the age of seventy-seven. He was the seventh son of Colonel Spencer Dudley Ryder and was educated at Cheltenham College and the R.M.A. Woolwich, whence he received a commission in the Royal Engineers. After the usual courses of instruction at Chatham, he proceeded to India and was posted in due course to the Survey of India, in which the whole of his subsequent career was spent.

Much of Ryder's earlier work up to the first World War was carried out on active service or deputation in China, Tibet, Persia and Turkey. Later he was placed in charge of frontier surveys in India, and after taking command of the Survey Service in Mesopotamia during 1917–18, he succeeded Sir Sidney Burrard in the latter year as surveyor general of India, retiring from that post in 1924.

Ryder's greatest contributions to geography were in the field of survey and exploration in China and Tibet. In 1895, not long after joining the Survey of India, he served on the Mekong Boundary Commission, demarcating the Burma-Indo-China frontier. During 1898–1900, with Major Davies, he surveyed most of the routes in the Yunnan Province of China and in parts of Szechwan. Their journeys ended in a voyage down the Yangtse River to Shanghai, and their work forms the basis of present-day maps of these regions. In 1901–2 he was again in China as a survey officer with the Chinese Expeditionary Force. After a brief interval in India, he joined the Tibet Frontier Commission in 1903 and Sir Francis Younghusband's mission to Lhasa (1904). Taking advantage of the newly imposed treaty terms and of the presence of British troops, Ryder was given a free hand to carry out exploration in southern Tibet, and accompanied by Captain Rawling and a very small party he travelled westwards up the Tsangpo valley, exploring and surveying many thousands of square miles of, for the most part, unknown country. They fixed the sources of the Tsangpo, Sutlej and Indus, surveyed Lakes Manasarowar and Rakas Tal, and the region of the holy mountain of Kailas. Their work was controlled by the positions of the Himalayan snow peaks to the south which had been fixed many years previously from the plains of India. A great number of additional peaks were fixed, and the claim that Mount Everest was the highest mountain, in any event in regions hitherto explored, remained unassailed. The expedition reached Simla by way of the Shipki Pass in January 1905; its results form by far the greatest single addition to knowledge of the topography of the Tibetan plateau.

In 1913–14 Ryder served as chief survey officer on the Turco-Persian Boundary Commission, and as deputy commissioner during the absence of Mr. Wratislaw in the later months. The demarcation of this long frontier was complicated by a number of intricate negotiations. For his explorations in China and Tibet Ryder received the Patron's Gold Medal of the Royal Geographical Society, the Silver Medal of the Royal Scottish Geographical Society, and the Gold Medal of the French Geographical Society, and he was awarded the C.I.E. for his work on the Turco-Persian boundary.

C. G. LEWIS.

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## Dr. Catherine Alice Raisin

DR. CATHERINE ALICE RAISIN, a pioneer who blazed many new trails, died at Cheltenham on July 13 at the age of ninety. Her early education was received at the North London Collegiate School, of which she always spoke with gratitude as being one of the earliest schools to start providing more serious education for girls. Miss Raisin continued as a teacher at her old school until 1875, when the opening of certain classes to women students was advertised by University College, London. Among these was a course in geology by Prof. Morris. Miss Raisin attended this class, and so became the first woman to take geology in the University. In the following year she joined Prof. Morris' classes in mineralogy, only to discover after the course was completed that it had not been officially open to women.

In 1878 the degrees of the University of London were thrown open to women, and Miss Raisin at once began to prepare for her B.Sc. After passing the Intermediate Science examination in 1879, she selected geology, botany and zoology as her three subjects. She attended Prof. Bonney's classes in geology at University College during 1880–82, and Prof. Bower's classes in botany. Attracted by Prof. Huxley's work in zoology, Miss Raisin obtained special permission from him, in 1883, to attend his classes at the Royal School of Mines. After graduating B.Sc. with honours in geology in 1884, Miss Raisin continued at University College as a research worker, and at the same time as a voluntary assistant to Prof. Bonney, who was then very much overburdened with work. She received her D.Sc. in 1898, and in 1902 was elected a fellow of University College.

During the years when she was preparing for her degree, Miss Raisin achieved one of her earliest ambitions by founding and organizing a discussion club for women—the Somerville Club—which foreshadowed the youth movement of to-day. The work involved must have seriously interrupted her studies, for when the Club opened in 1880 she had already enrolled a thousand members. Under her inspiring leadership, first as honorary secretary and later as chairman, the Club flourished actively for several years. Meanwhile, other educational amenities for women were being developed in London, and in 1887, having served its initial purpose, the Club was wound up.

During 1886–90, Dr. Raisin was demonstrator in botany at Bedford College for Women. In 1890 she succeeded Prof. Grenville A. J. Cole as head of the Geology Department at Bedford College, a position which she held, together with the headship of the Geography Department, until she retired in 1920. Her outstanding teaching and administrative ability are further evidenced by the facts that she was head of the Botany Department during 1891–1908 and was also vice-principal of the College during 1898–1901. From these additional duties she eventually resigned in order to give more time to the claims of geology.

The originality of Dr. Raisin's teaching was in no respect better shown than in her celebrated lectures on petrographic provinces, which became the more fascinating since they were illustrated by practical work on rock specimens of her own collecting from many of the classic areas of Europe and North America. She was a first-class petrographer, with a firm grasp of the optical properties of minerals—then quite exceptional. Rightly unbound by fashion in petrogenetic thought, as time has shown, she stood almost alone in Britain in stressing the work of Lacroix, Termier and Sederholm on granitization, even at the time when crystal differentiation was beginning to hold the field as a major petrogenetic process.

Dr. Raisin's published work includes a long series of petrological and stratigraphical studies, dealing with rocks from the British Isles, Europe, North Africa and India. Her first paper, concerned with the metamorphic rocks of South Devon, was published in 1887, and is notable as representing an early attempt to recognize and map metamorphic facies. Dr. Raisin is, however, best known for her detailed investigation of serpentines.

In 1893 Dr. Raisin was awarded the Lyell Fund by the Geological Society of London, being the first woman to receive any such recognition from this Society. At that time women were not even allowed to attend meetings of the Society, and Prof. Bonney received the award on her behalf. When in 1919 women were admitted as candidates for fellowship of the Geological Society, Dr. Raisin was elected a fellow.

Dr. Raisin will be remembered by her students, not only as a stimulating and enthusiastic teacher, who worked ungrudgingly to promote their interests, but also as a generous, brave and sympathetic woman whom they loved.

DORIS L. REYNOLDS.

## Prof. H. E. Annett, M.B.E.

THE death occurred on April 11, 1945, of Henry Edward Annett, at the age of seventy-four years. Dr. Annett's scientific career was varied and his interests ranged over several fields—tropical diseases, bacteriology and pathology among them.

As an undergraduate at the University of Liverpool, Dr. Annett studied physics under Sir Oliver Lodge, but later, in spite of Lodge's persuasions to continue his work as a physicist, he decided to study medicine. After graduating in medicine, he was elected to an 1851 Exhibition and carried out research on tuberculosis under Robert Koch in Berlin. He was a member of the first malaria expedition sent to West Africa by the Liverpool School of Tropical Medicine in 1891, and during the following year he himself directed a similar expedition. In 1905 he led the Animal Disease Expedition to Uruguay, and in 1906 the Colonial Office Expedition to the West Indies. He was later appointed to the chair of comparative pathology at the University of Liverpool, an appointment which he held until 1911.

Dr. Annett then devoted himself to research in bacteriology, a field in which he became widely known, and for some years was director of the Bacteriological Research Department of Messrs. Evans, Lescher and Webb, in Runcorn. While there, he discovered the 'Liverpool' virus used for killing rats and mice. During the War of 1914–18 he was asked to study the effect on child health of milk preservation by the use of formaldehyde and the conclusions he reached, which were embodied in a Select Committee report, led to a legal ban on formol preservation. For this service he was awarded the M.B.E. The later years of his life were devoted exclusively to researches on cancer and allied problems, and he was occupied with this work up to the time of his death.

Dr. Annett's health had been declining for some years, and his unfailing kindness and encouragement, graced with a rare sense of humour, will be missed by those younger research workers who had the good fortune to come into contact with him.

SARAH BARNES.

## Dr. W. Knoche

DR. WALTER KNOCHE, a well-known investigator on climatology, atmospheric electricity, geography and ethnology, died on July 3 at Buenos Aires. He was climatologist to the Servicio Meteorológico Nacional of the Argentine Republic, as a successor to the late Robert Mossman.

Knoche was born in Berlin on March 7, 1881, his mother being a sister of Paul Ehrlich, one of the pioneers of modern chemical therapeutics. Through his uncle's example, Knoche received a powerful stimulus towards medical and physiological problems, and indeed a great number of his climatological investigations were devoted to the relations between climate and man, animals and plants. He studied at Geneva and Berlin, as a pupil of von Richthofen in geography and von Bezold in meteorology. After a short scientific expedition to Bolivia, where he made an extensive series of valuable meteorological observations at the height of 5,200 metres, he became in 1910 the chief of the Meteorological and Geophysical Institute of Chile, a post which he held until 1916. A great number of his early publications deal with atmospheric electricity, based on his own observations on land and sea and on mountains throughout the vast area between Teneriffe and Easter Island, and especially South America. His expedition, in 1911, to Easter Island led him to begin a comprehensive study of its different geographical and anthropological problems, which he discussed in a valuable monograph.

During recent years, Knoche's chief interest was concentrated on phytoclimatology, the formation of deserts, colonization, classification of climates and general bioclimatology, and it is fair to consider him one of the pioneers of this new branch of science. He was the author, together with the late Vladimir Borzakov, of a book on the climate of Argentina, now in the press.

A more detailed review of Knoche's many publications, considerably more than two hundred in number and dealing with an unusually wide range of subjects, will be given in the Argentine journal *Ciencia e Investigación*.

OTTO SCHNEIDER.

## Prof. F. von Wettstein

THERE will be general regret at the information, received from private sources, that Prof. Fritz von Wettstein has died recently in Germany.

Son of Prof. R. V. Wettstein, of the University of Vienna, he achieved as great an eminence as his father in the advancement of botanical and genetical science. Under Erwin Baur at the Kaiser Wilhelm Institut, Berlin-Dahlem, he undertook research work on hybrids and polyploids in mosses, and was one of the first to show the relationships and characteristics of polyploid forms. In 1926 he was appointed professor of botany in the University of Göttingen, where his energies built up the Botanical Garden to be a centre for the breeding of cacti and for investigations on various cryptogams. In 1933 he was appointed to one of the premier botanical chairs of Germany, that of the University of Munich; and later, on the death of Erwin Baur, he was called to take charge, I believe unwillingly, of the German plant breeding and botanical programmes that were under way at the Kaiser Wilhelm Institut at Berlin-Dahlem.

Of a quiet unassuming character, earnest and extremely enthusiastic on any subject relating to botanical genetics, his death, at a comparatively early age (about fifty-eight), is a great loss to science. What I remember most distinctly about Wettstein was his extreme friendliness and overwhelming hospitality to all with whom he came in contact; and despite a lack of English, his ability to overcome language difficulties when talking about his well-loved *Funaria hygrometrica* and *Solanum* chimæras.

F. W. SANSOME.

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J. E. RICHARDS, Town Clerk.
Guildhall, Nottingham.

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Applications are invited for the post of Third Lecturer in Bacteriology and Assistant Bacteriologist in the Public Health Laboratory.

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Three copies of applications, with three copies of not more than three testimonials, should be sent to the undersigned (from whom further particulars may be obtained) not later than October 31, 1945.

C. G. BURTON, Secretary.
The University, Birmingham, 3.

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Write, quoting C.2641.A, to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by October 5, 1945.

## LANCASHIRE COUNTY COUNCIL

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A form of application, together with further details of the conditions of service, can be obtained from the undersigned, to whom applications should be sent not later than October 1, 1945.

R. H. ADCOCK, Clerk to the County Council.
County Offices, Preston.

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Applications are invited for the post of LECTURER IN CHEMICAL ENGINEERING in the Department of Oil Engineering and Refining. Candidates should have an Honours Degree in Science, preferably Chemical Engineering. Chemical Engineering Industrial experience is essential, together with a keen interest in research.

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The University, Edmund Street, Birmingham, 3.

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The Governors invite applications for the above post, at a commencing salary of £650 per annum.

Further particulars may be obtained from the Secretary, to whom applications must be sent not later than September 29, 1945.

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University Assistant in the Department of Natural History in the United College, St. Andrews. Applications to be made immediately to the undersigned, from whom further particulars may be obtained.

DAVID J. B. RITCHIE, Secretary.

**Applications are invited for post of** Superintendent in a Government Research Establishment. Salary will be at a fixed rate within the range of £1,050 to £1,200 per annum according to qualifications and experience (a higher salary would be considered in case of an applicant with special qualifications).

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Write, quoting F.3886.A, to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by October 5, 1945.

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Birmingham, 18.

