NATURE

No. 3788 SATURDAY, JUNE 6, 1942 Vol. 149

CONTENTS

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London

Advertisements should be addressed to
T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey
Telephone: Merstham 316

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad
All rights reserved. Registered as a Newspaper at the General Post Office

LEADERSHIP FOR THE NEW ORDER

AT a time like the present, when the war effort is rising steadily towards its maximum and fighting has intensified, there is apt to be impatience when the call for consideration of reconstruction and the future of the world is raised. Thus at the Labour conference held during Whitsuntide, criticism was directed against Labour Ministers for failing to secure more vigorous prosecution of the War, whereas long-range policy was given a subsidiary place. Nevertheless, even in the stress and turmoil of a world struggle, the foundations on which a better world shall be erected must be established; even although it is neither possible, nor perhaps desirable, to particularize, there should be some clearer conception of the future state of society in the minds of leaders of thought than is apparent among the general public. It is the task of those who have thought about what is to follow the end of the War to prepare the minds of others. Two notable recent speeches by Mr. Anthony Eden, Secretary of State for Foreign Affairs in Great Britain, and Mr. Henry A. Wallace, Vice-President of the United States, respectively, have given valuable leads.

Mr. Eden was speaking at Edinburgh on May 8, and devoted a portion of his address to the post-war world. He emphasized that, speaking as Foreign Secretary, he had in mind particularly the problem of keeping the peace. Without peace there is nothing for the future but ever-increasing social stress; and peace does not mean merely the absence of war. Peace in the true sense means stability in international relationships and active co-operation between all peoples; it is an affair for long years of effort, determination and good will. A peace treaty, however skilfully and thoroughly discussed, is but the skeleton, which can only be clothed with flesh and blood by human will and perseverance. The War has demanded intense effort and sacrifice, and we must not grudge similar sacrifices for peace. Every country has a direct responsibility for maintaining the peace. The increase in speed of communication characteristic of the pre-war period has been intensified by war conditions, so that in effect the world is shrinking, and the good neighbour policy is becoming more and more important for the future of mankind.

But just as social advancement is conditioned by peace, so is peace dependent on improvement in social conditions. Unemployment, malnutrition and low standards of life, in any country whatever, are each capable of endangering world peace. The British Commonwealth of Nations, the United States of America, the U.S.S.R. and China must therefore assume responsibility for the economic reconstruction of the world. This may mean economic sacrifices on the part of individual nations, but they will be well worth while if they can avert another world catastrophe. On a smaller scale, similar problems in connexion with the Colonial Empire will confront Great Britain; again the answer will be sacrifice, for the greater good of the many.

Mr. Eden's speech followed closely on the heels of addresses by Sir Stafford Cripps and Mr. Oliver Lyttelton, who also stressed the needs of the post-war world. Taken together, they are an encouraging sign that members of the Government in Great Britain not only appreciate some of the difficulties which lie ahead, but also the need for bold leadership in attacking them.

Mr. Henry Wallace was speaking on May 21 to the Free World Association, and, as the 'second man' in the United States, his words obviously were intended to convey the views of the United States Government. His speech emphasized in the first place four duties—again the stress was on giving rather than receiving. Referring back to the now well-known "four freedoms" enunciated by President Roosevelt in January 1941, he said they constituted nothing less than a people's revolution, towards the accomplishment of which the present time demands four duties : to produce to the limit, to transport as rapidly as possible to the field of battle, to fight "with all that is in us", and to build a just, charitable and enduring peace. This last inspires the other three duties. Modern science, he said, is "a by-product and an essential part of the people's revolution", and by its aid it is possible to ensure that everyone has enough food. Sufficiency of food is the first requirement in raising the standard of living, which is itself an essential part of the peace which must follow this War and must embrace not only the United Nations but also the Axis Powers. Scientific developments and their applications are thus, on Mr. Wallace's showing, an integral part in the advancement of society. "Modern science, when devoted wholeheartedly to the general welfare, has in it potentialities of which we do not yet dream."

As regards the part that America will play in the future ordering of world affairs, Mr. Wallace was very emphatic that it will continue the active collaboration of which the War has seen the beginning. It may even have the privilege, he said, of suggesting the freedoms and duties of the "common man". The motive will again be service, the older nations helping to start the younger nations along the path of industrialization. Productivity must be increased, so that the "common man" and his children may repay the world community all they have received.

World peace will have no place for a dominant or master race, based on Nazi or any other ideology, and with that myth must go the old conception of international cartels. Such cartels must be controlled internationally in the interests of the common man, as well as by their home Governments. Invention will thus be made to serve the many instead of the few.

These words of Mr. Wallace will be heartening to those who are striving to look beyond the immediate future. But they also demonstrate the need for fearless leadership in combating the wave of conservatism which is almost certain to come with the release of strain following upon the cessation of hostilities. Leadership, working upon a foundation of education towards the new ideals of world co-operation, can alone avert a dangerous setback.

The necessity of preparation for the changes in the ordering of society which must follow after the War was the basis of the proceedings of the second day of the annual conference of the Labour Party. The Party has a Central Committee on Post-War Reconstruction, on behalf of which a resolution was submitted affirming that "there must be no return after the war to an unplanned competitive society", and setting forth the broad principles of socialization which, in the Committee's opinion, are necessary to avert the danger. Measures of Government control have been found necessary for mobilizing the national resources in war and, it was affirmed, they are no less necessary for securing their best use in peace. While the amount, and method of exerting, such Government control, are highly controversial political questions which cannot appropriately be discussed here, the fact that the Labour Party has set up a committee to study such questions is encouraging, in that it will help to turn the minds of many, who might not otherwise give much consideration to the matter, to the urgent problems of a new world order.

While economic and political aspects of reconstruction plans were naturally prominent topics at the Labour Party Conference, the problem of the best utilization of the land and immediate post-war relief for Europe were also discussed. Sir John Orr has demonstrated the significance for the future of adequate food, proper housing and employment (see NATURE, April 11, p. 401). His own work, and that of other students of nutrition, has shown that a substantial proportion of the population of the world are living below or at the poverty line, and he has outlined a broad scheme for the improvement of conditions. The fundamentals of all such plans are based on scientific progress. Science has provided the knowledge required to improve beyond measure the well-being of humanity ; but that is not enough. Scientific workers cannot stand aside when they see the fruits of their studies put to wrong uses. Herein lies a great opportunity for education and leadership. Deference is paid by word of mouth and in writing to the importance of science and scientific method in plans for the future, but there must be deeper appreciation among the rulers of the nations of all that is involved. The word 'reconstruction' must not become a shibboleth ; indeed in some ways it is a misnomer, for many of the things which are passing away are outworn or have otherwise served their day. The old world order has failed to provide man with the conditions under which he can live a full life ; a new order is imperative to serve the progress of civilization.

It is therefore all to the good that men everywhere should be discussing the framework of world affairs which they will wish to build. The most that can be done—and it is of vital importance that it should be done—is that the opportunities which will be afforded by the fluid state of international affairs should be widely discussed now. Thus the sacrifice inevitable in raising the standard of life throughout the world will be understood and accepted as part of the duty due from every citizen dwelling under the banner of the 'four freedoms'.

RESEARCH ON ELECTRICAL SURGES

Surge Phenomena
Seven Years' Research for the Central Electricity Board (1933–1940). (Reference S/T 35.) Pp. viii+426. (London: British Electrical and Allied Industries' Research Association, 1941.) 50*s*. net.

UNTIL the advent of the Grid erected by the Central Electricity Board during the years 1928–33, there were very few high-voltage distribution lines in Great Britain. Most of the electricity used was generated in the immediate neighbourhood and distributed by cable networks so that electrical disturbances of atmospheric origin could not affect the supply system. This situation was changed in two directions when the 132-kv. network of transmission lines was erected; in the first place, the network itself was subjected to the effects of lightning discharges which could cause damage to insulators, switchgear and transformers, and secondly, surges on the high-voltage lines were transformed at generating and distributing stations and were passed on to the lower voltage distributing systems, which hitherto had been immune from externally produced surges. Thus the Central Electricity Board and the local electricity supply authorities became more painfully aware of the effects of surge phenomena and supplied a considerable impetus to the activities of the British Electrical and Allied Industries' Research Association in its general study of surges.

The large manufacturing concerns had encountered this aggravation of Nature in overseas markets, where long-distance high-voltage transmission had been established for many years, and they had taken effective steps to minimize breakdowns due to lightning, so that much of the electrical apparatus supplied to the Grid benefits from this earlier experience. But in spite of this, there were many gaps in our knowledge of the origin, propagation and effects of surge voltages, and it was to fill these gaps that the Electrical Research Association planned an extensive programme, for which it secured extra financial support from the Central Electricity Board. The E.R.A. reports issued from time to time have been available to members of the Association and some have appeared in the *Journal of the Institution of Electrical Engineers*; but this book under notice is the first public appearance of some of the researches, and it will serve as an invaluable reference book for countless engineers and research workers in applied electricity. There is no other book on the market which treats the general subject so comprehensively, though parts of the subject have naturally been more exhaustively treated elsewhere.

The book covers the threefold aspect of surges: their generation, propagation and effects, and a further section covers the measures in vogue to protect apparatus from the harmful effects of surges and concludes with some valuable recommendations for the protection of overhead lines. Each chapter has been written by a member of the staff of the Association or of one of its contributing firms, or by a member of the National Physical Laboratory, where many of the investigations were made at the instigation of the E.R.A. Surge Committee. Thus the style varies greatly and some of the chapters are not up to date, having been written many years ago and published without substantial alteration, but these defects are not serious. A more serious defect is the concentration of some of the chapters on the E.R.A. activities to the exclusion (in places) of the work of many other investigators; in other words, the book is not the encyclopædia it could have been, emanating as it does from a large research association. Maybe the War is responsible for this; lack of time may have prevented that general detailed supervision so requisite to uniformity and comprehensiveness.

The book opens with a brilliant review of our knowledge of lightning, a chapter hot from the technical press. Papers on lightning have appeared from the pens of physicists, meteorologists and engineers, but never has such a thorough co-ordination been attempted of all data relating to lightning as appears here. Some revolutionary conceptions are introduced, in particular the potentials of thunder clouds to ground, and the nature of the stepped-leader stroke discovered by Dr. B. F. J. Schonland in South Africa. It is even suggested that the nature of the lightning flash may be modified by the resistance of the point of contact of the flash to ground. The authors analyse some of the results of other workers which appeared at variance with established ideas and find a true harmony to exist. There follow descriptions of methods of recording surge voltages and currents, and a chapter on lightning research sponsored by the E.R.A. in Nigeria. Similar expeditions have been equipped in only a few other countries, and it is a matter of regret that the War has necessitated the cessation of this interesting and promising field of research after only two lightning seasons.

Faute de mieux, the E.R.A. has made the best use of man's puny imitation of lightning. Section 2 describes the generation and recording of artificial lightning, or impulse voltages, and the propagation of surges on transmission lines, two lines, one for 33-kv. and one for 132-kv. being made available by the Central Electricity Board for this purpose. The section opens with a mathematical treatment of wave transmission on overhead lines and cables. Lord Rutherford remarked that a mathematical theory is only of use if it gives a clear picture of the physical processes involved. In this chapter the reader is given a very clear picture of the effect on a travelling wave of the many factors encountered on a line: line resistance, line termination, overhead earth return wires, neighbouring conductors, lengths of cable, and corona.

For surges of amplitude below the corona onset voltage, attenuation due to skin effects is not appreciable, although in a few miles from the point of origin the rate of rise of voltage is very considerably reduced. This factor alone must be very beneficial in safeguarding inductive apparatus, in which stress concentration is greatest when the rate of rise of applied voltage is a maximum. If, however, the surge voltage exceeds the corona onset voltage, attenuation is very rapid apart from reduction of rate of rise of voltage. Thus in an example worked out in this chapter, a wave of ten times the corona voltage is reduced to one of five times the corona voltage in two miles. This chapter is well supported by the chapters describing tests on a 33-kv. and a 132-kv. line. In each case, below the corona limit attenuation was found to be small, so that waves propagated just below the corona value will probably reach terminal stations and be doubled by reflexion. These values may be serious for owler-voltage installations but not for the high-voltage lines where the margin between operating voltage and corona voltage is meagre. Above the corona limit, the oscillograms show how the travelling wave is sheared off, resulting in a pronounced change of wave shape which renders the surge far less harmful. The voltages induced in neighbouring phase conductors were studied on both systems, and it was shown that the induced waves might have amplitudes large enough on reflexion to cause sparkover. It appears certain that 3-phase surges will frequently be encountered at terminal stations. The section also includes a description of the apparatus used in the study of surge propagation, namely, the impulse generator and cathode-ray oscillograph.

Section 3 deals with surge voltage distribution in transformers, a subject on which there is an extensive literature but one on which finality has not been reached. The main contribution in this section is the study of the effect of increasing the end-turn insulation in transformers, and the old deduction that the provision of additional insulation on the end-turn does not incresae the safety of the winding is redetermined by a careful oscillographic study. Unfortunately, the results are not substantiated as one would like to see them, by actual tests to breakdown of normal and reinforced insulation. The transference of surges from one winding to another is skilfully handled, and the specially dangerous conditions relating to the open-circuited transformer are emphasized. The subject is very complicated on account of the wide variety of transformer designs, and the treatment here deals only with the straight concentric winding. Manufacturers will be aware of the great difficulty of extending these results to the many cases of complex windings encountered in practice.

The section on surges on insulation deals only briefly with a few classes of insulation, solid dielectrics, cables and insulators. It is of interest to note that in the brief reference to co-ordination of line insulation, the insulation levels for the main part of the transmission line, the line near stations, and the protective gap of the station are separated by good margins of 25–30 per cent, instead of the meaningless margins of about 10 per cent which have been discussed elsewhere in the past.

The fifth and last section deals with the measures employed to protect against the harmful effect of surges. These consist of means for diverting lightning strokes from electrical apparatus, and means for reducing the amplitude or gradient of the surge voltages arriving at electrical apparatus. The critical résumé of the literature on the protective range of lightning rods brings out the danger of basing deductions as to the probable behaviour of lightning on tests carried out on models. It is unfortunate that the chapter does not give more data on the effect of different dispositions of earth wires relative to the three-phase conductors, information known no doubt to the large supply authorities. The various devices in past and current use for shunting surges to ground or modifying their wave shape are described, and tests made on many of these by the National Physical Laboratory are given in detail. The proposed international specification for lightning arresters was under discussion in 1939, and the National Physical Laboratory views on the clauses are given here in the light of experience gained in testing various makes of arrester.

Surge absorbers or wave modifiers were also tested at the National Physical Laboratory. Some behave as capacitors, others as combinations of inductance and capacitance, while a third modifier designed by the E.R.A. comprises an inductance with negligible capacitance to ground, a spark gap in the form of an expulsion tube on the line side of the modifier to ground, and a damping resistance which is switched in parallel with the inductance by another spark gap having a short time lag. Thus up to the instant of breakdown of this latter gap, the voltage rise on apparatus connected to the modifier is determined by the inductance of the modifier and the capacitance of the apparatus, and therefore begins to rise slowly in the 1-cosine form, but after gap breakdown the advantages of damping are realized. The final chapter summarizes the merits of the various protective devices and makes recommendations for system protection under a variety of conditions.

Two aspects of surges are omitted. Practically no reference is made to surges due to switching phenomena, and no observations by supply authorities relating to surge phenomena are given.

T. E. ALLIBONE.

A MYSTICAL PSYCHOLOGY

The Psychology of C. G. Jung

An Introduction with Illustrations. By Dr. Jolan Jacobi. Translated from the German "Die Psychologie von C. G. Jung" by K. W. Bash. Pp. xi+169. (London : Kegan Paul and Co., Ltd., 1942.) 12*s*. net.

THE evaluation of Jung's contributions to psychology and psychiatry is by no means an easy task. His earlier achievements were as scientific as any made before or since in these difficult subjects. His book called "The Psychology of Dementia Precox" was a careful clinical study and showed that he was capable of exact observation. Again, his "Diagnostische Assoziationsstudien", which recorded his careful researches upon reaction times and their relation to unconscious emotion, proved the existence of those constellations of ideas and emotions which he formulated as "complexes". Adler has made so much of the "inferiority complex" (by which he meant feelings of inferiority and not a complex at all) that too often it is forgotten that it was Jung who first conceived the idea of the complex. Nothing could have been more promising than these observations based upon careful measurement. One might have thought that here at last clinical research was attaining definite scientific basis. In spite of this we cannot agree with Dr. Jolan Jacobi that "As a didactic and diagnostic method it has become an essential aid to all psychotherapy and belongs to-day to the standard equipment of psychiatric institutions, clinical psychological training and vocational guidance of every kind, and even finds its use in the law courts" (p. 38). Such a eulogistic description of controlled association is scarcely true—at least in Great Britain—but nevertheless by his careful investigation into reaction times Jung had made what appeared to be a fruitful start.

This work was performed between 1905 and 1907. It was in the following five years that Jung abandoned his clinical work and most unfortunately started upon the study of religions and myths. The result of this preoccupation was the publication of his work on "The Psychology of the Unconscious" which appeared in 1912. It is not exaggerating to state that Jung seems to have forsaken science for religion. This book caused his secession from the Psychoanalytical Society and made a schism with Freud. From then on he formulated his views uninfluenced by others. He developed the idea of the libido existing not as a physical craving as Freud envisaged it but as Dr. Jacobi defines it as "the totality of that force which pulses through and combines one with another all the forms and activities of this psychic system" (p. 50). In practice it appears to erupt in conceptions of gods and demons.

Jung made an attempt to return to clinical medicine in his publication of "Psychological Types", in which he described the extravert and introvert. This phase did not persist, and his later books have tended more and more towards obscurity and mysticism. Dr. Jacobi tries to refute this accusation of mysticism by comparing Jung's psychology with the conclusions of Whitehead and Eddington (although these also have been accused of the same fault) but does not do so very effectively. She says: "Before the word 'mystic' one no longer needs to feel the customary dread—above all, not to confuse it with cheap irrationalism, for it is precisely reason that here presses forward to its own limits, as modern logic likewise honestly attempts to define its own boundaries, not, as it were, by rejecting but by logically establishing the independence, indeed when one has rightly defined and thereby delimited the concept of 'cognition', the sovereignty of the 'mystical' " (p. 64). In spite of this attempt to cut the ground away from the critic, it is difficult to describe otherwise than as mystical and obscure the following passage from Dr. Jacobi's book: "The making conscious of those contents which constitute the archetype of the mana personality signifies therefore 'for the man the second and true liberation from the father, for the woman that from the mother, and therefore the first perception of their own unique individuality'. Only when he in the true sense of the word 'becomes united with God in spiritual childhood'; and then only if he no longer 'blows up' his thus broadened consciousness in order 'thereby paradoxically to lapse into a flooding of his consciousness by the unconscious', i.e. an inflation. Such presumption would indeed, in view of the deep insights he had won, be not astounding; everyone falls victim to it for a time in the course of the individual process" (p. 117).

Well might the reader ask what all this means. Does it imply that the patient might become conceited? One hesitates to say, but Dr. Jacobi states that such nonsense "is likely to have a decisive influence on the formation of the future conception of the world".

If we turn from the consideration of Jung's philosophy to Dr. Jacobi's exposition of it we must admit that her book is thorough and careful. She has made an honest attempt to expound Jung's difficult conceptions, and those who read it will gather some outline of the copious outpourings of the master. The book is divided into three parts: (1) The Nature and Structure of the Psyche; (2) The Laws of the Psychic Processes and Operations; (3) The Practical Application of Jung's Theory. There are a large number of diagrams, but whether they clarify the subject or not it is difficult to say. The book ends with a biographical sketch of Jung's life which seems rather inadequate. There is a complete bibliography (perhaps the most valuable part of the book) which extends to fourteen pages and includes a list of all works in the various languages into which his writings have been translated. There is an index of four and a half pages which seems adequate for a book of this size.

CLIFFORD ALLEN.

A SOCIAL REVOLUTION

Science and Human Prospects

By Prof. Eliot Blackwelder. (The Thinker's Forum, No. 19.) Pp. 32. (London: Watts and Co., Ltd., 1942.) 6*d*. net.

THE revolution which is in full swing might be dated for Great Britain from mechanical inventions of the latter part of the eighteenth century. She has dealt with scientific and mechanical changes rather than social or governmental, because British history has on the whole been peaceful; but she was able by her resources of coal and iron and the mechanical inventions to beat her neighbours in trade as well as at sea.

