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	Page
The Charter of Scientific Fellowship	379
Skilled Men in the State Services	381
Science in Progress. By Prof. J. A. Crowther	385
Method in Teaching Chemistry. By Dr. E. F. Armstrong, F.R.S.	386
Significance of the Hypothalamus	387
Conference on Science and World Order	388
The Commonwealth of Science	393
G. B. Cave, Charterhouse on Mendip. By F. J. Goddard and R. A. J. Pearce	394
Aspects of Mathematical Logic. By Dr. Harold Jeffreys, F.R.S.	396
The International Education Board. By R. Weatherall	398
Obituaries :	
Eng.-Captain J. Fraser Shaw. By Dr. F. S. Sinnatt, C.B., M.B.E., F.R.S.	401
Mr. L. A. Boodle. By Sir Arthur Hill, K.C.M.G., F.R.S.	402
Dr. M. Benjamin	402
Prof. C. Bartel. By G. D.	402
News and Views	403
Letters to the Editors :	
Deuteron-Tritium Reaction in Fluorine.—Dr. R. S. Krishnan	407
Reproduction in Capuchin Monkeys.—Prof. W. C. Osman Hill	408
Electron Energy-Levels in Biochemistry.—S. Baxter and A. B. D. Cassie	408
Constitution of a Sulphonamide.—M. A. Phillips	409
'Onion Skin' Structure of Carbonyl Iron.—C. E. Richards and E. V. Walker	409
Measurement of Physical Fitness.—Dr. John Cohen	410
A Peculiarity in Rainfall Variability.—L. C. W. Bonacina	410
The Relations between Science and Ethics.—Dr. Joseph Needham, F.R.S. ; Prof. Herbert Dingle	411
Leadership of Science.—H. Brewer	412
"The West Highlands and the Hebrides."—Dr. J. E. Richey, F.R.S.	412
Huygens' Pendulum Clock.—G. H. Baillie	412
Tin through the Ages. By Dr. F. J. North	413
Exhibition of Photography	414
Lightning Over-Voltages in Underground Cables	415

THE CHARTER OF SCIENTIFIC FELLOWSHIP

IN the conflict of ideas, the clash of two diametrically opposed ways of living, which are involved in the present War, the British Association's recent Conference on Science and World Order may well prove to have as profound a significance as President Roosevelt's clear enunciation of the four freedoms which are at stake, and as the declaration which arose out of his Atlantic meeting with Mr. Churchill. In place of the thoughtless blaming of science for the misuse of the knowledge and power with which scientific discoveries and their application have endowed mankind, we have the recognition that from henceforth science and statecraft, in Mr. Eden's words (see p. 403), must march together.

Nor is this all. The very holding of such a meeting in war-time, a meeting as truly international as the meeting of the Inter-Allied Council held also in London in the same week, attests the existence of the goodwill and faith in international co-operation required to lay the foundations of a better world. The merest glance at the programme of the Conference will have revealed how profound is the contribution of science to that task ; and how grave is the responsibility of statecraft to see that the fruits of planning by men of science are not misused, and to secure the free enjoyment by all of the greater health and leisure which science has made possible.

What is equally significant is that this partnership of science and statesmanship in the building of a new world order is only possible in the nations that still remain free. Without full freedom science cannot long persist, for the fountain heads of new knowledge and creative thought dry up and the quest for truth degenerates into the practice of a technique or cult. This we have already seen happening in Germany, though as many countries know to their cost, science is not yet dead in that country. None the less, the persistent interference with freedom of scientific investigation, of the expression of scientific thought, and with the international interchange of thought had already some time before the War led to a marked deterioration in the quality of scientific work in Germany, especially in fields of new and fundamental research. The British Association Conference in itself is a welcome reminder of the immense and incalculable assets, which are ours in the struggle against Nazism, through the international exchange of scientific thought still possible among the free peoples and the exiled men of science in their midst.

These are truisms obvious to any scientific worker, but it is well that they should be so clearly stated for a wider public, as has been done in the Declaration of Scientific Principles adopted at the final session of the Conference (see p. 393). The

Declaration indeed contains nothing new. It is an educational instrument of the first order, and if it is studied aright by scientific workers and by statesmen and administrators, there should be an end to the charge that in Great Britain, ministers of State or the Civil Servants under them are insufficiently equipped in scientific knowledge or grasp of scientific method and technique.

This Declaration of Scientific Principles is no mere statement of the conditions upon which such co-operation is possible. It demonstrates first and foremost the extent to which the future of science is bound up with that of democracy and the overthrow of Nazism. This struggle is part of the age-long struggle of scientific workers to preserve freedom of thought, of investigation and of expression in the face of unreasoning prejudice, stagnation and repression. The Declaration is an open renunciation of neutrality and an acceptance of special responsibility in the struggle against a tyranny which threatens to overwhelm intellectual liberty everywhere.

The acceptance of such responsibilities is not, however, prompted by the mere instinct of self-preservation, the conviction that to-day complete freedom of thought and interchange of knowledge and opinion are supreme necessities. It is equally prompted by a consciousness of the harmony of interests and aspirations between science and democracy itself. As the Declaration insists, full freedom of expression is of the essence of both science and democracy : where thought is enslaved both wither and decay.

More than this, since the direction of and resources available for scientific work are determined by the social and economic conditions in which the scientific worker finds himself, science is equally concerned with the economic freedom, the third freedom enunciated by President Roosevelt, and all that is implied in the adjustments of social and economic life, required for its realization. This is not merely a matter of the application of scientific knowledge or the mobilization of scientific resources for the acquisition of fresh knowledge in fields insufficiently explored. It is a question of outlook, of the adjustment of ways of living to facilitate the full and free adaptation of ideas to new conditions.

If, therefore, the Declaration of Scientific Principles is an affirmation of those principles upon which it has long been recognized that the fellowship of science is based, and of opposition to any policy of power which deprives men or nations of their free practice, it is equally a challenge to intense mental effort and clear vision. The vision of the possibilities inherent in the contribution of science to the solution of post-war problems and to the building of a nobler world order which the deliberations of the Conference have given, needs to be supplemented by exactly such a statement of principles and challenge to thought and endeavour.

It is well, therefore, that all should understand the basic implication that science must be the partner, not the handmaid, of the statesman or administrator. The State must impose no limits on liberty to learn, opportunity to teach or power to understand if society is to reap the full advantages of scientific thought and knowledge. Science can co-operate while retaining its independence. To sacrifice its independence may destroy co-operation by destroying science.

That truth can scarcely be emphasized too strongly to-day, and there was no more hopeful sign at the Conference than its ready acceptance by Government spokesmen as by the spokesmen of science. Equally vital is the stress laid in the sixth and seventh points of the Declaration on the world fellowship of science. Science truly has the world for its province, and the discovery of truth as its highest aim. The pursuit of scientific inquiry demands unrestricted international exchange of knowledge as well as complete intellectual freedom, and can only flourish through the unfettered development of civilized life. The Conference itself bears witness to the extent to which such international fellowship is still possible in Great Britain and to the hope which may justly be entertained of re-establishing it in Europe when the Nazi power has been destroyed. It may well be hoped, however, that the Conference with this pointed Declaration will stir us to use far more effectively than hitherto the immense moral and intellectual resources in international co-operation which we possess, not alone through our allies but also through the presence of *émigré* men of science from Germany and the occupied countries of Europe.

Any partnership must be based on mutual understanding and respect. No scientific worker, therefore, can fail to mark and honour the pledge given in the fifth point of the Declaration. Men of science are among the trustees of each generation's inheritance of natural knowledge. It is, as they attest, their determination to foster and increase that heritage by the fidelity of their guardianship and service to high ideals, shown to-day in their devotion in the defence of that heritage in the present struggle, no less than in the planning and thought which must go to safeguarding it in a new order yet to be. To scientific workers no less than to the administrator or statesman, the Declaration is a summons to thought and action. To both it may well bring the reflection : *noblesse oblige.*

SKILLED MEN IN THE STATE SERVICES

ONE of the most striking features which has emerged from the recent debates in the House of Commons on war production and on the coal industry, when attention was focused on serious deficiencies in the Government's man-power policy, is the extent to which such deficiencies are due to neglect to use scientific methods or knowledge. Shortcomings in policy are, in part at least, due to the absence of the knowledge essential for a right decision. Failures to use man-power or woman-power to the fullest advantage are equally due to the neglect to use scientific knowledge and method in the selection of personnel, whether in industry or in the armed forces. Absenteeism and other causes of lost time or defective output are due as much to neglect by management of experience acquired as long as twenty-five years ago as of the methods of management and administration which in recent years have rapidly acquired sound claims to be considered a science as well as an art as to failings of the workers themselves.

The importance of the contribution of science in this field has been well illustrated in a further broadsheet on man- and woman-power issued by Political and Economic Planning (P E P), in recent reports from the Select Committee on National Expenditure, and in interim reports of the Kennet Committee on the Calling Up of Civil Servants and of the Beveridge Committee on Skilled Men in the Services, which have appeared almost simultaneously. All alike point to certain matters in which the national effort falls short of the maximum through neglect in the past of scientific method or knowledge. Not all these defects can be remedied immediately. The Select Committee indeed suggests that the system of selection by testing could only be giving the fullest value to the Forces at the present time if it had been in use already for ten or twenty years.

The handicap which has been placed on our war effort by such neglect in the past is particularly well illustrated in this twenty-second report of the Select Committee and in the Beveridge and Kennet Committees' reports, all the more emphatically from the restraint which characterizes their recommendations and their warning against expecting to achieve rapid results by a sudden reversal of policy. The Select Committee points out that two types of test are at present necessary in the Forces : a simple intelligence test to ascertain if a man or woman is suitable for further training as a specialist, and a special aptitude test to determine what his or her particular work should be.

The latter tests must be designed by persons in the closest touch with those who have wide experience of the type of work to be carried out, and it is advisable to proceed gradually with their application. The Committee thinks that they should probably not be used at present outside such technical corps as the Anti-Aircraft and the Royal Armoured Corps. By the wider use, however, of the former simple testing of intelligence and by also ascertaining the capabilities of recruits by tests applied by the Ministry of Labour and National Service before they are posted to a corps, it should, in the Committee's view, be possible to remove many of the present anomalies. Other recommendations include a test of mental capacity level of those called to attend a medical board after registration and the rapid discharge of unsuitable personnel, as well as the grading of new intakes into classes for training in accordance with their intelligence levels.

The Committee, in addition, recommends that better use should be made of the capabilities of younger men, and while it recognizes that the qualities essential to an officer cannot be ascertained solely by testing, and recommends that the system of reports by commanding officers as to the suitability of men to be entered as cadets should be continued, these should be reinforced by a system of tests many of which have yet to be devised. The principle that officers should as a rule be selected from those whose intelligence, as measured by tests, reaches a certain level is, however, far-reaching, and its adoption may well make an important contribution to the discovery and selection of leaders in the armed forces and in civil life. There is no more vital problem for democracy to-day than that of throwing up its potential leaders in all ranks of society and training them for the duties and responsibilities they must carry whether at the highest or at intermediate levels.

The Beveridge Committee's interim report on skilled men in the Services indeed shows that the responsibility of making the fullest use of skill and knowledge is fully appreciated. Both in the Army and in the Air Force the necessary work of modification, repair, maintenance and servicing of machines and instruments of war, in the Committee's view, is now being performed with a notable economy of skilled men, secured by a high degree of dilution and extensive and well-designed arrangements for training. In many such matters of organization the armed Forces have long been far ahead of industrial or civilian establishments generally. Moreover, vigorous efforts are being made by the Army and Air Force to discover men now in the Forces not already engaged on such work whose qualifications make it likely that they could undertake it with success or could be trained to do so.

In spite of this, in view of the military programmes, a large increase of men engaged on such work is inevitable, exceeding the numbers who can be obtained within the Services by training or transfer, and although the information before the Committee in respect of the Navy was less, with the development of the war at sea the time has probably come when substantial addition to the recruiting of skilled men for the Navy has also become inevitable. Moreover, the report comments on the vital importance of guarding against the danger that the machines on which the lives of fighting men and the safety of the country depend may have to be entrusted to hands insufficiently skilled under inadequate supervision.

No scientific worker can fail to appreciate that this is a much more serious risk than the use by the Services of an excessive proportion of skilled men in relation to unskilled men on repair and maintenance. That such a choice may require to be made emphasizes the importance of eliminating another type of waste, not so much of scarce specialized skill in engineering and allied trades, as of physical strength or of education, experience and ability, to which the report also directs attention. Many men of military age are doing clerical, storekeeping and other light work in the Services which could be done by women or by older men. Until, however, the extensive plans already prepared in the Service Departments for substitution of women for men in all suitable kinds of work are realized, and so long as men of military age are used on work within the capacity of others, whether with or against the will of the Service Department, the Government will not escape criticism for waste of man-power.

On this question of remedying defects in the development or execution of policy the Kennet Report on the Calling Up of Civil Servants throws a significant sidelight. After the War of 1914–18 the Civil Service did not revert to normal recruitment on any substantial scale for nearly ten years. Meanwhile, recruitment was almost wholly from ex-Service men. In the clerical, executive and analogous fields there is an abnormally large proportion of persons between the early forties and the late fifties and a low proportion between thirty and forty. On the other hand, the thirty to forty group, or for the higher personnel, the twenty-five to forty group, is understood to contain many of the best of these with experience.

Such facts have to be taken into account in considering withdrawals from the younger group, while they indicate the basic reasons for some of the criticism that has of late been levelled against the Civil Service. Civil servants cannot be blamed for the consequences when the advice that they have given has been ignored by their Ministers or by the Cabinet, but the Civil Service as a body must bear a fair share of the responsibility if the techniques for obtaining information and for shaping and presenting policy lead to an excessive proportion of decisions proving to be ill-advised. The age-structure described by the Kennet Committee is what might be expected if the Civil Service as a whole tended to be using obsolete or inadequate technique and was not quite abreast of technical, scientific or social developments.

It follows from this that if the Kennet Committee is right in its opinion that the process of substituting women and older men for men of military age which is still in progress in the Civil Service can now be extended and accelerated, it is of the utmost importance to see that the loss of efficiency involved does not outweigh the advantage to combatant strength. The Committee recommends that this should be done by raising the age of reservation for Civil Servants in specified grades to much the same degree as it is being raised for reserved occupations in general, and that this should be accompanied by the cancellation of all deferments. Allowance must, of course, be made for exceptions, but the test must be whether deferment is necessary to provide for the efficient discharge of work essential under war conditions. Where the work is necessary and substitution wholly impracticable, deferment might be granted for an indefinite period. Similarly, efficiency demands a reasonable time to provide and train the substitutes, particularly in the higher grades, while the contemplated extension and acceleration of calling-up underlies the Committee's observation on the striking examples of waste which have already occurred through delay in rectifying the return to the Civil Service of men who were invaluable in their former office and where removal has been the cause of inefficiency and loss of man-power.

If the new drive to secure the full use of our man- and woman-power is to have its proper effect this test of efficiency must be kept in mind at every stage. It is from this point of view that the recommendations of the successive reports of the Select Committee on National Expenditure are of surpassing importance. There is no room for departmental failures in supervision, such as that of repair work in shipbuilding or reconditioning, or of individual eccentricities such as those of the trade union delegate upon which the Committee comments trenchantly in twentieth report. Such treacherous activities must be swiftly and ruthlessly suppressed.

The whole of the twenty-first report of the Select Committee is concerned with this question of eliminating waste of man-power, from the point of view of seeing that available labour is used as effectively as possible. It is of the utmost importance that, with our limited man- and woman-power, the output of every worker should be increased to the maximum. For this purpose it is necessary not merely that the individual worker should work his hardest, but also that the work should be organized as carefully as possible. It is this latter aspect that has received inadequate attention from the Departments concerned, and many of the problems it involves cannot be solved without scientific study.