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**The British Scientific Instrument** Research Association is planning a considerable extension of its activities and requires an Administrative Officer whose immediate duties will be to assist the Director in formulating and carrying out the scheme of expansion. The appointment will carry Superannuation under the F.S.S.U. Scheme and the salary will depend on technical qualifications and experience. Applications are invited before the end of September and should be addressed to the Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.1. Additional posts will be announced later.

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Write, quoting F.4826.A, to Ministry of Labour and National Service, A.9, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by October 5, 1945.

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Applications are invited from Registered Medical Practitioners, age 30 to 40 years, for the post of Assistant Medical Director at The Evans Biological Institute, Runcorn, Cheshire. Candidates should have a sound knowledge of modern scientific medicine, and be interested in the development and manufacture of biological and chemotherapeutic products. Salary £1,200 to £2,000 per annum according to qualifications, age and experience. Applications, together with testimonials, should be sent to the Medical Director, before January 31, 1946.

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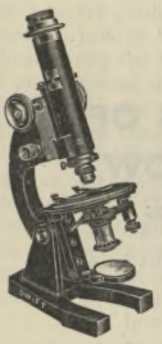

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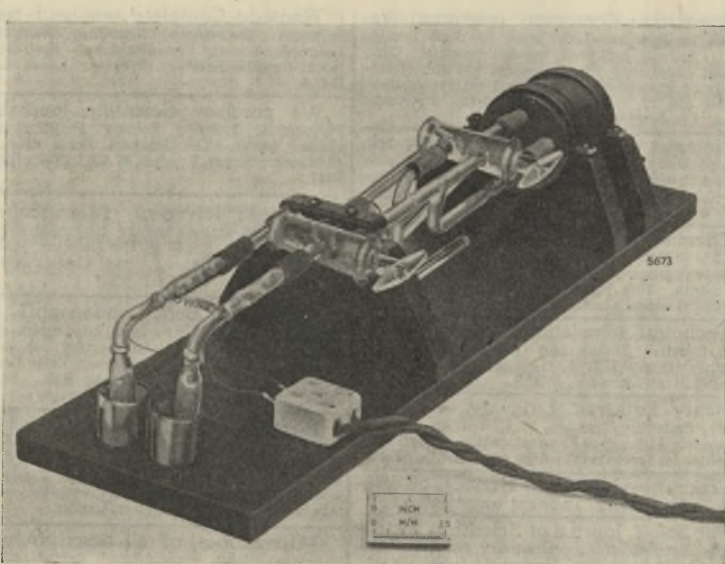



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# NEWS and VIEWS

## Dr. W. F. P. McLintock: Director of the Geological Survey of Great Britain

THE appointment of Dr. W. F. P. McLintock to succeed Sir Edward Bailey as director of H.M. Geological Survey and Museum is especially fitting at this stage in the long history of that institution. Dr. McLintock's keen analytical mind, his long administrative experience and his gifts for effective planning and exposition, are now brought most opportunely to the re-organization of the Survey's peace-time activities. After graduating at the University of Edinburgh, Dr. McLintock joined the Geological Survey in 1907 as assistant curator in the Museum of Practical Geology. In 1911 he left the Survey to take charge of the Geological Department of the Royal Scottish Museum, where he was responsible for the exhibits of the Geological Survey in Scotland. In 1921 he rejoined the Survey as curator and became deputy director in 1937.

Dr. McLintock's research has been concerned with the crystallography, mineralogy and paragenesis of the rare minerals datolite and petalite from Cornwall, with topaz and beryl from Lundy Island, and with zeolites from the Tertiary lavas of Mull. Of especial interest is his account of the metamorphism of sedimentary rocks by the combustion of hydrocarbons in south-west Persia. He described the Strathmore meteorite. His most important contributions, however, have been concerned with geophysical methods of geological survey. In 1926 he proceeded to Persia to study, under the auspices of the Anglo-Persian Oil Company, field methods of geophysical survey; and later, in collaboration with Dr. J. Phemister, he executed a number of surveys—gravimetric and magnetic—over geological structures such as dykes, faults, unconformities and buried channels, in order to obtain data for the critical appreciation of the value of geophysical methods in geological surveying. Dr. McLintock undertook the replanning of the Museum of Practical Geology on its transference from Jermyn Street to the South Kensington site, and was responsible for the scheme of exhibition in the new Museum. The success of this Museum and its recognition as the foremost geological museum of the world are mainly due to his untiring and enlightened directive efforts. Geologists look forward with confidence to the speedy recovery of its former glories.

## Mr. A. A. Kift

MR. A. A. KIFT, who has served for forty-three years with Marconi's Wireless Telegraph Company, Ltd. and during the last twenty years has been successively sales manager, assistant engineer-in-chief and contracts manager, retired from the Company's service at the end of August. Mr. Kift is one of the best known Marconi officials and is one of those engineers who joined soon after the Company's formation and may be said to be responsible for laying its foundations. Like many of those early wireless pioneers, Mr. Kift received his training as an electrical engineer at Finsbury Technical College. After a further specialized course at the Marconi Training College at Frinton, he was appointed to the erecting staff and was engaged in fitting some of the first half-dozen White Star liners which were equipped with wireless in and about the year 1902 at a time when a range of 50–100 miles with a coherer receiver was regarded as very satisfactory communication. After that, Mr. Kift's work for the Company, afloat and ashore, ranged from the Labrador coast to Varna on the Black Sea, with the erection of stations round the English coast interspersed with his foreign travel.

## Institute of Fuel: Deputy Secretary

MR. REYNOLDS-DAVIES has been appointed deputy secretary of the Institute of Fuel. Mr. Reynolds-Davies received his technical education at University College, Cardiff, and the South Wales School of Mines. He has had a wide experience as a chemical engineer and fuel technologist for several years. His industrial experience was obtained first of all as chemist on the Coke Oven Plant of the Cambrian Combine, now merged with the Powell Duffryn Associated Collieries, Limited. He was later engaged as assistant with the late Dr. W. R. Ormandy on Power Alcohol and Petroleum Products. This work was followed by nine years as one of the chemical plant managers with the British Industrial Solvents, Ltd. For the past three years, he has held the position of manager of the Development Department of the Royal Ordnance Factory at Bridgend.

## Carnegie United Kingdom Trust

THE thirty-first annual report of the Carnegie United Kingdom Trust, covering the year 1944, shows that the total expenditure on grants amounted to rather more than £71,000, the highest annual figure reached during the War. This includes £10,000 in aid of a post-war experiment to be undertaken in Shropshire, where a community house is to be established to serve partly as a residential college for short-term courses of adult education, but also as a focal point for cultural activities within the county. A special grant of £3,000 has also been made to Toynbee Hall to enable it to extinguish a deficit, largely on building account, the continued existence of which is due mainly to war conditions. A grant of £2,000 has been promised to the Council for the Promotion of Field Studies towards the initial cost of adapting and equipping a pioneer field centre at Flatford Mill, Suffolk (see *Nature*, **155**, 744; 1945). The largest block of expenditure during the year was on youth services, which took nearly £22,000 as against £23,000 in 1943. Grants to the headquarters of national youth organizations decreased by about £3,000, but club equipment grants increased by about £6,000 to £15,000. The Trust intends to continue for a further period its provision of grants in aid of the equipment of hostels and camps provided by national and voluntary youth organizations, under detailed conditions which have been communicated to the organizations likely to be concerned. Discussions with the National Association of Boys' Clubs have been proceeding during the year, and the Trust has agreed in principle to provide the capital sum required for the acquisition and the first stage of adaptation of a country house in which the Association proposes to set up a residential institution for standardized training. A report has also been requested by the Trust on periodical literature for juveniles, with the view of considering improvements in this field, and the report is to be prepared on its behalf and at its expense by the Research Department of the National Council of Social Service. The endowment income of the Trust amounted in 1944 to £122,801, and of this £80,366 was expended on grants and administration.

## A New Approach to School Mathematics

WITH the re-classification of secondary schools in Great Britain under the new Education Act, there is an urgent need for the complete overhaul of the curricula of these schools. This is especially true in the case of mathematics, evidence of which is to be found in the recent reports on school certificate mathematics (Conf. Exam. Bodies and Teachers' Associations, 1944); on the teaching of mathematics to physicists (Mathematical Association and the Institute of Physics, 1944); and on sixth form examinations in mathematics (Cambridge Joint Advisory Committee for Mathematics, 1945). In suggesting an alternative syllabus to those in operation at present, the first-named report makes the significant remark: "The whole syllabus is inspired by a desire to bring mathematics more closely in relation with the life and experience of the pupil". Herein lies the kernel of the question, and it is symptomatic of the dissatisfaction felt at the existing courses, which are largely dominated by the syllabuses of the examining authorities. With approximately four-fifths of the pupils now leaving secondary schools at school certificate level, the huge gap between examination mathematics and the essential needs of after-school life calls for some fundamental change. The need for a fresh approach to the mathematical curriculum has been ably dealt with by Mr. C. T. Lear Caton in his presidential address to the Midland Branch of the Mathematical Association (*Math. Gaz.*, July 1945), and his advocacy "to replan the mathematics courses in all types of schools to fit in with the new educational structure and to contribute more effectively to the needs of the post-war world" sums up very concisely the case for immediate reform.

In Britain, the logical process of making necessary basic changes in established systems is traditionally slow; but the second great world war has shattered many of those systems so that progressive action is urgently imperative. The late Sir J. J. Thomson ("Recollections and Reflections") tells of a student who only learned to respect mathematics because of its application to billiards! This interesting case typifies the need for emphasizing the outward aspect of the subject and provides the clue to the guiding principle for reform. The problem, however, is far from easy, for it will obviously be dangerous to swing over to the other extreme by rejecting all that has no relation to what Sir Percy Nunn calls "the world of outer realities lying in time and space" ("The Teaching of Algebra"). On the other hand, there is little reason in placing a canopy of alleged difficulty round such a topic as infinite series when they hold the very key to the method of calculating tables, about which most students are so inquisitive. Indeed, the whole trend of any movement towards an intelligent reformation must be directed with much understanding, mature knowledge and an absolutely unbiased outlook.

## Quality Control in Business

A SERIES of six articles by Mr. William B. Rice on quality control in business production and administration have been separately reprinted from *Western Industry*, the *Journal of the American Statistical Association* and the *Accounting Review*, and provides a useful introductory account for anyone interested in the application of statistical methods in business. Mr. Rice, who is the director of the Department of Statistics and Reports of the Plomb Tool Company of Los Angeles, writes with first-hand experience of the methods he describes and drives home his points with a wealth of practical illustration. The first four of his articles deal with the control of quality of a manufactured product on fairly familiar lines—an expository presentation which should do much to arouse interest among manufacturers. In the remaining two he extends the technique to business administration and office accounting, showing, for example, how excessive overtime costs in a department of an engineering plant were tracked down and eliminated, and how administrative charges in a business were brought under control. This is quite a recent development of the subject, and provides an interesting illustration of the growth of scientific methods in the most ordinary commercial operations.

The statistical theory required in quality control is comparatively elementary; but the most striking successes have been obtained by introducing it into factory production processes. In some cases the methods amount to little more than a systematic sampling of the product and a graphical presentation of the results; and yet they appear to lead to the tracing of sources of trouble in the manufacturing process with an efficiency which astonishes nobody more than the men who have had years of experience on the job and are naturally inclined to think that they have nothing more to learn about it.

## Nutritive Values of War-time Foods

DIETARY surveys of the population which are being carried out by the Ministries of Food and Health have created a demand for food-tables giving, for raw foods, values for proteins, fats and carbohydrates and for the relatively small number of minerals and vitamins most likely to be deficient in human diet. Values for the composition of many foodstuffs consumed in war-time were not available in existing tables, and the differences between the values for war-time and peace-time foods are often very great. The Medical Research Council War Memorandum No. 14 now sets out "Nutritive Values of Wartime Foods" (Tables compiled for the Accessory Food Factors Committee. London: H.M. Stationery Office). Numerous analytical data, published and unpublished, have been considered in selecting the representative values in these tables. Many individuals have been consulted and have provided valuable data and advice. The values, including those for waste, are based for the most part on the results of direct analyses carried out during recent years in Britain. Such values were not always available, particularly for the vitamins, and it was necessary to make a selection from the values in the literature, distinguishing carefully those foods the composition of which had not been affected by the War. The losses during cooking are variable, affecting vitamin C severely, vitamin $B_1$ to a less extent and vitamin A probably still less. For processed foods, an allowance for loss of vitamins by destruction during cooking has been made in the tables.

## Control of Weeds by Spraying

Loss in yield of cereal crops from competition with annual weeds is more serious than is generally realized, and gains of more than 50 per cent can often be expected as a result of correct spraying with a selective weed killer. Advisory Leaflet No. 315, Weed Control in Cereals, issued by the Ministry of Agriculture, gives much useful information on the subject. Up to the present, sulphuric acid has proved to be the most effective chemical for the purpose, as it kills a wide range of weeds and is quick acting even in dull weather. Its highly corrosive properties, however, make it difficult to handle; so copper chloride and dinitro-ortho-cresol (D.N.O.C.) are suggested as alternatives. Directions for the use of all three substances are given, and comparison made between the concentrations of spray required in each case for the eradication of a number of common weeds. As regards time of spraying, rather more latitude is possible with copper chloride and dinitro-ortho-cresol than with sulphuric acid, which kills weeds only in the seedling stage, but usually the acid has a slight advantage if the weather is cold and dull. Full instructions are given in the use of these spray materials, and any precautions necessary for the protection of the operator or care of equipment clearly mentioned.