It is not necessarily beneficial to undertake a revolution and therefore it would be well in the present movement to specify the good and what might be the better. Prof. Blackwelder's little book suggests some points.

(1) Mechanical force has now been carried almost to the extreme. The steam engine has come into its own. The result of this is the multiplication of the workpeople and the turning of a countryside into a town.

The first fruits of applying science to industry are not all good—great wealth for the proprietors but an ill life for the workpeople. The early part of the last century began the revolution to remedy this. A minimum of welfare was insisted on in factory legislation, and minimum rates of pay were afterwards secured, partly by union action, partly by the State.

(2) The second part of the revolution is ultimately superior. The State by the end of the century had taken education under its care. The English plan in education as well as government is to keep the best of the old and widen as far as resources yield. Although the level is low, knowledge, taste and goodwill to others have increased enormously.

(3) It has often been said that Christianity was never really active until the nineteenth century. And in these later appeals, it is noticeable that freedom is good for health. A benevolent and not dictatorial State is the ideal of the latter part of this revolution. As humanity has come together by the appliances of science, so it must work for higher things in art and music. The outbreak of industrial imperialism which stamped the latter part of the nineteenth century did not aim mainly at the higher things. They are the passionate quarry of the present crusade. A good life for all: any goodness being aimed at, it is seen that religion pervades the whole. Strange that a hundred years ago it was not regarded as irreligious to make fortunes for the few and neglect and degrade the multitude. Is it degrading to work?

The revolution through which we are now passing, aims at something far higher than before. The whole community shares and the State is the ultimate authority; and there will be as many intermediate bodies as needed, for education, for transport, for music and many more agencies, leading always to free initiative.

Beyond this, and more important than this, comes the international body. In this Great Britain will be preponderant, but other States including Germany will have their place. The United States will be at our side and we shall avoid the errors of 1918 in making treaties and excluding the enemy. We cannot believe in a final step back. Humanity which grew out of Western civilization will triumph. It may be long.

F. S. MARVIN.

SCIENTIFIC STUDY OF SOCIETY

By DR. HENRY A. MESS
Bedford College for Women, London

The Natural Sciences and the Social Sciences

THE lengthy correspondence in *The Times* a few months ago, a number of articles and letters in NATURE, and the discussions at one or two conferences, all bear witness to the widespread interest in the scientific study of society. They also show a certain amount of confusion of thought and some lack of information as to what is actually being done.

It is natural that there should be this interest at the present time. We have all learned some bitter lessons in the last few years. Among other things we have discovered what great disasters can come upon mankind through science. It was stated recently that one of the first men to fly, an old man now, is heart-broken by the knowledge of what flying has actually come to be. Nobel, who developed the manufacture of high explosives, was similarly saddened by the use to which they were put.

But we cannot turn our backs on science. Nor is it the development of science which is the real evil; it is the lop-sided development of science. It is the rapid growth of the natural sciences without a corresponding growth of the social sciences which has brought such dangers and disasters on us. This is now generally recognized, not least by the natural scientists.

The contrast between the competence of men in some directions and their incompetence in other directions has become a commonplace. Men can mould matter and use physical forces with remarkable facility. They have made the fairy tales come true; they can fly in the air, they can travel under the sea, they can penetrate the recesses of mountains, their whispers can be heard across continents and across oceans; they can work wonders with living matter, they can bring into existence new plants and new breeds of animals. Yet with all these powers at human command, there are millions who are imperfectly nourished, millions who are badly housed. Wars persist, more horrible because of our science. In the intervals between wars there is social strife; and we have the bitter paradox that when our manufacturers and our farmers produce abundantly, they are in danger of being ruined by low prices. Recurrent periods of unemployment blight the lives of multitudes. All this we seem to be unable to prevent.

The contrast between achievement and futility is glaring; and it is a challenge. What response to it shall we make? The answer is obvious. Since we cannot turn our backs on science, even if we would, we have no option but to go forward, to apply science to those spheres of human life in which at present we are so incompetent. Inevitably the question is being asked, more and more insistently, whether the application of scientific methods to the study of society cannot give us a control over social processes comparable to our control over physical forces. Can we find a remedy for the evils, of which we are so sensible, in a scientific study of society?

The answer is being given quite rightly that we can; a great increase of knowledge and a great increase of control are certainly possible. But having said that, it is necessary to give a warning. To argue directly from what the natural sciences have done to what the social sciences might do is unsound. The social sciences are bound to be very different from the natural sciences. Their subject-matter is different. The chemist and the physicist have to do with inanimate things, which do not have moods and wills, which do not alter just because they are being examined. The social scientist is dealing with nothing so consistent, nothing so tractable; he is dealing with the relations of human beings, conscious, sensitive, wilful, living creatures. If anyone thinks that we are likely to obtain laws of social development as precise and as little subject to variation as the great physical laws, he will pretty certainly be disappointed. It has hindered, and not helped, the social sciences that some of their practitioners have made exaggerated claims on their behalf. What can be claimed fairly is that the social sciences are capable of helping us to a much better understanding of the present and to a much clearer perception of the possibilities, the impossibilities and the probabilities of the future.

It cannot be said too emphatically that we need to be clear in our minds as to the distinctive natures and roles of the physical sciences and the social sciences. The former can contribute much to human welfare, as also much to human unhappiness; we need to think hard how to make the best of their contribution, and to do so will call for co-operation between physical scientists and social scientists. In this the former have a big part to play. But they cannot help much in what is one of the most urgent tasks of men to-day, the analysis of the nature and functioning of societies with a view to increasing our control over social forces. The physical scientists and the social scientists have really very little in common. Of course, they must both be objective, and they must both follow the rules of logic. But that is about all they have in common. Only harm is done if any attempt is made to force the methods or the canons of one upon the other. The chemist can experiment and weigh, and he can hope for exact results. There is only a very restricted field for experiment in the social sciences, and the social scientist is bound to take into account much that cannot be measured, but can only be assessed: hopes and fears, prejudices, the force of custom, the power of ideas. Some grotesque results have been reached when attempts have been made to measure that which is not really amenable to measurement; and, let us repeat, findings must often be stated in terms of alternatives and of probabilities. For example, I think that the majority of competent students of local government in Great Britain would say that *either* local government areas will be revised and enlarged *or* local authorities will decline in power relatively to the central government departments. Again, there is a strong likelihood that a defeated nation will develop within a decade or two a harsh and aggressive nationalism; but alternatively it may fall into a state of apathy and accept a position of permanent inferiority; or, more rarely, it may bend its energies to finding an idealistic solution of its difficulties, as Denmark did after 1864. It is impossible to say for certain which of these will happen, but it is very likely that one of them will happen.

The case is rather different with regard to the biological sciences. But here also we need to distinguish between the utilization of their findings for the advancement of human welfare and the more specialized task of analysing society. As an example of the former, we may take the impact upon public opinion of the researches of the dieticians. Clearly we are in deep debt to them, and clearly to maximize the utilization of their work there must be co-operation between physiologists and social scientists. In the same way there is a good deal of psychological knowledge which can be used. So far there is a parallel with the utilization of the work of the physical scientists. But in addition, the biologist and the psychologist have their distinctive contributions to make to social analysis. The biologists can tell us a good deal about the inheritance of intellectual ability, about the effects of marriages between persons of different race, and so on. The psychologists have taught us a great deal about the workings of the human mind, about the way in which the emotions can distort reasoning; we have such topical studies as Prof. F. C. Bartlett's examination of propaganda[1].

But while biologist and psychologist, and let us add economist, can throw a good deal of light on the functioning of society, and while each of them can do what no unqualified person can do, yet we should be still far short of an adequate analysis of society. In isolation the various social scientists are liable to fall into serious error, as the literature of eugenics and the long-drawn-out controversy with regard to instincts in man abundantly testify. A correct and an adequate analysis of society cannot be made by biologists only, or by psychologists only, or by economists only. There can only be an accurate and an adequate study of society when the different social sciences are related, and when there is team-work between those who practise them. This has always been a first principle of sociology, which is the general study of society.

The scope and methods of sociology are so commonly misunderstood in Great Britain that it is well to elaborate this a little. Comte's doctrine of the "social consensus" needs modification and re-statement; there are more partial autonomies in the social structure than he realized. Yet that there is an interplay of the various parts can scarcely be doubted, nor that it is intricate and important and needs careful study. Such study is undertaken by the sociologist; and because he is always aware of the interdependence of parts, he views society holistically. The objection generally raised is that the sociologist is attempting too much, and that he trespasses on too many fields. If the sociologist attempted to do the work of the biologist, the psychologist or the economist, that objection would be justified. But it is not so. The sociologist accepts the findings of the specialists; his business is to relate those findings, and to use them in the interpretation of the society which he perceives as a whole; sometimes also it is his business to make the specialists aware of alternative explanations of social phenomena. Doubtless to do this he requires some elementary knowledge of a number of social sciences, but that is very different to claiming to be an expert in them. It is probably desirable that a sociologist should be really well equipped in at least one specialist social science. That is one of the ways of advance; another is to secure that an increasing number of specialists in one or other of the social sciences have a background of general sociology.

It should be added that the sociologist has also one or two specialisms of his own, parts of the field of social study which have not been annexed by any special social science. Of these specialisms quite the most important is the study of social institutions. Such a book as Westermarck's "History of Human Marriage" falls within this field.

[1] "Political Propaganda", by F. C. Bartlett.

Practical Applications

When we are considering what practical benefits the scientific study of society might confer upon mankind, it is useful to distinguish between short-range and long-range inquiries. By short-range inquiries I mean those which are concerned with the problems of a particular society in a particular age. For example, the evacuation of school-children during the present War has presented what I should call short-range problems; the distresses of the Special Areas a few years ago were short-range problems, the many difficulties which arose in connexion with re-housing were short-range problems. The long-range problems are those concerned with social phenomena which are to be found everywhere and always, with such difficult questions as the limits within which human nature can be altered, or the causes of the rise and fall of civilizations.

Now with regard to short-range problems a great deal of advance could be made very quickly. It is largely a question of money; and if more adequate provision is made for the social sciences we can soon produce and employ men and women who will throw a great deal of light on our social problems, and who will ease greatly the process of dealing with them. It would not be difficult to draw up a list of short-range problems which could be investigated very profitably. Here, for example, are three suitable subjects for inquiry: (1) the difficulties and the effects of migration within Great Britain; (2) the conditions favourable and unfavourable to the growth of civic consciousness and local patriotism; (3) the social life of various types of English towns. On all these subjects something has been done, but not enough. There is much scattered material on internal migration in Government publications and in books dealing with unemployment and the location of industry; there is an interesting unpublished study of assimilation in the East Kent coal-field; but it cannot be said that there has been any adequate sociological study of this social phenomenon which is as interesting as it is important. With regard to the conditions affecting civic consciousness a great deal can be learned from the experiences of the new housing estates, as Mrs. Durant's fascinating study of the growth of Watling has shown us; her investigation might have been multiplied many times with great advantage. As to studies of particular towns, it is lamentable that we have not as yet any study of an English town which can be set alongside R. S. and H. M. Lynd's "Middletown" and "Middletown in Transition".

Such studies are not mere academic exercises; they supply knowledge much of which could be put to immediate use. Sociologists are in a position to render useful service to Government departments and to local authorities. After the War we shall be building a good many more new estates. A sociologist could point out ways of shortening the process by which a mere collection of houses and of families becomes a true society. In the same way, there is bound to be fresh migration, and a sociologist could suggest ways of easing the strains which there are sure to be when men and women go to live among strangers. I venture to prophesy that the quality of social life in our smaller provincial towns is likely to be in the near future a matter of public concern; here again the sociologists can be of use, though they will be handicapped for lack of those preliminary studies which might have helped them.

Much assistance could also be given in the sphere of international relations. Prof. C. E. Merriam, of the University of Chicago, with a team of co-workers, has reviewed the methods adopted in various countries to inculcate patriotism. Quite a deal could be learned from those studies which could be applied to the task of creating as quickly as possible a strong loyalty to a reconstructed League of Nations or whatever other supra-national body there may be set up after this War.

The long-range problems are another matter. With regard to these, the number of men and women who are competent to do effective research is likely to be small, and progress is likely to be slow. But sustained research might in time yield results of quite incalculable value. For example, how little we really know at present about human nature, about its variations, how far it is capable of change, to what extent it is the same always and everywhere. Yet there is a vast amount of material existent in the writings of historians and of anthropologists which, if it were carefully examined, might yield valuable results.

Here let me digress to emphasize the very special case which can be made out for generous support of anthropological research. I am not an anthropologist, but, like all sociologists, I am deeply in the debt of the anthropologists. Their special claim derives from urgency; the material upon which they work, the simpler societies, is fast vanishing; investigations which are not made in the next few decades will probably not be made at all; and these investigations throw light on social structure and on human nature which we are scarcely likely to obtain from any other source.

It is, I think, almost essential for effective study of long-range problems, and for that matter it is often desirable for the study of short-range problems, that there should be team-work. A society is a whole, and it needs to be studied as a whole; and that means either the co-operation of many specialists or the work of a man of encyclopædic knowledge. Men of the latter type are rare, are perhaps likely to become rarer. It is to team-work therefore that we must look more and more. But the planning of work by a team, and the intelligent co-operation of team-workers, both demand that knowledge of the interplay of the different factors in social life which is the special subject-matter of sociology. Everyone praises his own leather, and I do so unashamedly; it seems to me deplorable that the persons in Great Britain who have been appointed specifically to teach sociology can be counted on the fingers of one hand.

Whether that be accepted or not, there is at least widespread agreement that we need to take more seriously the scientific study of society. Concretely, that means better provision in the universities, more chairs and and more lectureships, more post-graduate studentships. It means better utilization of the already considerable knowledge of social scientists, and an enlargement among other things of the number of careers open to them. It means better understanding and more team-work among them. There is also a great work of popular education to be done. We need to increase immensely the number of those who have some scientific knowledge of the nature and functioning of society. When such knowledge is greater, and when it is more widely spread, we shall be on our way to a considerable measure of control of social forces; and we shall increase the use and decrease the abuse of the abundant knowledge placed at the disposal of mankind by the natural scientists.

WEST INDIAN AGRICULTURE

By SIR GEOFFREY EVANS, C.I.E.
Royal Botanic Gardens, Kew

WEST Indian affairs attracted considerable public attention in the period immediately prior to the outbreak of the present hostilities. Severe economic depression and the deplorably low standard of living had indicated that all was not well and general concern was manifested by the Imperial Government. Signs of considerable distress and labour unrest, culminating in disturbances in various Colonies during the late thirties, resulted in the appointment of a West Indian Royal Commission which toured the various Colonies in the Caribbean area during 1938–39, with the object of making specific recommendations. Unfortunately, the report of this Commission has not yet been released, but the main conclusions reached and certain recommendations made were published in February 1940 (Cmd. 6174). Now apart from Trinidad, which has a big petroleum industry, and British Guiana, which has developed bauxite mining and to a less extent gold and diamond diggings, all these Colonies depend entirely on the agricultural industry for their prosperity. The recorded opinion of the 1938–39 Royal Commission that "agriculture is the principal source of sustenance and wealth in the West Indies and the standards of life must largely depend on the intensive use of the soil" therefore accurately portrays conditions.

It is obvious from this that the betterment of agricultural practice underlies the whole problem of social and material progress in this area. The problems involved are intricate and not easy to solve, and it is opportune, therefore, that H.M. Stationery Office should have been able, even in these difficult times, to publish a book entitled "Agriculture in the West Indies" (Colonial No. 182), which gives a very complete and up-to-date description of conditions as they were just prior to the commencement of this War. The book has been compiled by Dr. H. A. Tempany, agricultural adviser to the Secretary of State for the Colonies, from documents supplied to the West Indian Royal Commission, and from other sources. It forms a valuable record of agricultural conditions in each Colony at the present time besides giving historical data which undoubtedly have considerable bearing on the existing state of affairs.

Unlike most other tropical areas, the West Indies have had no tradition of native agricultural practice to build upon, for the native Indian tribes rapidly disappeared under the Spanish rule which was established at the end of the fifteenth century, and the labour required for development was afterwards met by the importation of Africans and later, after the abolition of slavery, by indentured labour from India and to a lesser extent from China and the Portuguese Atlantic Islands.

As is pointed out in the book referred to above, the system of agriculture is really based on the methods in vogue in Great Britain and the European Continent before the great renaissance of the eighteenth century, with its development of rotations and mixed farming, took place. The negro brought few ideas with him, but perhaps insufficient credit has been given to the changes that have been introduced by the immigrants of East Indian origin. For example, it is perhaps not too much to say, that without the help of their traditional art, the development of the rice industry, which shows considerable progress in British Guiana and could, with a little encouragement, be developed much more in parts of Trinidad and Jamaica, would probably never have taken place so rapidly as it has, for the man of African descent has shown little inclination or aptitude for this type of cultivation.

Throughout the last three hundred years, agriculture has been based on the plantation system, which was first established by the Spanish, and later continued by the French, English and Dutch, when they in their turn began to acquire interests in the islands. Under this system, the land belonged to the planter, who farmed the whole estate with the aid of labourers. The latter owned no land and were not encouraged to cultivate crops for themselves. The crops raised were mainly for export. Sugar-cane has always been the staple plantation crop, and the prosperity of the West Indies may be said to have depended to a large extent, as in fact it does to this day, on the condition of the sugar industry.

Other plantation crops have had their ups and downs. Thus, cotton was cultivated on a large scale at the time of the American Civil War when supplies from the United States to England were interrupted. It ceased to be profitable when peace was declared, and all the memory that is left of it on many of the islands is hillsides covered with poor secondary bush, which are eloquent of the soil erosion that must have taken place during that period. The cacao plantations were started later during one of the periodic depressions in the sugar industry, much of the planting being done at the end of the last century and the beginning of the present one. Cacao is still a major crop in Trinidad, Tobago and Grenada, but is at present in a depressed condition owing to competition from West Africa and Brazil and the ravages of disease.

The cultivation of bananas for export began in a small way in Jamaica during 1868–69. It is somewhat curious that, like sugar-cane, it is not a native of the area, as the Gros Michel banana, which is the commercial variety, undoubtedly originated in the Far East. With the development of better methods of transport, a huge export trade arose and the average exports for the three years previous to this War were in the neighbourhood of twenty-three million stems a year. Now the banana in its turn has become subject to diseases and many growers have had to try to turn to other crops, and, as is the case with cacao, some of the land is going back to cane.

All through their known history, the West Indian territories have been subject to periods of intense depression, which have necessitated the holding of special commissions and inquiries. Prior to the recent commission, probably the most important one was the Royal Commission of 1897 because it did result in certain definite changes for the better. The sugar industry at the time was in the depths of depression; competition with beet sugar, grown under a system of bounties on the continent of Europe, was being severely felt and the Bourbon cane, which was the principal variety, was succumbing to disease. The Commission recommended the thorough overhauling of the sugar industry, the abolition of the sugar bounties, greater diversification of agriculture, the establishment of small holdings, together with the encouragement of peasant agriculture and the placing of scientific research on a proper basis. Many of the proposals were in part at any rate carried into effect. The sugar industry was overhauled and much centralization took place, leading to the amalgamation of many small estates, the adoption of better methods, and higher extraction in the factory. The sugar bounties were abolished in 1903.

An Imperial Department of Agriculture was established in 1898 and the cost of the operations were paid by the Home Government for ten years. Its headquarters were at Barbados, and it operated chiefly in the Windward and Leeward Colonies, but its influence and the results of its researches were felt throughout the archipelago. Much was done to encourage diversification of crops, one of the outstanding successes being the establishment of the Sea Island cotton industry, which is proving its value for war needs at the present time. New varieties of cane were introduced and cane-breeding operations fostered; chemists began to examine the soils and pathologists to investigate plant diseases and pests. In due course similar departments were organized for Jamaica, Trinidad and British Guiana, and in fact most of the agricultural departments now functioning in our tropical Colonies may be said to have had their inception and to be modelled upon the old Imperial Department of the West Indies.

The 1914–18 war period brought high prices and prosperity to the West Indies. The witchbroom disease had not yet appeared in Trinidad's cacao fields, which were at that time in their prime. Panama disease and the Cercospora leaf-spot did not then worry the banana plantations of Jamaica, and the lime producers of Dominica and St. Lucia obtained good crops and good prices, as the wither tip disease only appeared later. But after the short post-war boom, prices fell to a catastrophic extent and in many cases it appeared that the old plantation system was breaking down and would be unable to cope with modern conditions unless considerable modifications and adjustments were made.