Once again the Select Committee finds it necessary to direct attention to the neglect by managements or departments of the experience gained in the War of 1914–18, and particularly to utilize the services of the Industrial Health Research Board in inquiries into such problems as the number of working hours per week which gives the best output in any particular kind of industry. Neglect of this kind is far more damaging than absenteeism to the national effort, and the Committee points out that while a high rate of absenteeism is not always associated with bad management, good management certainly reduces it.

The Committee recommends that the Industrial Health Research Board's rightful status as the proper body for research into industrial health should be recognized. The Board should work in the closest co-operation with the Production Departments and have every opportunity to carry out investigations on a scale wide enough to cover the main problems of industrial health and efficiency in war. For this purpose its staff should be strengthened, and one of the first objects of inquiry should be the best length of working week for a wide range of different kinds of work, particularly the working week giving the best continuous output over a long period.

More important than the question of Sunday labour is that of securing that on the other six days of the week factories and plants are employed for as much of the twenty-four hours as possible. Only a minority of factories are working twenty-four hours a day, because a sufficient labour force has not yet been recruited and trained. Consideration should also be given to wages, for in so far as high wages are the result of bad rate-fixing they operate to cause loss of output.

Management, however, remains one of the most important factors affecting output, and the evidence shows that idling is frequently due to bad management or want of supervision. The pace and general spirit of a factory come from the top, and the importance of setting a good example in energy, punctuality and enthusiasm need not be stressed. Moreover, lack of work and enforced idleness, whether due to mismanagement inside the factory, insufficient stocks to tide firms over temporary breakdowns of supply, or to irregular allocation of contracts by Production Departments, cause loss of output by inducing a sense of frustration in workpeople which ultimately lowers their morale.

Many of the observations in the report are the everyday practice of modern management, and it is a sad reflection on the general standard in war-time that the Committee should find it necessary to allude to such commonplaces as the value of taking workers into the confidence of the management in overcoming difficulties, the importance of handling a recruit correctly at the outset of his career, the need for appointing men to positions of authority for their personal qualities of leadership, tact and organizing ability as well as for their technical skill, or to recommend that the Factories (Canteens) Order 1940 should be amended so as to require factories engaged mainly in work on behalf of the Crown, with a sufficient number of workers to make the arrangements feasible and necessary, either to provide their own canteens or to make suitable alternative provision. Similarly, although considerable scientific work has been carried out on the effects of conditions of lighting and ventilation upon output, and desirable standards of heat, light and ventilation are known with some precision for broad categories of work, these standards have frequently not been applied. It might well be argued further that the question of incentives to output, also stressed in the report, is largely a management matter, particularly in demonstrating to workpeople the real need for ever-greater output, which in war-time should be the ultimate stimulus.

If this admirable report appears to stress chiefly the responsibility of management, particularly in raising the quantity and quality of managerial ability and in increased collaboration with the work-people, it equally indicates the contribution to be made by the other two partners in the industrial team. Departments must accept a greater responsibility for the working conditions which affect the output of industry and for removing the external obstacles to output such as inadequate housing, transport and feeding arrangements. Workpeople must recognize that the conditions of industry during the War cannot in the nature of things be ideal, that special efforts are needed to overcome difficulties, that improvements, however energetically pursued, take time to achieve, and they must also realize the importance of the contribution of the individual to the total output.

When all this has been recognized the influence of the central administration remains a vital factor. There lies the main responsibility for keeping constantly under review the disciplinary provisions of the Essential Work Orders or for the executive action involved, removing from reservation a persistent offender who refuses to obey a direction under the Essential Work Orders. Moreover, the bringing to maximum efficiency of all members of the labour force is only one of the three stages of man-power policy which must be co-ordinated and developed by the Government itself. Unless this stage finds its place side by side with the systematic withdrawal of man years for the armed Forces and the civil defence services and with the determination of the civilian man-power necessary to maintain the output of goods and services for the armed Forces, for essential civil needs and for export, maldistribution of the existing labour force will persist and our war effort fall short of its maximum.

The P E P broadsheet gives an admirable analysis of the principles and problems involved in each of these three stages. The Schedule of Reserved Occupations is the sheet anchor of man-power policy, and it is clear from the Beveridge report that it is improbable that there are too many skilled men in the Forces relative to the number employed in industry. The criticism that in the distribution of man-power the armed Forces are favoured at the expense of production is less easy to answer and is likely to be further provoked by the present situation in the U.S.S.R. and the revision of the Schedule. The P E P broadsheet points out that the criticism might well be met so far as the Army is concerned by making its members both soldiers and workers. The Home Guard indeed represents one such solution, the use of specialized units such as Pioneers and Royal Engineers for the clearing of debris or maintenance of communications after an air raid another, while the use of soldiers in harvesting or their release for industrial employment is a further method, the possibilities of which should be fully explored during the winter months, particularly in view of the success of the system in Germany during the past winter.

It is upon the transfer of man- and woman-power to essential work that attention is chiefly focused at the present time. It would appear from the reports already cited that the Government is still without much of the essential information upon which to base a sound decision as to the civilian man-power necessary for war production and essential civil needs and exports. This alone would account for the hesitancy of the Minister of Labour and National Service and for his reluctance to use his wide powers of compulsion. None the less, as the broadsheet points out, it is very clear that the Schedule requires drastic revision, especially in the removal of reservation from many mobile girls who could be replaced by older women.

Here, as elsewhere, the evidence does not warrant the belief that our objective will be reached by persuasion alone. In the concentration of industry very few satisfactory arrangements have been made, while concentration has not yet been enforced upon the vast retail trades. There are far too many shops, even food shops, particularly butchers', and a reduction in these numbers will have to be considered, just as a reduction in women personnel is being done.

Again, the broadsheet points out that in the concentration of industry, efficiency indicates the importance of keeping management intact if possible, and turning efficient management over to the running, for example, of a factory dispersed on strategic grounds. Training again still receives inadequate attention, as well as the necessity of altering production methods not only to economize on skilled labour but also to simplify training. The economy of man-power in essential industry demands careful study if the periodical bottle-necks due to the shortage of workers with a particular kind of skill or experience are to be minimized, the transfer of workers from one type of work to another not impeded by difficulties in regard to wages or other conditions and the utmost advantage taken of youth and mobility among women.

The reports to which we have directed attention, and the P E P broadsheet do not afford ground ior either pessimism or optimism. They point indeed to definite shortcomings and indicate ways in which those shortcomings and mistakes may be and are being rectified. The dominant impression they leave is, however, the immense importance of the scientific contribution in thought, in technique and in material. No adequate man- and woman-power policy can be evolved without the fullest possible use of scientific methods of inquiry and of scientific analysis of definitely ascertained facts. The execution of such a policy will equally fail of its objectives unless from top to bottom there is the fullest use made of scientific and technical knowledge already available, the persistent application of scientific methods to all appropriate problems and unfailing readiness to utilize the help which scientific workers or scientific organizations can give in all matters affecting production, output or welfare. Impatient as scientific workers may sometimes be that more use is not made of their individual services, whether through the failure of the Central Register to function properly or through other causes, this is a far graver concern of them all—the responsibility of seeing that no opportunity is missed of bringing home to the nation, from the Government downwards, of the immense and vital contribution which science can make in our war effort. In that task they will rarely find such abundant ammunition as lies to their hand in the pages of the P E P broadsheet and these reports.

SCIENCE IN PROGRESS

Science in Progress
By L. J. Stadler, F. W. Went, J. F. Fulton, Douglas Johnson, Alfred C. Lane, H. P. Robertson, Carl D. Anderson, Duncan A. MacInnes, J. W. Beams, J. C. Hunsaker. Edited by George A. Baitsell. Second Series. (The Society of the Sigma Xi devoted to the Promotion of Research in Science: National Lectureships, 1939 and 1940). Pp. xii+317. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1940.) 24s. net.

THE tremendous advances which have been made during the past century all along the scientific front are not, it must be admitted, entirely without their counter-vailing disadvantages. Even if we reject the suggestion put forward by Rabindranath Tagore that science is the modern Mephistopheles to which mankind has sold its soul in return for material benefits destined in the end to bring about its destruction—a thesis which at the present time seems painfully plausible—and admit that the passion for scientific discovery which characterizes our age is one which must and should be satisfied, the extent and variety of the knowledge gained raise intellectual and philosophical problems of a formidable kind. A century ago a not unduly gifted individual might, if he cared to take the trouble (and many did) have a reasonably comprehensive view of what was afoot in all branches of what could then truly be called natural philosophy. To-day there is no natural philosophy; only an ever-increasing number of sciences, each with its specialists directing a closer and closer scrutiny on an ever-narrowing field of vision.

This is a pity; and not merely from a philosophical point of view. Fresh advances and new techniques developed in one science frequently open the way to big discoveries in apparently unrelated fields of action. Moreover, it is more than possible that the biggest advances of all are to be achieved in that no-man's-land which lies between the biological and physical sciences, and will be won by a combined attack from both sides. It is obvious that one of the most urgent needs of to-day is for better liaison work between the sciences. Possibly some enlightened university may be persuaded to re-establish the professorship of Things in General once held by the late Herr Teufelsdröckh at the University of Weissnichtwo. In the meantime, and as a sort of substitute, the Society of Sigma Xi has established in the United States a series of national lectureships to serve something of the same purpose. Reports of ten of these lectures, given in 1939 and 1940, make up the contents of this volume of "Science in Progress".

It is a very attractive and impartial cross-section of the sciences which is offered to the reader in this very attractive and handsomely produced volume. The subjects covered include the experimental alteration of heredity, the regulation of plant growth, experimental studies of the functions of the frontal lobes in monkeys, chimpanzees and man, how the earth shows its age, recent advances in aeronautics, and, of course, the expanding universe and cosmic rays. In addition there are articles of rather more specialized interest on the ultracentrifuge, on the motions of ions and proteins in electric fields, and on mysterious craters of the Carolina coast. Merely to read these subject headings is something of a tonic; it helps to restore one's faith that, however incompetent man may still be in the political sphere, he has some claim to his self-bestowed title of *Homo sapiens*. To appraise each separate article in the volume is beyond the scope of this review, and any selection would, probably, only reflect the personal tastes of the reviewer. I can only place on record that one reader, at any rate, found every article—each of which has been written by a research worker of international reputation in his subject—of interest, and that the collection as a whole was an intellectual stimulus.

The lectures, one gathers from internal evidence, were designed primarily for men of science, though no doubt intelligent non-scientific specialists were welcomed. Such an audience is one to put even the most distinguished lecturer on his mettle; for in spite of the division of interest, on which stress has already been laid, the unity of the scientific spirit remains unimpaired. Most of us know that our colleagues in other sciences are capable of most pertinent and valuable criticism of our theories when once we have succeeded in making clear to them what these theories are. The principal barrier between the sciences is not so much a difference in interest as a difference in vocabularies. Science suffers, along with the rest of mankind, from the curse of Babel! More than one of the authors of "Science in Progress" allude to this difficulty. Prof. Fulton, for example, writes "The title of this chapter should really have been 'Encephalization and functional localization in the primal frontal lobes.' However, I feared that this might frighten the physical scientists, for, although they invent words far more terrifying, they always seem a little intimidated by the simple words we devise in the biological sciences!" It cannot truthfully be said that all the distinguished authors who have contributed to the present volume have been equally successful in overcoming the language difficulty. Some have taken great pains to do so ; others seem scarcely aware that the problem exists. One does, occasionally, become aware of the substance behind the common complaint made by the layman that men of science "write an unintelligible jargon." What, for example, can a reader whose knowledge of chemistry is, perhaps, forty years out of date gather from such a statement as "Proteins can be broken down into various amino acids in addition to prosthetic groups ? " And yet, as the author might justly retort, how can the matter be put more clearly ? Probably science, like poetry, to which it has many affinities, is actually untranslatable.

No series of disconnected lectures, however distinguished, can produce the reintegration of science, so much to be desired. Yet the present volume stimulates the hope that such a reintegration is possible. Through all the diversity of topics one becomes aware of a unity of purpose, a unity of method, and a unity of thought much closer than one had imagined. Biology and physics do not seem so remote in outlook as one had sometimes thought. It is to be hoped that world conditions will not interrupt the activities of the Sigma Xi, and that the third series of "Science in Progress," promised for the autumn of 1942, will duly make its appearance.

J. A. Crowther.

METHOD IN TEACHING CHEMISTRY

Numerical and Constitutional Exercises in Organic Chemistry
By Dr. J. L. B. Smith and Prof. M. Rindl. Pp. ix+214. (London : Methuen and Co., Ltd., 1941.) 7*s*. 6*d*.

Calculations of Qualitative Analysis
By Prof. Louis J. Curtman and Sylvan M. Edmonds. Pp. vii+156. (New York : The Macmillan Company, 1940.) 8*s*. 6*d*. net.

THESE books originate, one from South Africa, the other from the United States, both countries of wide open spaces in which the larger proportion of the inhabitants live by doing practical things. Such environment might be expected to have an influence on the teaching in the universities at least of chemistry, which is essentially a practical subject, and it comes as a surprise to find students expected to give much time to mathematical exercises. Would-be chemists should certainly be taught mathematics up to the limit of the time available in their course, but this should be real mathematics. As Eric Gill has written in his autobiography, we are educated by the doing and not by the learning : this is the whole secret of education whether in schools or in workshops or in life. The actual business of learning—the acquiring of the use of tools without using them—is the very smallest part of a proper system of education. Some would say it is impossible, and it is largely for this reason that some of the hard-headed men in Lancashire and Yorkshire are sceptical of the value of a university education for their sons.

We do not go to school to learn football or cricket but to play them : there are not a few who hold that games are the backbone of our public school system, as is evidenced by the fact that those who are proficient in them are sought after for the better positions in life.

Organic chemistry in particular must be taught at the bench. The great school of von Baeyer at Munich was essentially a practical one, so was that of Emil Fischer in Berlin. Most of the chemists of repute, German or foreign, went to one or other of them ; they toiled all day long and often far into the night in the laboratory, seldom went to a lecture but read avidly and omnivorously the original literature ; hence they had the widest knowledge of chemistry as a whole. W. H. Perkin brought the bench tradition to England, and there are few among our leaders of yesterday and to-day who escaped his influence.

All the achievements have been at the bench. It is unfair to the student, to my mind, to keep him in the classroom when he should be at the bench. The original sin must, of course, be laid at the door of the examination, which means that the student is taught to satisfy the examiners and not the subject by which he hopes to earn his livelihood. There is much talk of peace aims : surely the greatest would be to abolish the present system of examinations which has put a dead hand on learning in schools and colleges, and to induct the student into a "brave new world" though of a more moral kind than Huxley's. There would then be fewer disappointments when an honours degree man finds himself a failure in practice in the late twenties.

Teaching as exemplified by these books is essentially on the wrong road : we must see that it is marked "no entry, unexploded bomb", in the most unmistakable way.

While we have criticized the system it would be unfair to be unkind to the books themselves. It is scarcely possible to deal with them in detail, they represent a careful attempt to treat the subject-matter according to the views of the authors.

To us sugar can never be $C_{12}H_{22}O_{11}$; we think of its crystals, its properties, its stereochemical formulæ; of the uncertainties which surround this; of those who have wrought at the solution of the problem; of how it is made by the plant in Nature; of the sheer marvel of its molecular architecture and the changes produced by shifting a hydroxyl group here and there; of the ways in which we can perhaps effect its synthesis.

Such an insight into a single substance is pure poetry; it has a spiritual implication beside, forced on us by the sheer orderliness of things. The student could be taught all this in a few lessons and become a seeker after knowledge with poetic fervour, which he could never achieve from a course of numerical and constitutional exercises.

E. F. ARMSTRONG.

SIGNIFICANCE OF THE HYPOTHALAMUS

The Hypothalamus and Central Levels of Autonomic Function

Proceedings of the Association for Research in Nervous and Mental Disease, December 20 and 21, 1939, New York. (Research Publications, Vol. 20.) Pp. xxx+980. (Baltimore, Md.: The Williams and Wilkins Co., 1940.) 10 dollars.