### West of Scotland Field Studies Council

In 1944 members of the Glasgow and Andersonian Natural History and Microscopical Society, including Dr. Inglis Cameron, carried out preliminary work which resulted in the inauguration in April 1945 of the West of Scotland Field Studies Council. On the Council are representatives of youth organizations, scientific societies, colleges and the University of Glasgow. Prof. Balfour Brown and Prof. C. M. Yonge, who have connexions with similar organizations in the south of Britain, are also on the Council. The Council is mainly, but not exclusively, concerned with the popularization of field studies. Its membership is widely representative, and includes amateur and professional naturalists, educationists, representatives of the Scottish Youth Hostels Association, Boy Scouts, etc. Its constitution provides it with useful powers of co-option. The Council is anxious to get in touch with other organizations of a similar nature, so that some type of co-operation may be established and there may be a free exchange of ideas. It has already set up panels of lecturers and outdoor guides, and is considering the preparation of guide-books to the natural history of the west of Scotland. The chairman is Prof. John Walton; the honorary secretary is Dr. T. Gregory Absalom, Art Galleries and Museum, Kelvingrove, Glasgow, C.3, to whom communications should be addressed.

### Durban Museum and Art Gallery

In the annual report for 1943–44 of the Durban Museum and Art Gallery, it is reported that their position as institutions of visual education and æsthetic enjoyment has been well maintained; but reference is made to the now common need among museums in all parts of the world for further and more suitable accommodation. Besides the usual routine work, many public lectures were given in the Museum and Art Gallery throughout the year, and there was much activity in connexion with the school services. The showing of educational films evidently takes a prominent place in these services. In reference to adult education, it is of interest that the South African Minister of Education appointed a committee to inquire into, and report upon, the part played by the Museum and Art Gallery in this realm of their activities. One of the photographic plates in this report depicts an interesting group of carved stone figures entitled "Baya Huba", by Mary Stainbank; this was recently acquired by the Art Gallery.

### Biochemical Research Foundation of the Franklin Institute

In Reports of the Biochemical Research Foundation of the Franklin Institute (7; 1942–43), stress is laid on the importance of co-ordination of the sciences of physics, chemistry and biology. By this means it is often possible to obtain a comprehensive view of a problem, whereas the isolated methods of the past would only come to an *impasse*. There are more scientific trained personnel in this Institute than in almost any college, and, free from the burden of teaching, all are co-ordinated and organized towards the special end. Direction of research towards certain projects is thus possible, and groups of scientific workers of varied character together with apparatus of unique quality are brought to bear on the elucidation of any problem. An example of this type of group co-operative work is the successful separation by physico-chemical methods followed by biological study of certain surface antigens of the typhoid bacillus having high immunizing powers without any great degree of toxicity.

### Announcements

Mr. Roy Innes has been appointed general secretary of the Association of Scientific Workers. Mr. Innes took a degree in mathematics and physics at the University of Manchester in 1937. For a time he was a science teacher, and in 1939 entered the newly formed Operational Research Section attached to Fighter Command, R.A.F. He succeeds Mrs. Reinet Fremlin, who has been with the Association for eight years.

An open meeting to discuss "Social Security for Chemists" has been arranged by the London Section of the British Association of Chemists. It will be held at the Assembly Hall, Royal Empire Society, Northumberland Avenue, at 6.30 p.m. on September 19.

*Voks Bulletin* No. 6, of the U.S.S.R. Society for Cultural Relations with Foreign Countries, includes a tribute to Mendeléeff, by M. Pervukhim, People's Commissar of the Chemical Industry of the U.S.S.R., in connexion with the seventy-fifth anniversary of the discovery of the periodic law, and an article by the late A. Fersman, of the Academy of Sciences of the U.S.S.R., on the periodic law and its significance for natural science, in which its bearing on geochemistry as well as on cosmic processes and theoretical chemistry generally are considered.

The following appointments have been made in the newly formed Department of Animal Health at the University College of Wales, Aberystwyth: Mr. R. Phillips, formerly senior lecturer in agriculture, to undertake research in animal husbandry and the administration of investigational centres; Dr. W. C. Evans, at present biochemist to the Inoculation Department, St. Mary's Hospital, London, to be special lecturer in biochemistry; Mr. E. Parker Pollard has been seconded by the Cooper Technical Bureau for research in parasitology; Mr. D. N. Fidler, to be research assistant (animal husbandry); Mr. R. A. Evans, at present of Crooke's Laboratories, and Mr. A. W. Davies, formerly of the Dunn Nutritional Laboratory, Cambridge, to be research assistants (biochemistry); Mr. T. R. Thomas, Carmarthen, to be consulting veterinary surgeon.

# LETTERS TO THE EDITORS

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

## X-Ray Analysis with the Aid of the 'Fly's Eye'

In a note in *Nature*[1], an example was given of the use of the 'fly's eye' for X-ray analysis. The reflexions of X-rays by planes around a crystal zone correspond in intensity to the optical spectra produced by a cross-grating, the pattern of which is that of the crystal structure projected on a plane perpendicular to the zone. The 'fly's eye' enables such cross-gratings to be made. The spectra they produce can be compared with the observed X-ray reflexions, thus avoiding the labour of calculation, at any rate in the first stages of the usual trial-and-error method of seeking the solution.

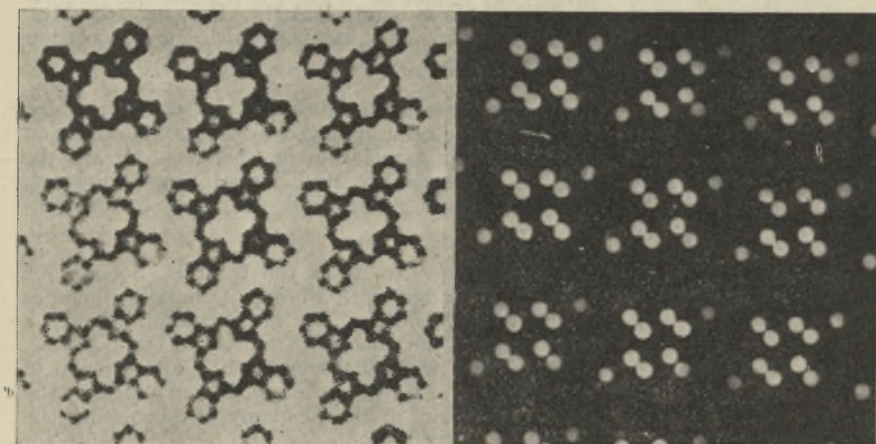
The original type of 'fly's eye' was a multiple pinhole camera, the holes being in a square array, forty to the centimetre. Each hole produces an image of a single illuminated object representing the unit of structure. An example of a cross-grating made in this way by Bunn is shown in Fig. 1*a*. It represents phthalocyanine and gave a good correspondence with observation (see *Nature, loc. cit.*). It has the disadvantages, however, that the images are diffuse because of the pinhole method and the grain of the photographic plate, and they are unequal in intensity because the minute pinholes are liable to be blocked by specks of dust.

The new type of 'fly's eye' described here gives much better cross-gratings. The pinholes are replaced by small lenses embossed on the surface of a 'Perspex' sheet. These are made by pressing a steel ball at regular intervals on a soft copper block, and casting or pressing 'Perspex' on the block. The actual array used for Fig. 1*b* consisted of lenses 0·5 cm. in focal length, 0·06 cm. in diameter and 0·13 cm. apart. A paper mask punched with corresponding holes cut out all light except that falling on the lenses.

The array of lenses, covering a circular area of 2·5 cm. diameter, with a photographic plate in their focal plane, is exposed to an illuminated ground-glass viewing screen on which black disks are laid representing the atoms in a single unit of pattern. They appear as transparent holes in Fig. 1*b*, which is an enlargement of the negative used as the cross-grating. The greater sharpness and uniformity of the pattern in Fig. 1*b* as compared with Fig. 1*a* is evident. The structure is that of durene[2] projected on (010), and referred to equal axes at right angles.

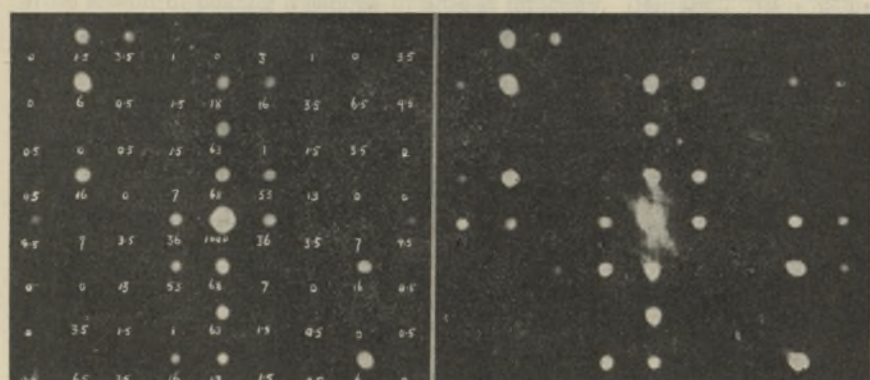
The cross-grating is mounted between optical flats with cedarwood oil in the interspaces, to reduce optical imperfections of the photographic plate. It is placed before a lens 1 metre in focal length, and the spectra photographed on a plate at the focus. It is convenient to use an eyepiece for viewing them. Fig. 2*a* shows the spectra so produced, the numbers representing the X-ray intensities recorded by Robertson. If allowance is made for the more rapid falling off of X-ray intensities with angle, due to the carbon scattering factor, it will be seen that the correspondence is good. Fig. 2*b* shows the poorer result when the optical flats and cedarwood oil were not used.

The new method has several advantages over the former one. The cross-grating is on a larger scale, hence the grain of the plate is not troublesome. The sharpness of the images should make it possible to represent the atoms as concentric rings so as to simulate the scattering curve of atoms. A series of gratings can quickly be made with different arrangements of the disks on the viewing screen, and it is therefore a rapid trial-and-error method in seeking a first approximation to the structure.



(*a*) (*b*)

Fig. 1.



(*a*) (*b*)

Fig. 2.

It is intended to publish elsewhere a more detailed account of the production and use of the gratings.

W. L. Bragg.
A. R. Stokes.

Cavendish Laboratory,
Cambridge. Aug. 9.

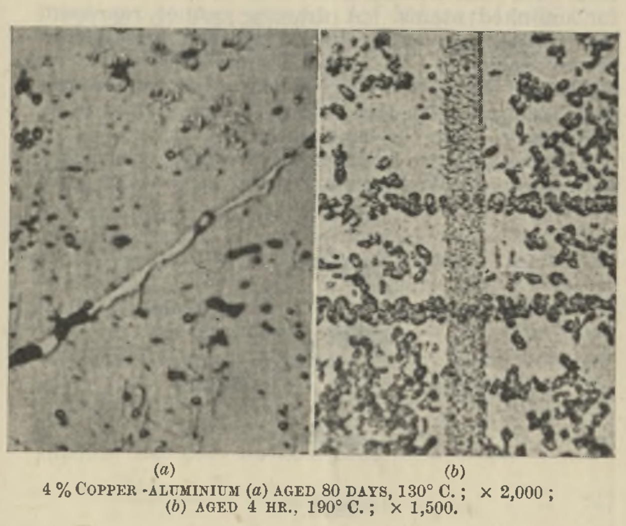
[1] *Nature*, 154, 69 (1944).
[2] Robertson, *Proc. Roy. Soc.*, A, 142, 659 (1933).

## Striated Structure of Age-hardened Alloys

Drs. Guinier and Jacquet[1] have referred to striated structures appearing in polished specimens, etched or unetched, in the earlier stages of the age-hardening of certain alloys and in particular of aluminium-copper and copper-beryllium alloys.

With regard to aluminium-copper alloys, an extensive research into the mechanism of ageing of high-purity 4 per cent copper-aluminium alloy has confirmed the view I put forward in 1940[2], that these 'striations' could be attributed to accelerated ageing resulting from plastic deformation on quenching, and has again led me to the conclusion that they are not a necessary accompaniment of the age-hardening process. The results I have obtained also show that the lattice-strains, set up in the early stages of ageing by the formation of the Guinier-Preston plates, are relieved when the latter attain a critical size by the precipitation of sub-microscopic copper-rich aggregates and sub-microscopic crystallites of the aluminium solid solution stable at the temperature of ageing. The beginning of the 'flat' on time-hardness curves marks the appearance of this process. As ageing proceeds, these copper-rich segregates and crystallites of aluminium become microscopic in size, as shown in Fig. *a*, which is a photomicrograph of the etched structure of high purity 4 per cent copper-aluminium alloy, quenched and aged 80 days at 130° C. White crystallites of aluminium solid solution, stable at 130° C., are seen in the grain boundaries and in the matrix, together with the black areas which are indicative of copper-rich regions.