The demand of the peasants to own land has been strongly in evidence for years past. It was brought forward at the time of the 1897 Commission, and following its recommendations, some land settlement was actually started in St. Vincent and other islands. These early settlements were comparatively few in number, but their history is interesting and the experience gained should prove most useful at the present time when, as a result of the work of the latest Commission, the need for the development of peasant agriculture has again been stressed. It is not too much to say that the early settlements were not an unqualified success; many of them proved failures due to lack of accurate information and knowledge of the underlying factors involved.

One of the reasons why the demand for land settlement has become so persistent in recent years is the increase in population. Formerly, an appreciable proportion of the labouring population found an outlet for their energies in neighbouring countries. A number emigrated and others found profitable employment for periods of the year in the cane fields of Cuba and other countries. It must be remembered that West Indian labour was largely drawn upon for the construction of the Panama Canal and the opening up of the oil industry in the Central American Republics. These developments offered employment at lucrative rates. The money thus earned enabled the labourer to maintain his family and household in his native island and resulted in the inflow of an appreciable amount of wealth from outside. Within the last ten years or so, this state of affairs has come to an end and immigration laws have curtailed the activities of the West Indian, who nowadays is forced to try to find his living in the British Colonies.

The difficult problem of finding a livelihood has, therefore, become aggravated. Some of the islands are really densely populated. For example, Barbados, which is about as big as the Isle of Wight, has a population of 1,163 to the square mile; Jamaica, the largest island, had a population of 1,173,600 in 1938, with a density of 263 per square mile, and had increased its population by more than 300,000 in eighteen years. For countries which depend entirely on agriculture and have no industries to speak of, these densities are high. The possibility of relieving the pressure by emigration has exercised the attention of many administrators in recent years. Unfortunately, the other islands are mostly already fully occupied and offer little scope, and the possibilities of the two mainland Colonies of British Guiana and British Honduras have frequently been considered. These two Colonies certainly have the area, and on that basis alone are considerably under-populated. The same might very well be said of Australia.

If one examines the facts, however, it is found that although British Guiana covers an area of about 90,000 square miles, and is, therefore, larger than England, Scotland and Wales put together, eighty-seven per cent is under heavy tropical forest, ten per cent under savannah, and only three per cent on the coast is cultivated. The old idea that land producing heavy rain forest in the tropics must be fertile has been largely exploded, and as a matter of fact the soil underlying these British Guiana forests is singularly poor, and as the few experimental settlements have proved, is incapable of supporting permanent agriculture. The same may be said of the savannah soils. These are also infertile and lacking in essential mineral salts. They at present support a small ranching industry, and it would seem that future developments would lie in the direction of improving the methods of cattle raising. It is possible, even probable, that the forestry industry may be scientifically exploited after the War, even though tropical rain forests are difficult to develop commercially because of the multiplicity of species they contain. Neither the cattle industry nor forestry will, however, be in a position to afford relief to the congested populations of the islands, even if the latter could adapt themselves to work which is specialized and to which they are not accustomed. In British Honduras again, forests predominate, and the evidence is that good agricultural land is strictly limited.

The best means of helping British Guiana at present lies in providing proper irrigation and drainage facilities in the frontal lands, with the view of developing land settlement with paddy as the basic crop, as the conditions are specially suited to this kind of cultivation. The peoples of East Indian origin are skilled in this form of agriculture, but it is more than doubtful whether immigrants from the islands, the majority of whom would be of African descent, would be able to settle down to it. It will be seen, therefore, that the two mainland colonies do not seem to present an easy solution to the over-population problems of the islands, and it is evident that these islands will have to try to find the solution within their own confined boundaries, so long at any rate as the present social and political restrictions affecting emigration continue.

There is no doubt that many of the islands could support a larger population if all the land available for agriculture were properly utilized. As already indicated, many of the plantations have become derelict and many others are not producing anything approaching their maximum. In many instances the estates are heavily in debt, with the result that considerable capital expenditure would be necessary to make them once more productive. But the owners usually find it impossible to obtain the necessary money to provide for the drainage and replanting and similar operations essential to maintenance of production. The long period of depressed markets has found the owners already mortgaged, and in many cases they continue to use out-of-date methods, so that they are in no condition to tide over bad times. The sugar industry has been able to carry on, though with difficulty, because the smaller estates have combined, the factories have been centralized, modern machinery installed, and scientific inquiries sought and new methods adopted. This was not the case with the cacao, the lime, and, to a less extent, the coco-nut plantations. These crops do not lend themselves so readily to centralization, and as a result many of them have become derelict. It has long been evident that some drastic measure would be needed so that the proper utilization of the available land might be able to meet the situation created by the rising population. Change of ownership and experiments in land settlement with peasant smallholders seem to be the inevitable outcome.

Another matter that has given grave concern is the great dependence of the islands on imports for the food supply. The tradition of the West Indies has been to grow crops for export. In Barbados, for example, the estimated value of the food crops actually home-produced in 1938 was about £135,000, while in the same year the food imports were £516,000 and animal foodstuffs another £78,000. Further, much of the food imported was not of high nutritional value, with the result that the public health authorities were gravely concerned about the malnutrition that was evident. The other Colonies show a similar dependence on imports for their food supplies, although to a less spectacular degree. These islands would be in a serious quandary if anything should happen to upset the smooth working of the shipping lines, as is likely to happen in time of war. A change of policy has, therefore, appeared in the last few years, hastened of course by the advent of the present War, but already seriously considered for some years previously. It is now generally accepted that these Colonies must be more self-supporting in food supplies and should endeavour to produce food of better nutritional value than much of that which is now imported.

The decision to open land settlement was made before the War, and the Governments of the most densely populated islands are taking the steps within their means to acquire suitable estates and settle them with peasants on small holdings. St. Vincent made a start at the beginning of the century. Jamaica has recently done much in this connexion, as in 1938 a sum of £650,000 was raised on loan by the Government to extend settlement further, and a separate Department of Land Settlement was formed. In the Leeward Islands, also, a good start has been made by the purchase of estates in Nevis and Antigua, and the other Colonies have taken similar action. It may be taken, therefore, that a commencement has been made; but it is necessary to sound a word of warning since the technique of successful land settlement in the tropics is not easy, and has many pitfalls. There is the matter of the form of land tenure, for example.

The demand for freehold is great. Naturally, everybody wants to own his bit of land, but Government has definite responsibilities in this direction that cannot be disregarded. It must be remembered that land is precious in the West Indies, and the pressure of population is great. Experience with the older land settlement has shown that there is a tendency to exploit the land. Steep slopes have been deprived of their tree cover for cropping, with the result that much of the soil has been lost and periodic floods have caused destruction lower down. Repeated cropping, without manuring, has impoverished the land, and so on. One could mention some of the older settlements of the islands where the land has been completely ruined in fifteen years and the settlers have then demanded to be placed on fresh land. Instances of this sort can obviously not be repeated on a large scale, because the area of cultivable land is limited and the soil once lost cannot easily be replaced, and so the time might arrive when there would be no worth-while land left for anybody.

In fact, the sooner it is recognized that the soil is the main, and in many cases, the only asset the islands possess, the better it will be for everybody, for once lost it cannot be recovered. The granting of freehold is a matter that needs very serious consideration, therefore, but whatever form of tenure is finally selected, reasonable security must be offered, so as to give the peasant the chance to improve his holding. Without such security, there will be the natural tendency to 'skin' the land. On the other hand, the Government must be in a position to remove anyone who disregards the rules safeguarding the land and adopts methods that result in soil erosion and impoverishment.

The plan is to adopt a system of mixed farming, involving rotational cropping and including the keeping of livestock. The main object of introducing livestock is to provide for a supply of pen-manure and so keep up the humus content of the soil. Under the high temperature and moist conditions of the wet tropics, the soil loses its organic contents far more rapidly than in temperate regions. The details of cropping have yet to be worked out and the size of the holdings will naturally depend on circumstances such as the locality and soil, size of holdings, and availability of irrigation water. It will be necessary that the peasant should be mainly self-supporting so far as food is concerned. On the other hand, he must be able to grow some crops for sale, otherwise he will not have the cash to provide himself with the necessities of life, such as clothing and amenities, nor will he be able to pay his rent and the taxes which are necessary to maintain the governmental and social services.

The class of livestock suited for peasant holdings requires special consideration. The cow is obviously essential, but the type has not yet been finally decided, although a good deal of work has been devoted to livestock in recent years, particularly in Trinidad and Jamaica. In these two Colonies, experiments have been made to grade up local stocks by the use of high-grade dairy breeds of European origin. The Holstein (Friesian) is the breed favoured in Trinidad, and several breeds, including the Channel Island types, in Jamaica. It has been found that the introduction of European breeds has tended to produce a type that is not really suited to the tropics, as, quite apart from the question of resistance to disease, the respiratory organs are not suited to the heat of the tropics. Efforts to improve matters in these respects are now in progress, using Zebu blood, and undoubtedly considerable progress has been made in producing superior milking cattle. The movement to establish dairies for the production of good milk for supply to the towns has increased of late years and cows bred for this purpose are supplying the gap. Under dairy conditions, however, the cows receive every care and skilled attention and a lot of supplementary and high-grade foodstuffs. Under peasant conditions, such will not be the case, and the cow will have to forage for itself, its food being supplemented with fodder crops and surplus waste from the peasant's holding. The peasant is not likely to be in a position to buy hard grain or cake from outside sources. It is difficult to imagine, therefore, that the large-framed cattle bred for dairy purposes will prove really suitable for the peasant, and one would like to see attempts made to solve the problem by careful selection from the common cows of the countryside.

It is true that there are no indigenous cattle in the country, but they were introduced several hundred years ago by the Spaniards, and running all through the islands one comes across small, shapely beasts, somewhat resembling some of the Channel Island breeds, which are thoroughly hardy and acclimatized and might prove the basis of such a breeding herd as is contemplated. Finally, there is the buffalo. It has been introduced into Trinidad on the sugar estates, but is used solely as a draught beast. Its value as a milch animal is not appreciated, yet in India and the East the buffalo cow is regarded as a fine milking beast and is highly prized as such. In the Colonies with large populations of East Indian descent at any rate, there would appear to be a reasonable prospect for its utilization as a milk-producer.

The details for the consummation of this programme of agricultural reform are now being worked out by the recently appointed Inspector-General of Agriculture, working within the organization set up by the Comptroller for Development and Welfare in the West Indies. The task is immense and one of the difficulties lies in the great variety of climate, soil and conditions that occurs in the various colonies. Each one differs from its neighbours to a remarkable degree, and each has its own peculiar problems. The difficulty of providing staff adequate to tackle the problems involved is enhanced by the number and often the small size of the units concerned. The larger Colonies, such as Jamaica, Trinidad and British Guiana, are in a position to maintain agricultural departments adequately staffed, but the smaller islands cannot afford this, and means will have to be found to pool their resources, and to provide the Inspector General of Agriculture with the necessary staff to carry out essential field experiments, to work out systems of cropping, demonstrate the results of research activities, teach the elements of animal husbandry, and arrange for the orderly marketing of the crops produced.

Many of the problems call for research in the first instance, and up to the present their investigation has not always proved possible. Research work is, in future, to be centralized at the Imperial College of Tropical Agriculture in Trinidad. This institution, after a life of some twenty years only, has already established for itself an enviable reputation and is regarded as the centre for agricultural knowledge, not only by the British Colonies, but also by the Latin American Republics that border the Caribbean Sea, and it has in addition strong cultural ties with the United States and Canada. Already its hands are full, for in addition to a heavy programme of long-range research, it is the centre at which agricultural cadets receive their training for work in the agricultural departments right through the tropical Colonies of the British Empire. The College also trains men for agricultural work in the West Indian area. If it is to be charged with a number of specific West Indian problems in addition, it will need a good deal more financial support, and will have to be expanded. It is undoubtedly the best place at which to carry out the contemplated researches, and, given adequate funds and the necessary increase in staff, there is no reason to doubt that it will fulfil its task.

The West Indies appear to be on the verge of great new developments. The traditional economic system which depended on the production of export crops and the import of food needs modification. Efforts must be made to render these Colonies far more self-supporting in their food requirements than has been the case in the past, for it is believed that a country which is self-supporting in food is far better able to tide over the periodic trade depressions which inevitably occur, since during such periods the export crops may have to be sold at prices far below cost of production or difficulty may even be felt in disposing of them at all. In either case, there is little enough money available to purchase even the bare necessities of life. So, the next few years may see a radical change in the West Indies in the direction of a more rational system of agriculture, having as its main object the better utilization of the land and the preservation of the all-important soil. The policy of settling people on small holdings will be accelerated with the main object of making these Colonies more self-supporting as regards food. In order to effect this, some of the estates which are redundant, or cannot be worked profitably as plantations under existing economic conditions, will have to be taken over and settled with small holders. This does not necessarily mean that the plantation system as a whole with disappear. Many of those which are favourably situated, such as the sugar estates in the larger islands, must continue, and should benefit because the change should result in a more assured supply of labour from a settled peasantry. In fact, a combination of the two systems, each lending support to the other and with interlocking interests, would seem to be the happiest augury for the future.

CARL VON LINDE

A Pioneer of 'Deep' Refrigeration

By J. H. AWBERY
National Physical Laboratory

CARL VON LINDE is probably known to most scientific workers as the designer of a liquid-air machine, and nothing else. He contributed, however, to ordinary refrigeration as well, and still more to the problems of gas separation which are now becoming of such technical importance. Thus it is fitting, in this year which sees the centenary of his birth—he was born on June 11, 1842—to survey his work and to realize the debt which we owe to him.

It was in 1876, when he was thirty-four years of age and professor of thermodynamics at Munich, that Linde took out his patent for an ammonia refrigerating machine. Before this, machines using ether had been used (they are now obsolete), as well as bulky and inefficient cold-air machines; but Linde had the scientific knowledge to calculate the thermodynamic efficiency attainable with different media, and the technical skill to design the plant well—so much so that Ewing, writing in 1908, was able to say: "The design of the Linde machine has been carried out with conspicuous care, and it owes much of its great success to excellence in mechanical detail". From the time of its introduction until recent years, the ammonia machine has been the most widely used refrigerating plant for all purposes except marine work, where carbon dioxide (which also was introduced by Linde, though independently by others) was preferred for various reasons. In recent years, the advent of the turbo-compressor has led to the use of organic refrigerants for air-conditioning work. The wide demand for small domestic plants has also been associated with the use of organic liquids, so that ammonia, though still widely used, is less dominant than formerly.

When he began to work on the production of liquid air, Linde had a clear idea of using it to produce oxygen by fractional distillation, and probably saw this as more important than the attainment of very low temperatures. At the time, air had already been liquefied by various investigators using a number of methods. Linde, in 1893, used a process not unlike that of the ordinary refrigerating plant, but with a heat interchanger to make the cooling cumulative. The air to be liquefied is compressed to a high pressure, cooled by circulating water, and then expanded through a throttle valve. (It is at this point that the process used by Claude differs. In Claude's arrangement, the gas expands in a cylinder and is made to do work so that the process is nearly adiabatic.) Here the temperature falls owing to the unresisted expansion. The cooled air leaving the valve then passes away up the outside of the pipe along which the air flows to the valve; thus the following air starts its expansion at a lower temperature. In this way, the air leaves the valve at continuously lower temperatures, until at last the boiling point is reached, and some of the air liquefies. From this time on, a steady state is approximately reached, in which part of the air leaving the valve flows away in the gaseous form, and may be regarded as the refrigerant, which completes its thermodynamic cycle by warming up to atmospheric temperature, while the remainder is liquefied.

The details of the process have, of course, been modified, but in principle Linde's first apparatus has been closely followed in subsequent design, and has been the basis, not only of liquid-air plants on a large scale, but also of plants for the liquefaction of hydrogen.

One of the two main deviations from the simple process outlined above consists in avoiding the waste which results from the expansion of all the air from high pressure to atmospheric. Actually, it is only that part of the air which is to be drawn off that need be lowered to atmospheric pressure. The remainder, which acts as the refrigerant, can be kept at a much higher pressure, thus greatly reducing the work of compression. To this end, the air at about 200 atmospheres is expanded to 40 atmospheres, and only that part which is to be drawn off is afterwards expanded to atmospheric pressure. It is found in practice that this increases the amount of liquid air obtainable for a given input of energy by about 10 per cent.

The other economy is to cool the air, before compression, by means of a subsidiary (ammonia) refrigerating plant. When the two modifications are used together, the efficiency is raised from about 0·1 gallon per kwh. to 0·3 gallon per kwh.

As mentioned above, Linde undertook the design of a liquid-air plant originally with the idea of using it to extract oxygen from the air, as an improvement on the chemical method then in use. His first really successful apparatus was described in 1902, and utilized the principle of the familiar rectifying column. This depends for its action on the facts that liquid and vapour in equilibrium with each other have different compositions, and that the boiling point of oxygen is higher than that of nitrogen. Thus a liquid with 20 per cent nitrogen and 80 per cent oxygen is in equilibrium with a vapour containing 52 per cent nitrogen and 48 per cent oxygen, while liquid with 80 per cent nitrogen and 20 per cent oxygen corresponds to a vapour with 95 per cent nitrogen and only 5 per cent oxygen.

In a simple rectifier for the production of oxygen, the liquid air, at a temperature just below its boiling point, enters the top of the column, consisting of a chamber stacked with glass balls, over which it trickles to the bottom. The liquid in the column meets a rising stream of oxygen, which is itself cooled and condensed, thereby giving up heat which evaporates nitrogen from the down-flowing liquid. The latter thus becomes progressively richer in oxygen, until at the bottom it consists of nearly pure oxygen. Arrangements are made to draw off the gas from the liquid which collects at the bottom. In its path, it is used to cool the incoming air, and similarly the nitrogen which escapes from the top of the column is made to act as a cooling medium before it finally escapes. By the nature of the process, if pure oxygen is required, the escaping nitrogen is far from pure; conversely, if the rectifier is operated so as to obtain pure nitrogen, then the oxygen is impure. To obtain both elements pure would require multiple rectification, in which the products from both ends were separately redistilled, and it is not at present commercial practice to make both gases in one plant.

It should be noted that the operation of a rectifying column so as to produce pure nitrogen involves appreciable modification. Instead of collecting the desired product as a liquid at the bottom, and allowing some to evaporate, it is then necessary to collect the gas at the top and to condense some of it to provide a downflow of the liquid. The device suitable for this purpose was introduced by Linde some eight years after his first rectifier, and is described as the Linde double-column rectifier.

In the early days of this subject, the only product of commercial importance was oxygen, which is now used (for example, in welding) on an enormous scale. In the last twenty years, however, the demand for nitrogen has become equally important, in view of its use in synthesizing ammonia. When it is required for this purpose, the plant which liquefies and rectifies the air is invariably on the site of the synthetic ammonia works, and the nitrogen merely flows along a pipe line from the rectifier to the point where it is used. Nitrogen of purity 99·96 per cent is now manufactured commercially, without the necessity for any chemical treatment.

This development would have astonished Linde, to whom the nitrogen was not only a troublesome impurity, but the more so on account of its being present to the extent of four fifths of the whole raw material.

His astonishment at the rise of nitrogen to an importance such that the two gases are now prepared in roughly equal quantities, would be small compared with his amazement if he could learn that some air is now liquefied for the sole purpose of extracting argon from it, and that there is every likelihood of a thriving industry growing up to extract krypton and xenon—gases which are present in the atmosphere to the extent of 1·1 and 0·08 parts in a million by volume.

Up to the present, the demand for argon arises solely from the needs of the gas-filled lamp, where its high molecular weight makes it of value in preventing the evaporation of the filament, and thus enables the latter to run at a high temperature and a correspondingly high luminous efficiency. Although the gas-filled lamp was only introduced about twenty years ago, its importance may be gauged from the fact that some thousand million such lamps are now made annually.

To separate argon from air, the latter is first fractionated into two components, an argon-oxygen mixture free from nitrogen and an impure nitrogen, which is rejected. The mixture of argon and oxygen is then rectified, by apparatus of the same type as that used in simple rectification; the argon so produced contains the residual nitrogen from the oxygen-argon mixture, the oxygen being practically free from nitrogen and containing about 0·2 per cent argon. The oxygen, of course, is not wasted; it is in fact an economic necessity to obtain a second product when the necessary large volumes of air are being treated to extract the 1 per cent argon which they contain.

Helium and neon have boiling points far below those of argon, oxygen and nitrogen. Hence they remain in the gaseous form, and accumulate at the top of the separating column. It is in some works found profitable to collect these gases from time to time, since neon is, or was until the black-out, in demand as a filling for the gas discharge tubes of striking red colour widely used for advertising purposes.