THIS volume contains thirty-four separate papers on different structural, functional and clinical problems related to that part of the brain which is known as the hypothalamus. A brief historical résumé of the literature and a reprint of Fröhlich's memorable contribution on a case of dystrophia adiposa genitalis form a fitting introduction to the papers which follow. Written by authors who have done outstanding work on the problems discussed by them, the various papers provide not only a review of previous work but also much unpublished new data.

On the structure of the hypothalamus there has been an attempt to codify the nomenclature of the cell masses and fibre tracts in the region, which will be of the utmost value to future workers. The unravelling of the connexions of the nerve cells and the fibre tracts which pass through this part of the brain has not yet been completed, but notable advances have been made. The very incompleteness of our knowledge of its structure makes the story of the functional significance of the region all the more fascinating. Knotted together in this relatively small part of the brain are the most diverse functions—cardiovascular control, water, carbohydrate and fat metabolism, control of body temperature, some aspects of sexual behaviour, gastro-intestinal regulation, an influence on pituitary activity, some measure of sleep control, and an effect on the somatic muscular responses. Contributions on each of these functions are to be found in the section on the physiology of the hypothalamus. The relation of the hypothalamus to the endocrine glands and especially to the pituitary body is discussed in many of the papers. Although the exact anatomical connexions between the pituitary gland and the central nervous system are by no means clear, abundant experimental and clinical evidence is disclosed to show that the nervous control of pituitary functions is of great importance.

Studies of diseases and new growths involving the hypothalamus are included in the third section of the book. Such studies are invaluable as they provide a means of checking in man the value of stimulation and extirpation experiments on animals. Actual stimulation of the region has been carried out in conscious human patients with results identical with those found in experimental animals. Changes in personality and emotional disturbances have been correlated with certain lesions which seem to release the hypothalamus from an inhibiting cortical control. The clinical and experimental evidence for such a control over hypothalamic activity seems now to be well founded. From the evidence now available, it seems probable that the hypothalamus can be regarded as the 'motor cortex' of the vegetative nervous system, receiving stimuli from, and acting under, the dual control of the thalamus and cerebral cortex. More explicitly, the hypothalamus is that part of the brain which maintains by means of the vegetative nervous system and certain endocrine glands the constancy of the *milieu intérieur*, or the internal environment of the organism.

The 'evenness' of the papers and the lack of serious overlapping are worthy of comment. There is every sign of careful editing in the production of the volume. While the papers are the products of those working in North America, there is ample reference to the activities of those in other countries, and especially to those pioneers who opened up, more than eleven years ago, in the proceedings of the Association for Research in Nervous and Mental Disease, the field which has been so abundantly fruitful. An extensive bibliography completes an outstanding volume which will be for many years an invaluable book of reference.

CONFERENCE ON SCIENCE AND WORLD ORDER

WHILE the older sections of the British Association from A to M have been obliged to suspend their activities because of the exigencies of the War, the Division for the Social and International Relations of Science—the youngest and, one might say, the adopted child of that elderly yet virile organization—organized a Conference on Science and World Order at the Royal Institution, London, during September 26–28. On the day preceding its public sessions, at a luncheon arranged by the British Council and attended by many members of the Government and Diplomatic Corps, Mr. Anthony Eden, the Secretary for Foreign Affairs, expressed the growing appreciation by our higher statesmen of the value of scientific training, scientific research and the applications of science in the conduct of public affairs (see p. 403).

The six sessions of the Conference were well attended by a varied and representative gathering. At the opening session on Friday, September 26, a message of commendation was received from the Prime Minister (see p. 403); and a letter outlining the basis of the Conference was sent to H.M. the King, from whom a message was received later (p. 403). Sir Richard Gregory, president of the British Association, and chairman of the Division for the Social and International Relations of Science, then gave the inaugural address. He announced that sub-committees to deal with the main topics raised at the Conference would be appointed by the British Association.

The deliberations during the sessions covered the relations of science to government, human needs, world planning, technological advance, post-war relief and the world mind, respectively. The many valuable papers presented will be more amply noticed in a series of articles in forthcoming issues of Nature. A perspective of the proceedings alone will be attempted here.

The discussion on "Science and Government", under the chairmanship of Sir Richard Gregory, was opened by Viscount Samuel, distinguished in the fields of both statesmanship and philosophy. He paid tribute to the scientific spirit, outlined the present organization of Government research departments (see Lord Hankey's speech in the House of Lords, Nature, April 12, p. 432), and advocated the establishment of science attachés to the principal embassies. Prof. A. V. Hill, M.P., Foulerton research professor of the Royal Society, followed with a warning to scientific men to be continually aware of the dangers arising from interest, prejudice and emotion, dangers which are certain to creep in when one attempts to deal with government and politics. He stressed the need to remove barriers between "government science" and "independent science" by the creation of more scientific advisory bodies attached to departments of State and the Cabinet.

Prof. L. Gulick, of the U.S. National Resources Planning Board, followed with a description of the New Deal's successful Tennessee Valley Authority and its achievements. Six main river dams have been completed and three more are under way on the Tennessee River itself, and several more on its tributaries for the multiple purpose of improved navigation, electrical power development and flood control. The present installed generating capacity now exceeds one million kilowatts, and by 1944 this will have been doubled. The revenue derived from the sale of electricity covers the operating expenses of all the Tennessee Valley Authority programme, which includes social work tending to improve housing, education, health and the standard of living generally.

Dr. P. W. Kuo, vice-minister of finance and former president of the South Eastern University of China, outlined the many ways in which a scientific approach to industrial problems has enabled China to strengthen its resistance to aggression, and how a reform of the currency system has contributed to China's ability to utilize to the utmost its resources. Prof. J. D. Bernal sketched five stages in the application of scientific method based on information, research, development, execution and control. Prof. J. B. S. Haldane gave a spirited address comparing the Academy of Sciences of the U.S.S.R. with the Bank of England in their relation to their respective Governments. Dr. A. Labarthe, editor of *France Libre*, formerly lecturer in technology and thermodynamics at the Sorbonne, speaking in French, pleaded for the establishment of a ministry of scientific research which would erect trial industrial plants for the investigation of new processes. Dr. J. Negrin, formerly professor of general physiology in the University of Madrid and lately head of the Spanish Republican Government, supplied the reflections of a professional man of science forced to take a leading part in the management of State affairs.

The second session of the Conference, which dealt with "Science and Human Needs", was under the chairmanship of H.E. the American Ambassador, Mr. J. G. Winant. He said in a speech which directed attention to the need for eliminating both the threat of force and of poverty: "We must abolish both hunger and the sword as a means of forcing labour."

Prof. E. Abel, formerly of the University of Vienna, expressed the gratitude of his many Austrian colleagues who are working in Great Britain.

Sir John Orr, director of the Rowett Research Institute, Aberdeen, implemented the chairman's appeal with fact and figures. He spoke with his usual vigour and clarity in favour of a food policy that would raise the health and intellectual standard of the masses, and advocated the appointment of an international convention to prepare the plans for a post-war food policy.

Sir Harold Hartley, chairman of the Fuel Research Board, gave a well-documented address on the world's heat and power requirements.

The Right Hon. Herbert Morrison, Home Secretary and Minister of Home Security, without committing the Government, agreed that a maximum and not minimum standard of living should be aimed at, and said that a scientifically defined welfare standard creates a principle for international collaboration. He ended upon a challenging note: "Shall man's mind become the master of material needs or shall it be tossed hither and thither by surging and misdirected economic forces?"

Dr. Wilder Penfield, president of the Royal College of Physicians and Surgeons of Canada, mentioned the action of official methods and stressed the necessity of making full use of suggestions given by men of science outside the official machine. He made a strong appeal for an air-borne ambulance service, in which a beginning might well be made in the Near and Middle East, and he read a manifesto from McGill University asking that research workers should reconsider their work in relation to the urgent requirements of war.

Prof. W. G. Holford, professor of civic design in the University of Liverpool, discussed in a paper the correct use of land in the country and the opportunities and limitations of planning. Mrs. Mary Agnes Hamilton, of the London County Council, spoke as a representative of consumers, and made an appeal to men of science to help the poorer housewife do away with the drudgery associated with house-work.

The last speaker of the Friday session, Prof. A. C. G. Egerton, professor of chemical technology in the Imperial College of Science and Technology, pointed out the problems of food and power, both of which are derived from the sun's radiation, and pictured diagrammatically a scheme of human activities illustrating the interconnexions.

Saturday morning's session on "Science and World Planning" was under the chairmanship of H.E. the Soviet Ambassador, M. Maisky. He pointed out that in the U.S.S.R., a country with unified and strong administration, which has accepted the principles of planning, twenty years has been necessary to reach the present state of planning. One must not expect that the necessary requisites of world planning can be crowded into a day or two. M. Maisky said that Soviet men of science were unable to attend the Conference owing to difficulties of communication, and their speeches that were to have been relayed by radio had been jammed by German interference. He read a message from the U.S.S.R. Academy of Sciences in which Soviet men of science expressed their solidarity with their colleagues in allied countries in their combined effort to achieve final victory over barbarity and tyranny.

A message from General Smuts sent by radio and reproduced by gramophone was also heard by the Conference. "Science", said the voice from the other hemisphere, "is the greatest torch which the spirit of man has kindled in the modern world, and nothing—not even in the dark hour of our civilization—should be allowed to interrupt its kindly light. With our victory, science will not merely be reinstated to her honoured status, but a new era will open for her. Our aim is not only more knowledge and ever-new discovery of truth, but also the promotion of social welfare and the building of a great society of free people."

The session began with a paper by Lord Hailey discussing the colonial problems of the British Empire. He showed how the changed conception of the function of the State, namely, its intention to deal with the welfare of the individual, is bound to have a beneficial repercussion upon colonial policy. From his wide experience in Africa he illustrated the type of problems which have to be solved. A collaborator of Lord Hailey, Prof. G. Findlay Shirras, professor of economics in University College, Exeter, directed attention to some of the problems confronting India, with its large and ever-increasing population.

Prof. Alvin Hansen (political economist, Harvard University, and special economic adviser, Federal Research Board) outlined the current programme of research in the United States relating to post-war reconstruction, such as soil conservation, agriculture, nutrition, urban development and international relations. "It is my conviction", he said, "that internal prosperity in my country could be very much promoted by continued economic collaboration between Great Britain and the United States of America—collaboration to pursue parallel and co-ordinated policies of internal expansion."

Prof. P. Sargant Florence, professor of commerce in the University of Birmingham, analysed the problems of distribution of industry and advocated greater dispersion of "foot-loose" industries to ensure the blending of town and country amenities and outlook.

Prof. J. Métadier brought greetings from the Free French Forces and submitted a fairly detailed plan for the creation of an international society for promoting scientific research.

Mr. D. P. Riley, of the University of Oxford, who is known for his work on X-ray crystallography, spoke as one of the younger generation of British scientific workers. He pleaded for a greater share for the younger men of science in the councils of scientific planning, in the laboratory and in the factory. He advocated setting up sub-committees of the British Association to investigate further the problems raised at the Conference ; also the formation of an international committee, including workers of all grades and, if possible, the setting up of a club in London which would serve as a meeting-place for scientific men of all nationalities. The president, Sir Richard Gregory, intervened at this point and expressed his sympathy with the younger scientific investigators. He pointed out that so far as the Division for the Social and International Relations of Science of the British Association is concerned, they have taken an important part in its development. As he had mentioned earlier, in his presidential address, the Council of the Association will be asked to set up special subcommittees to consider the problems brought to the notice of the Conference.

Mr. Hugh P. Vowles, in a forceful address on "Giant Power and World Planning", compared the Soviet electrification programme with that in other countries, and concluded that only under a nonprofit system is it possible to develop the power resources in a co-ordinated scientific manner.

Captain H. Barnard, of the Free French Forces, brought greetings from General de Gaulle and was warmly received by the Conference. He discussed the steps necessary to render it impossible for Germany to wage another war, and stressed the point that men of science have means of helping to prevent economic crises, which are the major source of widespread unemployment leading to such movements as Nazism.

A communication from the Right Hon. Lord Onslow dealt with the conservation of wild life and advocated the establishment of national parks. Mr. O. N. Arup discussed the elimination of waste by planning and standardization. Dr. Othmar Ziegler outlined what a rationally extended international system could do to ease social tension.

Mr. Maurice Dobb, lecturer in economics in the University of Cambridge, pointed out that the postulates of early economists no longer hold good owing to monopolist competition, and advocated socialist planning. "Unless there is a boldly conceived action by the State on an extensive scale," he declared, "we may face a post-war slump that will put 1920 and 1929 in the shade."

The fourth session of the Conference covered the field of technological advance and was reminiscent of the usual British Association gatherings. The President of Czechoslovakia, Dr. Beneš, took the chair. He recalled that the first president of his country, the late Prof. Masaryk, had been a distinguished man of science, and declared that science and technology have played a decisive part in the progress and prosperity of his country. After analysing the growth of technology and its danger when used as an instrument for nationalist and expansionist aims, he concluded : "This conference of scientists is the manifestation of the urgent and categorical needs of the free world to liberate subjugated science, to use science and technology in the post-war world for the work of real, social reconstruction. But it is also a manifestation of our definite and firm will not to permit in the future the misuse of great inventions and all kinds of technological progress for criminal and destructive purposes."

The first paper was by Prof. C. H. Desch, scientific adviser to the Iron and Steel Research Council. It covered the field of conservation of natural resources, showing that while agricultural products may be periodically renewed under rational cultivation, mineral ore deposits are not inexhaustible. Indeed, copper, tin, gold and phosphate deposits, at the present rate of production, are believed to have a life of less than a century. Commercial exploitation tends to "skim the cream", and the proposed international authority which will control the fair distribution of mineral resources will likewise have to deal with the question of conservation.

Dr. L. E. Howlett gave an account of the progress made by Canada's optical industry, greatly helped by Research Enterprises Ltd., a Government-owned company working in close co-operation with the National Research Council. Dr. G. Coumoulos (Greece) stated that Greek industry and technology have tended to be much influenced by outside considerations instead of developing organically from the needs of the country.

Mr. A. J. Couzens presented a paper, prepared by himself and Mr. M. Yarsley, upon the uses and advantages of plastics. He stated that the War has given a powerful impetus to the plastics industry and that plastic material can be developed to meet specific needs.

A French man of science—who desired to remain anonymous—attempted a mathematical analysis of technological progress. The development of aviation and other technical developments may be represented by an exponential law ; that is, such factors as the amount of goods and passengers carried, if plotted with their logarithm against time, give a straight line (law of organic growth). The same speaker suggested that there should be organized a special team of research workers whose duty would be to foresee the problems likely to arise from new technological development, or from present trends solve them before they become acute. For example, the problem of new sources of energy must be solved before the reserves of fuel are exhausted.

Dr. C. H. Waddington, of the Strangeways Laboratory, Cambridge, predicted, among the likely technical advances in biology, more extended technique of vernalization, utilization of hybrid vigour, and the production of entirely novel crop plants by means of such drugs as colchicine. Animal productivity will be increased by artificial insemination, and the hormonal control of sex development may well play a part in the poultry and perhaps the dairy industries.

The next paper to be presented was by a group of three Czechoslovak investigators, Drs. G. Lewi, R. Eisler and J. Cisar, and dealt with the technology of insufficiently utilized raw materials or waste products. This was followed by an outline of the technical advance in the building industry by Mr. R. Fitzmaurice, principal scientific officer to the Building Research Station, and by a communication from Dr. J. H. de Boer on the need for closer collaboration between universities and industrial research laboratories.