Furthermore, Wassermann's[3] suggestion that striated structures may be attributed to mechanical twinning resulting from quenching stresses is not confirmed. Fig. *b* is the photomicrograph of part of a large grain of high-purity 4 per cent copper-aluminium alloy, in which several 'striations' were revealed on etching the quenched and aged specimen. The specific etching reagent has developed the crystallites of the aluminium solid solution, stable at the ageing temperature, as referred to above. The 'striations' are composed of many of these crystallites, and it is clear that where the two bands of striæ cross one another, no change in direction occurs. My researches into the relationship between cold-work and age-hardening show that cold-working (strain-hardening) and age-hardening are similar processes, and that when the lattice has been strained to a critical amount, relief occurs by the formation of crystallites of aluminium along the planes of slip, resulting in accelerated ageing. Hence the crystallites shown in Fig. *b* are due to accelerated ageing in strained areas.



(*a*) (*b*)
4 % Copper-aluminium (*a*) aged 80 days, 130° C.; × 2,000; (*b*) aged 4 hr., 190° C.; × 1,500.

If quenching is very severe, as it was in the case of the specimen mentioned above, 'striations' are formed; it is probable, however, that they are deformation bands of the type found by Barrett and Levenson[4] in compressed aluminium. The spontaneous development of striations in copper-beryllium alloys is, I think, a different phenomenon; rather they are associated with the development of internal strains in the lattice due to the formation of beryllium-rich zones, as postulated by Guinier and Jacquet, and *not* to plastic deformation. The relief of strains set up takes place in these alloys on a macro-scale, that is, with the formation of striations similar in type to Lüder's lines; in the case of copper-aluminium alloys, the relief of strain in the early stages is on a sub-microscopic scale and is not accompanied by 'striations'.

In the near future I hope to publish full details in support of my statements.

M. L. V. Gayler.

Metallurgy Division,
National Physical Laboratory,
Teddington, Middlesex.
July 10.

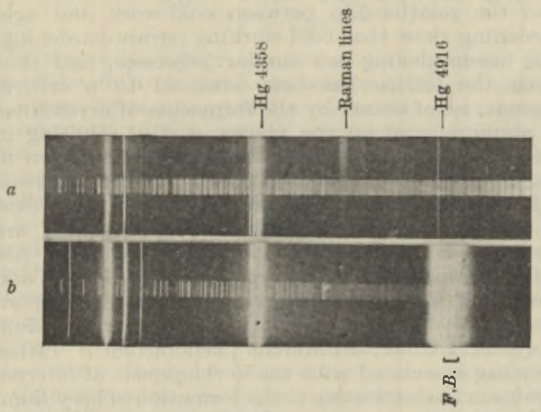
[1] *Nature*, 155, 695 (1945).
[2] Gayler, M. L. V., and Parkhouse, R., *J. Inst. Met.*, 66, 67 (1940).
[3] Wassermann, G., *Z. Metallkunde*, 30, 62 (1938).
[4] Barrett, C. S., and Levenson, L. H., *Amer. Inst. Min. Met. Eng.*, Inst. Met. Div., 137, 112 (1940).

## Fluorescence of Dipropyl Ketone at Low Temperatures

It is well known that fluorescence bands sometimes undergo changes in position and intensity with the change of state and temperature of the substance, and also they sometimes show some structure at low temperatures. Organic substances which do not exhibit any fluorescence at room temperature but show intense fluorescence bands at low temperatures are, however, very rare.

While investigating the Raman spectra of organic substances at low temperatures, we have observed that dipropyl ketone is one such substance. When it is irradiated in the solid state at about −170° C. by light from mercury arcs condensed by thick glass condensers, it yields a feeble Raman spectrum containing also a very intense fluorescence band extending from λ 4880 up to λ 5100, the short wave-length edge of the band being less diffuse than the long wave-length edge. The Raman spectrum of the liquid at room temperature observed under similar conditions does not show any appreciable fluorescence in the visible region, as can be seen from the spectrum reproduced; the spectrogram for the solid at about

− 170° C. is also reproduced. It can be seen that the intensity of the fluorescence band is as large as that of the undisplaced mercury lines, even though a narrow slit was used; the undisplaced mercury lines were due to strong stray diffuse light coming from the irradiated mass of the solid, which was translucent.




It has been observed that the band mentioned above does not appear immediately after the double-walled 'Pyrex' tube containing the liquid is completely immersed in liquid oxygen. This shows that the band is not due to liquid oxygen. The substance freezes at − 32·6° C., but the band does not appear even when the liquid is solidified and the temperature goes down below − 50° C. As the temperature is lowered further, a feeble continuous fluorescence extending from λ 4920 up to about λ 5300 is observed, and when air at atmospheric pressure is allowed to fill up the annular space between the walls of the double-walled container, the temperature of the solid attains a value of about − 170° C. and the intense band shown appears simultaneously. Visual observations show also the presence of a very weak diffuse and broad band at about λ 5200; but owing to the insensitivity of the plate in this region this band has not been recorded on the plate.

The facts mentioned above indicate that change of state of the substance is not responsible for the origin of the band. It is the contraction of the solid at lower temperatures which gives rise to the strong fluorescence. Thus probably this fluorescence of dipropyl ketone furnishes direct evidence of the appearance of fluorescence due to strain in the molecular lattice. The investigations are being pursued.

S. C. Sirkar.

Physics Department,
University of Calcutta.

B. M. Bishui.

Indian Association for the
Cultivation of Science,
Calcutta. April 28.

## Hydrogen Bond Linking of Quinol Molecules

Crystal structure examination has shown that quinol molecules may link by hydrogen bonds in a special manner. The compound $SO_2.3C_6H_4(OH)_2$ [1] is found to have a rhombohedral lattice; the corresponding hexagonal unit cell, $a = 16{\cdot}3$, $c = 5{\cdot}8_1$ A., contains nine molecules of quinol and three of sulphur dioxide. From X-ray intensity relationships and absent spectra, the evidence of face development, and the negative results of pyro-electric and piezo-electric tests, the space group should be $R\bar{3}$. For β-quinol, Caspari[2] found a unit cell of very similar dimensions, without a centre of symmetry, and of the possible space groups $C^1_3$–$C3$ and $C^4_3$–$R3$ preferred $C^1_3$–$C3$; a determination of atomic positions was not attempted. We have confirmed the polar character, but from absent spectra find the space group to be $C^4_3$–$R3$. From the great similarity, after allowance for the sulphur dioxide, between our X-ray data for β-quinol and the sulphur dioxide compound, the two structures must have much in common. As a safeguard, therefore, against erroneous conclusions due to faulty space group suppositions, the structure of the sulphur dioxide compound was developed, without the initial assumption of centrosymmetry, by three-dimensional Patterson and Fourier methods. In the early stages this procedure brought in a symmetry centre, and for the subsequent work the space group was taken as $R\bar{3}$ in accordance with this and the other evidence.

The linking of quinol molecules in this compound may be seen from Figs. 1 and 2. In Fig. 1, circles represent oxygen atoms of the hydroxyl groups linked by hydrogen bonds to form approximately plane hexagons of side 2·7 A. These hexagons are connected as shown through rods which represent the quinol molecules. For clarity the benzene rings have been omitted, and the rod itself coincides with the line joining the two oxygen atoms of one molecule. This gives a set of quinol molecules linked to form an infinite cagework in three dimensions. Although the hexagon is a satisfying hydrogen bond arrangement, having a parallel in the crystals of boric acid[3], and the oxygen to carbon link represented by the direction of the rod is at nearly the tetrahedral angle to the two hydrogen bonds as is commonly the case, the molecular grouping of Fig. 1 is a very ineffective one for space filling. Comparison with the 2·7 A. sides of the hexagons will show a very large central space and, on each face of the roughly rhombohedral framework, gaps which are wide compared with an atomic diameter. These gaps are so large that it is possible to insert a second identical framework. This is displaced vertically half-way between the top and bottom hexagons, and the holes of the structure are such that the two cageworks are able to interpenetrate each other without closer contact than that usual for unlinked atoms. A drawing cannot represent this owing to overlap effects, but the stereoscopic representation of Fig. 2 gives a simple visual demonstration of the relative dispositions of two frameworks each identical with that of Fig. 1, but viewed from a different angle for convenience.

Although the two frameworks now approach to give normal van der Waals distances and there are no gaps

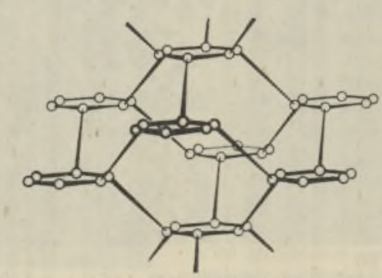


Fig. 1.

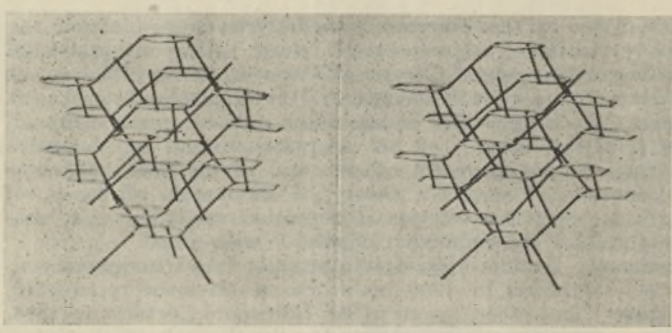


Fig. 2. THE STEREOSCOPIC EFFECT MAY BE OBTAINED BY USE OF A SIMPLE STEREOSCOPE, FOR EXAMPLE, HILGER'S, OR BY HOLDING A CONVEX LENS OF FOCAL LENGTH *c.* 10 CM. CLOSE TO EACH EYE.

through which a molecule may easily enter or leave, there remain, between the two cageworks, cavities of sufficient size to contain a small molecule at normal unlinked distances from the surrounding atoms. These cavities, which may be seen in Fig. 2, are bounded at top and bottom by the hydrogen bond hexagons of the two different cageworks and at the sides by quinol molecules as a whole. It is in these separate enclosures that the sulphur dioxide, or other molecule in similar compounds, is located.

The detailed structures of the compounds and a discussion of applications of the type of union exemplified will be given elsewhere.

*Note added in proof.* Our unit cell dimensions, slightly greater than Caspari's, led to further work including a molecular weight determination from unit cell size and density, comparison of X-ray intensities and chemical analyses, all of which show that 'β-quinol' crystallized from methyl alcohol is a compound containing one molecule of methyl alcohol to three of quinol and is thus closely related to the sulphur dioxide compound.

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Oxford. May 14.

[1] Clemm, A., *Ann.*, **110**, 352 (1859).
[2] Caspari, W. A., *J. Chem. Soc.*, **130**, 1093 (1927).
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## Degree of Association of Water from the Energy of Viscosity and the Work of Cohesion

ON a previous occasion[1], it has been shown that the energy of viscosity equals the work of cohesion for non-associated liquids. For associated liquids the energy of viscosity is greater than the work of cohesion by a definite increment. This increment of energy is the energy of association per bond between two associated molecules. Equating the difference between the energy of viscosity, $E_{\text{visc.}}$, and the work of cohesion, $W_c$, to the energy of attraction between two interacting dipoles, it is possible to calculate an apparent dipole moment of the molecule, and from the apparent dipole moment one can calculate the degree of association of the substance. Thus it is postulated that for a liquid where all the dipoles take part in association complexes,

$$\frac{E_{\text{visc.}} - W_c}{N} = E(r)_{\text{dipole interaction}} \quad . \quad . \quad (1)$$

where $E(r)_{\text{dipole interaction}}$ is the energy of interaction between two dipoles.

This energy of interaction between two dipoles results from the summation of two effects: (*a*) the attraction between the dipoles[2] (the so-called orientation effect); (*b*) the mutual enhancement of the dipole moments of the molecules by mutual interaction, due to the polarizability of the molecules[3].

Let $\mu$ be the dipole moment of the molecules, $r$ the distance between the centres of the dipoles and $p$ the polarizability of the molecules; then for a parallel arrangement of the dipoles:

$$E(r)_{\text{orientation}} = \frac{\mu^2}{r^3}; \; E(r)_{\text{polarizability}} = \frac{2.\mu^2.p}{r^6}; \quad . \quad . \quad (2, 3)$$

and

$$E(r)_{\text{dipole interaction}} = E(r)_{\text{orientation}} + E(r)_{\text{polarizability}} \quad . \quad (4)$$

From equations (1) to (4) it follows that

$$\mu = \sqrt{\frac{E_{\text{visc.}} - W_c}{N} \cdot \frac{r^3}{1 + 2p/r^3}} \quad . \quad . \quad (5)$$

If all the dipole molecules would form association complexes, then equation (5) would give the true value of the dipole moment. However, the difference between $E_{\text{visc.}}$ and $W_c$ derives only from the fraction of the molecules which take part in the associated complexes. If the liquid is only partially associated, equation (5) will give an apparent dipole moment smaller than the 'true' or experimentally determined moment.