It is clear from what has been said above that Linde was one of those pioneers whose work was so well done that it could bear extension in many directions: for many of the later developments, carried out since his death, have retained his methods with only minor modifications.

OBITUARIES

Sir Joseph Larmor, F.R.S.

Joseph Larmor was born at Magheragall, Co. Antrim, on July 11, 1857. In his schooldays at the Royal Belfast Academical Institution, he is described as a "thin and delicate black-haired boy of most precocious ability both in mathematics and classics". He gained a scholarship at Queen's College, Belfast, where he graduated with the highest honours. From there he proceeded to St. John's College, Cambridge. A severe illness made it necessary for him to lose a year; but he took the Mathematical Tripos in 1880 and came out Senior Wrangler, J. J. Thomson being second. Larmor was at once appointed professor of natural philosophy in Queen's College, Galway. He was there during 1880–85, and then returned to St. John's College as lecturer. In 1903 the Lucasian professorship fell vacant through the death of Sir George Stokes; Larmor succeeded him, and held the famous chair of Newton until his retirement in 1932. His last years were spent at Holywood, Co. Down, where he died on May 19.

The researches by which Larmor will chiefly be remembered belong to the years about 1895–1905, which are now looked upon as a transition period. The great wave of expansion of physical science in mid-Victorian times, in which Maxwell, Kelvin, Stokes, Rayleigh and others were prominent, had spent its force. Apart from one or two 'small clouds on the horizon', the classical theories seemed to have been well rounded off; and it was beginning to be said that the possibilities of progress were approaching exhaustion. Later the new conceptions associated with quantum theory and the theory of relativity were to arise, and wake theoretical physics into another outbreak of feverish progress. In the interim, two names stand out prominently, Lorentz and Larmor. Their work has not been effaced by the newer developments. Larmor's results are accepted as fundamentally sound, and are now turned to account in ways which must have greatly perturbed the conservative mind of their originator. The magnitude of his achievement was recognized by the award of the Copley Medal of the Royal Society in 1921.

Of the two rivals in the Tripos of 1880, Thomson was the first to achieve wider eminence, originally as a theoretical physicist but later in experimental researches. Larmor, who always remained on the theoretical side, developed more slowly, and it was not until 1892 that his work gained him election into the Royal Society. From 1894 until 1897 he published a notable series of memoirs on electromagnetic theory in the *Philosophical Transactions*; these form the foundation of his book "Aether and Matter", published in 1900. The purpose was to work out systematically the idea, then gaining ground, that matter is essentially an electrical structure. In particular, the continuous electric fluid of Maxwell was replaced by a particle theory which recognized that electricity, like matter, is atomic in structure. A particle theory of electricity was very much in keeping with the experimental advances of the time, but that seems to have been partly a coincidence. The electron was not discovered experimentally until 1897. In "Aether and Matter" the term electron is used indiscriminately for positive and negative charges, although it was not until twelve years later that this view of the nature of positive electricity became reconciled with experimental knowledge.

"Aether and Matter" is, in substance, one of the greatest of scientific books. It is a difficult book, because Larmor's habitual obscurity of style often makes his published work almost as unreadable as his handwriting. But to the student of the period 1900–5 it was the one gateway to new thought, inspiring and revolutionary. It must not be inferred from the title that it represents a wholly antiquated form of thought. Scientific writers nowadays have to bow to the prejudice which does not allow the ether to be named, and are obliged to use a periphrasis; but the 'resonators' and the 'particles in negative energy levels', now employed to fill the space where the ether used to be, expose the error of those who thought the ether had become unnecessary. Modern progress has modified Larmor's "Aether" no more and no less than Larmor's "Matter".

Of special interest was Larmor's result that, if matter is electrically constituted, any moving object must suffer a minute contraction in the direction of its line of motion. The first suggestion of such a contraction was a brilliant guess proposed by FitzGerald to explain the unexpected result of the Michelson-Morley experiment. In the light of Larmor's theory it becomes no longer a hotly disputed hypothesis, but an immediate deduction from the electromagnetic laws universally accepted. In this and in other developments it is difficult to disentangle the shares of Larmor and Lorentz; and perhaps it is of no great moment to separate contributions which have now become woven together. But, from the account given in Whittaker's "History of the Theories of Aether and Electricity", it appears that the well-known Lorentz transformation was originally given by Lorentz in the form of a first-order approximation, afterwards extended by Larmor to the second order, and finally shown by Lorentz to be exact. Since it is in the second order approximation that the contraction effect is found, it was Larmor's contribution which elucidated it; and we shall perhaps do justice between Holland and Ireland if we speak of the "Lorentz transformation" and the "FitzGerald-Larmor" contraction.

Among Larmor's outstanding contributions were two results continually quoted and used in present-day researches, namely his formula for the radiation of energy by an accelerated electron, and his theory of the precession of electron orbits in a magnetic field. He wrote valuable papers on a variety of subjects including hydrodynamics, waves and the Heaviside layer. He was an enthusiast for the Principle of Least Action as the key-stone of physics, and wrote extensively on the transformation of electrodynamics and other branches of physics into that form.

After his own revolutionary outbreak, Larmor became decidedly conservative in his scientific views. It was difficult to ascertain how much he appreciated the new developments in relativity theory and quantum theory, because he was accustomed to adopt a pose which exaggerated his aloofness. In examining dissertations with him one had always to listen to a tirade against the wild kind of problem on which the modern young man spends his time; but he was generally well informed on the actual subject-matter. My impression is that he followed the new theories very attentively, but always cherished the hope of finding a weak spot in them.

Although his heart was with the physicist of the nineteenth century, Larmor must be counted as the harbinger in England of the new ideas which mark the present century. He was the first to throw off the obsession which possessed an earlier generation—that everything must be explained as though the universe had been made from materials and contrivances similar to those of an engineering workshop. The ether of "Aether and Matter" (a development of MacCullagh's rotationally elastic ether) was not a material fluid possessing density, compressibility or other characteristics of gross matter; it was an entity of a different order with properties describable symbolically, in which the "freely mobile intrinsic strains" were shown to give birth to the commonly recognized properties of matter. It was tempting, after his conservative outbursts, to chaff him as having been the moving spirit in the revolutionary ideas which so much disturbed him—and it is undoubtedly true that his teaching had had great influence in that direction—but it was plain that he did not like the accusation.

Introduction to MODERN PHYSICS

By F. K. RICHTMYER
Late Professor of Physics, Cornell University
and E. H. KENNARD
Professor of Physics, Cornell University

723 pages, 9 × 6, 233 illustrations, 35s. net
Third Edition

THIS well-known text has been brought up to date and almost entirely re-written in accordance with recent advances in atomic theory and in the physics of the nucleus and of fundamental particles.

The double process of shortening existing material and of modernizing the viewpoint has resulted in a text admirably adapted to the requirements of the student who wishes to obtain a correct perspective of the growth and present trend of physics as a whole.

Contents

Preface
Introduction
Historical Sketch
Electromagnetic Waves and Moving Charges
The Photoelectric and Thermionic Effects
The Theory of Relativity
The Origin of the Quantum Theory
The Nuclear Atom and the Origin of Spectral Lines
Wave Mechanics
Atomic Structure and Optical Spectra
The Quantum Theory of Specific Heats
X-Rays
The Nucleus
Cosmic Rays
Appendices
Index

McGraw-Hill Publishing Co. Ltd.
Aldwych House, London, W.C.2

The Faraday Society

6 Gray's Inn Square, London, W.C.1.

The June/July issue of the Transactions, which will be published on the 1st of July, will include the following papers:

Electrokinetic Behaviour of Carborundum. By A. J. Ham and W. Hodgson.

The Crystal Structure of β-Isoprene Sulphone. By E. G. Cox and G. A. Jeffrey.

The Ionisation Constant of Benzoic Acid in Methanol-Water Mixtures. By H. N. Parton and J. Rogers.

Sediment Volumes and the Specific Viscosity of Suspensions and Solutions in Mixed Liquids. By E. W. J. Mardles.

Experimental Criteria for the Recognition of Chain-Thermal Explosions. By F. S. Dainton.

The Kinetics of the Autoxidation of Inorganic Reducing Agents. Part I—Titanous Chloride. By H. A. E. Mackenzie and F. C. Tompkins.

METHUEN

The Psychology of Early Childhood

A study of mental development in the first five years of life

By C. W. VALENTINE, M.A., D.Phil.

This book, by the well-known author of *The Difficult Child and the Problem of Discipline*, traces all aspects of mental development from the first hour after birth to the stage of reasoned thought at about four or five years of age.

Demy 8vo. 576 pp. 22s. 6d. net

Testing Results in the Infant School

By D. E. M. GARDNER
City of Leeds Training College

A thoroughly documented vindication of the principle of freedom in modern education.

Crown 8vo. 6s. 6d. net

Practical Acoustics and Planning Against Noise

By HOPE BAGENAL

This book, by an acknowledged expert, is an up-to-date summary of information on sound-proofing, planning against noise, and auditorium design.

"Ought to be on the bookshelf of every student and practising architect."—*Builder*.

Crown 8vo. Illustrated. 7s. 6d. net.

Intermediate Algebra

By N. McARTHUR, M.A., B.Sc., and A. KEITH, M.A., B.Sc.

A new work designed for the use of first year University students and higher classes in schools.

"A genuine contribution to mathematical education."—*Schoolmaster*.

Crown 8vo. 8s. 6d.

Experimental Physics

By D. H. BELLAMY
Normanton Grammar School

A new book for H.S.C., Inter B.Sc., 1st M.B., and M.P.S., containing over 230 experiments, with hints, lists of apparatus, test questions and practical examination questions.

"An excellent book."
—*Scottish Educational Journal.*

"The treatment throughout is sound."
—*Times Educational Supplement.*

Crown 8vo. 8s. 6d.

The Cambridge Evacuation Survey

Edited by SUSAN ISAACS

"Scientific in the best sense."—*British Weekly.*
"This extremely valuable survey."
—*Times Lit. Supp.*

Crown 8vo. 8s. 6d. net

Methuen & Co. Ltd., 36 Essex St., W.C.2

WEEK-END COURSE FOR INDUSTRIAL MEDICAL OFFICERS

An intensive course on Factory Medical Services and Industrial Diseases will be held at the London School of Hygiene and Tropical Medicine, Gower Street, W.C.1 (Tel. MUSeum 3041), at the week-end June 27 and 28, 1942. The course is a practical one and primarily for Works Medical Officers. Fee one guinea.—Apply to the Secretary for further information.

THE UNIVERSITY OF SHEFFIELD

The Council are about to appoint a TEMPORARY ASSISTANT LECTURER in MATHEMATICS, at a salary of £300 per annum. Consideration will be given to any candidate, man or woman, who possesses an Honours Degree which includes Mathematics. Further particulars may be obtained from the undersigned, with whom applications should be lodged by June 24.

W. M. GIBBONS,
Registrar.

NORTHUMBERLAND COUNTY COUNCIL

PUBLIC HEALTH DEPARTMENT

Applications are invited from science graduates for the appointment of temporary Assistant in the Council's Bacteriological Laboratory. Salary £400—£500 p.a. according to qualifications and experience.—Applications immediately to the Bacteriologist, County Laboratory, Newburn, Northumberland.

Microscope and comprehensive set of slides of zoological subjects in large fitted cabinet. S. Elliman, 118 Park Street, London, W.1. Mayfair 8240.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

AGRICULTURAL ECONOMICS

Applications are invited for the vacant post of First Technical Assistant (male) in the Economics Department.

Applicants must hold a degree in agriculture with special qualifications in, or aptitude for, economic investigation. Duties will include field work, financial and cost accounting and lecturing. The selected candidate will be expected to provide a car.

Salary, subject to approved service, £250×10—300×20—400 plus cost of living bonus.

Applications should be lodged with the undersigned on or before June 12, 1942.

6 Blythswood Square, Glasgow. A. J. WILSON, Secretary.

THE UNIVERSITY OF LEEDS and THE YORKSHIRE COUNCIL FOR AGRICULTURAL EDUCATION

LECTURESHIP IN HORTICULTURE

Applications are invited for this post. Salary £450 to £550 according to qualifications. Further particulars may be obtained from the Registrar, The University, Leeds, 2, who will receive applications up to June 15, 1942.

Physicist (36), M.Sc., D.Phil., 5 years research experience, seeks industrial post. Good testimonials. Could be free August.—Box 854, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

UNIVERSITY COLLEGE OF HULL

Applications are invited for the temporary Headship of the Department of Physics during the absence of Professor Palmer on national service. Salary according to qualifications and experience, with maximum of £800. Particulars from the Registrar, to whom applications must be sent by June 13.

Applications are invited from persons with a thorough knowledge of agriculture and horticulture, particularly as applied to fruit growing and glasshouse crops, preferably with a training in entomology, for a technical post in pest control matters with a large and important group. The successful applicant may be required to live in any part of Great Britain. Full particulars of qualifications, experience and salary required should be furnished, and applications, which will be treated in strict confidence, should be addressed to Box 855, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

Microscopes Wanted for important scientific and research work. Complete and elaborate outfits up to £500 particularly required. Highest possible prices paid. Prompt cash. High prices also paid for Leicas, Contaxes and similar miniature cameras.—Wallace Heaton, Ltd., 127 New Bond Street, London, W.1.

Microscopes, second-hand, a large selection of instruments in perfect condition; 3d. stamp for list.—Chards, Specialists (Est. 70 years), Forest Hill, S.E. 23.

LARGE DEPARTMENT FOR SCIENTIFIC BOOKS

★ FOYLES ★

Booksellers to the World

New and secondhand Books on every subject. Catalogues Free

113-125 CHARING CROSS ROAD, LONDON, W.C.2

Open 9 a.m.—6 p.m. including Saturday

Tele: GERrard 5660 (16 lines)

Our RARE BOOK DEPARTMENT is the LARGEST Stockist of Complete Sets, Runs and separate Volumes of

SCIENTIFIC PERIODICALS, ACADEMICAL AND LEARNED SOCIETY PUBLICATIONS

(English and Foreign)

WE INVITE OFFERS OF THESE, FOR WHICH WE ARE PREPARED TO PAY THE HIGHEST COMPETITIVE PRICES

COMPLETE LIBRARIES PURCHASED

Specially wanted. Complete set or any volumes of NATURE.

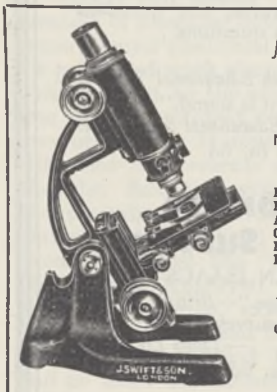
EARLY SCIENTIFIC WORKS AND BOOKS ON THE HISTORY OF SCIENCE WANTED

CATALOGUES ISSUED

WM. DAWSON & SONS LTD.

43, Waymouth Street, - - - - LONDON, W.1

Welbeck 1621.



JAMES

SWIFT

& SON LTD.

Manufacturers of

MICROSCOPES for

BIOLOGY MINERALOGY, METALLURGY PHOTOMICROGRAPHIC & PROJECTION APPARATUS, GONIOMETERS, REFRACTOMETERS, SPECTROMETERS, OPTICAL MEASURING & TESTING APPARATUS, POLARISING PRISMS & OPTICAL ELEMENTS

REPAIRS TO ANY MAKE OF ABOVE INSTRUMENTS

Owing to prevailing conditions delivery cannot always be guaranteed

81 Tottenham Court Road London, W.1

MICROSCOPES AND ACCESSORIES **WANTED** HIGHEST PRICES GIVEN

Write, call or phone

DOLLONDS

35 BROMPTON ROAD, LONDON, S.W.3

Telephone: Kensington 2052

Short and Mason Ltd. manufacture Aneroid and Standard Mercurial Barometers, Thermometers, Anemometers (including M.O. Pattern), Hygrometers, Raingauges, Sunshine Recorders, and Thermographs (including M.O. Patterns) for Meteorological Purposes. Naturally supplies are short, but certain types are still available from stock.

SHORT & MASON

LIMITED

THE INSTRUMENT HOUSE

LONDON E.17

RECENT PUBLICATIONS

Carnegie Institution of Washington

WASHINGTON, D.C.

Pub. No.

338. STOCK, LEO FRANCIS (editor). **Proceedings and Debates of the British Parliaments Respecting North America.** Volume V, 1739–1754. Octavo, xxv + 658 pages. Paper, $3.50; cloth, $4.00.

511. CHATELAIN, VERNE E. **The Defenses of Spanish Florida, 1565 to 1763.** Quarto, vii + 192 pages, 4 plates, 22 maps. Paper, $2.25; cloth, $2.75.

533. MORRIS, EARL H., and ROBERT F. BURGH. **Anasazi Basketry, Basket Maker II through Pueblo III, A Study Based on Specimens from the San Juan River Country.** Quarto, viii + 66 pages, frontispiece, 43 text figures. Paper $1.50; cloth, $2.50.

Embryology Reprint Volume I. **Embryology of the Rhesus Monkey (Macaca mulatta).** Collected papers from the Contributions to Embryology. Quarto. Paper only, $1.00.

Year Book No. 40 (July 1, 1940–June 30, 1941). Octavo, 346 pages, 4 text figures. Paper, $1.00; cloth, $1.50. Reports on current research from all the departments of the Institution.

The Carnegie Institution of Washington, Washington, D.C., has published some 750 volumes covering the wide range of its researches. Orders may be placed direct or through regular dealers. Advise subjects in which you are interested, and catalogue will be sent upon request.

SCIENTIFIC BOOKS

Large Stock of Books in all branches of

PURE AND APPLIED SCIENCE

including

CHEMISTRY : PHYSICS AND MATHEMATICS
ENGINEERING : BIOLOGY : AGRICULTURE, ETC.

FOREIGN BOOKS

supplied from Stock or obtained under Licence

SECOND-HAND BOOK DEPARTMENT: 140 Gower Street.

Inquiries invited for Literature on **ANY SCIENTIFIC SUBJECT.**

SCIENTIFIC AND GENERAL STATIONERY

H. K. LEWIS & Co. Ltd.
136 Gower Street, London, W.C.1
Telephone: EUSton 4282 (5 lines)

HEFFER'S
BOOKSHOP

In spite of all difficulties Heffer's still have a fine stock of new and secondhand books in nearly every field of science, medicine and technology. Catalogues are issued from time to time so far as paper control regulations allow.
Heffer's will be glad to buy any quantity of good books you wish to sell, so please send particulars to

W. HEFFER & SONS, LTD.
BOOKSELLERS, CAMBRIDGE

MACMILLAN'S
NEW BOOKS

Fighting for What?

SIR JOHN BOYD ORR, F.R.S.
Director, Rowett Research Institute, Aberdeen

A food policy which is to form an effective basis for post-war reconstruction must be concerned not with trade interests but with the nutritional needs of the people. Sir John Orr, one of the world's leading authorities on nutrition, whose work on the League of Nations Technical Commission on Nutrition and the Ministry of Health Advisory Committee on Nutrition has brought far-reaching results, offers here a food policy which can be applied on a world-wide scale. Sir John examines the impact of his policy on world society and continues the argument to include the most important aspects of the fourth freedom of the Atlantic Charter, namely, food and home on a satisfactory health standard, together with security of work. Sir John Orr's views have inspired many politicians, sociologists and men of science both in Great Britain and abroad; here they are crystallized in a form suitable for all types of readers. 2*s.* 6*d. net.*

Biography of the Earth:
Its Past, Present and Future

PROF. GEORGE GAMOW
Professor of Theoretical Physics, George Washington University

Prof. Gamow is distinguished for his contributions to nuclear physics and also as a skilful writer able to convey highly technical conceptions to the general reader. In this latter vein he has already written books on relativity and on the solar system, and now he has shown the contribution which various sciences have made to our knowledge of the history and structure of the earth. 12*s.* 6*d. net.*

MACMILLAN & Co. Ltd.
St. Martin's St., London, W.C.2

E498

EQUIPMENT FOR SPECTROCHEMICAL ANALYSIS

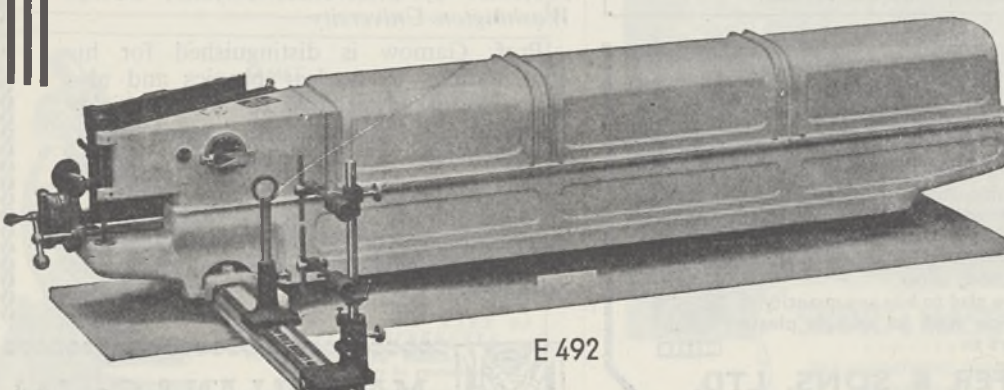
FOR NON-FERROUS METALS
The Barfit Flat-Field Medium Quartz Spectrograph and accessories (illustrated above)

FOR FERROUS METALS
The Fully Automatic Large Quartz Spectrograph and accessories (illustrated below)

In constant use in works laboratories in conjunction with the HILGER Non-recording Microphotometer for rapid quantitative routine analysis of industrial alloys.