A rather different note was struck by Dr. J. E. D. Swann of the Association of Scientific Workers in a paper on the "Organization of Science for War Production". In an incisive manner the speaker criticized the inefficient utilization of scientific workers in the war effort and the insufficient exchange of information between different manufacturing concerns.

Prof. Enrico Volterra returned to the purely technological aspect with a paper on some recent applications of the theory of elastic dislocations in civil engineering, and finally Mr. Ritchie Calder wound up the afternoon's proceedings by pointing out that a definite picture of a "second industrial revolution" resulted from the many papers presented to the Conference.

"Science and Post-War Relief" was the theme of the fifth session, under the chairmanship of H.E. the Chinese Ambassador, Dr. Wellington Koo. "The trying experience of relief workers at the end of the last world conflagration", Dr. Koo said, "shows clearly that rationalization and co-ordination through the use of scientific methods are necessary to the accomplishment of efficient results free from delay and waste." Like the chairmen of previous sessions, Dr. Koo emphasized that only a successful issue to the present struggle will enable scientific people to build according to their plans a new edifice of world order.

Mr. Philip Noel Baker, M.P., formerly professor of international affairs in the University of London, suggested that Governments should agree to strive towards an international food standard on the lines set out by Sir John Orr, and outlined the relief work done after the War of 1914–18 by the Nansen organizations and other bodies connected with the League of Nations.

Mr. R. Allen, of the American Red Cross, gave some of his recent experiences of relief work in Unoccupied France, and stated that a reservoir of medical supplies is being accumulated at Geneva and elsewhere to be used in case of epidemics. Prof. J. Löwy, of the University of Prague, mentioned the curative resources of Europe—sea and mountain air, climatic factors and medicinal springs—which should be made more generally available, and suggested that a special body should investigate this subject. Dr. Kuo Zing-Yang expressed the desire of Chinese men of science to collaborate in solving post-war problems, and pleaded that China should be granted full partnership and not be treated from the point of view of diplomatic expediency.

Mr. W. L. Kelly, of the International Institute of Wool, speaking as an Australian farmer, asked that measures should be taken now towards the storage of foods in such countries as Australia. Mme. Priestman-Breal, of the Friends Relief Mission, gave an excellent address on the psychological approach of relief work, based upon her experience in Poland after the War of 1914–18.

Sir John Russell, director of the Rothamsted Experimental Station, whose original theme was to have been the "Impact of Science on Agriculture", substituted instead a talk on "Restoring the Scorched Earth". He appealed to the competent authorities in the United States and Canada to ensure that the numerous varieties of crops specially suited to their different regions, which have been produced by Russian plant breeders, should be given a temporary home under suitable conditions.

Dr. Anni Noll, of the Pioneer Health Centre, Peckham, London, gave some of the findings from that unique experiment in the promotion of healthy surroundings for the family as a unit. Dr. E. Kodicek, lecturer in psychology in the University of Prague, advocated an efficient organization of scientific experts and politicians. Dr.

Eugen Wallach, formerly manager of the Hirsch-Kupfer Gesellschaft, discussed the post-war control of metal resources and the human aspects of industrial reconstruction. Mr. H. G. Norman, chairman of the British Federation of Social Workers, stated that in the new post-war world, human emotional needs must have a place, and trained social observers, experienced in the art of human understanding and social healing, will be needed. The session ended with an address by Mr. Hugh H. Smith, of the Rockefeller Health Foundation, on the role of epidemiology in the post-war world.

The last session of the Conference was devoted to "Science and the World Mind". The chairman, Mr. H. G. Wells, confronted with a much too limited time to do justice to the subject, arranged for his address to be duplicated and distributed; he requested the speakers to comment on several definite points, a federal world language, the problem of spelling and phonetics, the meaning of words and the storage and distribution of ideas. Unfortunately, Mr. Wells's suggestions did not reach the various contributors in time, and while some made a commendable attempt to rewrite their papers or adapt them to the chairman's suggestions, the majority spoke on their prepared subjects.

Prof. L. Hogben, professor of zoology in the University of Birmingham, had originally prepared a paper on education for government. In a brilliant improvisation he sketched the history of the idea of auxiliary international language, towards which some four hundred attempts have been made from the seventeenth century onwards.

Mr. J. G. Crowther, of the British Council, dealt with education of the public, and Prof. Max Born, professor of natural philosophy in the University of Edinburgh, with the teaching of science. "The human race", Prof. Born said, "is slowly awakening from a dream mind into a state of clearer consciousness." Dr. J. Needham, reader in biochemistry in the University of Cambridge, developed the theme that a principle of increasing organization is discernible in living beings and culminating in social organization counter to the principle of degradation of energy to a dead level.

Mr. J. A. Lauwerys, of the University of London Institute of Education, under the title the "Scientific Content of General Education", presented the views of a group the members of which are concerned with the training of science teachers "Mere giving more time to science is not enough," he said; "the scientific method and the scientific attitude must be fostered and the material must be chosen from a wider field and treated in a modern manner."

Mrs. S. Neville-Rolfe, of the British Social Hygiene Council, in a well-delivered address, advocated an institute of social biology and stressed the need for a wider understanding of the emotional nature and the requirements of man. The causes of war, she stated, lie in the lack of ability, character and emotional development of man himself. A true democracy can only be created by the emotional and intellectual development inspired with a positive purpose in life. Youth can appreciate the opportunity and accept the responsibility of mustering the forces of evolution and directing them to the development of man.

Prof. Skalinska, of the University of Cracow, spoke on behalf of the Polish men of science, men and women who had to find refuge in other lands, and Count Zamoyski assured the Conference that no man-made creeds will in future obstruct the relations between Poland and the U.S.S.R.

Prof. Julian Huxley, like some of those who had preceded him, did not speak on his prepared subject, "The Scientific View of Education as a Social Function", but undertook the difficult task of summarizing the main points that had emerged during the proceedings of the Conference.

The meeting was then taken over by the president, Sir Richard Gregory, who repeated the promise that committees would be appointed by the Council of the British Association to prepare considered reports upon several main points that had been raised. He then presented the Charter of Scientific Fellowship (see p. 393), a concrete proof of the new spirit which the Division for the Social and International Relations of Science has been formed to foster.

Thus ended a memorable Conference, leaving a mixed impression of light and shade, of brilliant flashes of intellect and dark patches of unco-ordinated effort. Unfortunately, in practically every session the time allowed to the speakers became progressively shorter towards the end of the meeting, irrespective of the nature and the importance of the subject-matter. There was much lack of unity and proper relationship in the too numerous papers, insufficient drive towards results to be achieved, and lack of clear vision of the potentialities of the situation. Some would claim that the Conference was nothing but a sterile hybrid between the free-platform attitude of previous British Association meetings on one hand, and the purposeful drive which inspires many younger scientific workers on the other. Others hold that in spite of all imperfections, one can discern in these deliberations the amœbic beginning of a world mind, as yet halting and incoherent, but full of promise for the future.

THE COMMONWEALTH OF SCIENCE*

INTELLECTUAL freedom is an essential condition of progressive human development. Throughout the ages, individual scientific workers have been forced to fight and to suffer in order that life and intellect may be preserved from the effects of unreasoning prejudice, stagnation and repression. To-day they feel compelled to proclaim their special responsibility in the struggle against any subjection which would lead to the betrayal of intellectual liberty.

The war now devastating our world involves an age-old conflict of ideas. Liberal minds of the last generation were convinced that the battle for independence of thought and free expression of opinion was finally won; yet once again this conviction is being violently assailed. The fight to maintain it must perforce be resumed, for the danger of losing the heritage of freedom seems graver than ever before.

During the past third of a century, changes in the conditions of life have come about, more profound than any in human history. Distance has been virtually abolished; cognizance of events has become simultaneous throughout the world; all men have become neighbours. Fresh discoveries open up undreamed-of potentialities for good or for evil, but their proper use demands correspondingly high ethical standards.

While only a century ago the village was an almost self-sufficing unit, to-day the world is our unit. To such a disturbing change of outlook and obligations, we are not yet attuned, and we must readjust our way of living, for only by the fullest and freest adaptation of ideas to new conditions can this readjustment be achieved. Intense mental effort and clear vision are now needed.

In the past, freedom for the written and spoken word was desirable; to-day, complete freedom of thought and interchange of knowledge and opinion are supreme necessities. Full freedom of expression is the very essence of science as well as democracy: where thought is enslaved science, like democracy, withers and decays. Men of science must, therefore, declare clearly and emphatically the principles which underlie their beliefs and guide their conduct.

Accordingly, the principles of the fellowship of science are here affirmed; and it is maintained that any policy or power which deprives men or nations of their free practice convicts its agents of an iniquity against the human race.

Declaration of Scientific Principles

1. Liberty to learn, opportunity to teach and power to understand are necessary for the extension of knowledge, and we, as men of science, maintain that they cannot be sacrificed without degradation to human life.

2. Communities depend for their existence, their survival and advancement, on knowledge of themselves and of the properties of things in the world around them.

3. All nations and all classes of society have contributed to the knowledge and utilization of natural resources, and to the understanding of the influence they exercise on human development.

4. The basic principles of science rely on independence combined with co-operation, and are influenced by the progressive needs of humanity.

5. Men of science are among the trustees of each generation's inheritance of natural knowledge. They are bound, therefore, to foster and increase that heritage by faithful guardianship and service to high ideals.

6. All groups of scientific workers are united in the fellowship of the Commonwealth of Science, which has the world for its province and the discovery of truth as its highest aim.

7. The pursuit of scientific inquiry demands complete intellectual freedom and unrestricted international exchange of knowledge; and it can only flourish through the unfettered development of civilized life.

* The New Charter of Scientific Fellowship presented by Sir Richard Gregory, Bart, F.R.S., president of the British Association, at the end of the Conference of Science and World Order.

G. B. CAVE, CHARTERHOUSE ON MENDIP

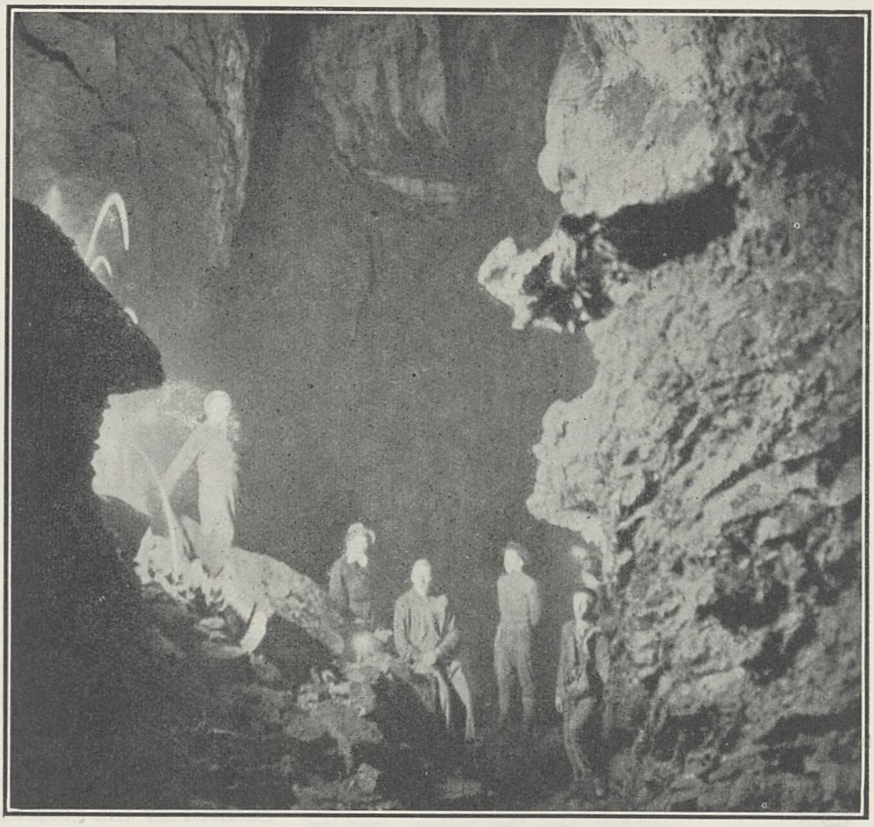
By F. J. GODDARD AND R. A. J. PEARCE
UNIVERSITY OF BRISTOL SPELÆOLOGICAL SOCIETY

IN these modern times the opportunities for making new geographical discoveries have become very scarce, and for this reason the opening up of a large new cave system, such as G.B. cave, within twelve miles of Bristol, should be of considerable interest to the scientific world.

The range of Mendip Hills in Somersetshire extends from the upper valleys of the Frome and Brue in the east some 23 miles down to the Bristol Channel. It is generally about 6 miles in width, and its south-western face descends to low moors drained by the Axe, and other streams, to Cheddar and Wells. It is with this area that the Spelæological Society of the University of Bristol is concerned.

The Mendips consist principally of carboniferous limestone, but at its highest point, Blackdown, which rises to a height of more than 1,000 ft., the limestone and the limestone shales have been eroded, leaving a cap of Old Red Sandstone. The numerous caves to be found in this district are formed by the action of surface water penetrating the strata at the juncture of the Old Red Sandstone and the limestone.

To the south of Blackdown, the strata dip in the direction of the famous Cheddar Gorge, and on this face there lies a pitted and mine-scarred patch of ground aptly named Gruffy Field. Close by runs the Roman road which once carried Mendip lead to the coast of the Bristol Channel. A small stream runs into this field and disappears at the base of a cliff at the end of a small gorge which it has carved for itself in bygone ages. This stream and neighbouring swallow holes, or swallets, have been investigated by the Society for the past twenty years; most notable of these excavations was that by E. K. Tratman, now professor of dental surgery at King Edward VII College of Medicine, Singapore, who always believed that a large cave system lay beneath the surface at this point.



GENERAL VIEW OF THE MAIN CHAMBER OF G.B. CAVE. THE ROOF OF THIS CAVERN IS 120 FT. ABOVE THE FLOOR-LEVEL AND THE TOTAL LENGTH OF THE GORGE, OF WHICH IT IS THE LARGEST PART, IS 786 FT.

About 100 yards west of the point where the stream now penetrates the rock, there is a dry swallet where it formerly disappeared. At the instigation of F. J. Goddard, who was secretary of the Society at the time, and the co-discoverer of the cave, Dr. C. C. Barker, work was begun in this choked streamway early in 1939. Owing to the small size of the rock fissure, progress in the actual stream bed was found to be very difficult, and another shaft was sunk a few yards away, to a final depth of twenty feet. At the bottom of this hole was revealed a small crack from which

Erratic stalactites on roof of 1st grotto, G.B. Cave

there issued a draught strong enough to extinguish the flame of a candle held in it; this gave us an indication that a cave system lay within reach below. However, it was found impossible to enlarge the crack in the solid rock by normal means, and we resorted to the use of a charge of explosive. This proved most effective, and after the debris had been cleared, it was found just possible to force an entry through it into a small passage.

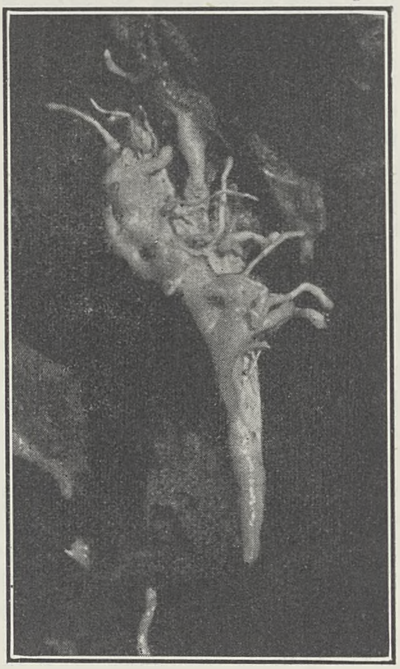
This soon opened up into a gallery leading into a grotto of extraordinary beauty. In this grotto the calcareous formations take on an amazing variety of shapes. Both stalactites and stalagmites branch and twist into fantastic shapes for the formation of which there has as yet been advanced no satisfactory explanation. These erratics have been termed 'helictites', and there are very few caves known where they exist in such profusion as they do in all parts of G.B. Cave. It is interesting to observe that they have not been found elsewhere on Mendip, except for a few examples in a new chamber of East Twin Swallet, in Burrington Coombe, recently opened up by the Society.