Writing

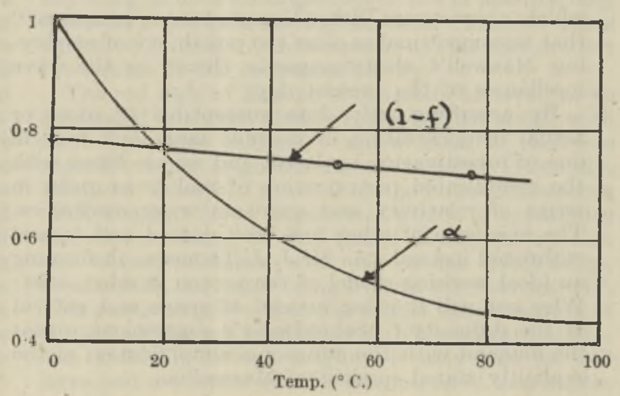
$$\frac{E_{\text{visc.}} - W_c}{N} = \alpha \, . \, E(r)_{\text{dipole interaction}}, \quad . \quad . \quad (6)$$

where α is the degree of association or the fraction of single molecules taking part in association, one may obtain the relation between the apparent and the true dipole moment,

$$\alpha = \left(\frac{\mu_{\text{apparent}}}{\mu_{\text{true}}}\right)^2 \quad . \quad . \quad . \quad . \quad (7)$$

Similar equations can be derived for antiparallel arrangements of the dipoles.

The principles outlined above were used to calculate the apparent dipole moment and the degree of association of water, which exists in the parallel arrangement. Calculation of the apparent dipole moment of water at 0° C. gave a value of $1{\cdot}86 \times 10^{-18}$ E.S.U. × cm., and at 100° C. the value obtained was $1{\cdot}2 \times 10^{-18}$ E.S.U. × cm. The observed value of the dipole moment of water is about $1{\cdot}85 \times 10^{-18}$ E.S.U. × cm.



The degree of association of water was then calculated and the results are shown on the accompanying graph. According to our calculations, near the melting point water is completely associated (that is, every molecule takes part in associated complexes), while at the boiling point only 42 per cent of the molecules behave in this manner. It is interesting to compare the values of $\alpha$ with the fraction of the dipoles, $f$, which have free rotatory power as given by Bernal and Fowler[4]. The values of $(1 - f)$, the fraction of the dipoles having no free rotatory power, are given graphically.

At present work is in progress to apply these principles to other substances and to the mechanism of viscosity.

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May 28.

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## The Fitzgerald Contraction as the Origin of our Experience of Time and its Lapse Rate

Let it be assumed that the origin of the sensation of time and the flux of time lies in the Fitzgerald contraction of brain material. If the brain material is carried relatively to 'space' or 'ether' with constant speed, the sensation will be steady in amount, and so the flow of time will seem to be uniform. For all speeds of motion the contraction is a well-known function of the speed, and it is the most simple postulate that the sensation of the lapse-rate of time is altered correspondingly.

Sir James Jeans has advanced the postulate that the brain is responsive to the one-way increase of entropy. This is possible and perhaps plausible in virtue of the magnitude of the individual brain mechanism attached to a centre of brain response; but it must be remembered that entropy flux can only be presumed to be steady as an average. There is no such limitation in the case of the Fitzgerald contraction. Its action is one-way unavoidably.

Using Maxwell's equations in the form

$$\text{Curl } E + \dot{B} = 0\,;\ \text{div } B = 0\,;$$
$$\text{Curl } H - \dot{D} = 0\,;\ \text{div } D = 0\,;$$

which characterize Schrödinger's recent treatment[1], that treatment makes clear the possibility of employing Maxwell's electromagnetic theory in the wave mechanics of the present day.

By accepting only data susceptible of ideal or actual demonstration, a possible large and fruitful line of investigation is closed, and we are faced with the complicated picturization of reality as given in terms of relativity and quantum wave mechanics. The existence of ether has been denied and 'space' enthroned instead. As Sir J. J. Thomson, in forming an ideal working model of the proton in ether, asks: Why not call it ether instead of space and get rid of the difficulty? Schrödinger's suggestions repeat the demand with the additional simplification of the explicitly stated quality of Maxwellian.

In this connexion we have to regard afresh the striking announcement given to the International Congress of Physics at Paris in 1900 by Kelvin, at once of his renunciation of the longitudinal component of the electric displacement in wave motion through the ether; of his adoption instead of Maxwell's electromagnetic ether; and of his final adherence to Boscovich's theory of the action of forces, of electric attraction or repulsion as providing a basis for the connexion of matter with ether.

In this way, Kelvin brought to a triumphant conclusion in 1900 his work on wave-theory, matter, and ether, begun in his Baltimore Lectures in 1884, and continued intermittently throughout the intervening years. This was perhaps the greatest investigation made in theoretical physics since Newton wrote. It vindicated the claim that investigators in physics should not be trammelled by the modern arbitrary restriction. The picture of Nature they give may actually lie nearer its heart.

Now, with this claim made prominent, what, more fully, of the picture of Nature presented by Kelvin? Primarily, the Maxwellian ether, having negative compressibility and made stable by atomic support in a material medium built up of these atoms. If a physicist of Kelvin's rank was satisfied with that, it should surely give confidence.

Finally, let this ether be that part of the ether contemplated by Schrödinger[1], corresponding to Maxwell's electromagnetic equations. We need only consider the four dimensions of ether, three mutually perpendicular to each other in our own universe, and one normal to those in the fourth dimension. Regard the ether flux as entering the three-dimensional model, contemplated by Schrödinger, from the fourth dimension, and we can regard the working of the model as due to the energy carried into the model by the etherial current. There is no need to contemplate as existing in reality any higher order of ether dimensions than four. To consider space-time only complicates the picture of reality offered to us.

W. Peddie.

The Weisha, Ninewells,
Dundee. May 18.

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## Bread in Jersey during German Occupation

Through Mr. E. F. Mitchell, president-elect of the National Association of Master Bakers, Caterers and Confectioners, we received a sample of bread made in Jersey during the German occupation. The analytical data we obtained on this sample will probably be of interest to many.

The bread was naturally stale and dry, so that it is possible, in view of the moisture content (10·9 per cent), to compare the figures obtained directly with those of flour or meal. The bread had the disadvantage of being very dark and unappetizing, while it did not have the advantage of a high vitamin $B_1$ content usually associated with dark and long-extraction bread. Actually, the vitamin $B_1$ figure is no higher than that of the present fairly good coloured 80 per cent flour, which has about 0·80 I.U./gm. The riboflavin is also not especially high; but the nicotinic acid content is substantially higher than that of present-day flour in Great Britain.

It will be observed that the bread has a very high fibre content, due to the presence of some very coarse fibrous material. We have examined a portion of this material sieved out from the flour. It is not of the nature of bran and appears to be just coarse extraneous fibrous material. We are informed that 3–4 per cent of such material can be easily sieved out of the flour without removal of bran. It had a fibre content of more than 16 per cent and a vitamin $B_1$ content of only 1·0 I.U./gm. The presence of this material naturally reduces the digestibility of the bread.

| | Bread received from Jersey % | Present-day 80% flour % |
|---|---|---|
| Moisture | 10·88 | 13·50 |
| Protein (N × 5·7) | 8·27 | 11·40 |
| Ash | 2·71* | 0·75 |
| Oil (by hydrolysis) | 0·81 | 1·80 |
| Fibre | 2·37 | 0·20 |
| Carbohydrates and undetermined matters (by difference) | 74·96 | 72·35 |
| | 100·00 | 100·00 |

* This contains 1·69 per cent salt.

| | Bread received from Jersey | Present-day 80% flour |
|---|---|---|
| Vitamins— | | |
| $B_1$ | 0·77 I.U./gm. | 0·80 I.U./gm. |
| Riboflavin | 0·82 μgm./gm. | 0·60 μgm./gm. |
| Nicotinic acid | 36·0 μgm./gm. | 16·0 μgm./gm. |

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## Progressive Clines

THE geographical regularities of variation, including the well-known examples subsumed under Bergmann's and Sloger's rules, have been receiving much attention from recent writers on evolutionary subjects, under the general head of 'clines'. However, the type of cline involving increasing specialization in a given geographical direction, although first described more than forty years ago, seems to have been entirely neglected in these discussions.

In 1902, Leche[1] in discussing the hedgehogs (*Erinaceus* s.l.) pointed out that within three of the groups into which he divided them, the geographical representatives showed an increasing specialization as one proceeds from North India towards North Africa. (He was apparently mistaken as to the affinities of form, but the correction only makes the case still more convincing[2].)

As a result of careful studies of the horseshoe bats (*Rhinolophus*), Knud Andersen[3,4] arrived at similar conclusions. The Ethiopian forms are less primitive than their relatives farther east, notably in the following characters: (1) the reduction of certain premolars (a general tendency in bats); (2) specializations of wing-structure (here his conclusions were confirmed by Revilliod[5]); and (3) detailed structure of the nose-leaves. Disregarding the last point, the value of which as an indication of evolutionary level may be questioned, we can still say that wherever such differences are demonstrable, forms from Africa and the Western Palæarctic are more specialized than their nearest relatives in the Oriental region. In this genus, forms from the western and eastern areas are seldom conspecific, and there is often considerable geographical overlap. Evidently, barriers to inter-crossing are very easily developed even between closely related groups in *Rhinolophus*, thus accounting for the astonishing number of species in the genus.

The most important of a number of examples cited by Leche in a later paper[6] concerns the porcupines of the genus *Hystrix*. Thus the enlargement of the nasal region (which is already marked in *H. brachyura* from the Malayan region in comparison with more primitive genera) is much more extreme in the Mediterranean *H. cristata*, where the nasals cover more than half the dorsal surface of the skull, and (together with the frontals) are enlarged vertically by air sinuses. Indeed, the erection of a separate genus *Acanthion* for *H. cristata* would be quite justified were it not for the almost complete chain of intervening forms in India and Western Asia. There is no geographical overlapping between these, and it may be possible to consider all of them as forms of one polytypic species or super species.

For character-gredients of this sort, which unlike the usual ones clearly pertain to different evolutionary levels, I propose the term progressive clines, in accordance with the cline terminology introduced by Huxley[7].

Whereas Leche and Andersen both considered this phenomenon as migration in the direction of the more advanced forms (that is, from east to west), I have proposed an alternative explanation[8], namely, the far greater climatic changes during the Tertiary in the western part of the Old World, as opposed to the relatively stable conditions in the Far East. Further, owing to the Atlantic acting as an outlet to the drift ice during the Glacial Period[9], the land masses bordering on that ocean have also been subject to a maximum of climatic change during the Pleistocene. In regard to man, Hazayyin[10] has emphasized the importance of these changes in stimulating the evolution of Palæolithic cultures, which have an important centre of dispersal in the Saharan region. In other organisms the influence of changing conditions upon the rate of evolution is generally recognized, and has been confirmed by modern theory. Furthermore, division of a species into several more or less isolated populations is also favoured by severe conditions, and this tends to produce the same effect[11].

A cline such as that found in *Hystrix* might be termed an orthogenetic series, but that the occurrence of the most advanced forms in the region where external factors known to favour rapidity of evolution are most pronounced makes it unnecessary to assume the operation of orthogenesis in the sense of a hypothetical immanent force or agency.

A final decision as to whether these clines have anything to do with migration or not is possible only from very full palæontological data. The few cases where we have some information of this sort are not favourable to the migration theory.

The red deer of Europe is generally believed to be descended from the closely related Tibet stags, with more primitive antlers; Central Asia is therefore regarded as the original home of the group. Recently, Beninde[12] described a deer from the Lower Pleistocene of Mosbach, *Cervus acoronatus*, which is apparently directly ancestral to the recent European species, and almost identical with one of the Tibet stags, *C. macneilli*, the latter being slightly more advanced[13]. This seems to prove that the higher specialization of *C. elaphus* was not correlated with a westward migration from an eastern origin; it may just as well have had a western cradle, whence, as *C. acoronatus*, it spread eastwards. It is significant that the region adjacent to the eastern border of Tibet, where *C. macneilli* occurs, is an important refuge for primitive forms (for example, *Uropsilus*, the giant panda).

Secondly, the European badger (*Meles m. meles*) may be considered more advanced (in the excessive broadening of the upper molars) than the races of Asia Minor (*M. m. ponticus*[14]) and Persia (*M. m. canescens*[15]). But even as recently as the earliest Neolithic of Denmark, some eight thousand years ago, the badgers of this country were more primitive in this respect, approaching the Asiatic forms[16].

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## South African Onychophora

Attention has been directed in the Research Items in *Nature* of May 26 to a paper by Holliday[1], on the habits of South African Onychophora, *Opisthopatus cinctipes* and *Peripatopsis Moseleyi*, from Natal. Both this work and an earlier publication by the same author[2] have dispensed with the custom of reference to published literature.

A number of subjects are dealt with, but in nearly every case the facts described have long been known and in recent years much research has been directed to them in Britain. The note in *Nature* directs attention to Holliday's observations on the season of birth of *P. Moseleyi*, and to the number of young born per year; to the new-born young eating their first moult; and to the covering of food by saliva and the probability of at least partial liquefaction of the food before ingestion.