FULL DETAILS IN CATALOGUE S.B. 107
POST FREE FROM

ADAM HILGER LTD. 98 St. Pancras Way Camden Road **LONDON** N.W.1
Phone: GULliver 4451



E 492

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

Larmor had a strong attachment to his native country. It is no coincidence that "Aether and Matter" is so largely a development of the work of his countrymen MacCullagh, Hamilton and FitzGerald. It was probably his intense feeling over the Irish question which persuaded him to enter Parliament, where he represented the University of Cambridge as a Unionist from 1911 until 1922. He can scarcely have found the position congenial; and it was clearly not the right field for his abilities. His most important work outside the University was as secretary of the Royal Society from 1901 until 1912. As a University teacher, his lectures were obscure, ill-ordered and difficult to follow; but they were well worth the effort to follow. There are doubtless many who can, like the writer, testify to the inspiration which they imparted.

A. S. EDDINGTON.

WE regret to announce the following deaths:

Dr. H. A. Des Vœux, president of the National Smoke Abatement Society, on May 20.

Prof. A. R. Forsyth, F.R.S., emeritus professor of mathematics at the Imperial College of Science and Technology, on June 2, aged eighty-three.

Dr. Emil von Grósz, honorary fellow of the Royal Society of Medicine and president of the International Campaign against Tuberculosis, aged seventy-six.

Dr. John Lindsay, professor of physiology and histology at the Glasgow Veterinary College, aged seventy-seven.

Mr. E. Hesketh, a well-known refrigeration engineer, on May 18.

Mr. R. G. McConnell, director of the Geological Survey of Canada and Deputy Minister of Mines during 1914–20, on April 1, aged eighty-five.

NEWS and VIEWS

National Institute for Medical Research

Sir Henry Dale, P.R.S.

SIR HENRY DALE, who retires from the post of director of the National Institute for Medical Research on September 30, has long been the central figure in some of the most active fields of physiological and pharmacological research. During the years 1906–14, he was director of the Wellcome Physiological Research Laboratories, where he gathered around him a very brilliant team of workers. He then joined the staff of the newly formed Medical Research Committee, which became the Medical Research Council in 1920. He has been the effective head of the Council's laboratories at the National Institute at Hampstead since they were first opened. Under his leadership these laboratories have become world-famous.

Much of Dale's early work centred around the pharmacological analysis of extracts of ergot, which were found to contain, among other things, ergotoxine, tyramine, histamine and acetylcholine, all of which had interesting properties and all of which served as the origins of broadening advances. With various collaborators he showed that histamine and acetylcholine are both normal constituents of the body of mammals, and he has done more than anyone else to establish the significance of these discoveries. The work which demonstrated the relation between acetylcholine and nerve endings won the Nobel Prize for Physiology in 1936, which he shared with Otto Loewi. Many other fields of work have been illuminated by his clear brain and genius for experiment, which have done great service to British medical research not only through his own work and that of his immediate colleagues, but also through advice and help freely given to a very large number of people. He has mainly been responsible for the success of the League of Nations in establishing international standards for the biological standardization of bacteriological products, hormones and vitamins, and a large proportion of the actual international standards are kept at the National Institute.

Prof. C. R. Harington, F.R.S.

PROF. C. R. HARINGTON, professor of chemical pathology in the University of London, and director of the Graham Research Laboratories at University College Hospital Medical School, who is to succeed Sir Henry Dale as director of the National Institute for Medical Research, became well known through his work on the active principle of the thyroid gland, which he started with Prof. George Barger in Edinburgh and continued in University College, London. Thyroxine had been isolated by E. C. Kendall but not in sufficient quantities for accurate chemical work. With various collaborators Harington devised an improved method of isolation, determined its structure, synthesized it, resolved it into its optical isomers, showed that the natural isomer was lævo-rotatory, synthesized a number of allied substances some of which had similar pharmacological actions, isolated from the thyroid gland a simple polypeptide which differed from thyroxine in its absorption from the intestine, and showed that di-iodotyrosine was also present in the thyroid. These different aspects of work on a new active principle are generally shared among many different laboratories, and it is remarkable that one man could do so much.

Later, Harington and his colleagues did important work on crystalline insulin and synthesized glutathione. Recently they have been working on the preparation of antibodies which counteract the effects of substances such as thyroxine and aspirin, by combining these comparatively simple substances with proteins and using the compounds thus formed as antigens. Prof. Harington was appointed a member of the Medical Research Council in 1938; he has been editor of the *Biochemical Journal* for some years. His outstanding qualities certainly justify the Council in appointing, as the director of its laboratories, a man who happens to have no medical degree.

Award of James Watt International Medal

THE Council of the Institution of Mechanical Engineers has unanimously awarded the James Watt International Medal to Mr. A. G. M. Michell, of Melbourne, on the nomination of the Institution of Engineers, Australia, the South African Institution of Engineers, and the Engineering Institute of Canada. The Medal was founded by the Institution in 1936 to commemorate the bicentenary of the birth of James Watt on January 19, 1736, and is awarded every two years to an engineer of any nationality who is deemed worthy of the highest award that the Institution can bestow and that a mechanical engineer can receive. In making the award the Institution has secured the co-operation of the leading mechanical engineering institutions and societies in all parts of the world. Mr. Michell, who was elected a fellow of the Royal Society in 1934, is best known for his work in connexion with thrust and journal bearings, but he has, in addition, made a number of extremely valuable contributions to the science of engineering in connexion with centrifugal pumps and crankless engines. His outstanding achievements as a man of science, a mathematician of international fame, an inventor, and a producer fulfil in a unique way the conditions of the award of the Medal. Without the Michell bearing the high-powered modern ship and the large central power station would scarcely have been possible to-day; and it is, therefore, most appropriate that the Institution of Mechanical Engineers, which is so largely concerned in the development and application of power, should have recognized the pioneer work of Michell by awarding him this Medal. The last award of the Medal was made to an eminent Continental engineer, Prof. Aurel Stodola, who was associated with the development of the scientific basis of the design of steam turbines.

Carl von Linde, 1842—1934

CARL VON LINDE, the centenary of whose birth falls on June 11, and whose work on refrigeration is the subject of an article by Mr. J. H. Awbery elsewhere in this issue (p. 630), was one of the outstanding German engineers of his time. A lecturer of distinction, he was also a successful inventor, a sound constructor, and an indefatigable investigator. Born at Bernsdorf, Oberfranken, Bavaria, he was the son of a pastor, being the third child in a family of nine. His early training had much to do with his success, and in one of his writings he pays a touching tribute to his mother. From school at Kempen he was able to enter Zurich Polytechnic and there came under the influence of the remarkable trio Zeuner, Reuleaux and Clausius. The lectures of Clausius on heat greatly influenced him. From Zurich he entered Borsig's locomotive works at Berlin, and then joined Krauss's new works at Munich. In 1867 he drove Krauss's first locomotive to the World Exhibition at Paris. Soon after this he became an assistant professor at Munich Technical High School, and it was there that he first turned his attention to refrigeration, publishing in 1871 a paper on "Improved Ice- and Refrigerating Machines". The first machines built to his designs were constructed at the famous Maschinenfabrik-Augsburg, which afterwards built the first Diesel engines and has recently been in the news. On April 5, 1876, he took out his patent for an ammonia machine. His work proved so valuable to the brewing industries that in 1879 he resigned his professorship and founded at Wiesbaden the Gesellschaft für Lindes Eismachinen. A.-G., a concern dealing with the planning and design of refrigerating installations.

By 1891 Linde's success was such that he was able to resume his experimental work, establishing for this purpose a research institute at Munich. In 1895 he produced liquid air on a scale hitherto unknown, and in 1902 he erected the first oxygen works. The company founded in 1879 led to Linde machines being made in many countries. In 1901 a gas liquefaction works was opened at Höllsriegelskreuth near Munich, in 1920 a factory for pumps and compressors was started at Sürth near Cologne and another branch was opened at Mainz. An energetic member of the Verein deutscher Ingenieure, in 1897 Linde was awarded its highest distinction, the Grashof Medal. He was especially interested in Oskar von Miller's work in founding the Deutsches Museum at Munich, and some of his original apparatus is preserved there. He lived to the great age to ninety-two, passing away at Munich on November 16, 1934. His portrait is reproduced in Matschoss's "Great Engineers" (1939).

Physicists during and after the War

IN his address delivered at the annual general meeting of the Institute of Physics in London on May 28, the president, Sir Lawrence Bragg, spoke of the vital part physicists are playing in the national effort and referred to some of the many interesting applications of the science that have been brought to fruition under the stress of the War. The main part of his address was, however, concerned with the future, and his proposals were based on the assumption that mankind is at present in the throes of one of the great mutations of history. He believes that the oncoming technological age will require many scientific workers to continue as technologists into which they have had to turn themselves in these war years, and he suggested that the present training of physicists will need considerable modification to produce more men suitable for this type of work. Anyone who has had experience as an internal examiner is familiar with the type of graduate who knows all about the constitution of the atom but cannot read a vernier scale or perform simple exercises in mensuration. "Industry", he said, "wants physicists who have some idea how thick a piece of copper wire has to be to carry a hundred amperes."

The Planning Committee of the Institute of Physics, of which Sir Lawrence is chairman, is examining the whole question of the training of physicists after the War, although rightly, at present, many of its meetings were concerned rather with the present training and supply of physicists. Having in mind the Government's declared policy of devoting attention to post-war planning and especially to that part concerned with our export trade, the Board of the Institute has instructed the Planning Committee to examine the position of physicists after the War. A memorandum on training has, therefore, been prepared with the view of provoking open discussion, and copies of it will be available to non-members of the Institute on request. Sir Lawrence urged the constant interchange of physics students and staff from the universities with corresponding personnel from industrial and Government laboratories and made some concrete suggestions for the realization of this project. The Institute of Physics in cooperation with other scientific and engineering institutions has certain of these and similar proposals under examination. Physics will have to play an ever-increasing part in both our old-established and newer industries if they are to be enabled to compete fairly in the world's markets after the War. The Institute must, therefore, give the lead in seeing that Great Britain has a sufficient number of adequately trained and able physicists to meet the requirements of industrial and Government undertakings.

A Liquefaction Plant for Natural Gas

THE city of Cleveland, on the south shore of Lake Erie, has a population of more than 1,200,000. For domestic purposes and many industries, natural gas is supplied by the East Ohio Gas Co., the gas being brought to Cleveland through four pipe-lines from Hastings, West Virginia, about 150 miles distant. In the early part of each year, short spells of extremely cold weather are experienced, and during these spells there is a great increase in gas consumption. To meet these exceptional demands a liquefaction and storage plant has been erected possessing many interesting features. A description of the plant and a diagram of the processes involved are given in the *Engineer* of May 22. The natural gas is first freed from moisture, carbon dioxide and nitrogen, and then by means of refrigerators the gas is liquefied and its temperature reduced to $-258°$ F., at which temperature it is stored in three insulated spherical tanks under a pressure of 10 lb. A tank consists of an inner sphere of stainless steel 54 ft. in diameter, and an outer sphere of mild steel 60 ft. in diameter. The intervening space is filled with cork through which dried gases are passed to absorb moisture. The total amount of liquid gas stored in the three tanks is equal to the amount of free gas which could be contained in fifty ordinary gas holders each having a capacity of 3,000,000 cub. ft.

Institute of Physics

THE annual report of the Board of the Institute of Physics which was adopted at the general meeting held on May 28 records the continued growth in numbers and activities of the Institute. One of the features of the year was the formation of the Industrial Radiology Group—the first subject Group to be formed—under the auspices of the Institute. This step has already been followed by the formation of an Electronics Group. The following were elected to take office on October 1, 1942: *President*, Sir Lawrence Bragg; *Vice-Presidents*, Dr. W. Makower and Mr. T. Smith; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *Ordinary Members of the Board*, Prof. J. Chadwick, Prof. J. D. Cockcroft, Mr. D. C. Gall and Mr. E. B. Wedmore.

Newton Tercentenary Celebrations

THE Royal Society will, if circumstances permit, celebrate, at its anniversary meeting on November 30, the tercentenary of the birth of Sir Isaac Newton. The programme, which will be a modest one owing to the War, is to include three lectures, to be delivered in the Society's apartments at Burlington House, Piccadilly, on "Newton and the Science of his Age", by Prof. E. N. da C. Andrade, Quain professor of physics in the University of London; "Newton as an Experimenter" (with demonstrations), by Lord Rayleigh, emeritus professor of physics in the Imperial College of Science and Technology; and "Newton and the Science of To-day", by Sir James Jeans, professor of astronomy in the Royal Institution of Great Britain.

Storage of National Wheatmeal

A REPORT on the problem of the storage qualities of National wheatmeal has been published by the Research Association of British Flour-Millers in *Milling* of May 23. Storage trials were carried out over a period of a year and included not only laboratory experiments but also tests under commercial conditions in mills, bakeries and buffer depots. Moisture content is the most important factor determining storage life: thus at 14, 14½ and 15½ per cent moisture contents, provided the storage conditions are good and a sound wheat grist is used, the wheatmeals will keep in good condition for 9 months, 4–6 months and 2 months respectively. Temperature is a further factor, and whereas at 60° F. a wheatmeal of 15½ per cent moisture remained in good condition for 11 weeks, at 77° F. it kept only for 3–4 weeks. An additional point of importance revealed by the experiments is that National wheat meal is more prone to insect infestation than white flour.

Silver Leaf Disease

SILVER leaf is one of the most serious diseases with which fruit growers have to contend, and the Advisory Leaflet No. 246 issued by the Ministry of Agriculture should do much to clear up misunderstandings on the nature of the disease and thereby improve the methods of control. *Stereum purpureum* is a parasitic fungus which attacks the living tissues of the wood by means of wound penetration. It does not occur in the foliage, and the silvering of the leaves is merely a secondary effect of the attack. Discoloration and eventual death of the infected woody parts of the tree occur, followed by the development of fruiting bodies, by means of which the disease is spread. Illustrations of these fructifications are given, for their recognition on dying trees, old stumps or logs is important if adequate control of the disease is to to be obtained.

The silvered leaves do not constitute a source from which the disease can spread. Natural recovery is always a possibility in a slightly affected tree, and removal of all silvered branches in the early stages may prevent an extension of the trouble. Branches that have begun to die back, however, must be cut out and burnt early in the summer and no stumps or roots of a dead tree left in the ground. Every effort should be made to prevent and protect natural wounds on the trees, as it is at such surfaces that the parasite gains an entry. Many kinds of fruit trees may be attacked by this disease, but plums are particularly susceptible, though the variety, or the stock on which the variety is grafted, may influence the susceptibility to some extent. A list of the more commonly attacked varieties of plum and apple is given.

Carnegie United Kingdom Trust

THE twenty-eighth annual report of the Carnegie United Kingdom Trust (Dumfermline: The Trust) covers the year 1941, and for reasons of economy omits the accounts from the general distribution although they can be obtained on application. Considerations which govern the grant policy of the trustees are detailed in an appendix. The two main policies upon which the Trust is now engaged, operating on a year-to-year basis, are youth service and music. In regard to the former, grants have been offered to local voluntary bodies in aid of capital expenditure on the equipment of clubs for young people, including both the initial equipment of new clubs and the provision of additional equipment for existing ones. Contributions have also been made to the headquarters administration of the National Associations of Boys' Clubs, Girls' Clubs and Young Farmers' Clubs in England and Wales and in Scotland. Publication of the full report on the exploratory work on mixed clubs for young people of both sexes is anticipated early this year. Grants have also been made for the training of potential youth leaders, but the experiment with youth service camps in Oxfordshire has proved unsuccessful and has been discontinued. The Music Education Committee is encouraging the establishment throughout England and Wales of county music committees to co-ordinate all amateur musical activities in the administrative county areas and to foster new developments. The joint Committee for Drama seeks to promote the establishment of county drama committees and the appointment of county drama organizers. Contributions to the Land Settlement Association have been considerably reduced, but grants to the National Council of Social Service have continued at the £5,000 level in 1940–41–42. In addition, a grant of £3000 to the Y.M.C.A. has enabled the Association to continue its scheme of training boys for farm work and placing them in permanent positions on the land; more than six hundred boys were successfully trained and placed during 1941.

New Zealand Earthquakes

ACCORDING to a bulletin just received from the Dominion Observatory, Wellington, twelve strong earthquakes were registered during February 1942 by the thirteen seismographic stations in New Zealand. The interpretation of many of the seismograms was hindered by microseisms, though it is thought that the earthquake of February 17, the preliminary waves from which arrived at Wellington at 04h. 18m. 24s. U.T., had its epicentre in the Coral Sea. A good deal of minor activity, which is expected in New Zealand, was recorded, and many local shocks were reported as having been felt by observers throughout the islands. The highest intensity reached was 6 on the Rossi-Forel scale (ringing of bells, stopping of clocks, breaking of windows, etc.), which occurred on two occasions: on February 21 at 22h. 23·9m. U.T., felt at New Plymouth, and on February 22 at 12h. 18·1m. U.T., felt at Whakatane and Opotiki, and followed by numerous minor shocks.

Earthquakes Registered in Switzerland

FROM October 1, 1941, until January 31, 1942 (bulletins just received from Zurich), fifty strong earthquakes were registered by the seismographs at Chur, Basel, Neuchâtel and Zurich. Some of these earthquakes were local (that is, in Switzerland), and others have been noticed previously in NATURE. Two, which have not been mentioned previously, occurred in Italy. They were on November 10, 1941, with epicentre near Lago di Garda, *eP* being registered at Chur at 03h. 29m. 21·8s. U.T., and on January 2, 1942, with epicentre in the neighbourhood of Trento, *eP* being recorded at Zurich at 09h. 00m. 41·2s. U.T.

Leprosy in Brazil

ACCORDING to the *Journal of the American Medical Association* of April 4 the prevalence of leprosy in Brazil is comparable to that of the U.S.S.R., which has about 170,000 lepers to 170 millions of population. There are now sixteen modern leprosariums, where 15,173 patients were isolated on December 31, 1941. In the State of São Paulo more than 90 per cent of the contagious cases are isolated in six leprosariums, about 2,500 cases are isolated in the State of Minas Gerais and about 1,000 in the State of Para. There are 15 preventoriums where the healthy children of lepers are interned and many more institutions of the kind are being organized. Since 1938 the technique of infiltrations of the lesions through multiple local injections of chaulmoogra oil has been increasingly used with good results. The epidemiology of leprosy in Brazil is now being investigated. About 25 per cent of the cases are of the purely nervous form. The disease is more prevalent in males than in females and in coloured natives than in white Brazilians. The prevalence is also higher in white foreign people and in white foreign-born Brazilians than in white native-born Brazilians.

University College, Exeter: Air-raid Damage

DURING recent air attacks on Exeter, certain parts of University College were damaged. Some damage was done to the Botany Laboratories, the office building and the Handicraft Centre were completely burnt out, considerable damage was done to the new Library and two halls of residence. All the glass-houses, potting sheds, storehouses, etc., on the College estate were destroyed.

Comet Grigg-Skjellerup

A TELEGRAM from Tokyo has been transmitted by Strömgren announcing the discovery of this comet by Kanna Sekituti. Its position on May 9d. 11h. U.T. was R.A. 7h. 10m., Dec. 11° 46′ N. The magnitude is given as 10.

In the "Handbook of the British Astronomical Association", 1942, Mr. F. R. Cripps has provided the elements and an ephemeris for this comet. The position is very close to that given in the "Handbook", and the object can be easily found from the ephemeris without any corrections.