The way on from this chamber is up a 10-ft. climb into another grotto rivalling the first in its fairy-like beauty. From this there leads a series of climbs and crawls 300 ft. in length which try the fortitude and tax the agility of even the most hardened caver. They end in an unpleasant water-crawl about 2 ft. high and 18 inches wide, which we have named the Devil's Elbow; emerging from the end of this, one looks down into a large boulder chamber from a height of about 15 ft. The amount of icy water rushing along this passage and over the drop prevented further exploration for some months, but in March 1940 four members were able to fix a rope over the lip and descend into the chamber.

We were delighted to find that a large rift led steeply out of this chamber down over a series of potholes to a narrow slit in the rock. Squeezing through this one by one, we found ourselves in an enormous chamber, so high that the light from our acetylene headlamps would not illuminate the roof. We followed the stream along its floor, over a mass of shattered boulders until we were halted by a drop. The chamber, or, as we have christened it, the 'Gorge', widens out at this point into a cavern about 100 ft. in width and 120 ft. high, and its roof is hung with magnificent formations, which can best be viewed from a gallery which runs high up along one wall. Lining one side of the chamber are hanging tapestries of white stalactite fully 60 ft. high, while large stalagmite bosses, many feet across, are set in the walls; in fact, it is only by using lengths of magnesium ribbon as illumination that the true magnificence of this cave can be appreciated, so huge are its dimensions.

After negotiating the drop, we found that the Gorge gradually narrowed down to end in a small sump chamber, where the stream disappeared underneath the rock in a syphon, or sump. At this point one is 480 ft. below the surface, and the total length of the Gorge is 786 ft., so that as a single continuous chamber it must be one of the largest in Great Britain.

Subsequent exploration revealed a new series of chambers and passages leading from the roof of the main chamber, some of which ascend to within 100 ft. of the surface. These chambers contain



Erratic stalactite or helictite, from 1st grotto, G.B. Cave some of the most beautiful formations of all, including some fine erratics four or five feet long, and some curious, slender, apparently windswept stalagmites.

A number of true cave pearls have also been found here, together with a large amount of so-called coral formation, making the cave unrivalled in Mendip both from the point of view of size and beauty.

Owing to its size, and the narrowness and intricacy of its upper passages, the survey and photography of the cave have not been easy. Our work has, in addition, been held up by the salvaging excavation undertaken by members of the Society on the site of our museum, the valuable contents of which were destroyed by fire during an enemy air raid on Bristol.

However, the survey has been completed, and we are now concentrating upon obtaining a comprehensive photographic record of the cave, which offers unlimited possibilities in this direction, and upon an attempt to follow the stream still farther into the heart of Mendip past where we now lose it.

ASPECTS OF MATHEMATICAL LOGIC

By Dr. Harold Jeffreys, F.R.S.

It is recorded that when a pupil asked Confucius what he would do first if he had absolute power, the Master replied "I should reform language". (The development of the theme in the text of the "Analecta" is scarcely worthy of it, but incorporations are suspected.) The history of mathematical logic since "Principia Mathematica" affords an admirable illustration. Even before that great work, the need for unambiguous definitions and for the explicit statement of even the most harmless hypotheses was a main source of inspiration; but later investigators have found that ambiguities remained. In particular, there was a confusion between a symbol and the thing designated by it, and a propositional function was sometimes a property and sometimes what Prof. Willard Van Orman Quine in his recent book, "Mathematical Logic"*, calls a "statement matrix", that is, an expression that would become a statement if it contained names in place of variables. It was hoped also, especially in Russell's popular works, that the actual existence of numbers could be demonstrated in terms of the theory of classes.

It seems to me that such an approach was bound to be unsatisfactory if the scientific use of mathematics was to be justified. For equality of number between classes has to be defined in terms of an empirical method of comparison, and an empirical hypothesis is used in the statement that two classes defined in terms of some property, found similar in one test, will be found similar in another. This hypothesis is so elementary that it has usually passed unnoticed, but if mathematics is justified only for classes satisfying certain axioms, it follows (1) that we cannot significantly speak of the number of individuals with a certain property if the number is liable to change, (2) if there are in the world no classes at all that satisfy the axioms, the whole system breaks down. The fundamental objection to this approach, from the point of view of an empirical scientist, is that we must be able to query and test any empirical statement whatever, and this cannot be done if some such statements are selected and made part of the method of analysis itself.

Later writers have mostly abandoned Russell's attempt; the best known is probably Carnap. Axioms are now regarded as abstract statements, and a clear distinction is drawn between a thing and its name. Logic reduces to stating the rules of a language and investigating what kind of statements can be made in the language. Actual demonstration of the existence of structures formally similar to those laid down in the abstract rules is left to the empirical sciences. Even where the rules are not satisfied they can still serve as a useful standard of comparison. The chief aim now is to show that the rules themselves do not lead to contradiction; ordinary language, if not supplemented by rules that have been discovered by persons still living, does lead to contradictions—some are sufficiently elementary to be given in "The Week-End Book".

It is easy to show that if two contradictory propositions are demonstrable (in the ordinary sense) in a language, then every proposition in the language is demonstrable. If we have p and $\sim p$, and we consider any other proposition q, then p entails (p or q); but $\sim p$ and (p or q) together entail q; hence p and $\sim p$ entail q. Similarly, of course, they entail $\sim q$. This result in one form or another occurs in all the modern languages of mathematical logic. Now if every proposition capable of being stated in a language could be proved both true and false, the language would be of little scientific use; and this argument shows that a useful language must contain no contra-

* Mathematical Logic. By Prof. Willard Van Orman Quine. Pp. xiii+348. (New York: W. W. Norton and Co. Inc.; London: George Allen and Unwin, Ltd., 1940.) 21s. net.

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Contents

Part I
ELEMENTS OF SOIL PHYSICS
Origin and General Characteristics of Soils
Soil Moisture : Soil Plasticity and Consistency
Seepage Phenomena and Frost Action in Soils

Part II
ELEMENTS OF THE MECHANICS OF EARTH MASSES
Stresses in Earth Masses
Compression Strains : Theory of Consolidation
Shearing Resistance and Conditions of Failure of an Earth Mass
Review of Parts I and II ; and Introduction to Part III

Part III
STRUCTURAL APPLICATIONS
Stability of Foundations
Stability of Cuts and Embankments
Stability of Retaining Walls and Bulkheads
Settlement of Structures
Soil Sampling and Soil Testing
Appendix A. Wet Mechanical Analysis of Soils
Appendix B. Pressure from a Distributed Load
Index

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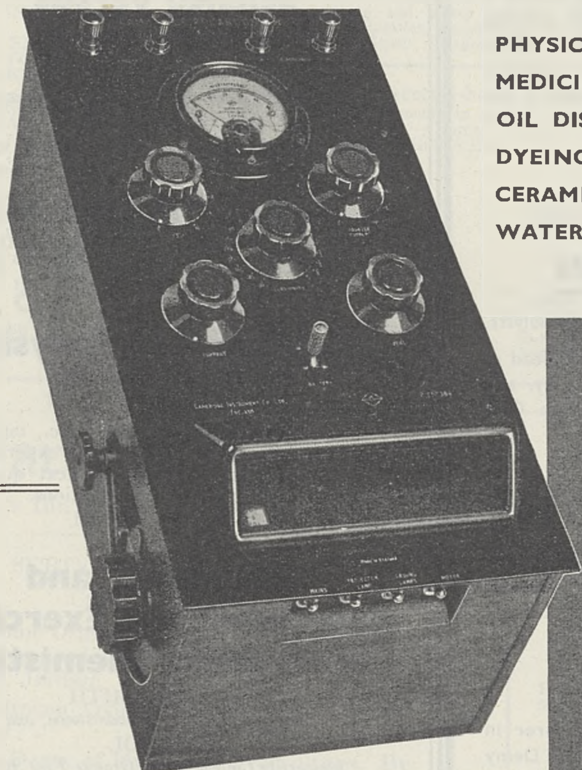

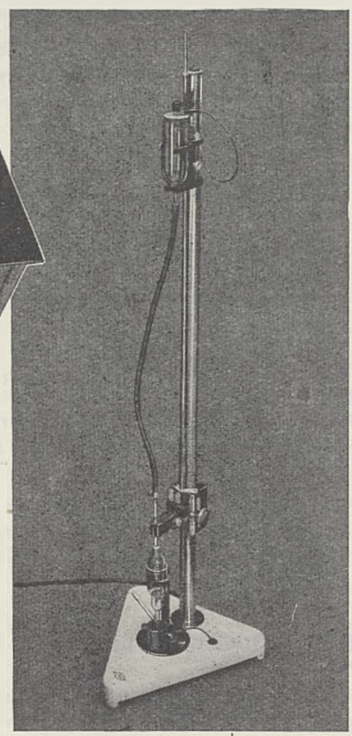

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dictions at all. But it also follows that if we can find a proposition in the language that cannot be proved in the language, then the language is consistent. It is not easy to find such propositions; to prove that a proposition cannot be proved is a very different matter from merely failing to prove it. Carnap, however, produces one. But it might happen that every proposition could be proved true or false in the language without any being provable to be both. It has been proved, however, by Gödel that any consistent language that includes arithmetic contains a statement that can be neither proved nor disproved. In his present book, Quine gives a proof that such a statement exists in his system even before arithmetic has been constructed. This is towards the end of the book, and the argument is difficult. But as a result of this type of work we have now much stronger reason than we had for asserting the consistency of logic and mathematics, and we also know that they can never be complete: we can never lay down formal rules that will enable us to decide whether any statement expressible in the language is true. Twenty years ago we might have had doubts about consistency but thought that somehow every proposition could be either proved or disproved, possibly both.

Quine has introduced a novel feature in the treatment of the theory of types, which is much simpler than in Russell and Whitehead's analysis. In the latter the famous contradiction about whether the class of all classes that are not members of themselves is a member of itself or not is resolved by including in the logic of classes a rule that the statement that a class is a member of itself is neither true nor false, but simply meaningless. This led to much complication, because, for example, a real number was defined as a class of rational numbers, and therefore no rational number could be a real number; the real numbers that we ordinarily regard as rational fractions belong to a different type. Quine finds that he can manage with a less drastic criterion. He still finds that certain classes need special treatment, but that he can give a formal rule for recognizing them by inspection of their definitions, and that it is not necessary to deny the meaning of such a class; but it cannot be a member of another class. He is thus able to introduce a universal class V consisting of all things that can be members. This would be impossible in the "Principia" analysis, since no class could include members belonging to different types. We can apparently say now, if we want to, that $0{\cdot}5000\ldots$ is the same thing as $\frac{1}{2}$ and not something different in kind.

Quine's criterion for the recognition of anomalous classes might be compared with the epistemological considerations given in a recent paper by Bridgman. I think that closer inspection would show that the process of constructing them could never be carried out because no consistent order could be given for carrying out the steps. Carnap and Quine both exclude epistemological considerations from their analysis, but I think that without them they lose a valuable source of suggestions, and one that the empirical sciences cannot possibly dispense with.

I would have liked to see some reference to the difficulty in formal expression of logic propounded by Lewis Carroll in "What the Tortoise said to Achilles". The point is that if we know p and (p implies q) we can infer q and proceed to assert q by itself; this is an essential principle of inference. But if we try to state it symbolically and use it, we simply build up longer and longer expressions and never reach a stage where we actually say 'q'. We can *see* what the rule means and act on it, but we cannot state it formally. This is recognized in "Principia". But some of the modern systems try to avoid the notion of meaning altogether and to speak only of symbols as actual specimens of printers' ink, giving rules for substitution of one type of expression for another. We can see what this means, and carry out the various cancellings permitted by the rules. But it seems to me that if the notion of meaning is eliminated, Lewis Carroll's difficulty is reinstated, and the process will only build up longer expressions and never enable a theorem to be asserted by itself. I think that Quine's system retains enough of the notion of meaning to permit an answer to it, but it should be made explicit.

I have been particularly interested in these recent developments because I have been trying to do for induction what Carnap and Quine seem to have done (in different ways) for deduction: to construct a self-consistent formal theory that will enable statements of certain types to be expressed, but such that the theory by itself says nothing about the truth or probability respectively of any empirical proposition. "Principia" assumed some empirical laws, and so, I think, do the 'printers' ink' theories. But for Carnap and Quine logic and mathematics are languages and their study is the analysis of those languages. This is analogous to the only satisfactory interpretation that I can find of the use of numbers to express probabilities; that it is the choice of a language to give more compact and less ambiguous expression than ordinary language can. If this is true in probability theory, it must be true of pure mathematics, which deals with the extreme cases of probability. There are advantages as well as disadvantages when workers follow totally different routes, and nevertheless arrive so near the same destination.

THE INTERNATIONAL EDUCATION BOARD

By R. Weatherall,
Eton College

THE International Education Board was set up in 1923. The idea behind it was to help to make good some of the ravages of the War of 1914–18. The money, which amounted in all to nearly twenty-eight million dollars, was provided by John D. Rockefeller, jun., who with characteristic modesty imposed no conditions on the manner in which it should be spent, except that it should be used for "the promotion and advancement of education throughout the world.*" The inspiration with regard to the policy which should be followed came almost entirely from the late Dr. Wickliffe Rose, under whose guidance the Board has achieved something which for its breadth and diversity must be unique in the technical progress of the world.

What is education ? In Rose's mind it became for the most part, not the dissemination of certain accepted ideas and cultural patterns, for that he felt might well be left to the various national Governments, but the desire to forward the understanding of the natural world by the best possible means. The claims of educational training, particularly training for agriculture, were not overlooked, but they played a subsidiary part in the comprehensive scheme which he put forward for the support of the best research institutions and the most promising scientific workers, whose work was being held up for lack of funds. His primary object was to add to the total stock of human knowledge, and his scheme he looked upon as "tactics in the campaign against human ignorance." No considerations of national prestige were allowed to stand in the way, and except for agriculture, no attempt was made to strike a balance between the competing claims of the different branches of science, for in Rose's view, "all knowledge is inter-related, and if we help in any one field we help in all the others." So it came about that the greatest scene of the Board's activities lay in Europe, including the British Isles ; but a small number of individual projects in the United States received some of the largest grants, while smaller ones found their way to such places as South Africa, China, the Philippines and New Zealand.

In all, "fifty-seven universities, research centres, and other institutions were provided with new buildings, equipment, endowment and other material aids ; and 603 individuals, chosen for their promise of future usefulness, were assisted in their higher education, given opportunity to study under world authorities in their chosen fields, introduced to new pastures of research under conditions which at the time seemed favourable to their development. Through grants for these various purposes, thirty-nine countries, representing Europe, Africa, Asia, Australasia, and the Americas, were aided."

A visit of Dr. Rose to Europe in 1923 initiated a scheme under which the whole world, but particularly war-worn Europe, was scoured for young scientific workers showing exceptional promise, whose studies were held up through lack of means. After careful scrutiny these were granted travelling fellowships for a year, which enabled them to profit by the best scientific experience available in the world in their own particular line. Within the five years, 1923–28, an exchange of workers and of scientific ideas took place on an unprecedented scale.

But this scheme of fellowships in science would have been held up by the cramped facilities existing in many of the leading research institutions. Realizing this, the International Education Board made available large sums to be spent upon buildings, equipment and endowment. One of the first institutions to benefit in this way was the Institute of Theoretical Physics at Copenhagen, under Niels Bohr. There facilities for research and for teaching were greatly augmented. Grants from the Board also made it possible to provide new accommodation for the Institute of Physical Chemistry at Copenhagen, where J. N. Brönsted had won international fame, and had attracted many students from foreign lands.