The months of birth and the number of young of *P. Moseleyi* was published by Purcell in 1900 for Natal[3], and data for other localities by Manton[4] in 1938. The fact that *Peripatus* usually eats its moulted integument has been established for many years (Steel, 1896[5], and others). A very much more detailed account of the feeding mechanism, use of saliva, the ingestion of both solid and liquid food, the nature and mode of action of the digestive enzymes of the salivary and intestinal juice, etc., has been published by Heatley[6], and Manton and Heatley[7]. Concerning the drinking by *Peripatus*, Holliday makes no reference to the much fuller treatment of the control of water-loss and the occurrence of drinking by Manton and Heatley[7], and Manton and Ramsay[8].

Work on the South African Onychophora has been going on in Britain for the past twelve years. Four species were brought to England alive in 1933 and two species lived in the Zoological Laboratory, Cambridge, for four years after removal from their native haunts.

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[1] Holliday, R. A., *Ann. Natal Mus.*, **10**, 433 (1944).
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[5] Steel, T., *Proc. Linn. Soc. N.S.W.*, **21**, 94 (1896).
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## Use of Stereographic Projection for Statistical Problems

Mr. Naylor's recent article[1] on an approximate method for estimating multiple correlation should direct attention to the many possible uses of projection methods in statistical work. The proof that he quotes from my lengthier and more accurate procedure referred primarily to the substitution of a stereographic projection in demonstrating Pearson's equations for correcting for selection[2]: the special problem of partial correlation was treated as an extreme case of selection. (There is incidentally an unnoticed error in Pearson's own diagrams; his placing of $D$ and $G$ relative to $E$ and $F$ violates the conditions of consistency which must obtain for correlations between three real variables.)

I should, however, point out that the formulæ that follow from my proof differ somewhat from those reached by Mr. Naylor. He assumes that it is only "*beyond the first combination*" (his italics) that "the partial regressions are not quite equal to the partial correlations". But even partial regressions of the first order cannot be identified with the corresponding partial correlations. Hence his equation for the proportionate weighting of $A$ and $B$ should read.

$$\frac{\text{Weighting for } A}{\text{Weighting for } B} = \frac{b_{CA.B}}{b_{CB.A}} = \frac{\cos B \sin CB}{\cos A \sin CA} = \frac{\sin PB}{\sin AB}$$

Thus, the weights should be proportional, not to the angles at the base (as he states), but to the segments into which the base $AB$ is divided.

From the equation in this form it is quite possible to build up *exact* expressions for multiple correlations of a higher order. As his note implies, I have found both globular and stereographic projections a useful aid for illustrating these formulæ; but for practical computation I am doubtful if either the exact or the approximate procedures are really superior to the more familiar devices in common use.

For laboratory work we have used printed stereographic nets (obtainable from T. Murby and Co., now Allen and Unwin, Ltd.) and a boxwood stereographic scale (from C. F. Casella and Co., Ltd.). But for correlational studies (for example, rotation of factors) it would be helpful if the nets and scales could be marked in terms of cosines rather than of angles.

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[1] *Nature*, **156**, 58 (1945).
[2] *Phil. Trans. Roy. Soc.*, A **200**, 25 (1902).

# RELATION OF THE GONADAL HORMONES TO CERTAIN DERMATOSES*

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In this article those dermatoses arising from female gonadal hormone disturbances are described. It goes without saying that other hormones may be involved in like cases, and that hormonal dysfunction can also be a factor in dermatoses in men. The description is limited to women because in them the origin of hormonal dermatoses is often demonstrated by accompanying genital dysfunction due to disturbance of hormonal balance or to hormone deficiency, which can be corrected by synthetic hormone therapy to give results which are striking enough to confirm the diagnosis.

Varied though they are, the dermatoses considered here represent only a few of the aspects of the bearing of the hormones on the skin, which, as Novak has said, "is directly and precisely influenced, as is no other tissue to the same extent, by modifications in the genital system".

*Eczema.* This is a dermatosis in which a gonadal hormone factor is often demonstrable. I have already related to the Société de Dermatologie[1] two observations which demonstrated, first, the importance of hormonal imbalance in certain eczemas, and secondly, the bearing of this factor in the treatment of these diseases which often resist the ordinary remedies but are cured by injections of the requisite hormone. Both cases were in young women who gave long histories (twelve years in one, six in the other) of chronic eczema of the backs of the hands and wrists. Although they both had shown phases of improvement alternating with aggravation, their skin lesions had never completely disappeared except during pregnancy. In both cases the eczema had cleared up at the beginning of pregnancy only to reappear again a short time after term. Both patients had normal menstrual cycles and gave histories of premenstrual aggravation and post-menstrual attenuation of the disease. Although these cases were clinically identical, one was cured with œstrone and the other with progesterone. Basically, however, the same mechanism was involved in both cases, namely, a disturbance of balance between the hormones of the follicle and corpus luteum, and restoration of balance produced a cure.

In other cases the cause is a hormonal deficiency rather than an imbalance, as in the case of eczema due to a natural or artificial (surgical) menopause which can be cured by injections of œstrone.

The male hormone can also be used as an anti-œstrogen in the treatment of eczema and other dermatoses. Lafitte and Huret[2], and Lortat-Jacob[3], have had good results from the use of testosterone in certain eczemas of women who presented signs of œstrogenic over-activity.

*Psoriasis.* The chronicity, resistance to treatment and frequent relapses of psoriasis are well known. The use of hormones has figured among the researches made to find an efficacious treatment.

As far back as 1923 Spilmann, Parisot and Simonin[4] published an observation showing the possibilities in this idea. Their case was a woman who had twice seen her psoriasis disappear completely during pregnancy. Spilmann and his collaborators collected blood from her during the second pregnancy, and when the psoriasis returned three months later, they were able to cure it by injections of the patient's serum which had been kept in a refrigerator. They had, in effect, applied indirect hormonal therapy, and Spilmann, in a later article, suggested that the active principle had been the luteal hormone.

There are some cases of psoriasis which appear at puberty, and others which follow the menopause. It seems reasonable, in such cases at least, to investigate the possibility of a hormonal deficiency or imbalance.

*Acne.* This is a dermatosis which is obviously related to sexual development. It is never seen before puberty and its connexion with genital dysfunction is well known.

In juvenile acne I have seen good results follow the use of gonadotropic hormones.

The same is not the case in the acne of middle-aged women or of the menopause, when a direct action of the gonadal hormones can be demonstrated. Then it is sometimes a question of an acne of the rosacea type with small papulo-pustules seeded among varicosities of the cheeks and nose (relapsing miliary acne of Brocq). Often these papulo-pustular lesions are localized on the chin where some become indurated and evolve slowly. This localization of acne on the chin in women was known to the dermatologists of old as indicating ovarian dysfunction. In other cases of this type acne with large indurated elements is associated with rosacea. These two forms are frequently seen in women approaching the menopause, or in castrates. Injections of anti-œstrogenic hormones seem to give the best results.

Jausion, who attaches much importance to the role of staphylococcus albus in acne, has shown that this organism grows well on media containing hormones, and states that it grows best in sebum the composition of which resembles that of the sexual sterones.

*Herpes simplex.* The recurrent type of herpes in women often appears at the time of menstruation. It is probable that hormonal imbalance favours the appearance of this disease which is directly caused by a filterable virus. In most sufferers from recurrent herpes related to menstruation the lesions are trivial, and patients are seldom found who feel it necessary to submit to hormonal treatment.

*Pruritus Vulvæ.* Rebellious to treatment, long-continued and sometimes so intense as to produce obsession or even suicide, vulval or ano-vulval pruritus occurs at different stages in the sexual history: during the active phase and also at the menopause.

Many German authors (Seitz, Kaufmann, Rust, etc.) have described good results from the use of œstrogenic hormones in the treatment of this condition at the menopause, and I can confirm this in a large number of cases. On the other hand, I have never had the success claimed by these authors by using ointments containing œstrone.

Unlike the other dermatoses already described,

* First published in *La Presse Médicale*, June 30, 1942. Translated by Dr. James Marshall.

in pruritus there is almost always a deficiency of œstrone and by replacement therapy cures are obtained which are the more striking in stubborn cases of long standing and accompanied by breakdown in general health.

*Lichenification.* There have been described cases of circumscribed lichenification (névrodermites) of hormonal origin. In the cases I have observed hormone therapy has produced at best only an improvement in the condition. I have, however, had one case of diffuse lichenification of the thighs in which progesterone caused a very marked improvement[5].

*Relapsing Erythema Multiforme.* This is a rare type of hormonal dermatosis corresponding to the 'dysmenorrhœic dermatitis' of the Germans, of which I have elsewhere recorded a case[6].

The dermatoses described above are those in which I have been able to define a relationship to the gonadal hormones. There exist others, no doubt, and Desaux[7] has collected a series of cutaneous reactions which he ascribes to hyperœstrinism.

What, then, are the requirements for postulating a hormonal basis in a case of this type ? Most important are a history and clinical findings of associated genital dysfunction. With many others I believe that estimation of urinary and blood hormone levels and biopsy of the endometrium are of doubtful value in diagnosis.

The best approach is from the clinical angle. One must discover by careful questioning symptoms of genital functional disturbance which the patient is unlikely to volunteer in connexion with the dermatosis which caused her to seek attention. Any relation between evolution of the lesions and the menstrual cycle must be discovered, for example, premenstrual or intermenstrual exacerbations, or regressions at these times ; disappearance of lesions during pregnancy. A detailed menstrual history is essential. One must search for evidence of the clinical syndrome of hyperœstrinism described by the gynæcologists and which, according to Séguy, is characterized by (*a*) intense and painful mammary congestion ; (*b*) intermenstrual pain localized in one or both ovaries, which may become palpably enlarged ; (*c*) a clear cervical secretion increased in amount and duration over the normal ; and (*d*) intermenstrual metrorrhagia. In these cases the periods are usually painful and copious, with clots of blood and mucus, and are spaced every 21 days or even less. In other cases, on the contrary, there is a marked diminution in the menstrual flow, going on at worst to the hyperhormonal amenorrhœa of Zondek.

Unfortunately it is impossible precisely to tabulate the dermatoses with corresponding hormonal deficiencies, excesses or imbalances. There remains, however, therapeutic test : a cure resulting from the injection of a given hormone is good evidence of relationship. Empiricism still has a large part to play in the field of hormonal dermatoses.

*Conduct of treatment.* It is impossible to lay down hard and fast rules, but certain general principles must be remembered : (1) More dermatoses are related to hyperœstrinism than to a deficiency (relative or absolute) of œstrone. (2) The anti-œstrogens (progesterone, testosterone) are more easily regulated than the œstrogens, the effects of which are sometimes paradoxical or unexpected. (3) While œstrone is a very active substance, progesterone and testosterone are feebly acting anti-œstrogens. In other words, one must use the latter substances in much larger doses than the former.

It is to be noted also that, in certain cases, a dermatosis which has once yielded to, let us say, progesterone can later become resistant to this hormone, but can be alleviated by œstrone. Such necessary therapeutic changes are explained by postulating an alteration in the state of hormonal imbalance. Similar states have been noted by Chiray and his collaborators in certain asthmas of hormonal origin.

Finally, if one wishes to attempt a rapid treatment, which will at the same time establish the diagnosis, one must administer the chosen synthetic hormone by injection, and leave aside oral treatment, in the early stages at least.

The following scheme can be used as a practical guide.

1. *Dermatosis with intermenstrual exacerbations.* (*a*) With evidence of hyperœstrinism : Use testosterone as an anti-œstrogen during the first ten days of the cycle, in doses of 10 mgm., every other day for four or five injections. (*b*) With no evidence of hyperœstrinism : Use moderate doses of œstrone, for example, 3–5 injections of 1 mgm. during the eighth to fifteenth days of the cycle. Beware of high dosage.

2. *Dermatosis with premenstrual exacerbations.* (*a*) Hyperœstrinism is usually the cause : prescribe 3–5 injections each of 10 mgm. of progesterone over the nineteenth to twenty-sixth days of the cycle. (*b*) Excess of the luteal hormone is sometimes present, and may be absolute, or relative, due to œstrone deficiency in the latter half of the cycle. It is in such cases that anti-œstrogens have a paradoxical effect and provoke a premenstrual mammary swelling. Œstrone should be used in relatively large doses, for example, 15 mgm. in three injections over the last eight days of the cycle.

3. *At the menopause.* (*a*) Natural menopause : Use œstrone, at first in small doses (1 mgm. per injection), and progressively raise the dose to reach finally a total of from 10 to 20 mgm. per month, depending on the symptoms and on the effect obtained. If œstrone is badly supported (in women with menopausal hyperœstrinism), change to testosterone giving three 10 mgm. injections per week, every other week. Some cases may be found to react better to the acetate of testosterone than to the propionate. The dosage is the same for both. (*b*) Artificial menopause (surgical or X-ray). In these cases vaso-motor symptoms (flushes, palpitations) and recrudescences of extra-genital disorders conform to a menstrual rhythm. Progesterone should be given by injection to a total dosage of 30 to 40 mgm. per month, during the fortnight preceding the appearance of each menstrual syndrome.