Date	R.A.	Dec.	r	ρ
June 10·0	9h. 48·6m.	+31° 53·8	0·899	0·370
18	11 02·5	38 12·4	0·944	0·338
26	12 33·3	41 39·1	0·999	0·331
July 4	14 03·7	40 36·7	1·064	0·348
12	15 15·7	36 15·2	1·135	0·388
20	16 07·9	30 42·7	1·210	0·445
28	16 45·6	25 16·2	1·288	0·515

Announcements

AT the anniversary meeting of the Linnean Society of London held on May 28, the following were elected officers for the year 1942–43: *President*, Dr. E. S. Russell; *Treasurer*, Major F. C. Stern; *Deputy Treasurer*, Dr. B. Barnes; *Secretaries*, Mr. I. H. Burkill (botany) and Dr. Malcolm Smith (zoology). The new members of Council are Dr. G. S. Carter, Dr. F. C. Fraser, Mr. C. C. Hentschel, Dr. N. A. Mackintosh and Dr. R. Melville.

THE National Institute of Hygiene, which was recently founded in Paris, will consist of four departments devoted respectively to epidemiology, general hygiene, problems of nutrition and social diseases (cancer, syphilis, tuberculosis and alcoholism). Each department will be provided with laboratories. The institute will be under the authority of the State Secretary for Family and Health. A National Institute for Social Insurance has also been founded in Paris and will be under the authority of the State Secretary of Labour.

LETTERS TO THE EDITORS

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

Origins of Human Graphic Art

THE following incident deserves scientific record, both for its intrinsic interest and for its bearing on the possible origins of human graphic art.

Meng, a young mountain gorilla (*Gorilla g. beringeri*), previously in the Zoological Society's collection at Regent's Park, was kept in a cage with white tiled walls, illuminated by a single powerful electric light. When he stood in a certain position close to the wall, the light cast a well-defined shadow of the animal on to the white surface. I was watching him one day in February 1939, when he was approximately one and a half years old. Seeing his shadow before him at one moment, he stopped, looked at it, and proceeded to trace its outline with his forefinger.

Luckily, there was an independent scientific witness of this act, as I was accompanied by Mr. E. B. Ford of Oxford. He also had noticed the gorilla's action, and agreed that it was clearly deliberate. The animal proceeded to repeat the same action twice more, but then went on with his play.

I later arranged for a small projection lantern to be set up in the cage so that shadows of different shape could be thrown on the wall. However, the gorilla refused to take any interest, and was never seen to repeat the original performance before his death at the age of about three years. I should add that Meng was exceptionally intelligent and docile.

I can find no record in the literature of any anthropoid performing a similar action. It would be of considerable interest if observation and experiment designed to elicit similar behaviour were carried out on other young anthropoids.

Various suggestions have been made as to the origins of human graphic art: for example, scribbling, the incision of geometrical patterns or their tracing in sand or clay, tracing the outline of a hand or other object held against a rock face, as well as deliberate attempts at representation. To these I think we should add the possibility of tracing the shadows cast by a low sun against a more or less vertical cliff or cave-wall.

JULIAN S. HUXLEY.

Zoological Society,
Regent's Park,
London, N.W.8.
May 12.

Effect of Ascorbic Acid on the Survival of Traumatized Animals

CLINICAL observers seem to be generally agreed that there is little relation between the degree of traumatic shock and the severity of the injury by which it is produced. However, the following observations, made during the course of a general study of wound ballistics, suggest that there is a quantitative relation between shock and trauma, even though there may remain some doubt how far the traumatic shock seen in experimental animals is equivalent to the clinical condition of 'shock' observed in man.

The primary purpose of these observations was to relate the degree of trauma, expressed in terms of the energy by which it is caused (all other conditions being kept constant) and the severity of 'shock' as estimated by the mortality-rate in groups of anæsthetized animals traumatized to different degrees. Thus, in a first series of experiments with anæsthetized guinea pigs, it was possible to calculate the amount of energy transmitted to the tissues by the missile by which they were injured. It was found that the amount of energy is related both to the degree of tissue damage and to the mortality-rate.

In a second series of experiments, anæsthetized guinea pigs were traumatized by means of a weight falling from different heights. It was again found that there is a definite relation between the mortality-rate and the amount of transmitted energy. Thus, death practically never occurs when the energy of the blow is less than 2·75 kgm. m. It occurs more frequently at energy levels between 2·8 and 3·4 kgm. m., and appears to be constant at a level of 3·7 kgm. m. Post-mortem examination of the animals used in these experiments showed the typical hæmorrhagic lesions which are stated to be characteristic of shock (Moon, 1938)[1].

If it be assumed that the condition of the animals during the post-traumatic interval is equivalent to that which is clinically recognized as 'shock', these experiments suggest that there is a quantitative relationship between the intensity of shock and the chances of survival on one hand, and the degree of trauma administered on the other. A similar conclusion is suggested by Noble and Collip (1942)[2] in a paper which has just appeared.

A further series of experiments has been carried out in order to test the effect of ascorbic acid on the survival of guinea pigs injured by a falling weight. It was found that animals subjected to the minimum degree of traumatization which otherwise would have caused 100 per cent mortality always survived after the subcutaneous injection of ascorbic acid, in doses above 100 mgm./kgm. body weight. The beneficial effect of the ascorbic acid becomes increasingly less if treatment is delayed after traumatization. Thus, if the injection of ascorbic acid is made after the lapse of an hour, survival occurs in only some 50 per cent of the experimental animals. Following a suggestion by Dr. A. N. Drury, the influence of vitamin B_1, in doses of 5–15 mgm./kgm. body weight, was also tested. This substance was found to be less effective than ascorbic acid, only four of a group of ten traumatized animals given vitamin B_1 surviving.

The way in which ascorbic acid exercises its effect in these circumstances is unknown. Guinea pigs, like man, do not synthesize their own ascorbic acid, but obtain the vitamin from their food. All the guinea pigs used in these experiments were maintained on the same diet, but, since no vitamin C estimations were performed, it is not impossible that some of them were deficient in this factor. Whether or not this was the case, the experiments suggest that the administration of ascorbic acid in doses higher than the normal vitamin requirement has a very marked effect upon survival. The possibility that the effect is due to some pharmacological property not encompassed by the term 'vitamin' was tested in a further set of experiments on rats, which were also traumatized by means of the falling weight technique. As in the case of guinea pigs, it was found that rats which were traumatized at a level of energy-input at which control experiment showed that death would normally ensue, survived if given ascorbic acid, shortly after the trauma, in a concentration of 100 mgm./kgm. body weight. Since rats synthesize their own ascorbic acid and are animals in which, by definition, ascorbic acid is not a vitamin, it is probable that the beneficial effect of the substance after trauma is due to some other pharmacological property which it possesses.

The above experiments, of which a full account will be published later, are part of a programme of work on wound ballistics carried out under the direction of Dr. S. Zuckerman.

GEORGES UNGAR
(Free French Forces).
Department of Human Anatomy,
Oxford.

[1] Moon, V., "Shock and Related Capillary Phenomena," Oxford Medical Publications (1938).

[2] Noble, R. L., and Collip, J. B., *Quart. J. Exp. Physiol.*, 31, 187 (1942).

A New Synthesis of X-Ray Data for Crystal Analysis

RECENTLY considerable discussion has taken place about the use of Patterson vector diagrams in crystal analysis[1]. The difficulties of interpreting these diagrams in the case of complex structures as pointed out in this discussion and particularly emphasized by Sir Lawrence Bragg have led me to develop a more efficient method. This seems to be possible in the following way. Imagine a linear crystal consisting in its unit interval of s dimensionless atoms of atomic number Z_α and parameter x_α ($\alpha = 1,2, \ldots s$). Then we can define a quantity $E(h)$ deducible directly from X-ray intensity data by

$$E(h) = \sum_{\gamma=0}^{t} g_\gamma \cos 2\pi h u_\gamma, \quad \ldots \ldots \quad (1)$$

where $g_0 = \frac{1}{2}\sum_{\alpha=1}^{s} Z_\alpha^2$, $g_\gamma = Z_\alpha Z_\beta$, $t = s(s-1)$, $u_\gamma = x_\alpha - x_\beta$ or $1 - (x_\alpha - x_\beta)$ according as $x_\alpha - x_\beta <$ or $> \frac{1}{2}$ respectively. My principal idea in the new method is to synthesize the empirically deduced $E(h)$ according to equat. (5) given later in such a way that $E(h)$ is put empirically into the form :

$$E(h) = \sum_{\mu=0}^{N/2} P_\mu \cos 2\pi h u_\mu, \quad \ldots \ldots \quad (2)$$

where N is the number of divisions into which the fundamental unit interval of the linear crystal is divided. The possibility of the empirical determination of equat. (2) rests on the discovery of the equation,

$$E(q) = \frac{q \sin \pi q}{\pi} \sum_{h=0}^{\infty} (-1)^h \frac{E_h}{q^2 - h^2}, \quad \ldots \quad (3)$$

where h is zero or an integer and q any real number; $E_0 = E(0)$, $E_h = 2E(h)$. Equat. (2) is then established by a suitable method of Fourier expansion of $E(q)$ given by equat. (3). The final formula for the calculation of P_μ is,

$$P_\mu = \sum_{h=0}^{\infty} a_{\mu h} E_h, \quad \ldots \ldots \quad (4)$$

in which $a_{\mu h}$'s are constants depending on N and independent of the structure investigated. $a_{\mu h}$ decreases with h so that the right-hand side of equat. (4) is a convergent series. The linear relationship between P_μ and E_h enables P_μ to be computed quickly by a computing machine or by means of strips similar to those devised by Beevers and Lipson[2] for the computation of Fourier summation.

It is to be noted that equations (1) and (2) are of the same form. If N is chosen large enough, equations (1) and (2) would be almost identical term by term. Consequently, a comparison of the empirically determined P_μ with the theoretically calculated g_γ gives us information not only of the numerical values of u_γ but also of which pair of atoms this u_γ is due to. Furthermore, since Z's are known integers, the identification mentioned above is possible even when the values of P_μ determined empirically are not exactly equal to those of g_γ. This may arise from an incorrect choice of N, from the approximation introduced in equat. (5) mentioned below, or from the experimental error within the limit of modern intensity measurement. The choice of N is guided by the accuracy of intensity measurement, the complexity of the structure investigated, and the number of atoms contained in the unit interval. If necessary, the question whether N has been chosen correctly or not can be settled by making various syntheses for different values of N, say, N, $N/2$, $N/4$ to see if some of the equivalent terms in equat. (2) shift or not, or the values of some P_μ suffer a great change. In this way more exact and more definite information can be obtained.

$E(h)$ defined by equat. (1) is deduced from the observed $|F(h)|^2$ values of the actual structure by

$$E(h) = \frac{|F(h)|^2 8}{2\psi(j)^2}, \quad \ldots \ldots \quad (5)$$

where $\psi(j)$ is the well-known function involved in the calculation of atomic structure factor f by the Thomas-Fermi method[3]. Numerical values of $\psi(j)$ for j ranging from 0 to $3 \cdot 85\pi$ are available[4]. Equat. (5) is exact if the structure investigated is one of a pure element or an alloy in a disordered arrangement. When the structure contains no comparatively heavy atoms, equat. (5) is still almost exact; otherwise it is true only to a near approximation. But in the last case only those terms in equations (1) and (2) which involve the contributions of the heavy atoms stand out, and therefore an identification of these terms alone is sufficient for an analysis. We thus expect the method to be applicable to all cases.

Finally, we may construct a point diagram in the one-dimensional discontinuous μ space in which every point μ is associated with a corresponding P_μ according to equat. (2). The result is similar to the Patterson vector diagram, with the following differences :

(1) The quantity marked on the diagram is $Z_\alpha Z_\beta$. Thus the nature of the vectors is known at once.

(2) The diagram is a point diagram so that there is, theoretically speaking, no fear of interference of peaks provided the unit interval is finely divided. If superposition between peaks takes place, this superposition will be known directly from the comparison $P_\mu = g_\gamma$; otherwise the peaks should remain distinct from each other, no matter how close they crowd together. The last statement means that the method is applicable to complex as well as simple structures. The sharpening of peaks is partially successful in the modified Patterson method[5]. But

there the gain in resolving power is at the expense of the truthfulness of the background of the diagram by the introduction of undesirable spurious peaks.

(3) Since the series in equation (4) is convergent, it can be cut off at a suitable high order term without appreciable effect on the calculated values of P_μ. Thus, in contrast with all the Fourier methods, the so-called diffraction effects should be theoretically inappreciable in the new method.

In view of these significant improvements, we conclude that the new synthesis will be able to derive more useful information directly from the observed data than the classical Patterson, and so further narrow down the choice of alternative structures in an actual analysis.

I cannot enter here into many points which are essential for the complete understanding of the method. A detailed account, including the extension to two and three dimensions and the generalization of the method to other classical Fourier methods, will be given elsewhere. The calculation of $a_{\mu h}$'s of a two-dimensional synthesis for $N = 100$ is being undertaken. As a preliminary study and as an illustration, the method has been applied to the analysis of the simple known structure of iron pyrites. The result has been briefly described in *Science Records*[6].

S. H. YÜ.

Metals Research Institute,
National Tsing-Hua University,
Kunming.

Feb. 22.

[1] Wrinch, NATURE, 142, 955 (1938); Bragg, W. L., NATURE, 143, 74 (1939); Bernal, NATURE, 143, 75 (1939); Robertson, NATURE, 143, 75 (1939).
[2] Beevers and Lipson, *Phil. Mag.*, 17, 855 (1934).
[3] Bragg, W. L., and West, *Z. Krist.*, 69, 118 (1929); Debye, *Phys. Z.*, 31, 419 (1930); Woo, *Tsing-Hua Science Reports*, 1, 55 (1931).
[4] Yü, *Tsing-Hua Science Reports*, 1, 155 (1932).
[5] Patterson, *Z. Krist.*, 90, 517 (1935).
[6] Yü and Ho, *Science Records, Academia Sinica*, 1 (1941).

Enzymatic Production of Bacterial Polysaccharides

SEVERAL investigators have reported the formation of polysaccharide material by sterile filtrates obtained from various species of spore-forming bacilli. Thus in 1910 Beijerinck[1], using 'viscosaccharase', an enzyme present in filtered preparations of *B. mesentericus*, observed the formation of 'slime' on a sucrose-agar medium. In 1930 Harrison *et al.*[2] isolated this enzyme and showed that the 'slime' was a levan. Dienes[3], working with Oerskov's milk-bacillus and with organisms of the *subtilis* group, demonstrated that sterile extracts of these organisms could form from sucrose 'extra-bacterial' granules of a polysaccharide nature. He, too, was probably dealing with a levan-synthesizing enzyme which has now been isolated in an active form from Aerobacter[4].

From *Leuconostoc mesenteroides* Heyre and Sugg[5] isolated in an ingenious manner an enzyme which could synthesize, from sucrose alone, a dextran identical both chemically and serologically with the dextran produced by the living organism. Some time ago in these laboratories we also isolated an extremely active exocellular dextran-synthesizing enzyme from *L. mesenteroides*, but circumstances caused the interruption of the work before our investigations were completed. Inasmuch as we hope to resume the research at some future date we now publish our preliminary results, which initiate a new field of study concerning the symbiosis of yeasts and bacteria.

Our investigations[6] dealt with the search for growth-promoting factors which could stimulate dextran production by Leuconostoc species. We obtained a number of 'slimes' from a beet-sugar factory, and one of these was subjected to bacteriological analysis by Prof. A. J. Kluyver of Delft and was found to contain *L. mesenteroides, Saccharomyces cerevisiæ* Hansen and a Streptobacterium, each of which he isolated in pure culture. Since many natural viscous fermentations, such as Kephir and Tibi[7], are due to the symbiotic action of yeasts and bacteria, it occurred to us to grow this strain of *L. mesenteroides* in symbiotic association with *Saccharomyces cerevisiæ*. The growth medium was that described by Stacey and Youd[6] and 5 c.c. quantities were inoculated separately with the yeast and the Leuconostoc and incubated at 30°. After two successive subcultures from the mixed culture there was a remarkable production of dextran, the yield reaching a maximum in forty hours, whereas a period of ten days was required by the *L. mesenteroides* in pure culture to produce its maximum yield. After a third successive subculture it was noted that an opalescence occurred in the medium after one hour. that there was considerable dextran production after four hours, while after ten hours the whole medium formed a gel composed almost entirely of dextran. In the four-hour culture above, microscopic and cultural examination revealed the almost complete absence of both yeasts and bacteria, so that dextran production at this stage was undoubtedly due to exocellular enzymatic action. Confirmation of this was forthcoming from the fact that heavy inoculations from sterile filtrates of twenty-four-hour cultures produced dextran in a few hours on the same sucrose-peptone medium. This production was, however, less dramatic than that obtained by inoculation with an equal amount of unfiltered ten-hour cultures, and there is little doubt that in the latter case the enzyme system was sharply stimulated by a factor elaborated *in situ* by the living yeast cells.

The dextran was of the mucoid type and, after isolation, remained insoluble in water. By the method described by Daker and Stacey[8] it was obtained in a less viscous, water-soluble form, $[\alpha]_D + 180°$ in water, N, 0·5 per cent, and gave only glucose on acid hydrolysis.

The isolation of an enzyme capable of synthesizing a polyglucose having 1 : 6-linkages[9] from sucrose (glucose-1-fructofuranose) would appear to have a significance comparable with Hanes's discovery of the starch-synthesizing enzyme which utilizes glucose 1-phosphate; and further work in this field should lead to an understanding of some of the underlying mechanisms of enzymatic synthesis.

M. STACEY.

A. E. Hills Laboratories,
University of Birmingham.

May 14.

[1] Beijerinck, M. W. K., *Akad. Wetensch.*, Amsterdam, 12, 635 (1910).
[2] Harrison, Tarr, and Hibbert, *Can. J. Res.*, 3, 499 (1930).
[3] Dienes, *J. Infec. Dis.*, 57, 12 (1935).
[4] Aschner *et al.*, NATURE, 149, 527 (1942).
[5] Heyre and Sugg, *J. Exp. Med.*, 75, 339 (1942).
[6] Stacey and Youd, *Biochem. J.*, 32, 1943 (1930).
[7] Mayer, H. D., "Das Tibi-Consortium" (Delft, 1938).
[8] Daker and Stacey, *Biochem. J.*, 32, 1946 (1938).
[9] Peat, Schlüchterer, and Stacey, *J. Chem. Soc.*, 581 (1938).

Simplification of Musical Notation

THE value of the scientific method, to which Lord Brabazon appeals, lies in the proper use of experiment. There is available to-day a growing amount of piano music which is written without key signature, because it is without key, and with chromatic notes inserted as required. It is easy to find out whether it has the advantages Lord Brabazon assumes for his tentative proposal to omit key signatures as a first step towards a simpler notation.

For my own part I find this music difficult to read, because I have then to read each note. That may be one reason why such music repels me. But for earlier music, for which staff notation was developed, Lord Brabazon's analogy with the printed book is a good one. Just as one does not read each letter, perhaps not even each word, of a printed sentence (whence the difficulty of proof correction), so in reading music one has no time to read each note. One reads groups of notes.

Such proposed alternatives for staff notation as I have seen do not readily assist this kind of reading. In other words, they hold no promise of standing up to the scientific test, that of the control experiment. Until someone invents a notation that does, which will make music in twelve-tone technique easier to read, and perhaps to understand, musicians will remain hopeful but not expectant.

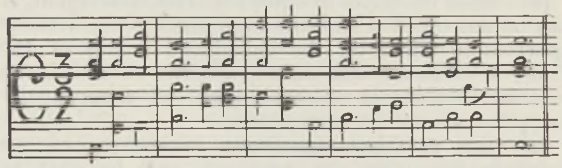
LL. S. LLOYD.

Department of Scientific and Industrial Research,
Teddington, Middlesex.

THE plea of Lord Brabazon in NATURE of May 16, p. 554, will be strongly supported by thousands of would-be players to whom the complications of clefs, key changes and accidentals have proved an impassable barrier, and by the parents of many otherwise musical children who have given up their pianoforte studies in despair because of these difficulties. On the plea of the greatest good for the greatest number, therefore, Lord Brabazon's appeal ought to receive most careful and unbiased consideration, and not least from those musicians whose real desire it is to extend the art of music-making among ordinary people. Furthermore, the use of a special form of stave for the piano and organ would not be so great a departure from tradition as might at first be supposed, for is it not on a par with the provision of special clefs for some of the instruments in the orchestra ? (Incidentally, why must we continue to use an *H* to denote a *C* clef, and a *C* for an *F* clef ?)