The University of Göttingen received very material help. Its pre-eminence lay in the spheres of physics, mathematics and mathematical physics. In 1926 assistance from the Board led to the enlargement of the Physical Institute, and enabled a large number of visiting students to work under the distinguished leadership of James Franck, Max Born, and Robert Pohl. The same year also saw a considerable sum going to build and equip a new Mathematical Institute, which provided far better facilities for the work and teaching of such distinguished mathematicians as Hilbert, Hermann Weyl, Richard Courant, Landau, Herglotz, Felix Bernstein, Paul Bernays, Otto Neugebauer, and

* Education on an International Scale : a History of the International Education Board, 1923–1938. By George W. Gray. Pp. xiii+114. (New York : Harcourt, Brace and Co., Inc., 1941.) 2 dollars.

Emmy Noether. Thanks to the International Education Board, Göttingen became truly pre-eminent in its own particular field.

Proceeding along the same lines the Board came to the aid of the laboratory for low-temperature research under Kamerlingh Onnes, at Leyden, and supplied much-needed equipment with which The Svedberg of the University of Uppsala might pursue his investigations into protein structure. In Paris the Board founded and endowed a professorship in mathematical physics, and allotted further sums for the erection and upkeep of the Institut Henri Poincaré. One small donation, with pleasant associations, amounting to five hundred dollars a year, for a short period provided Einstein with the services of an assistant in making a fresh approach to the mathematics of the quantum theory.

In Stockholm grants from the Board completed the sums necessary for the erection of a Biological Institute. These grants were forthcoming chiefly because of the distinguished contributions which von Euler had made to the chemistry of fermentation. The Board also made itself mainly responsible for the finance of the new Institute of Cosmical Physics at Tromsö, for the Institute of Physics and Chemistry at Madrid, and for the new research outpost of the Jungfrau High Altitude Institute on the Sphinx, the rocky spur adjoining the Jungfraujoch in Switzerland. Much attracted by the zeal and energy of Prof. José Castillejo, Dr. Rose placed great hopes on the new Institute in Madrid. Smaller subventions went to the Universities of Utrecht, Vienna and Warsaw.

In the field of astronomy a comparatively small sum financed the preparation of a bibliography of books, papers and other publications in all languages referring to the minor planets. A considerably larger grant was made to Harvard University to be spent in moving the southern astronomical station from Peru to Mazelspoort, near Bloemfontein in South Africa, and for improving its equipment. There the 60-inch Rockefeller reflector was erected, and as a consequence, the surveying of the southern stellar hemisphere, and in particular of the outer galactic systems, has been considerably extended, to the tune of about five thousand photographic plates each year now pouring into Harvard from South Africa.

But perhaps the one project which will endure as the most symbolical monument to the policy and achievements of the International Education Board is the 200-inch telescope on Mount Palomar. This project required boldness in its conception, it needed very careful preliminary survey work, it depended upon the solution of many intricate problems in applied physics, and it could be carried through only with the expectation that large sums would be forthcoming to bring it to completion. Six hundred thousand dollars, for example, were spent on experiments with fused quartz for the mirror before the decision was reached to use a special form of Pyrex glass. As a result of careful estimates the International Education Board decided in 1928 to set aside six million dollars for the whole project, including the necessary housing and site, as well as the astrophysical laboratory and shops at Pasadena. Of this sum a balance of four hundred thousand dollars remained unspent at the beginning of 1941 to meet the final expenses of construction and installation: fine testimony to those who drew up the original plans.

The biological sciences were not neglected. At the same meeting at which it was decided to finance the 200-inch telescope, a large-scale building programme was agreed upon to bring all the scattered and greatly overcrowded faculties in botany, zoology and general physiology at Harvard University into one single Department of Biology. Not only were material facilities greatly increased and given new dignity, but the co-ordination of these allied branches of biological science promises to have far-reaching results. Mainly at August Krogh's instigation, something similar had been achieved some years earlier at Copenhagen, where grants from the Board assisted in the foundation of an Institute of Physiology to serve for the study of physiology, biochemistry, and biophysics. Thus Copenhagen received assistance from the Board for three separate institutes, each world famous.

Edinburgh was the recipient of generous donations from the Board for its Department of Research in Animal Breeding under F. A. E. Crew; and for housing and equipping the Zoological Laboratories on a new site. The Jardin des Plantes in Paris was given a grant for the rehousing of its priceless herbarium. Assistance was given to the Marine Biological Station at Naples to get it going again after the disturbances of the War of 1914–18, and smaller donations went to the Marine Biological Station at Plymouth, the Botanical Conservatory of Geneva, the French Society of Biology at Paris, the University of Utrecht and the University of Cracow.

Even the claims of scientific publications were not overlooked. A grant was made to the University Foundation in Belgium to help in making good the losses in books and periodicals suffered in the War of 1914–18. Funds were also made available to nurse a number of technical journals in Italy through the critical post-war years. A grant to the International Bureau of Weights and Measures provided an important new measuring instrument, a set of reference books, and a much-needed addition to its overcrowded building. Similar grants assisted in the publication of two volumes of the Annual Tables for the International Committee of Annual Tables of Constants and Numerical Data in Paris, and for a set of International Critical Tables for the National Research Council in the United States.

In agriculture alone was any attempt made to finance broad experiments in education. Based upon what had already been achieved in the United States, the first of these projects to be set going was a scheme of rural clubs in Denmark. This included farm clubs for boys, and similar ones in gardening and domestic economy for girls and women. Within a short time requests were received to establish schemes in Sweden and Finland. Help was also forthcoming for the Village Association in Hungary, and for the Fram-Kursus Institute in Oslo, which provides correspondence courses in forestry and agriculture. But in the sphere of agriculture a far wider range was achieved through the system of travelling professorships and agricultural fellowships. These together covered thirty-nine countries, and five States in the United States, ranging as far away as China and New Zealand. Some of these fellowships were arranged on an exchange basis, with most happy results.

The University of Cambridge received most generous treatment from the Board. Preliminary plans to finance a Department of Entomology were expanded to cover the extension, rebuilding, equipment and support of laboratories for agriculture, and the associated sciences of botany, physiology and zoology, in a co-ordinated scheme. To round off its benefactions to Cambridge, which in all totalled nearly three million dollars, the Board gave a handsome donation to the new University Library.

One promising development was the sponsoring of a co-operative undertaking between Cornell University and the University of Nanking. Cornell agreed to assign each year one of its professors in the Department of Plant-Breeding to spend several months at Nanking, and the International Education Board met all expenses not otherwise provided for. This arrangement came to an end in 1931, by which time trained Chinese workers were available, and the idea of scientific crop improvement had spread to other parts of China.

Other donations for agricultural purposes included sums to enable the International Institute of Agriculture in Rome to carry through the world census of crops and livestock in 1930, and to extend its library facilities. A small donation made it possible for J. O. Veatch to make a detailed demonstration soil survey of a certain part of Scotland. Assistance was also forthcoming for agricultural institutes in Poland, Hungary, and Austria; for the Agricultural College at Hohenheim in Germany; for the Willie Commelin Scholten Laboratory at Baarn, Holland; for the Central Institute of Agricultural Research at Stockholm; for the Institute of Agronomical Research at Paris; and for Rothamsted Experimental Station at Harpenden. A grant to the University of Sofia completed the sums necessary for the erection of a College of Agriculture, which at the beginning of the present War was the "most competent and active outpost of scientific agriculture in the Balkan States."

The humanities were not forgotten, but the policy here was to make large grants to three selected institutions. One of these grants went to the American Academy in Rome, and was used for extensions, for increasing the number of fellowships, and for the permanent endowment of its library. Another made it possible for the American School of Classical Studies in Athens greatly to extend its work, and to excavate the ruins of the ancient Athenian Agora, which has now yielded priceless archæological finds. The largest grant of all rounded off the pioneering work of Dr. J. H. Breasted by providing a truly magnificent building for the Oriental Institute at the University of Chicago: an institute which has become the centre for Oriental studies in the United States, and has set before itself a stupendous programme in archæological investigations.

In the sphere of education as commonly understood generous support from the International Education Board led to the foundation of the International Institute for Foreign Students working at Teachers College, Columbia University. This Institute has been much concerned with the psychology and culture of foreign peoples of non-European civilizations. It has been of great value in developing a new educational outlook in different parts of the world, to which places students have been able to carry back first-hand experience of Western civilization. A timely donation from the Board helped to bring about the re-organization of Negro education at Atlanta University, with better provision for graduate and professional training. Other grants were made to the Phelps Stokes Fund for educational survey work in British West Africa, and to enable African educationists to visit the United States. Support was also given to educational activities in Liberia, including the foundation of the Booker Washington Agricultural and Industrial Institute at Kakata, modelled on the Tuskegee plan of practical education.

Twenty-eight million dollars is a large sum of money. It is small compared with the amounts available for spending week by week, whether for war or for peace, in the leading countries of the world. The bare summary of what the International Education Board was able to achieve is fine testimony to the vision and understanding of those who were responsible for devising its policy and carrying it out. With them men counted for more than things, but they realized that even pre-eminent men cannot work without things, of which they deserve the best that are obtainable.

Now, some of the work of the Board is already in ruins. Buildings have been demolished, men of science driven from their homes, prohibited from pursuing their investigations, and some even put to death. In ever-widening circles across the world, all that the International Education Board stood for is in a state of dissolution and suspense, borne down by the forces of nationalism and ignorance which it strove to eliminate. As men of science we may reflect that even that is a natural phenomenon. Reaction and war have come upon us because we have not yet learned to understand and control those mass movements of mankind which are called national policies.

In drawing up his plans Dr. Rose paid next to no attention to the social sciences. That in its way was characteristic of the period and country in which he lived and worked. His feeling was that in these sciences no clear principles are to be found. The principles may still be wanting. Their lack is the measure of how much is waiting to be done ; for it is useless to go on piling up technical information if knowledge of man himself lags so far behind. We may question the economics which rendered so much scientific progress dependent on the fortune of one man, while realizing that without his aid technical science would have made less rapid strides. When the clouds of war lift again, let us hope that still larger endowments will be forthcoming for the progress of knowledge, the fount of all education, and that they will be used to make the threat of war remote, not by force but by international understanding directed to the good of all mankind.

OBITUARIES

Eng.-Captain J. Fraser Shaw

ENG.-CAPTAIN J. FRASER SHAW, of the Fuel Research Station, Greenwich, died at his home at Chislehurst on July 23.

As an engineer in the Navy he specialized in the burning of fuel and he took part in the organization of the courses for naval cadets who had to qualify in engineering. Later he was responsible for courses of instruction on oil fuel and turbines. He was present at the Battle of the Falkland Islands and his record throughout the campaign was a brilliant one. He was mentioned in dispatches and after the Battle of the Falklands was promoted immediately to the rank of commander. It may be recorded that he was a magnificent athlete and played for his country at Rugby football, being popularly known as "Rugger Shaw".

The knowledge Shaw had gained upon the use of liquid fuels was recognized towards the end of the War of 1914–18, when he was appointed liaison officer between the Admiralty and the Ministry of Munitions (Mineral Oil Production Department). During this period of his service he obtained a wide knowledge of all processes for the production of oil from indigenous materials, and in view of this special knowledge he was seconded from the Navy to take charge of the Fuel Research Station during its erection. He continued his service until 1922 when he resigned his commission to take up the appointment of chief engineer of the Fuel Research Station and liaison officer with the Admiralty.

As chief engineer of the Fuel Research Station he was responsible for the organization of most of the programmes, and in particular all investigations which were carried out on a large scale. He was interested in the scientific and technical aspects of the carbonization programme, and especially processes for the production of oil by low-temperature carbonization and hydrogenation. In association with Dr. King he read a paper before the Institution of Gas Engineers and received the Gold Medal of the Institution. A year later he described in a Fuel Research Technical Paper the details of the low-temperature carbonization plant which had been designed and erected at the Station and for which he had been largely responsible. His long experience in the burning of oil in the Navy gave him a special interest in methods of heat transfer and in particular the burning of coal in a pulverized form. In order to realize the essence of his work it may be noted that some of the experimental plants at the Fuel Research Station are on such a scale that the results may be applied directly in industry, and it was the object of the organization to translate the observations made in the laboratory into plant which could be operated in industry. He possessed in a remarkable degree a capacity for improvising plants on an intermediate scale by which the inherent features of a process could be investigated in the first place on this scale before proceeding to the erection of a large-scale unit.

Shaw was a most enthusiastic and kindly leader and he brought together the industrial men who had to operate the large-scale units and the directing staff into the harmony which is necessary when laboratory observations have to be translated on to a large scale. His name will not be found on the title-page of many of the publications of the Fuel

Research Organisation because he wished his assistants to receive the maximum credit. It remains, however, to say that every investigator had been helped to the full by his wise and able guidance.

F. S. SINNATT.

Mr. L. A. Boodle

THE death of Mr. Leonard Alfred Boodle, formerly assistant keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew, on August 22, has removed from our midst a very learned botanist and a most conscientious and devoted public servant.

Boodle started his botanical career at the Royal College of Science, and after taking his A.R.C.S. he was for seven years demonstrator at the College under the late Dr. D. H. Scott. Soon after Dr. Scott went to Kew as honorary keeper of the Jodrell Laboratory, Boodle joined him as his private assistant, and it was then that Boodle's valuable work on plant anatomy commenced. Before that he visited South Africa and worked on marine algæ, with the late Mr. George Murray. The genus Boodlea was named after him.

When Dr. Scott resigned his honorary keepership of the Laboratory in 1906, Boodle was put in charge, having been appointed an assistant at Kew in 1904. He was appointed assistant keeper of the Laboratory in 1909 and retired under the age limit in May 1930.

Boodle was blessed with a splendid memory and had a remarkable knowledge of botany and botanical literature ; he was a very valuable critic. Diffident of his own powers and most meticulous in all he undertook, he spared no pains in working out fully any problem presented to him, but his published work was not very large and much first-class research work he carried out, unfortunately, was never published. His papers on the vascular structure of the Pteridophyta are a worthy memorial of his careful and exact methods.

Prof. E. J. Salisbury writes : "He was a man of whose profound anatomical knowledge and surefootedness we all had the greatest respect. His extreme modesty and retiring nature led to many not appreciating to the full his great gifts."

ARTHUR W. HILL.

Dr. M. Benjamin

WE have learnt with deep regret of the death in a recent aeroplane accident of Dr. M. Benjamin, while engaged on work for which he was seconded from industry to the Ministry of Supply. He was a physicist of great promise who had begun to make his mark in pure science as well as in applications to industry.

His work in pure physics consists of a number of careful and interesting studies of electron emission from various types of surfaces. The earliest (Benjamin and Rooksby, *Phil. Mag.*, **15**, 810 ; **16**, 519 ; 1933) cleared up in a remarkable way the peculiar features of the emission given by coatings of mixed oxides of strontium and barium. Then followed studies of the migration of barium and thorium ions over various surfaces, the resulting changes in thermionic emission being used to indicate the migration (and evaporation). Quite recently, in collaboration with Jenkins, Benjamin was engaged in the study of electron emission from metal points as a function of direction of emission and surface conditions, studies which are in course of publication by the Royal Society. The observed emission patterns were of great variety and complexity ; they promise to provide new and important information for the electron theory of metals, and of the nature and properties of a metal point formed on a single crystal.

There was another side of Benjamin's life and character. He was one of those who took kindly to the practice of maintaining frequent personal contacts with the industry which, in effect, gave men such as him their chance. Although this left only part of his time and energies for his researches, it provided a fund of knowledge on recurrent but unexplained phenomena demanding inquiry. For him, however, the main urge was probably rather in the fact that, in the making of thermionic valves in thousands, the slightest misunderstanding leads to waste and delay ; of these he was most impatient, and difficulties increased his activities in factory and laboratory to a fury. Nevertheless, his actual approach was always one of friendly interest, and he was as apt to learn as to teach. This attitude encouraged in all manner of people responsiveness and trust, so that his interventions were not merely accepted but were often claimed with insistence. His most recent work brought out his qualities to the full, with results which will be far-reaching.