In the last two cases (3(*a*) and (*b*) ), treatment must be long continued as it is a true replacement therapy.


1 Garnier, *Bull. Soc. franç. de derm. et syph.*, 319 (March 1939).
2 Lafitte and Huret, *La presse méd.* (March 29, 1939).
3 Lortat-Jacob, *Paris-méd.* (Jan. 6, 1940).
4 Spilmann, Parisot and Simonin, Réunion derm. de Nancy (May 12, 1923).
5 Garnier, *Bull. Soc. franç. de derm. et syph.*, 128 (Feb. 1941).
6 Garnier, *Bull. Soc. franç. de derm. et syph.* (Feb. 1940).
7 Desaux, *Arch. Hosp.*, No. 5 (1939).

# PRACTICE OF MEDICINE IN THE UNITED STATES

IN January, 1943, the Council of the New York Academy of Medicine appointed a Committee on Medicine and the Changing Order, which was charged with the study of the economic and social changes which are now taking place or are likely to occur in the future, with the question of how these changes may affect medicine and how the best possible medical care may be made available to the largest number of people at the lowest possible cost. This Committee, composed of representatives of the physicians, dentists and nurses and of laymen belonging to industry and various professions, has issued an interim report (2 East 103rd St., New York, 1945). A final report is expected early in 1946.

During its twenty-two months of activity, the Committee held weekly conferences at which it was addressed by experts. The list of speakers shows that a wide field was covered, for economists, historians, publicists, bankers, industrialists and representatives of labour were among those invited. Other weekly conferences studied medical education, hospital problems, rural and industrial medicine, public health and problems of dentistry and nursing. Monographs on major current socio-medical problems were planned to treat contemporary medicine in all its aspects, and some of these are well on the way towards completion; some short treatises have already been published.

Defining its approach to its problems, the Committee states that medicine carries definite moral and social responsibilities. Modern medical problems have been accentuated by recent economic and social dislocations and have been long in the making. Complicated and costly as its administrative structure now is, medicine has its own history and has continuously tried to improve its science and practice. It has largely depended upon benevolence and charity; this dependence has benefited it, but has created many of its present difficulties. Medicine obviously cannot, without great harm, allow its progress to be governed by profit and loss, and it cannot compromise with quality. There is a widespread demand for good medical care which costs as little as possible, so that medicine cannot continue to work as it has done. If the quality of medicine is to be maintained, medical education and research are basic problems, and laymen must understand what medical education involves. The present curriculum needs revision. Its duration is ever increasing, so that from seven to nine years are spent in training and often several more years in specialized study, so that the medical man begins practice at an advanced age with a large capital investment and a relatively short time in which to recover it. These problems are more important than they appear, and efforts must be made to enable the medical practitioner to become productive earlier without adversely affecting his training. The rapidity of scientific development imposes an increased need for postgraduate education and refresher courses, and this need will increase in the future.

The quality of medical practice is also largely dependent upon public understanding and demand, so that people cannot obtain the full advantages of modern medicine without the intelligent and informed co-operation of the public. Hospitals present major problems. They not only treat the sick, but have also essential educational functions, and any changes made in hospital organization involve numerous factors. The medical man, moreover, nowadays does more than treat the sick; he may look after those who are well, or serve schools, industry, insurance companies, public health and so on; all these activities need planning according to possible future developments. Preventive medicine must also be carefully planned. The economic problems of medicine are complex, but real economy in medical care comes from the quality and competence of the treatment rather than from expenditure upon illness. It is therefore likely that better treatment, even though it costs more, will be the cheaper in the long run. Fewer illnesses rather than lower fees may prove to be the solution.

Current efforts to cure human ills by massive doses of social legislation are full of great dangers, the greatest being the fact that laudable ends will be betrayed by incompetent means used to gain them. Social legislation has, in itself, no power; it must have practical ends and means. Based upon wishful thinking, it can be harmful. We need precise definition of the factors involved and workable proposals which will effect progress. Experiments in various forms of medical care must obviously be undertaken before legislation is attempted.

With all these principles and attitudes of mind, somewhat nebulous though they are, many British medical men will agree. Most of them are, indeed, reflected in recent British plans for the reform of medical education which have been noticed in these columns (see, for example, the report of the Goodenough Committee on Medical Schools and the report of the Committee of the Royal College of Physicians of London, *Nature*, **154**, 315 and 322; 1944). Everywhere in the world the problems confronting this Committee in the United States are demanding attention. It is good to know that most of those who are dealing with them are agreed that, in the future, medical care must be the best that is possible, and at the lowest cost; and that, above all, the freedom of the medical man to act and of the patient to consult whom he likes must be preserved.

# OCEANOGRAPHICAL RESULTS OF THE LAST VOYAGE OF THE U.S. NON-MAGNETIC SHIP *CARNEGIE*

THE Carnegie Institution of Washington is issuing a series of reports on the scientific results of the last voyage of the *Carnegie*, and has recently published the first two of the series to deal with physical and chemical oceanography[1]. The voyage was started in May 1928, and was brought to a tragic end after 18 months, when the vessel was destroyed by fire. A general account of the voyage was published by the ship's surgeon in 1932[2]. One cruise was made in the North Atlantic Ocean, and extensive voyages in the Pacific Ocean, crossing most areas north of 40° S. in the east, and 10° N. in the west.

The publication of both reports has been long delayed. Dr. Sverdrup's chapters on the North Atlantic and Pacific Oceans were written in 1931, and although some revision has been possible, it is not sufficient to take all subsequent work into consideration. The other chapters appear to date from about 1935. While regretting this delay, oceanographers will acknowledge the readiness with which the data have been made available in manuscript form at any time since 1931.

A large section of the physical report deals with the accuracy of the methods of observation. A deep-sea thermometer is suspended fairly rigidly in a stout sealed glass tube which protects it from the effect of pressure. The reading is obtained by arranging to break the mercury thread by making the thermometer turn over in a frame at the required depth. Minor corrections have to be applied, but an analysis of the *Carnegie* measurements indicates that the error in the final reading of a single thermometer was usually considerably less than $\pm 0 \cdot 045°$. By using a pair of thermometers at each depth, the accuracy was increased.

The depth of the observation cannot be assumed to be the same as the length of wire used in lowering the instruments, because surface drift, and possibly undercurrents, make the wire take an appreciable angle from the vertical. The discrepancy is measured by the comparison of readings of two thermometers, one protected against pressure, and the other unprotected and calibrated to show the effect of pressure. A comparison of such measurements with the wire-lengths when the wire was more or less vertical indicated that the thermometer depth measurement was usually reliable to within 1 per cent at 1,000 metres and 0·5 per cent at 5,000 metres. Tables and graphs are given for correcting thermometer readings ; but it is believed that they will not be found so generally useful as those by Geissler (1931)[3] and Schumacher (1935)[4], not mentioned in the report.

The *Carnegie* wire soundings were also checked by thermometric depth measurements. Whenever possible the ratio of thermometric depth to length of wire paid out was plotted against the measured angle of the wire at the surface, and the points fall fairly closely about a curve. The depth factor taken from this curve is 0·99 for an angle of 10°, and 0·90 for an angle of 60°. The factors would not necessarily be the same for a different vessel, or one differently manœuvred. The weak point of the *Carnegie* echo-sounder was its timing device, and it has been found necessary to correct the soundings by factors based on the comparison of wire soundings and echo-soundings when they were made close together. When the Fessenden oscillator failed, they used an improvised shot-gun, fired a foot or two below the surface, and made allowance for the greater initial velocity of sound from such an explosive source. It is worth noting that the ultimate standard for the depth measurements was the calibration of the unprotected thermometers, shown to be fairly reliable by the measurements on wires that were nearly vertical.

The analyses of the salinity of sea water were made by measuring the electrical conductivity of samples at carefully controlled temperature. It was a substitution method using water of known salinity. The errors in the determinations proved to be greater than those expected from the titration with silver nitrate, and the electrical method is not likely to replace titration in general use. Minor deviations from the controlled temperature are probably the chief source of error, and they are difficult to avoid.

The second part of the report deals with the information which has been gained from the measurements. One of the most interesting features is a wealth of new information about the deep-water layers in the Pacific Ocean. The measurements confirm that no highly saline water sinks from the surface into the deep layer, and the highest salinities in the deep water are found near the bottom where water of Atlantic and Indian Ocean origin creeps slowly northwards from the Southern Ocean. Compared with the deep-water circulation in the Atlantic Ocean, the Pacific deep-water movements are very sluggish.

The measurements of oxygen, phosphate, silicate and *p*H, described in the report on chemical results, are in close agreement with the conclusions based on temperature and salinity. The concentrations of phosphate and silicate in the deep water are unusually high, and the oxygen contents and *p*H values unusually low, all indicating that the deep water is long removed from the photosynthetic activity of the surface layer, and that there has been time for an abnormal increase in the products of oxidation and decomposition of organic material.

G. E. R. Deacon.

[1] Scientific Results of Cruise VII of the *Carnegie* during 1928–1929 under Command of Captain J. P. Ault. Oceanography IA : Observations and Results in Physical Oceanography. By H. U. Sverdrup, F. M. Soule, J. A. Fleming and C. C. Ennis. Pp. vii + 156. 1.75 dollars. Chemistry 1 : Chemical Results of the last Cruise of the *Carnegie*. By Herbert W. Graham and Erik G. Moberg. Pp. vii + 56. 1 dollar. (Carnegie Institution of Washington Publications 545 and 562.) (Washington, D.C. : Carnegie Institution, 1944.)

[2] "The Last Cruise of the *Carnegie*". By J. Harland Paul. (Baltimore, Md. : Williams and Wilkins Co., 1932.)

[3] "Tiefenmessung mit ungeschützten Thermometern", by H. Geissler. *Ann. Hydrog. u. Mar. Meteorol.*, **69**, xii, 433–438, Plate 45 (1931).

[4] "Kippthermometertafeln neuberechnet auf Grund der Formeln, von W. Hansen". By A. Schumacher. *Ann. Hydrog. u. Mar. Meteorol.*, **63**, vi, 237–239, Plates 33–36 (1935).

## THATCH GRASS

*IMPERATA cylindrica* (L.) Beauv., which is a widespread grass of the tropics and sub-tropics, thrives on abandoned or poorly cultivated land. Although it may provide fodder suitable for very primitive types of agriculture, it is undoubtedly a troublesome weed which as the result of present upheavals is likely to become even more of a problem than in the past. For this reason a recent publication solely concerned with this species is particularly appropriate*. The booklet, in which five authors collaborate to cull the available literature, is of considerable interest not merely to the agriculturist but also to everyone at all interested in the grasses.

At the beginning is a chapter by C. E. Hubbard on the taxonomy of the species and its five varieties. His lucid explanation of the synonymy and the position with regard to varieties make delightfully smooth reading of an aspect which must have been difficult both to straighten out and to express so clearly. He admits five varieties, of which *major* (Nees) C.E.H. is the most widespread, being found in South-east Africa and Ceylon as well as throughout India, Malaya, Indo-China, the western Pacific Islands and Australia. The variety *africana* (Anderss) C.E.H. occupies a region in Africa south of the tropic of Cancer ; var. *europæa* (Anderss) Asch. & Graeb. is confined to an area round the Mediterranean and eastwards across a strip south of the Caspian to Afghanistan ; var. *latifolia* (Hook. f.) C.E.H. occurs

* *Imperata cylindrica* : Taxonomy, Distribution, Economic Significance and Control. Imperial Agric. Bur. Joint Pub. No. 7. Pp. 63. (Imp. Forestry Bureau, Oxford, and Imp. Bureau of Pastures, Aberystwyth.) 2*s*. 6*d*.

only in North India, and var. *condensata* (Steud.) Hack. ex Stuckert is a native of Chile.

*Imperata cylindrica* ($S=20$) belongs to the tribe *Andropogoneæ*, and Janaki-Ammal has succeeded in obtaining fertile hybrids with *Saccharum*, using, for the ovule parent, plants of the clone P.O.J. 2725 ($S=106$), which itself is derived from the cross *S. officinarum* ($S=80$) × *S. spontaneum* ($S=112$) backcrossed twice with *S. officinarum*.

Unfortunately, the section on the anatomy of *Imperata* falls short of the level of the rest of the work. As it is difficult to convey much information by description alone, there would have been a considerable gain if only a single plate of figures redrawn or copied from the literature could have been substituted for part of the text. Mere descriptions are very inadequate, especially when in a compilation of this sort there seems a tendency to quote authorities just because they have made a statement, regardless of how absurd it may be. For example, what use is there in quoting Duval-Jouve (1875) as saying that round the bundle "There is an inner ring of cells without chloroplasts, the colouring matter being diffused throughout the cell", suggesting that the chlorophyll is either dissolved in the vacuoles or diffused through the cytoplasm? Again, merely saying that in var. *major* "Each vascular bundle of the first order is surrounded with a two-layered bundle sheath, the inner sclerotic, the outer thin walled" might suggest to the uninitiated that *Imperata* should belong to the Pooideæ: a few simple drawings, possibly from Vickery, would have been much more useful than any description.