As a practical contribution may I put forward a simple solution ? Why not make the appearance of the printed music bear an easily recognized resemblance to the array of black and white keys on the keyboard ? Thus : make the stave consist of horizontal lines in sets of twos and threes, so that the *black lines* correspond to the *black keys*, and the white spaces the white keys. This would do away with the "treble" and "bass" clefs, with their different names for similarly placed symbols, and eliminate all sharps and flats. The three octaves at present included within the compass of the normal treble and bass clefs would naturally occupy a little more space, but the gain in clarity is obvious, every note on the keyboard having its unmistakable and unique position on the printed page.

The following example shows the first six bars of the National Anthem in the key of *A* (3 sharps) written in the new notation*. The 'dot' forming the commencement of the "C" at the beginning of the stave represents the middle *C* of the piano.



The line denoting middle C sharp is purposely made bolder ; this guides the eye and improves clarity.

Leger lines, with similar gaps between the groups of twos and threes, would be employed for notes above and below the stave, but the use of the (8ve) and (16ve) devices is to be strongly recommended wherever possible.

If any music publisher should be sufficiently interested and large-minded to answer Lord Brabazon's plea by preparing to issue a series of graded classical and popular music in some such simplified notation, as soon as war-time restrictions are relaxed, he would earn the gratitude of many now living who are debarred from 'making their own music' by the barbed-wire entanglements of sharps and flats, and would bring into the realm of possibility for future generations an era of 'music without tears'.

KENNETH B. WOOD
(formerly Musical Director,
Southfields Central Hall, S.W.)

135 Sunny Gardens Road,
Hendon, N.W.4.

* Since devising this stave I have found that one on similar lines was put forward some 50 or 60 years ago by Mitcherd. Evidently then the times were not propitious !

Luminous Phenomenon Accompanying the Cyprus Earthquake, January 20, 1941

As reported in NATURE of February 1 and 8, 1941, an earthquake of intensity VII or VIII on the Forel-Mercalli scale—the severest in Cyprus for the last sixty years—occurred on January 20, 1941, at about 5.35 local time. The beginning, as recorded at Ksara Observatory near Beyrouth, was 3h. 37m. 38s. G.M.T.

The epicentre lies between Cyprus and the Syrian coast, 200 km. from the latter and probably near the south-east coast of Cyprus. This is a region where earthquakes are not very rare.

A bright flash associated with the earthquake was seen from the eastern and central parts of the island. A Nicosia Hodja who was on the minaret for morning prayer, in describing the event, said that he first heard a deafening noise suggesting the impact of a gigantic projectile on the surface of the earth with a simultaneous rocking motion so severe that he feared the minaret would collapse. Afterwards he saw a brilliant reddish object like a huge globular lightning moving slowly towards the east. The tremors then changed into horizontal waves and gradually vanished. There is strong evidence that direction of the flash was pointing to the epicentral area.

ABDULAZIM AZIZ.

Department of Agriculture,
Nicosia,
Cyprus.

RESEARCH ITEMS

Modern Stone-Age Man in South Australia

An interesting light is thrown on possible methods used by early man by a recent description of modern stone-age man in the Musgrave Range, South Australia. The Pitjendara tribe is one of the most primitive in Australia, and among their few possessions are spears and spear-throwers fitted with an adze stone on the end. The manufacture of these spear-throwers is the subject of a recent paper "An Unrecorded Method of Manufacturing Wooden Implements by Simple Stone Tools", by C. P. Mountford (*Trans. Roy. Soc. South Aust.*, 65, (2); 1941). The tools selected were natural stones chosen for possible cutting edges, but left undressed. With these as the sole instruments a shaped slab of wood was stripped from a small mulga tree—a slow, laborious process—and the bark removed before being taken to camp. Here the shaping and finishing took place with the help of smaller, but still unflaked, stones, and finally with the aid of the adze stone of a finished spear-thrower. The adze stones themselves were merely flakes of chert with good cutting edges and were stuck into the handle end of the spear-thrower with spinifex gum warmed over the fire. When these stones became blunted with use there were some attempts to create a fresh cutting edge by tapping them with the wooden blade of a spear till miniature flakes were broken off. The throwing peg was made of wood and attached by spinifex gum to the tip of the spear-thrower and then securely bound with tendon. The stones used in these processes were all discarded and left behind, and as such stones bear no recognizable trace of their use by human beings, a material culture such as that of the Pitjendara tribe might well become extinct without leaving any trace of its existence.

Hæmophilia-like Condition in Pigs

Hæmophilia and blood conditions that resemble this abnormality have been known in man for many years. On the other hand, such a condition appears to have remained hitherto undetected among pigs. R. Bogart and M. E. Muhrer have described a hæmophilia-like condition in a line of inbred Poland China pigs (*J. Herod.*, 33, No. 2, 1942.) The feature first becomes evident at about two months in age but is by no means constant in this respect. In general, the abnormality becomes increasingly severe as the animals become older. Like hæmophilia in man, it is due to a thromboplastin deficiency. It appears that this hæmophilia-like condition in pigs is due to a recessive gene and that the variation between different individuals as regards the severity of the abnormality is brought about by modifying genes. The character is not sex-linked as in man but would cause great losses to pig breeders should the gene concerned become widespread. The authors observed the phenomenon in animals used for breeding at the Missouri Agricultural Experiment Station.

Colchicine and the Production of New Types of Forage Crops

Until recently the production of improved varieties of plants has been almost restricted to selection and hybridization within and between closely related species, since intergeneric hybrids show a complete or high degree of sterility. Colchicine affects mitosis, and cells which have an optimum dose of this substance may begin to divide but fail to complete the process, so that the two sets of chromosomes reunite with a consequent doubling of the chromosome number. If this effect can be induced in tissues which will eventually give rise to the gametic tissues, normal pairing of chromosomes occurs at meiosis so that fertility is restored and an amphidiploid type is produced. The difficulty to date has been to devise a method of application of the colchicine which produces sufficient penetration of the tissues without killing the plant. F. H. Peto and G. A. Young (*Canadian J. Res.*, 20, No. 3, Sect. C; 1942) have tested methods of application of colchicine to sterile hybrids of Triticum species with *Agropyron glaucum*. The more effective methods were (1) immersion of the young seedling in 2 per cent colchicine solution and (2) enclosure of the decapitated seedling stem in a capsule containing agar with 0·1 or 0·4 per cent colchicine. The latter method affected the young tillers and proved the most effective; of the surviving plants 21·2 per cent showed fertility, and this treatment also led to less wastage of the valuable hybrid material than methods involving immersion of seedlings or seed in the solution. The application of these methods to Triticum-Agropyron hybrids shows that fertility may readily be induced in the sterile hybrids by doubling of the chromosome number; this opens the possibility of combining the characters of related genera and the production of a vast range of new types of forage crops. One such colchicine-induced fertile amphidiploid, first produced in 1938, is now available in sufficient quantity for extensive field tests, while a number of others will be ready for similar trials in the course of a few years.

Diseases of Miscellaneous Crops

Several uncommon diseases of seakale, artichoke, sweet corn, asparagus and rhubarb have been briefly described by D. E. Green (*J. Roy. Hort. Soc.*, 67, Pt. 3; March, 1942). Rhubarb is occasionally attacked by the honey fungus, *Armillaria mellea*, in addition to crown rot and grey mould. Seakale may be infected with club-root, black-rot (*Pseudomonas campestris*), soft-rot (*Bacterium carotovorum*) and violet root-rot (*Helicobasidium purpureum*), which also parasitizes chicory, artichoke and asparagus. Grain mould of sweet corn may be caused by several fungi of the genera Penicillium and Fusarium.

Analysis of Certain Foods

At a meeting of the Society of Public Analysts and Other Analytical Chemists held on May 6, E. T. Illing and E. G. Whittle gave analytical data for samples of soya bean meal and of cereal fillers ('pabs' and bread) and discussed them in relation to the methods used. Starch was determined by several methods: precipitation by alcholol, and precipitation as iodo-compound which in some instances was decomposed and the starch precipitated by alcohol and weighed. Soya meal gave consistently high results by the first method, and moist mixtures of soya meal and bread gave low results by the last one. Methods were suggested for calculating the contents of soya meal, cereal and filler and meat in sausages and the like from the determined percentages of water, fat, protein, starch (by alcoholic precipitation) and salt-free ash. Some observations were made on the microscopic detection of soya.

Gravimetric Micro-determination of Magnesium

THIS method was described by P. F. Holt at a meeting of the Society of Public Analysts and Other Analytical Chemists on May 6. Benedetti-Pichler's method for the gravimetric micro-determination of magnesium, in which the metal is precipitated and weighed as $MgNH_4PO_46H_2O$, was found to give results which varied according to the time allowed for precipitation. Consistent but high results were obtained if the precipitate was allowed to stand in contact with the mother-liquor for several hours. A precipitation time of one hour or less gave values which were irregular but approximated to that calculated from the formula. Good values are obtained by this method if five hours are allowed for precipitation of the magnesium-ammonium salt and an empirical factor is used for conversion of precipitation weight to weight of magnesium.

Quantum Chemistry

THERE is a remarkable identity, due to Dirac, connecting the operators of exchange and spin. Taken in conjunction with the principle that in the problem of several electrons, a wave function must change sign when the orbital and spin co-ordinates are both subjected to the same permutation, the identity shows that any permutation of the orbital variables can be obtained from a certain spin operator. In other words, spin compensation goes with antisymmetry of the spin function. This is known to be fundamental in the quantum explanation of chemical bonds. E. Schrödinger has obtained a generalization of Dirac's identity (*Proc. Roy. Irish Acad.*, 47, 39 ; 1941). In the generalization, chemical compensation of spin occurs in groups of particles, instead of in pairs of single particles. Something like this applies to the heavy particles (proton-neutrons) in the nucleus. Spin compensation in this case corresponds to unit charge for each two particles. This view is supported by its agreement with several basic results concerning the nucleus.

Frequency Comparisons

L. A. MEACHAM (*Bell Lab. Rec.*, 20, No. 7, March 1942), in an article on high-precision frequency comparisons, describes a test circuit capable of making short time measurements. When measurements must be made within a short period, direct methods fail because the time intervals cannot be determined with sufficient accuracy ; but as deviations rather than absolute values are of interest, it is possible to substitute comparisons between the frequencies of two or more similar but independent oscillators. Excellent precision is obtainable by this method with equipment built to check the performance of bridge-stabilized oscillators used in the Bell System frequency standard. The oscillators were designed to be stable within 0·0001 c./sec. and the testing circuit, therefore, had to detect a variation of ten times this amount. Furthermore, the momentary nature of the changes necessitates that the measurements represent nearly instantaneous frequency values and be obtained at very brief intervals. Two 100 kc. oscillators are employed, adjusted to differ in frequency by about 0·1 c./sec. Their outputs are added together in a hybrid coil and the sum amplified and rectified to fire a thyratron tube once each beat cycle, in turn discharging a condenser through a spark coil. The resulting high voltage from the coil causes a brief flash of light in the neck of a mercury vapour lamp. A circular scale marked in milliseconds is rotated by a 1,000-cycle motor synchronized with current from the frequency standard, to record the time between flashes. Each discharge illuminates the scale and records the time on a slowly moving film, so that the time which elapses during a single ten-second beat-cycle is recorded to the nearest thousandth of a second, and any irregularity in the beat frequency amounting to more than one part in ten thousand becomes apparent. As the frequency of the beat pulses is only one millionth of the frequency of either 100 kc. oscillator, the precision of the comparison between the pair of oscillators is approximately one part in ten thousand million (10^{10}). An irregularity so small as to be undetectable by any rapid direct method thus produces a very noticeable record in the new measuring device.

Penetrating Cosmic-Ray Showers

Counter experiments on showers penetrating at least 50 cm. of lead are reported by L. Jánossy (*Proc. Roy. Soc.*, A, 179, 361 ; 1942). It is concluded that these penetrating showers are parts of extensive air showers, are neither energetic cascades nor knock-on showers but are probably connected with the production of mesons. The connexion of the penetrating showers observed at sea-level with the production of mesons in the atmosphere is discussed from the alternate postulates that the mesons are (i) produced by photons and (ii) that they are mainly produced by protons and possibly neutrons.

Movements of Hydrogen Flocculi

M. A. ELLISON has described his investigations on surges near sunspots and quasi-eruptive flocculi in the vicinity of chromospheric eruptions (*Mon. Not. Roy. Astro. Soc.*, 102, 1 ; 1942). A short account is given of the spectroheliosCope which was used at Sherborne (*J. Brit. Astro. Assoc.*, 50, 107 ; 1940) but some modifications were introduced for the present investigation. Ellison has kept a special watch for surges since 1940 and has found that they are the most frequent of all prominence types, though they are the most short-lived of chromospheric phenomena. Radial velocity - time curves are shown in diagrams and a table includes various details regarding position, times of beginning and ending, etc. Distance integrals and accelerations are deduced and the former are in satisfactory agreement with the heights observed for the limb prominences of corresponding type. In the case of quasi-eruptive flocculi, the Doppler time-curves are of the same general form as those for surges, but the velocities of ascent and descent are greater. In one case the velocity of ascent was found to be a little greater than the value of g on the sun's surface. In the years 1940–41 about five hundred measures of radial velocities were made on active short-lived dark flocculi which occurred in the vicinity of sunspots. A well-defined maximum frequency of descending motions was shown to exist at about 30 km./sec. and of ascending motions at 35 km./sec. These figures are in good agreement with those obtained by H. W. Newton at Greenwich in 1930–33. There is one important difference, however. The Greenwich analysis showed a high percentage of radial velocities in the range 0·9 km./sec., and the Sherborne results did not reveal this. The apparent discrepancy is due to the fact that Ellison sought specially for active flocculi and omitted slow-moving flocculi.

A TYPE OF PLASTIC DEFORMATION NEW IN METALS

By E. OROWAN
Cavendish Laboratory, Cambridge

SINGLE-CRYSTAL wires of zinc or cadmium' extremely soft in general, are as hard as polycrystalline wires if the glide plane (0001) is nearly parallel to the wire axis, so that the usual glide mechanism cannot work in extension or bending. In an attempt to operate the glide mechanism in cadmium crystals of such orientation, the crystals were axially compressed. As the load increased, they suddenly collapsed by forming peculiar kinks with sharp ridges and regular curvatures; the two main types of kinks are shown in Fig. 1. The regular curvatures, the non-crystallographic orientation of

a *b*

Fig. 1.
PHOTOGRAPHS OF KINKS IN ORIGINALLY CYLINDRICAL CADMIUM SINGLE-CRYSTAL WIRES OF 1 MM. DIAMETER.

the planes determined by the ridges, and certain other features show that the phenomenon cannot represent ordinary glide or twinning.

A survey of the literature showed that kinks of perfectly similar shape were observed by Mügge[1] in crystals of disthene (cyanite) compressed parallel to their glide plane. Disthene being transparent, Mügge was able to determine the lattice orientation in the kinks by means of the polarizing microscope. According to his results, the structure of the kink in Fig. 1 *a*, for example, would be that shown in Fig. 2; this has been confirmed in the present case of cadmium crystals so far as is possible with X-ray methods. Beside regions with continuously bent glide lamellæ ("flexural glide"[2,3]), the deformed crystals contain planes *k*, *k'*, in which the glide lamellæ are so sharply bent that they appear broken; hence the sharp ridges and trenches shown for both specimens in Fig. 1. This characteristic part of the phenomenon is shown schematically in Fig. 3. Under the shear stress indicated by the horizontal arrows, a part of the crystal (that above the plane *k*) splits up into submicroscopic glide lamellæ of equal thickness which swing from the initial position shown by dotted lines to that drawn in full lines. The 'plane of kinking' *k* need not be a crystallographic plane; its orientation depends on the stress conditions. For geometrical reasons, the glide planes in the 'kink' (that is, the part above *k*) are mirror images of the glide planes in the undeformed part, with the plane *k* as a mirror. In contrast with twinning, however, the *lattice* in the

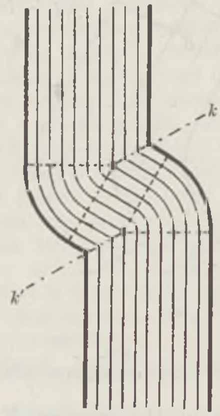


Fig. 2.
STRUCTURE OF THE KINK IN FIG. 1 *a*.
Thin parallel lines, glide planes. Broken lines, boundaries of the wedge-shaped regions of flexural glide. Dash-dotted lines *k* and *k'*: planes of kinking.

kink is not a mirror image of the undeformed lattice: a lattice direction shown by the double-headed arrow in the undeformed part, for example, changes to the similarly marked direction in the kink.

There is a characteristic difference between ordinary flexural glide and kinking. In flexural glide, the lattice constants at the compressed (concave) sides of the glide lamellæ differ from those at the extended (convex) sides; hence, the lattices of neighbouring lamellæ cannot fit upon each other, and dislocations between the lamellæ will be more or less evenly distributed over the region of flexural glide. In kinking, on the other hand, the glide lamellæ remain practically plane within a certain distance from the plane of kinking. As they swing over into their new position, they glide over each other like a row of

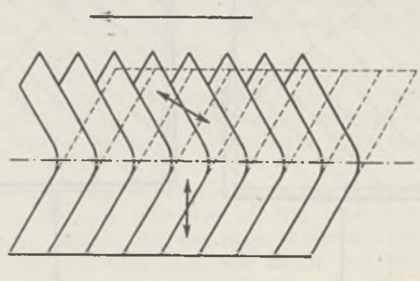


Fig. 3.
MECHANISM OF KINKING.

books tilting to one side, and finally settle in a position in which the lattices of neighbouring lamellæ must be expected to fit upon each other correctly, while the dislocations are concentrated in the plane of kinking. In other words, the amount of glide between neighbouring lamellæ must be an integral multiple of the lattice period in the direction of glide. Fig. 4 shows that the amount of glide between neighbouring glide lamellæ is $2\,AB = 2t.\tan\varphi$, where t is the thickness of the lamellæ, and φ the angle between the glide plane and the normal to the plane of kinking. The condition that this should be an integral multiple of the lattice period a in the direction of glide is

$$2t.\tan\varphi = n.a.$$

This is the same phase relationship as that expressed

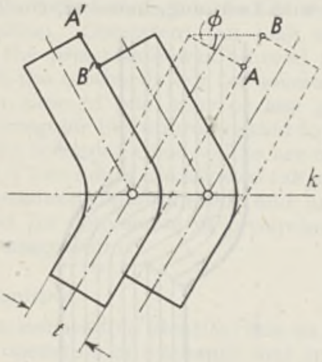


Fig. 4.
AMOUNT OF GLIDE BETWEEN NEIGHBOURING GLIDE LAMELLÆ.

by Bragg's law in the case of X-ray diffraction; $t/\cos\varphi = d$ is the spacing of the glide lamellæ in the plane of kinking. It is proposed to check this equation by X-ray measurements of the thickness of the glide lamellæ.

Fig. 5 shows how plastic extension and compression may result from kink bands. In these diagrams the

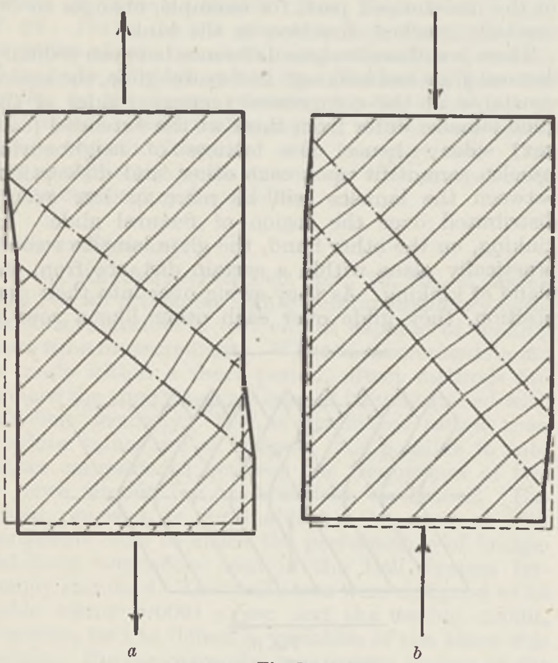


Fig. 5.
EXTENSION AND COMPRESSION OF A CRYSTAL PRODUCED BY KINK BANDS.
Thin parallel lines, glide planes.

initial position of the glide planes was assumed to make angles of 45° with the stress axis, as is the case, for example, with sodium chloride crystals stressed in the (100) direction. If the angle φ is small, the angle between the kink band and the specimen axis is only slightly less than 45° in compression, and only slightly more than 45° in extension; thus in such cases the kink bands can easily be confused with genuine glide bands. Brilliantow and Obreimow[4] have shown that, in fact, the deformation bands in sodium chloride crystals compressed at room temperature represent not glide bands but what they called "irrational twins" or "big twins". While, for geometrical reasons, twins cannot be "irrational" in the sense used by these authors, it is clear from their description that at room temperature sodium chloride deforms mainly, or entirely, by kinking, and its well-known deformation bands are not glide bands but kink bands. There are many indications[5] that deformation bands in metals hitherto considered glide or twin bands may be, in reality, kink bands; and the possibility must be kept in mind that glide may begin in many or in all cases with kinking. The phenomenon of jerky extension[6] points in this direction.