That his colleagues in the Laboratory feel his loss to be most grievous goes without saying, but there will be many elsewhere who will miss him and will know the reasons for these feelings.

Prof. C. Bartel

NEWS has reached his friends in Britain that Prof. Casimir Bartel, the distinguished mathematician and former Polish prime minister, was recently executed by the Germans for alleged co-operation with the Russians. His death, at the age of fifty-nine, deprives Poland of a man who would have been most useful to the nation in the future reconstruction after the country's independence is restored.

Born at Lwow, Bartel received a technical education before entering the University of Munich to study mathematics. When he returned to Lwow he taught mathematics (in particular geometry) at the Polytechnic High School, becoming in turn lecturer, assistant professor, full professor, rector and finally principal of this institution of university rank.

In science, Prof. Bartel was the most eminent of contemporary Polish mathematicians. After the War of 1914–18, when Poland regained its liberty, the nation depended upon its men of science and learning to undertake its leadership, and Prof. Bartel was among those who responded to the country's call. In 1919 he accepted the post of minister for railways and communications in Prof. Paderewski's first government, and he was therefore largely responsible for co-ordinating the three systems previously forming part of the German, Austrian and Russian systems. He resigned in 1922, but four years later became first premier and then deputy prime minister under Marshal Pilsudski. He retired from politics in 1930 and returned to Lwow to resume his scientific and academic interests.

When the Germans occupied Lwow they closed the University and Polytechnic and arrested many eminent men. The fate of Prof. Bartel gives rise to concern for the safety of the other distinguished Polish savants still in Nazi hands. G. D.

We regret to announce the following deaths:

Mr. H. S. Ball, O.B.E., principal of the School of Metalliferous Mining, Cornwall, on September 26, aged fifty-three.

Mr. R. T. Baker, formerly curator of the Technological Museum, Sydney, a well-known authority on Australian eucalypts and pines, on July 14, aged eighty-six.

Mr. D. P. Petrocochino, C.B.E., a well-known benefactor to Greek archæology, one of the founders of the Anglo-Hellenic League, recently in Athens, aged eighty.

Mr. A. H. Smith, C.B., keeper of Greek and Roman antiquities in the British Museum during 1909–25, on September 27, aged eighty.

Prof. Myron Harmon Swenk, chairman of the Department of Entomology in the University of Nebraska, aged fifty-eight.

Prof. Isaac Weinberg, an authority on the Amharic and Abyssinian languages, recently in Warsaw, aged sixty-three.

NEWS AND VIEWS

Conference on Science and World Order

Message from H.M. the King

The following message from H.M. the King was sent to the Conference on Science and World Order, held during September 26–28: "I thank you sincerely for your message on the occasion of the opening of the conference held by the Division of the British Association for Social and International Relations of Science which was so wisely established a few years ago. The social benefits which scientific research, by free practice and under right guidance, can bestow on all mankind grow ever greater. It is right that such benefits should be shared among all peoples alike. I am happy, therefore, to join with you in welcoming the many distinguished scientists from oversea and in thanking them for the free gift of their knowledge. I sincerely hope that this valuable interchange of ideas will further the lofty aims which the British Association has consistently produced since its foundation.—George R.I."

The Prime Minister's Message

The Prime Minister sent the following message to the Conference: "One of our objects in fighting this war is to maintain the right of free discussion and the interchange of ideas. In contrast to the intellectual darkness which is descending on Germany, the freedom that our scientists enjoy is a valuable weapon to us, for superiority in scientific development is a vital factor in the preparation of victory. The presence of representatives of so many different nations is striking proof of that universal desire for liberty of thought which all the power of the Gestapo will never entirely stamp out.

"It will take a long time for the civilised Powers to repair the trail of material and moral havoc which Germans leave behind them. It will require all the resources of science. But I look forward to the day when the scientists of every nation can devote all their energies to the common task, and I wish you every success in the work that you are undertaking now."

The Foreign Secretary's Statement

At a luncheon given to the delegates to the Conference by the British Council on September 25, Mr. Anthony Eden, Secretary of State for Foreign Affairs, said that there was never a more appropriate time for such a conference; the representatives of the free scientific spirit from many lands were in Great Britain—and here of their own free will. They were to discuss what kind of world will be created when Hitlerism is destroyed. In recent generations science has set free new powers for our use, and, if we so determine, for our incalculable good. But lately, in the hands of evil men, these powers have been used to destroy all that is good in order to dominate and enslave all that is humane. No one action can more clearly reveal the present German spirit than the replacement at the University of Heidelberg of the inscription, "To the living spirit", by "To the German spirit". This German spirit has made German scientists slaves of the regime, and opposed to all that science represents. That spirit must be overcome.

We have called on men of science, Mr. Eden said, in the cause for which we are fighting. We shall need them no less in the cause for which we are working in peace. The advent of the machine has brought great material gain, but it has brought its terrors also. It has brought astonishing material advantages to many, but it has led to inequalities, to much selfishness, to unfair division, and to materialism. If after the War we are to remove the fear of want as well as of war, science and statecraft must work together. "In war-time, diplomacy is the servant of strategy. In peace-time I pray that it may be the servant of science."

New Hawker 'Hurricane' Aircraft

Information recently released upon the Mark II type of this aeroplane is of a certain technical interest. It has become a general fighter in use, and, as such, has now been fitted with a new series Rolls-Royce engine with a two-speed supercharger. This gives improved speed and climb at greater altitudes, while maintaining its good performance at lower heights. The principal change is in its armament, which is now four 20-mm. cannon or twelve machine guns, in the place of the original eight machine guns. The twelve machine gun type with improved performance is intended for dealing with enemy fighters when 'in-fighting', at short range. For this a maximum deluge of bullets for a short period is needed, while the enemy machine is in range. The cannon type is better for attacking the comparatively slow-moving bomber, shipping, or ground targets. The small individual shells are more effective against this type of target when a hit is scored, and the chances of hitting are sufficiently good as the target is comparatively slow in manœuvre, and can be kept in range more easily. Cannon fire is able to destroy enemy aircraft on the ground, armoured vehicles, and even small ships, against which machine-gun fire has been found to be not very effective. In the United States the opinion is held that even larger cannon, 37-mm. type, should be used. The heavier ammunition needed means that a smaller number of shells can be carried, and that the rate of fire is slower, but it is considered that the greater and more widespread damage from the larger shell, when it does score a hit, more than compensates for this.

Wind and Tide

To the layman, the exploitation of natural resources that are now going to waste may appear a good opportunity of getting power cheaply. To the engineer the obstacles in the way of their economic application often appear well-nigh insuperable. Thus the proverbially fickle wind has rarely been regarded seriously for the generation of electricity on any appreciable scale. This is not the opinion of the Central Vermont Public Service Corporation which, according to the *Electrical Review* of August 22, is connecting to its 44-kv. system a 1,000 kw. 2·3 kv. wind-driven alternator, said to be the first of its kind. In describing the equipment *Power* states that the plant, which is installed at a height of 2,000 ft., is expected to run for about 4,000 hours in the year, nearly three-quarters of the time on full load. Possibly the most important feature of the station is its association with a wind-power research laboratory, in which fundamental and engineering knowledge can be gained for the economic design and construction of wind-driven generating units in the future. In contrast to the erratic behaviour of the wind is the exactly predictable ebb and flow of the tide, which in this respect has an advantage over waterfalls that depend upon seasonable and weather vagaries. Its punctuality is not enough, however, to compensate for its intermittent action, and so a purely tidal scheme would have to be debited with the standing charges on steam plant required for filling in the valleys.

It was estimated to be much less expensive in overall costs to provide 550,000 kw. by steam plant than to harness the River Severn for the purpose. Only by virtually changing the scheme to a more ordinary hydro-electric lay-out could power from the tide compete with coal for generating electricity; that is, by using a large proportion of the tidal energy to pump water to a reservoir for driving other turbines in the slack periods. A similar idea was behind the Passamaquoddy project for producing 80,000 kw. from the River Maine. Even then production cost has been estimated at nearly twice that obtainable with a modern steam plant. As an addendum to his report to the United States Federal Power Commission, the chief engineer, Mr. R. B. McWhorter, envisages an elaborate seventeen-project programme, of which Passamaquoddy would form a part, in which case the cost per kwh. would be substantially less than that obtainable with steam. A great handicap to the development of tidal power is the length of time involved in construction—in the case of the Severn Barrage the capital expended would be unremunerative for about fifteen years. Moreover, contingencies are less easily covered by a reasonable percentage than they are with thermal stations. The favourable margin shown by the British scheme in comparison with steam will have increased materially since the report was published eight years ago. Much would depend on the value of improved road connexions between England and South Wales with which the proposals were associated, but unless some improvement is to be anticipated in the coal position after the War, the report might well be re-examined in the light of more recent developments.

Technical Bibliographies

During the past ten years the staff of the Sheffield City Libraries have compiled a number of bibliographies on technical subjects of special interest to research workers and technical staffs of local firms. In the compilation of these bibliographies expert help has been enlisted where necessary, and the collaboration between trained bibliographers and technical specialists has resulted in the production of a very useful series of reference lists, each relating to one specific subject and including papers and articles from technical periodicals as well as books fully or in part concerned with the subject. The fact that all the references can be consulted in the Sheffield City Libraries is a great convenience to local students and workers, although it naturally robs the bibliographies to some extent of completeness. Perusal of typical lists shows, however, that this lack of completeness does not detract substantially from the value of the compilations, a testimony to the thoroughness with which the City Librarian has catered for the needs of local industries in his acquisition of books and periodicals.

Since the outbreak of the War this bibliographic work has found and met an increased demand; an extensive annotated bibliography on steel sheet and strip issued in three parts has been in particularly heavy request from other parts of Great Britain and from overseas. Encouraged by this demand from a wider area, the City Librarian has prepared a list of recently compiled bibliographies; the subjects at present available include: acid tanks; austenitic steels; auto-frettage process; bending, straightening and reeling of steel; bonus systems; cold drawing of steel; cold heading of steel; cold pressing: colloidal metals; colouring of metals; decarburization of metals by hydrogen; electrolytic pickling and polishing; extrusion of steel; fatigue of metals; fluorspar-froth flotation; ingots: segregation and crystallization; patents on rock drill bits; manufacture of steel tubes; polarography; riveting of steel; rolling mills; spinning of steel; steel manufacture and properties; sulphur and phosphorus determination in iron and steel; tool steels; vertical boring mills; workshop practice and machine tools (books only). Applications for copies of any of the lists should be sent, with 3*d.* to cover postage, to the Central Library, Sheffield, 1.

The Lister Institute of Preventive Medicine

Though damaged on two occasions and partly evacuated, the Lister Institute of Preventive Medicine has spent an active year, as shown by its annual report. As usual, the work has covered a wide field, including studies on antigens, phosphorylation in osteoid tissue, fat metabolism, and mucolytic enzymes. The Division of Nutrition, working at Cambridge and East Malling, has continued its vitamin studies. The Cambridge group has in particular investigated the nutritive value of different portions of the wheat grain and has been instrumental in recommending the use of 85 per cent extraction flour with added calcium for bread-making; the national wheatmeal flour is of this extraction, but the decision to add calcium to it has not yet been taken. The nutritive value of yeast has also been investigated, and this work is of particular importance since it is easy to grow yeast on certain waste materials, thereby providing a human food rich in first-class protein and vitamins of the B group. Dr. Zilva, at East Malling, has continued his work on vitamin C.

The Henry Lester Institute of Medical Research

The Henry Lester Institute of Medical Research, Shanghai, has also recently issued its annual report, and this shows that all activities have had to be restricted owing to the war in China. Studies on nutrition occupy a large part of the report, and Prof. Earle, who has recently been visiting Great Britain, states that "it is remarkable how many clinical signs and symptoms among Chinese patients can now be explained in terms of vitamin and mineral deficiency". Apart from many cases of two classical deficiency diseases—beriberi and pellagra—it has recently been found that ariboflavinosis is very common among the Chinese: more than a hundred cases were investigated during the latter part of the year. Deficiency of riboflavin is the latest recruit to human deficiency diseases, and has been shown by Sebrell to be surprisingly common in the United States. The condition, which includes eye and mouth lesions, undoubtedly occurs also in Great Britain.

Winter Wheat Seed

The Council of the National Institute of Agricultural Botany, Cambridge, has decided to offer for sale about a hundred quarters of Steadfast, a winter wheat bred by Prof. F. L. Engledow, of the Cambridge University Plant Breeding Institute. Hitherto the wheat has been grown in the Institute's trials under the number 198 (20*c*). Orders are invited from members of the Agricultural Seed Trade Association, National Association of Corn and Agricultural Merchants, National Association of British and Irish Millers, and other established dealers in seed corn. Steadfast is the outcome of a cross between Little Joss and Victor, and as regards general habit, growth and type of ear is intermediate between the parent varieties. It possesses the excellent tillering properties of Little Joss, and ripens at the same time, and requires the same seed rate. The straw is shorter and its resistance to lodging is superior to that of Little Joss, but it has the same resilience and excellent thatching and feeding properties of that variety. As regards milling quality, Steadfast approximates the bread-making value of the 'softer' English wheats; it does not attain the exceptional quality of Yeoman or Holdfast. It is particularly suited to light and medium soils, but also thrives on the Black Fen, where its resistance to yellow rust will be specially valuable.

A Film Studio Electrical Installation

Mr. F. V. Hauser, chief engineer of two studio groups at Denham (Uxbridge, Middlesex) and Pinewood (Iver, Bucks), comprising twelve stages with a plant capacity of 7,000 kw., recently gave an illustrated lecture about studios to the Association of Supervising Electrical Engineers in London. Confining his detailed description to the Pinewood installation, Mr. Hauser said that the maximum electric demand for studio photographic purposes approximated to 2,000 kw. As D.C. at low voltage is necessary for arc lighting, five electric diesel generators totalling 2,360 kw. have been installed with three-wire distribution at 230/115 v. for studio lighting and at 230 v. only for all other purposes. To reduce noise and vibration, the engine foundations were formed of single island rafts of concrete 2 ft. thick, set 9 ft. below floor level and covered with a 2·5 inch sandwich of 'Coresil' cork on which rested a common concrete block 7 ft. deep, the whole weighing 1,000 tons. The insulating air space around the foundation is 9 in. wide.

To minimize voltage ripple (hum) interfering with sound recording, the generators have graded air gaps, specially shaped pole faces and skewed armature slots, so avoiding the expense of heavy smoothing choke coils in main feeders and individual arc lamp circuits. The studio switchboards (four 3,000 amp. and three 5,000 amp. panels) and distribution features include bare aluminium ring mains (19,500 ft., weighing nearly 34 tons) supported by 'Sindanyo' racks attached to the roof steelwork, descending in sheet steel conduit to distribution boards at floor level, which are equipped with audible and visible signals for the overhead distribution 'grid' attendants. The object is to keep the floor free from trailing cables and feeding points, lighting equipment being stored overhead in the grid for quick lowering. Master control is exercised within the studio from a mobile desk on castors, plug-connected by a fifty-line multiple cable.