Although *Imperata* is able to withstand great variation in temperature and will grow up to 2,000 m., and only extreme aridity will prevent it from growing in areas otherwise suitable, it is essentially a tropical or sub-tropical plant. It is light-loving and rapidly colonizes cleared ground or abandoned plantations, spreading profusely by 'seeds' and rhizomes which grow out vigorously from the short basal internodes of the aerial shoots. Its ability to regenerate quickly after firing is one of the factors which make it a menace where primitive shifting cultivation is practised.

Although there are reports of *Imperata* being useful as a nurse crop, it is probably never the best plant for the purpose and is often very harmful later. Again, even if cut continually to encourage a more palatable growth, the general opinion is that it is not a good fodder plant and could probably always be replaced by a better species. (In the chapter on grazing value, an improvement would have been made by stating in Tables 3–5 which are as percentages of dry weight and which as wet weight, and perhaps also, to have included dry-weight percentages in Table 4 for easy comparison with the others.)

After reading the chapters recording the black marks against the species, it is somewhat of a relief to learn that it is apparently the thatch plant *par excellence* and is often cultivated carefully for this purpose, alone. No doubt this will lead to a struggle between the various interests in the future.

Its suitability for paper-making is negligible owing to (1) the difficulty of obtaining a product of good colour without excessive bleaching treatment, (2) the short fibre-length, and (3) the impossibility of obtaining sufficiently large and constant supplies of a uniform quality within the economic radius of a mill.

With regard to control, mechanical methods such as ploughing and hoeing are effective especially if persistently employed; but perhaps the line which may be most usefully followed is the exploitation of the plant's intolerance of shade, either by encouraging re-afforestation or by sowing smother crops.

Except for the bibliography, a five-page list of common names in various languages and dialects completes this pleasing little work. If this could be the first of a number of booklets of this type, the others would certainly be at least as welcome, especially at the low price of half-a-crown.

B. C. SHARMAN.

# THE IMPERIAL CANCER RESEARCH FUND

THE forty-second annual report of the Imperial Cancer Research Fund* includes an account of progress made in scientific work in the laboratories at Mill Hill.

Mr. H. G. Crabtree has continued his investigations on the effect of substances which retard the carcinogenic action of 3:4-benzpyrene and 1:2:5:6-dibenzanthracene painted on the skin of mice. Bromobenzene and unsaturated dibasic acids, which readily combine with sulphydryl groups, are able to neutralize carcinogenic action. On the other hand, aldehydes, which form unstable derivatives with sulphydryl compounds, have only a slight inhibitory action on carcinogenesis. Another aspect of carcinogenesis, namely, the stimulating effect of wound healing, has been studied by Dr. D. B. Pullinger. She finds that multiple injuries followed by healing may double the incidence of tumours caused by painting with carcinogens. The effect is greatest when the more potent agents are used; with weak or intermediate carcinogens the effect is negligible. The more active carcinogens are presumably able to overcome resistance to the neoplastic change.

The relation of mammary cancer and the milk factor or mammary tumour inciter, present in the tissue of mice belonging to strains susceptible to mammary cancer, has been further investigated by Dr. L. Dmochowski. The factor, derived from any high-cancer strain mice, can induce breast cancer in susceptible strains although their genetic constitution differs from that of the strain from which the milk factor was obtained. Breeding females of low-cancer strain mice do not themselves develop breast cancer even after injection of large doses of the mammary tumour inciter. A proportion, however, of their offspring, both females and œstrone-painted males, develop mammary cancer. The effect of the milk factor was originally shown by foster-nursing young mice immediately after birth. Now, however, tumours have been induced by injecting relatively large doses of material into four-month old mice with well-developed mammary glands. The mammary tumour inciter has no direct influence on the incidence of lung cancer. The sarcomatous transformation of the stroma of cancers is probably independent of the milk factor as it takes place in lung tumours free of mammary tumour inciter. Dr. R. J. Ludford and Miss H. Barlow find that tissue of a lung tumour from a mouse without milk factor is just as active in causing fibroblastic growth in tissue culture as was tissue from similar tumours from mice containing the milk factor.

* Imperial Cancer Research Fund. Forty-second Annual Report 1944–1945. Pp. 32. (London: Royal College of Surgeons.)

# FORTHCOMING EVENTS

### Saturday, September 15

CONFERENCE ON "FRIEDEL-CRAFTS CATALYSTS AND POLYMERISATION" (in the large Chemistry Theatre, The University, Manchester), at 10.30 a.m. and 2 p.m.

### Saturday, September 15—Sunday, September 16

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Portland Hall, Little Titchfield Street, London, W.C.1).—1945 ASLIB Conference.

**Saturday, September 15**

At 11.45 a.m.—Prof. J. D. Bernal, F.R.S.: "Information Service as an Essential Factor in the Progress of Science"; at 2.30 p.m.—Symposium on "Links with the U.S.A.".

**Sunday, September 16**

At 3.30 p.m.—Discussion on "The Great Book Shortage—its Effect on Education, Research, Empire Intercommunication and the Re-establishment of Cultural Relations in Europe".

### Wednesday, September 19

PHYSICAL SOCIETY, COLOUR GROUP (in the Small Physics Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W.7), at 3.30 p.m.—Dr. Dora R. Ilse: "Methods for Investigating Colour Discrimination in Insects" (with colour films and demonstrations).

### Friday, September 21

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (in the Lecture Theatre of the New Chemistry Building, The University, Leeds), at 2 p.m.—Prof. A. C. Chibnall, F.R.S.: "The Contribution of the Analytical Chemist to the Problem of Protein Structure" (Second Procter Memorial Lecture).

# APPOINTMENTS VACANT

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

BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Town Hall, Barry, Glam. (September 21).

PHYSICISTS by firm of Domestic Refrigerator Manufacturers in South Midlands to train for position of responsibility in laboratory testing and research work—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting A.808.XA (September 22).

CIVIL ENGINEERING ASSISTANT—The Engineer and General Manager, Tees Valley Water Board, Corporation Road, Middlesbrough, endorsed 'Additional Civil Engineering Assistant' (September 24).

TWO SUPERVISORS (Production Engineer) for Telegraph Workshops at Calcutta, Jubbulpore and Bombay for manufacture of stores connected with Telecommunication Development—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2484.A (September 28).

LECTURER IN AGRICULTURAL CHEMISTRY—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh 8 (September 29).

LECTURER IN COLOUR CHEMISTRY—The Secretary, Royal Technical College, Glasgow (September 29).

PRINCIPAL OF THE CARDIFF TECHNICAL COLLEGE—The Director of Education, City Hall, Cardiff (September 29).

TECHNICAL AND INDUSTRIAL ASSISTANT in the Industrial Department of the Liverpool Gas Company—The Personnel Superintendent, Radiant House, Bold Street, Liverpool 1 (September 30).

COUNTY ANALYST—The Clerk of the County Council, County Offices, Preston, Lancs. (October 1).

ELECTRICAL ENGINEER—The Town Clerk, Municipal Buildings, Weymouth, endorsed 'Electrical Engineer' (October 1).

PROFESSOR OF BACTERIOLOGY in the Department of Pathology (Ref. No. F.4802.A), and a LECTURER IN MECHANICAL ENGINEERING (Ref. No. C.2794.A), in the University of Cape Town—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (October 15).

BOROUGH ENGINEER AND SURVEYOR—The Town Clerk, Town Hall, Watford, Herts, endorsed 'Borough Engineer' (October 15).

GEORGE HOLT CHAIR OF PATHOLOGY—The Registrar, The University, Liverpool (October 31).

HEAD OF THE ENGINEERING DEPARTMENT of Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth.

GRADUATE PHYSICAL CHEMISTS with experience in the Printing Ink or Paint Industry to assist in the investigation of problems connected with the drying of printing inks from the physico-chemical aspect, and an ASSISTANT with experience in scientific and technical abstracting—The Director of Research, Printing and Allied Trades Research Association, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

ADMINISTRATIVE OFFICER—The Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.1.

TEACHER OF BUILDING SUBJECTS (MATHEMATICS, GEOMETRY, etc.), and a TEACHER OF CHEMISTRY (with subsidiary BIOLOGY or alternative subject), at the Cambridgeshire Technical College and School of Art—The Chief Education Officer, Shire Hall, Cambridge.

PRINCIPAL OF THE LOWESTOFT TECHNICAL INSTITUTE—The Chief Education Officer, County Education Department, County Hall Ipswich.

LECTURER IN ENGINEERING SUBJECTS (MECHANICAL) to Higher National Certificate standard—The Principal, Erith Technical College, Belvedere, Kent.

# REPORTS and other PUBLICATIONS

*(not included in the monthly Books Supplement)*

### Great Britain and Ireland

A National Basic Outline of Religious Instruction. Prepared by a Committee of Representatives of the Joint Conference of Anglicans and Free Churchmen, the Association of Education Committees, and the National Union of Teachers. Pp. 24. (London: National Union of Teachers, 1945.) 2*d*. [98

Burton-on-Trent Natural History and Archaeological Society. Local Records for 1944. Edited by H. J. Wain. Pp. 16. (Burton-on-Trent: The Museum, 1945.) 1*s*. [98

Medical Research Council: Industrial Health Research Board. Report No. 88: A Study of Women on War Work in Four Factories. By Dr. S. Wyatt, assisted by R. Marriott, W. M. Dawson, Norah M. Davis, D. E. R. Hughes and F. G. L. Stock. Pp. 44. 9*d*. net. Conditions for Industrial Health and Efficiency. Pamphlet 3: Why is She Away? the Problem of Sickness among Women in Industry. Pp. 22. 4*d*. net. (London: H.M. Stationery Office, 1945.) [98

Tory Reform Committee. The Charter of the United Nations and the Covenant of the League of Nations. A Comparison by Prof. H. A. Smith. Pp. ii+7. (London: Tory Reform Committee, 1945.) [228

Ministry of Fuel and Power: Committee on the Efficient Use of Fuel. Fuel Efficiency Bulletin No. 41: How to Look After a Boiler Plant. Pp. 10. (London: Ministry of Fuel and Power, 1945.) [228

British Rubber Producers' Research Association. Publication No. 57: The Structure of Polyisoprenes, Part 4, Double Bond Interaction in Certain Carbalkoxy-substituted 1:5-Dienes. By L. Bateman and G. A. Jeffrey. Pp. 6. Publication No. 58: The Structure of Polyisoprenes, Part 5, Ultra-Violet Absorption Spectra of certain Carbalkoxy-substituted 1:5-Dienes, and the Charge-Resonance Spectra of Glutaconic Ester Enolate Ions. By L. Bateman and H. P. Koch. Pp. 8. Publication No. 59: The Behaviour of Keten towards Olefins and Olefinic Peroxides, by Ralph F. Naylor; Reactivity of Isoprenic and Analogous Hydrocarbons towards Thiocyanic Acid and Dithiocyanogen, by Ralph F. Naylor. Pp. 4. Publication No. 60: The Interaction between Rubber and Liquids, Part 7, The Heats and Entropies of Dilution of Natural Rubber by various Liquids. By Miss J. Ferry, Geoffrey Lee and L. R. G. Thomas. Pp. 12. (London: British Rubber Producers' Research Association, 1945.) [228

### Other Countries

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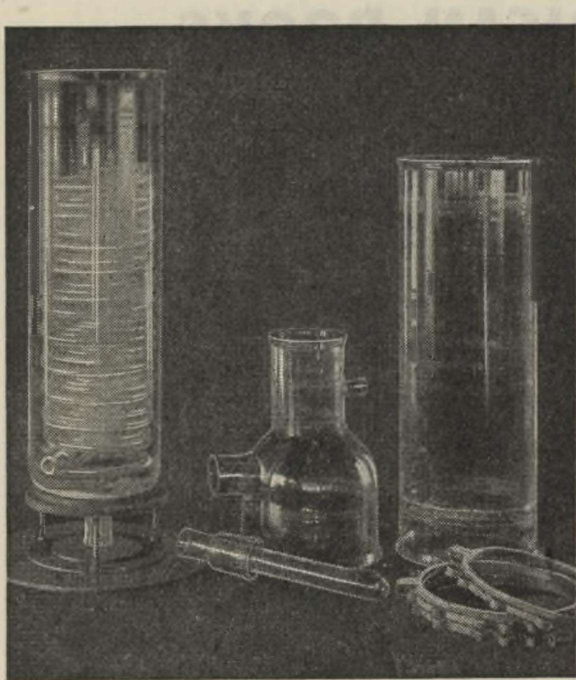

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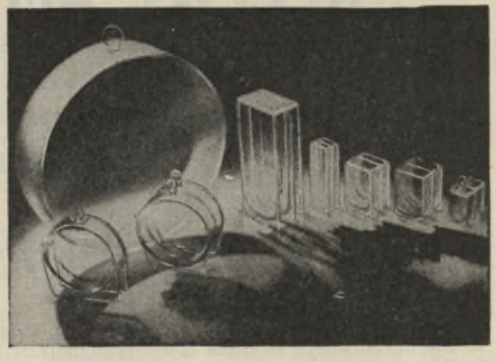

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