It is known[7] that the angles between the Lueders bands in mild steel and the direction of stress are slightly less than 45° in compression, and slightly more than 45° in extension, in conformity with the behaviour of kink bands as shown in Fig. 5. Together with the sharp yield point observed in mild steel, this suggests that the deformation in mild steel may at least begin with kinking instead of glide or twinning.

Once a kink band has been formed, further deformation may take place either by glide across the band[5], or by gradual broadening of the band (displacement of the planes of kinking representing its boundaries). This latter type of deformation has actually been observed in cadmium crystals; its mechanism is identical with that theoretically postulated by Sir Lawrence Bragg some time ago[8]. In contrast with the familiar mechanism of deformation by glide packets sliding upon each other, the Bragg mechanism consists in a displacement of the boundaries between slightly differently oriented regions, such as represented by the original lattice on one hand, and the kink on the other.

[1] Mügge, O., *Neues Jahrb. f. Miner.* 1, 71 (1898).
[2] Mark, H., Polanyi, M., and Schmid, E., *Z. Phys.*, **12**, 58 (1922).
[3] Ewald, P. P., in "The Physics of Solids and Fluids" (Blackie and Son, 1936), 121.
[4] Brilliantow, N. A., and Obreimow, I. W., *Sow. Phys.*, **6**, 587 (1934); **12**, 7 (1937).
[5] See, for example, Elam, C. F., *Proc. Roy. Soc.*, A, **153**, 273 (1936).
[6] See, for example, Orowan, E., *Proc. Phys. Soc.*, **52**, 8 (1940).
[7] Nádai, A., "Plasticity" (McGraw-Hill, 1931), 90.
[8] Bragg, W. L., *Proc. Phys. Soc.*, **52**, 105 (1940).

INDIAN FISHES AND MOSQUITO CONTROL

MUCH has already been written on the control of mosquitoes in India by introducing larvicidal fishes, and the researches of Hora and Nair resulted in successfully freeing the valve chambers of the Pulta Pumping Station of mosquito larvæ by introducing the killifish, *Aplocheilus panchax*. It was, however, still a vexed question as to whether this fish feeds preferably on mosquito larvæ in natural conditions. An interesting paper by T. J. Job[1], based on detailed experiments, shows that this fish is definitely of great practical utility in anti-mosquito campaigns. The efficiency of *Aplocheilus panchax* in mosquito control has been studied by estimating: (*a*) the mosquito ratio in its diet, (*b*) the extent of check exercised by the fish in natural pieces of water, and (*c*) the effect, in the field, of introducing and of withdrawing the fish.

Food analyses of collections of fish from diverse natural habitats of rather low larval density, from observation chambers and pits of fairly high larval density, and from experimental aquaria with equal supplies of different food items, have revealed a decided preference for mosquito larvæ on the part of this fish. The author mentions the following attractive features of mosquito larvæ : convenient size, suitable pose of rest at the surface, enough mobility, absence of obnoxious exoskeleton, palatable nature and easy availability. All these must be factors which find favour with the fish.

Surveys of various types of natural water showed that whenever *Aplocheilus panchax* and mosquito larvæ occur in mutual association, and so long as the fish population is of an appreciable strength and the mechanical barriers, if any, are penetrable by the fish, the larvæ seldom thrive beyond the early instars. So far as *Aplocheilus panchax* is concerned, its efficiency for mosquito control, as proved from previous records and the present investigations, is fully established, and, being the most widely distributed and easily acclimatized of Indian killifishes, the practical possibilities of using it extensively in anti-mosquito campaigns is obvious.

The efficiency of the glassfishes (Ambassis) has also been estimated[2], and though they are less efficient than the killifish in control of malaria mosquitoes, their larvicidal activity is found to be of some significance. It is, however, in the control of the guinea-worm that the importance of Ambassis is shown, through their cyclopsidal habits. The intermediate host of the guinea-worm is known to be the copepod Cyclops or some closely related genus, and the glassfishes feed voraciously on these.

A third paper by the same author[3] deals with the bionomics of the spring eel, *Mastacembelus pancalus* (Hamilton), and shows that the number of mosquito larvæ in the gut contents is insignificant and that, "though to a small extent the fish may help to reduce the number of larvæ in marshy pools, it is not of any cognizable value in control of mosquitoes. Again . . . the proportion of *Cyclops* met with in the food of the species is too small to have any significance in the control of the Guinea-worm".

[1] Efficiency of the Killifish *Aplocheilus panchax* (Hamilton) in the Control of Mosquitoes. By T. J. Job, *Proc. Nat. Inst. Sci. India*, 7, No. 3 (1941).

[2] "Food and Feeding Habits of the Glassfishes (*Ambassis* Cuv. and Val) and their Bearing on the Biological Control of the Guinea-worm and Malaria", by T. J. Job, *Indian J. Med. Research*, **29**, No. 4 (1941).

[3] "Life History and Bionomics of the Spiny Eel, *Mastacembelus pancalus* (Hamilton), with Notes on the Systematics of the Mastacelidae", by T. J. Job, *Rec. Ind. Mus.*, **43**, Part II (1941).

PROPERTIES OF RUBBER AT LOW TEMPERATURES

AN interesting account of the effect of low temperatures upon the properties of rubbers is given by M. L. Selker in an article entitled "Brittle Temperature of Rubber" (*Bell Lab. Rec.*, 20, No. 7; March, 1942). When crude rubber is held at about 14° F. (−10° C.) for some days, crystallization occurs and the rubber becomes stiff and opaque but remains elastic to some extent, permitting slight bending and stretching without breaking. Well-vulcanized rubber does not crystallize, but loses its ability to retract when stretched. Crude or elastic rubber, however, loses elasticity completely if cooled to 70–80° F. below zero. If bent suddenly at right angles a glass-like breakage occurs. This transition to brittleness occurs at a sharply defined temperature which differs for various natural and synthetic rubbers.

To study these brittle temperatures, the Bell Telephone Laboratories recently constructed a simple apparatus consisting of a quadrant (arranged to carry as many as six rubber specimens) mounted on a shaft turned by a simple crank, and supported in a narrow insulated tank into which acetone and 'dry ice', or other cooling solution, may be placed. The specimen to be tested is fastened to the quadrant and turned down into the solution sufficiently long for it to assume the bath temperature. A quick rotation of the crank then brings the specimen sharply up against a rigid metal bar projecting from the edge of the tank towards the rim of the quadrant. If the brittle temperature has not been reached, the specimen will bend, but otherwise it will break off cleanly.

It has been found that the rubber becomes so tough at these low temperatures that considerable force is required to break it. Tests carried out on natural and synthetic rubbers showed that the brittle point of soft vulcanized rubber, about − 75° F. (− 59° C.), is essentially the same for all the vulcanizing periods common in industry. Certain of the synthetic mixtures show the same behaviour. With rubber compounds vulcanized with an accelerator and a large amount of sulphur, or sulphur alone, the brittle temperature was found to vary nearly linearly with the amount of chemically combined sulphur. All the usual rubber compounds have brittle temperatures above that of crude rubber. Any addition of asphalt or resin and of many oils tends to raise the brittle temperature a few degrees. Zinc oxide and carbon black, however, can be added in large quantities with small effect. The use of appreciable amounts of coarse fillers such as calcium carbonate, on the other hand, produces compounds with high brittle points after vulcanization. The various types of reclaimed rubber can be distinguished on the basis of their brittle temperatures, that from tyre tubes having the lowest.

Only two of the synthetic rubbers are comparable to natural rubber in elasticity at low temperatures. Synthetic rubbers also differ from natural rubber in having higher brittle temperatures than their compounds.

There seems to be little relationship between brittle temperature and the size of the molecule of the substance. In general, the large molecules have lower brittle temperatures than the small, but the change seems to be sudden rather than gradual. There appears to be a definite molecular size that must be attained before the brittle temperature characteristic of the material is reached. For rubber, this size corresponds to a molecular weight between 6,000 and 30,000, while for polyisobutylene it is between 1,500 and 10,000. The difference between the brittle temperatures for large and small molecules may be very great, as exemplified by polyethylene, which has a brittle temperature of + 5° F. (− 15° C.) for small molecules, and − 91° F. (− 68·5° C.) for the large.

FORTHCOMING EVENTS

Monday, June 8

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Major Offermann: "National Parks of the Belgian Congo".

APPOINTMENTS VACANT

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

WOMAN LECTURER IN GEOGRAPHY at the Brighton Municipal Training College—The Education Officer, 54 Old Steine, Brighton (June 10).

GRADUATE TEACHER OF MATHEMATICS AND ENGLISH in the Junior Technical School of the Castleford, Whitwood Mining and Technical College—The Director, Education Offices, Smawthorne Lane, Castleford, Yorks. (June 12).

FIRST TECHNICAL ASSISTANT (male) in the Economics Department—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (June 12).

LECTURER IN PHARMACEUTICAL SUBJECTS—The Principal, Leicester College of Technology and Commerce, The Newarke, Leicester (June 13).

LECTURER IN HORTICULTURE—The Registrar, The University, Leeds 2 (June 15).

HEADMASTER OF DERBY SCHOOL—The Acting Clerk to the Governors, Education Office, Becket Street, Derby (June 16).

GRADUATE TEACHER OF MATHEMATICS AND SCIENCE at the Grimsby Technical College—The Director of Education, Education Committee, Grimsby (June 17).

WORKS ENGINEER OF THE SALVAGE DEPARTMENT—The General Manager, Civic Centre, Birmingham 1 (endorsed 'Works Engineer') (June 20).

CHAIR OF NAVAL ARCHITECTURE, tenable at King's College, Newcastle-upon-Tyne—The Acting Registrar, University Office, 46 North Bailey, Durham (June 22).

PATHOLOGIST AND DIRECTOR OF THE CLINICAL RESEARCH LABORATORY—The Secretary and Treasurer, Victoria Infirmary of Glasgow, 40 St. Vincent Place, Glasgow, C.1 (June 27).

LECTURER IN CIVIL AND MECHANICAL ENGINEERING—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1 (June 30).

TWO ASSISTANT ENGINEERS with knowledge of River and Land Drainage Works—The Engineer, River Nene Catchment Board, Priestgate, Peterborough.

CIVIL ENGINEER in the service of the Government Railways, West Africa—The Secretary, Overseas Man-power Committee (Ref. 282/b), Ministry of Labour and National Service, Hanway House, Red Lion Square, London, W.C.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Tin Research Institute. Publication No. 109: Report for 1941; Summarising Recent Researches and Developments in the Uses of Tin in Industry. Pp. 12. (Greenford: Tin Research Institute.) [145

Family Allowances. Memorandum by the Chancellor of the Exchequer. (Cmd. 6354.) Pp. 11. (London: H.M. Stationery Office.) *2d.* net. [145

Iron and Steel Institute. Special Report No. 28: Second Report on Refractory Materials. Being a Report by the Joint Refractories Research Committee of the Iron and Steel Industrial Research Council and the British Refractories Research Association. Pp. v+168+3 plates. (London: Iron and Steel Institute.) 16*s.* [155

Hull Museum Publications. No. 192: Index to Hull Museum Publications, Nos. 145–191. Compiled by T. Sheppard. Pp. 56. No. 212: Record of Additions. Edited by Thomas Sheppard. Pp. 58. No. 213: Bronze-Age Implements (in the Mortimer Museum, Hull). By T. Sheppard. Pp. 40+13 plates. (Hull: Hull Museum.) [215

Current Trend of Population in Great Britain. (Cmd. 6358.) Pp. 12. (London: H.M. Stationery Office.) 2*d.* net. [265

Proceedings of the Royal Society of Edinburgh. Section B (Biology), Vol. 61, Part 3, No. 19: pH Phenomena in relation to Stomatal Opening, 2–5. By Prof. J. Small, Miss M. I. Clarke and Mrs. J. Crosbie-Baird. Pp. 233–266. (Edinburgh and London: Oliver and Boyd.) 2*s.* 9*d.* [295

University of London. Report of the Acting Principal on the Work of the University during the Year 1941–1942. Pp. 8. (London: University of London.) [295

Other Countries

U.S. Department of the Interior: Geological Survey. Bulletin 883-C: Spirit Leveling in Texas, Part 3: West-Central Texas, 1896–1938. Pp. ii+151–239+1 plate. 15 cents. Bulletin 906-F: Phosphate Investigation in Florida, 1934 and 1935. By P. V. Roundy. (Contributions to Economic Geology, 1938–39.) Pp. iv+267–345+plates 55–63. 30 cents. Bulletin 915-D: Geophysical Abstracts 99, October–December 1939. Compiled by W. Ayvazoglou. Pp. ii+133–195. 10 cents. Bulletin 916-H: Transit Traverse in Missouri, Part 8: West-Central Missouri, 1906–37. Pp. xiii+1025–1156+1 plate. 20 cents. Bulletin 917-B: Geology of the Upper Telling River District, Alaska. By Fred H. Moffit. (Mineral Resources of Alaska, 1938.) Pp. iv+115–157+plates 2–7. 50 cents. Bulletin 918: The Goodnews Platinum Deposits, Alaska. By J. B. Mertie, Jr. Pp. iv+97+9 plates. 50 cents. Bulletin 919: Spirit Leveling in Michigan, 1896–1938. Pp. iii+523+3 plates. 65 cents. Bulletin 920: Pre-Cambrian Geology and Mineral Resources of the Delaware Water Gap and Easton Quadrangles, New Jersey and Pennsylvania. By W. S. Bayley. Pp. v+98+5 plates. 40 cents. Bulletin 921-A: Manganese Carbonate in the Batesville District, Arkansas. By Hugh D. Miser; with a Chapter on Minerals of the Ores, by D. F. Hewett and H. D. Miser. (Contributions to Economic Geology, 1940.) Pp. v+97+10 plates. 60 cents. Bulletin 922-R: Quicksilver Deposits in San Luis Obispo County and Southwestern Monterey County, California. By E. B. Eckel, R. G. Yates and A. E. Granger. (Strategic Minerals Investigations, 1940.) Pp. v+515–580+plates 78–87. 75 cents. Bulletin 923: Geology and Mineral Resources of the Randolph Quadrangle, Utah–Wyoming. By G. B. Richardson. Pp. v+54+8 plates. 55 cents. Bulletin 925-B: Geophysical Abstracts 101, April–June 1940. Compiled by W. Ayvazoglou. Pp. ii+51–92. 10 cents. Bulletin 925-C: Geophysical Abstracts 102, July–September 1940. Compiled by W. Ayvazoglou. Pp. ii+93–126. 10 cents. Bulletin 926-A: Mineral Industry of Alaska in 1939. By Philip S. Smith. (Mineral Resources of Alaska, 1939.) Pp. iii+106+1 plate. 20 cents. Bulletin 931-A: Tungsten Resources of the Blue Wing District, Lemhi County, Idaho. By Eugene Callaghan and Dwight M. Lemmon. (Strategic Minerals Investigations, 1941.) Pp. iii+21+5 plates. 30 cents. Bulletin 931-B: Some Quicksilver Prospects in Adjacent Parts of Nevada, California and Oregon. By Clyde P. Ross. (Strategic Minerals Investigations, 1941.) Pp. iii+23–37+plates 6–8. 25 cents. (Washington, D.C.: Government Printing Office.) [155

U.S. Department of the Interior: Geological Survey. Professional Paper 193-E: Additions to the Wilcox Flora from Kentucky and Texas. By Edward W. Berry. (Shorter Contributions to General Geology, 1938–40.) Pp. ii+83–99. 15 cents. Professional Paper 195: Geology of the Kettleman Hills Oil Field, California: Stratigraphy, Palæontology and Structure. By W. P. Woodring, Ralph Stewart and R. W. Richards. Pp. v+170+57 plates. 1.50 dollars. (Washington, D.C.: Government Printing Office.) [155

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 849-A: Geology and Ground-Water Resources of the Lufkin Area, Texas. By W. N. White, A. N. Sayre and J. F. Heuser. (Contributions to the Hydrology of the United States, 1940.) Pp. iv+58+2 plates. 30 cents. Water-Supply Paper 849-B: Effect upon Ground-Water Levels of Proposed Surface-Water Storage in Flathead Lake, Montana. By R. C. Cady. (Contributions to the Hydrology of the United States, 1940.) Pp. iii+59–81+plates 3–10. 35 cents. Water-Supply Paper 851: Surface Water Supply of the United States, 1938, Part 1: North Atlantic Slope Basins. Pp. iv+496+1 plate. 60 cents. Water-Supply Paper 879: Surface Water Supply of the United States, 1939, Part 9: Colorado River Basin. Pp. vii+309+1 plate. 35 cents. Water-Supply Paper 882: Surface Water Supply of the United States, 1939, Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. vii+246+1 plate. 30 cents. Water-Supply Paper 883: Surface Water Supply of the United States, 1939, Part 13: Snake River Basin. Pp. viii+315+1 plate. 30 cents. (Washington, D.C.: Government Printing Office.) [155

Smithsonian Miscellaneous Collections. Vol. 101, No. 11: Amphipod Crustaceans collected on the Presidential Cruise of 1938. By Clarence R. Shoemaker. (Publication 3677.) Pp. ii+52. (Washington, D.C.: Smithsonian Institution.) [195

Proceedings of the United States National Museum. Vol. 92, No. 3135: Some Cestodes from Florida Sharks. By Asa C. Chandler. Pp. 25–31. (Washington, D.C.: Government Printing Office.) [195

Forest Research in India and Burma, 1940–41. Part 1: The Forest Research Institute. Pp. iii+161. (Delhi: Manager of Publications.) 1.12 rupees; 2*s.* 6*d.* [265

Annual Report of the Imperial Council of Agricultural Research, 1940–41. Pp. iv+190+10 plates. (Delhi: Manager of Publications.) 2.12 rupees; 4*s.* 6*d.* [265

Indian Forest Records (New Series). Utilisation, Vol. 2, No. 5: Experiment on the Air Seasoning of *Pinus longifolia* (Chir) Sleepers in the East Almorah Division, U.P. By M. A. Rehman. Pp. vi+109–150+4 plates. (Delhi: Manager of Publications.) 1.2 rupees; 1*s.* 9*d.* [265

Bureau of Education, India. Appendices to Education in India in 1937–38. Pp. iii+48. (Delhi: Manager of Publications.) 14 annas; 1*s.* 3*d.* [265

Imperial Council of Agricultural Research. Proceedings of the Fourth Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India, held at Izatnagar (Bareilly) from the 18th to 20th November 1940; with Appendices. Pp. 250. (Delhi; Manager of Publications.) 5.10 rupees; 8*s.* 9*d.* [265

University of Pennsylvania. Theoretical Magnetic Susceptibilities of Metallic Lithium and Sodium. A Dissertation in Physics presented to the Faculty of the Graduate School in partial fulfilment of the requirements for the Degree of Doctor of Philosophy. By John Bard Sampson. Pp. 8. (Philadelphia: University of Pennsylvania.) [265

University of Pennsylvania. The Electrical Conductivity of Titanium Dioxide. By Marshall Delph Earle. A Dissertation in Physics presented to the Faculty of the Graduate School in partial fulfilment of the requirements for the Degree of Doctor of Philosophy. Pp. 10. (Philadelphia: University of Pennsylvania.) [265

University of Pennsylvania. The Theory of Gaseous Isotope Separation in a Force Field with Application to the Ultracentrifuge. By George Harold Wilson. A Dissertation in Physics presented to the Faculty of the Graduate School in partial fulfilment of the requirements for the Degree of Doctor of Philosophy. Pp. 26. (Philadelphia: University of Pennsylvania.) [265

State of California Department of Natural Resources: Division of Fish and Game, Bureau of Marine Fisheries. Fish Bulletin No. 58: The Commercial Fish Catch of California for the Year 1940. By the Staff of the Bureau of Marine Fisheries. Pp. 47. (Terminal Island, Calif.: California State Fisheries Laboratory.) [265