Recent Earthquakes

THE Jesuit Seismological Association at Saint Louis, U.S.A., has determined tentatively the epicentres of three recent earthquakes. From the readings of seismograms from eight stations the earthquake of June 27 at 17h. 11m. 30s. G.M.T. was found to have an epicentre near 16° N., 93° W., which is south-west of La Concordia in southern Mexico. By the Brunner chart the depth of focus was estimated to be 200 km., which is somewhat unusually deep for the fairly frequent normal and intermediate earthquakes in this area. From the readings of seismograms from sixteen stations the earthquake of July 1, at 7h. 50m. 57s. G.M.T., was found to have an epicentre near 34·4° N., 119·5° W. Damage by this earthquake was done in and about Santa Barbara, California, and the agreement is good. From the interpretations of records from ten seismographic stations the epicentre of the earthquake of July 3, at 7h. 11m. 51s. G.M.T., was found to be near 31° S., 68·7° W. This earthquake was felt at Mendoza in the Argentine Republic.

On August 15, a strong earthquake giving a full suite of pulses was recorded at Kew Observatory. The preliminary pulses registered at 6h. 16m. 45s. G.M.T., S at 6h. 22m. 42s., M at 6h. 29m. 34s. and the earthquake finished recording at 10h. 10m. having lasted nearly four hours. The maximum ground amplitude at Kew was 82μ and from the above tentative interpretation of the record the epicentre has been estimated to have been 4,330 km. distant from Kew.

Disease in New South Wales

ACCORDING to Dr. E. Sydney Morris, director-general of public health of the State of New South Wales, the chief event in the State since 1875 has been the rapid growth of Sydney, so that though the State is about 95 per cent rural the population has become increasingly urban. In 1939 the population was 2,749,134, of whom 1,380,940 lived in the metropolitan area of Sydney. Since 1875 the mortality from tuberculosis in New South Wales has dropped steadily, whereas the cancer mortality has increased at nearly the same rate. In 1875 the tuberculosis mortality was 154 and the cancer mortality 31 per 100,000 population. In 1895 the rates were respectively 109 and 44, in 1935 they were 105 and 39, and in 1939 tuberculosis fell to 37 and cancer rose to 113. The mortality from heart disease has shown an enormous rise in recent years. In 1875 it was 79; it fell to 57 in 1893, and has since risen, at first slowly and then rapidly, to 259 in 1939. As regards infectious diseases, influenza showed a mortality of about 5 until the great epidemic of 1891, when it rose to 87: it dropped to 8 in 1893 and 5 in 1917. In 1919, it rose to 319·3, and in 1920 it fell again to 18. Since then it has shown abrupt rises and falls. In 1899, when the incidence of scarlet fever was the highest on record (48·5 per 10,000 population), the mortality from this disease (2 per 100,000) was the lowest recorded until then. The mortality from measles has shown a great reduction in the height of the peaks since 1915 and a smaller incidence in the intervening troughs.

Population of Sweden

ACCORDING to preliminary estimates of the Central Office of Statistics, the population of Sweden in 1940 was 6,370,964. Comparison with the figure at the end of 1939 shows that the population has increased by about 30,000, corresponding to 4·68 per thousand. The growth of the population was split up as follows: 1,648 in the country, where there are at present 3,990,114 inhabitants, and 27,977 in the towns, where the population is now 2,380,850. Preliminary statistics for births and deaths during the past year show the following figures: 95,457 births and 72,584 deaths, that is, a surplus of births of 22,873, of which 12,927 were in the country. Lastly, there were 6,870 immigrants and 3,186 emigrants, giving a net surplus of 3,684.

Announcements

IT has now been announced that Prof. L. G. M. Baas-Becking, who was placed in custody in a prison in Scheveningen, Holland (NATURE, May 17, p. 606), has now been released by the German authorities and has assumed again the directorship of the Botanical Institute of the University of Leyden.

THE Joint Committee for Scientific, Technical and Engineering Supervisory Staffs, of 30 Bedford Row, London, W.C.1, has arranged a meeting and exhibition of technical films chosen to show the applications of scientific and technical advances in industrial processes, to be held at the Portland Hall, Little Tichfield Street, London, on October 11 at 3 p.m.

THE library of the University of Louvain, which was damaged in the War of 1914–18 and rebuilt largely through American generosity, was again destroyed in May 1940. Of the 900,000 books only 15,000 survive, of 800 manuscripts only 15; 3,000 collections of periodicals were completely destroyed by fire, likewise 811 incunabula and 200 valuable engravings, including some by Dürer and Holbein and 22,606 photographs of all known Coptic manuscripts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

Deuteron-Tritium Reaction in Fluorine

IT was shown in a recent paper[1] that the 'deuteron-tritium' (d, ^{3}H) reaction was responsible for the formation of ^{62}Cu, ^{106}Ag and ^{120}Sb by deuteron bombardment of copper, silver and antimony respectively. The same reaction is known to occur in beryllium[2] and nitrogen[3]. It therefore seemed desirable to look for other examples of this reaction. It has now been established that the (d, ^{3}H) reaction takes place in fluorine also.

Sodium fluoride was bombarded with deuterons of 9 Mev. energy and a lanthanum fluoride separation was made from the irradiated sample. The fluoride fraction showed, in addition to a short-period activity, an intense positron activity decaying with a period of 112 ± 2 minutes. The absorption curve in aluminium for the total radiation is shown in Fig. 1 (Curve a). The logarithmic absorption curve for the positrons obtained after extrapolation and subtraction of the annihilation radiation background is represented in the graph by Curve b. By comparing this curve with that for the β-rays of radium E, one obtains an absorption limit for the positron spectrum equal to $0{\cdot}23 \pm 0{\cdot}01$ gm./cm.^{2} of aluminium, corresponding to a maximum energy of $0{\cdot}72 \pm 0{\cdot}02$ Mev. Thus the properties of this radio-element are identical with those of the well-known ^{18}F [4] and should therefore be attributed to the same. ^{18}F is known to be formed from fluorine by the (n, $2n$) reaction. Control experiments which were carried out in order to establish that in the present experiments the 112-min. fluorine activity was formed directly by the action of deuterons, showed that the background neutron effect was negligible. ^{18}F is formed from fluorine under deuteron bombardment by the reaction

$$^{19}\mathrm{F}\ (d,\ ^{3}\mathrm{H})\ ^{18}\mathrm{F}.$$

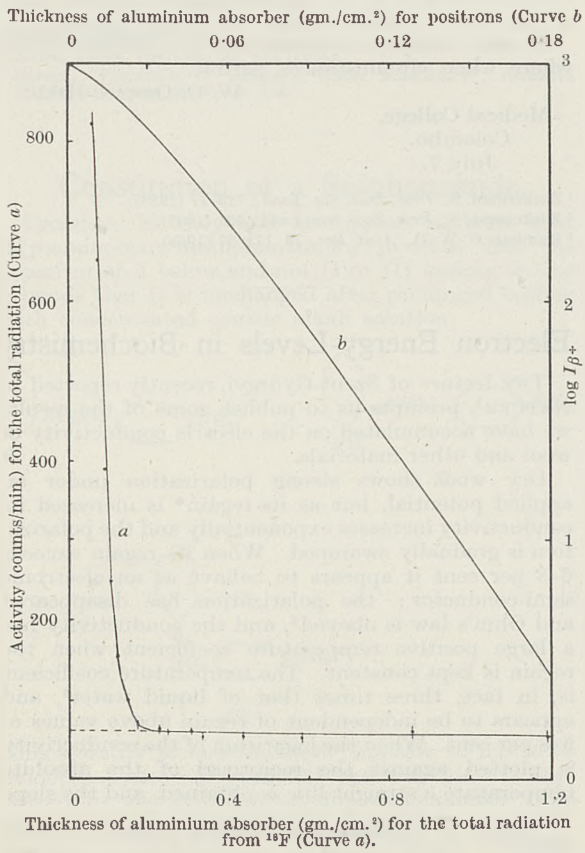


Fig. 1.

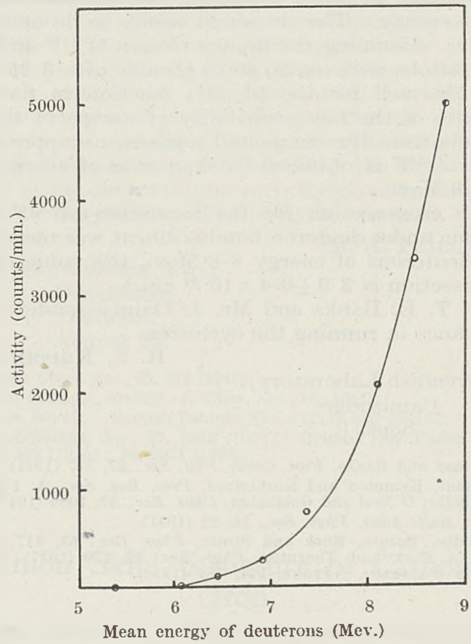


Fig. 2.

EXCITATION FUNCTION FOR THE FORMATION OF ^{18}F.

Excitation function measurements were made using the powder technique. Targets were prepared by spreading equal quantities (7 mgm.) of pure sodium fluoride as uniformly as possible over an area of 1 sq. cm. on thin copper foils. The layer of powder was fixed in position by the addition of a few drops of a solution of cine-film in amyl acetate. In each case a copper foil of 0·35 mgm./cm.^{2} thickness covered the deposit. Targets so prepared were bombarded separately with deuterons of different specified energies for five minutes each, keeping the beam steady during each run but not necessarily at the same value for all the runs. Aluminium foils were used when deuterons of less than the maximum energy were required. After bombardment, the sodium fluoride was dissolved in water and a lead fluoride separation was made. The precipitate was washed well and dried. Correction was made for any loss of material that had taken place during chemical separation by weighing the dried precipitate. The activity of the lead fluoride precipitate was measured two hours after the end of bombardment and its subsequent decay was followed. From the family of decay curves the energy-yield curve for the 112 min. positron activity was determined and is reproduced in Fig. 2. In most cases the points plotted represent the means of three separate bombardments at a single energy. The threshold seems to lie at about 6 Mev. Assuming the known masses of ^{18}F and ^{19}F, calculations were made, and a Q value of $-3{\cdot}25$ Mev. was obtained for the (d, ^{3}H) reaction in fluorine. Because of the low probability of escape of the ^{3}H particle from the compound nucleus, no appreciable yield of ^{18}F is obtained for deuterons of energy less than 6 Mev.

The cross-section for the formation of ^{18}F from fluorine under deuteron bombardment was measured. For deuterons of energy 8·8 Mev., the value of the cross-section is $3{\cdot}9 \pm 0{\cdot}4 \times 10^{-27}$ cm.².

Dr. T. E. Banks and Mr. J. Dainty rendered me assistance in running the cyclotron.

R. S. KRISHNAN.

Cavendish Laboratory,
Cambridge.
Sept. 1.

[1] Krishnan and Banks, *Proc. Camb. Phil. Soc.*, **37**, 317 (1941).

[2] Oliphant, Kempton and Rutherford, *Proc. Roy. Soc.*, A, **150**, 241 (1935); O'Neal and Goldhaber, *Phys. Rev.*, **57**, 1086 (1940).

[3] Borst, *Bull. Amer. Phys. Soc.*, **16**, 35 (1941).

[4] Dubridge, Barnes, Buck and Strain, *Phys. Rev.*, **53**, 447 (1938); Pool, Cork and Thornton, *Phys. Rev.*, **52**, 239 (1937); Yasaki and Watanabe, NATURE, **141**, 787 (1938).

Reproduction in Capuchin Monkeys

So little is known of the reproductive processes of any South American monkey that additional data on the typical genus Cebus are worthy of record. Capuchins seldom breed in captivity, only three records during a hundred years being given for the London Zoo by Zuckerman[1] and no further cases being mentioned in his revised report of 1937[2]. Since that date Hamlett[3] has given a detailed account of the œstrous cycle, ovulation and menstruation in Cebus, but he left many questions unanswered.

The present notes are based upon observations made on two male *C. xanthosternos* mated with three female Capuchins—two *C. vellerosus* and one *C. apella*. All three females have recently given birth to hybrid offspring.

Copulation, which Hamlett never saw, was inferred by him to occur at day-break, or some time before the arrival of laboratory staff, as it "seems unlikely that the monkeys copulate at night". With my animals copulation only occurred at night, usually at dusk. It differs in several ways from the process in Old World monkeys (*a*) in being very prolonged—up to twenty minutes in duration ; (*b*) in the extraordinary vocal sounds accompanying the performance. These sounds are emitted by both participants and were echoed by an older (half-grown) baby living in the same cage. Copulation takes place *a posteriori*, but the male has long intervals of quietude during which he sits back without withdrawal, though continuing the vocalization. Restriction of copulation to certain periods of the menstrual cycle has not been noted, though this may be possible. No externally visible sign of menstruation has been observed in any of the females.

Gestation is probably of similar duration (that is, six months) to that of Old World monkeys, since one female *C. vellerosus* produced her offspring exactly seven months after first introduction to a male *C. xanthosternos*. Sexual behaviour was observed after the first three weeks.

The new-born differs from that of Old World monkeys in clinging to the mother's back, nuzzling its way round to her breast only at feeding time, thereafter returning to her back, clinging with its arms around her neck and its legs around her flanks. It does not use its tail for aiding its hold. The dorsal position is maintained from the first day.

The placenta is evidently eaten, since no sign of it was to be found within a couple of hours of birth, which occurred in one case in the day-time.

The three babies, despite their differing parentage, are all remarkably alike, and differ equally from either parent. They are all brown-bodied and black-limbed. The head pattern consists of a dark, almost black, oval central patch with a light, almost white, area on either side. The hair is long and soft on the head, not short and stiff like the father's or long and upstanding like the mother's. The body hair is lank and of the same texture as the mother's, so that the baby passes unnoticed except at close quarters.

Another curious feature is the extraordinarily rapid growth of the young compared with the tardy growth of Old World monkeys. The oldest baby was as large as its mother (*C. apella*) at the age of six months, and continued to grow after that, though it has not attained at the age of a year so great a size as its father, which belongs to a larger species.

A more complete account will be published elsewhere when circumstances permit.

W. C. OSMAN HILL.

Medical College,
Colombo.
July 7.

[1] Zuckerman, S., *Proc. Zool. Soc. Lond.*, 716–17 (1930).

[2] Zuckerman, S., *Proc. Zool. Soc. Lond.*, 321 (1937).

[3] Hamlett, G. W. D., *Anat. Rec.*, **73**, 171–87 (1939).

Electron Energy-Levels in Biochemistry

THE lecture of Szent-Györgyi, recently reported in NATURE[1], prompts us to publish some of the results we have accumulated on the electric conductivity of wool and other materials.

Dry wool shows strong polarization under an applied potential, but as its regain* is increased its conductivity increases exponentially and the polarization is gradually swamped. When its regain exceeds 6–8 per cent it appears to behave as an electronic semi-conductor : the polarization has disappeared and Ohm's law is obeyed[2], and the conductivity has a large positive temperature coefficient when the regain is kept constant. The temperature coefficient is, in fact, three times that of liquid water[3], and appears to be independent of regain above values of 6–8 per cent. When the logarithm of the conductivity is plotted against the reciprocal of the absolute temperature a straight line is obtained, and the slope

* Regain is the percentage moisture content calculated on the dry weight.

of the line corresponds to an activation energy of 1·3 electron volts. This energy is little influenced by ionic impurities, or by the electrodes used to measure the conductivity. If the water is replaced by methyl alcohol, the conductivity phenomena remain unchanged except that the activation energy is lowered to 1 electron volt.

These facts make it difficult to identify the electric conductivity of wool with ionic conductivity, whilst they do appear to fit readily with the hypothesis that the wool-water and wool-methyl alcohol systems are electronic semi-conductors ; or that there are electronic energy bands in the system which are separated from the ground-levels by forbidden zones.

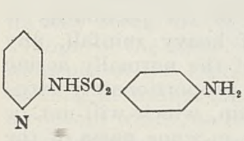
The conducting system seems to be the water or methyl alcohol appropriately adsorbed on a surface. This was tested by a study of the conductivity of glass surfaces. These show the same variation of conductivity with relative humidity of the surrounding atmosphere, and with temperature, that other fibres show. The activation energy is 1 electron volt, but otherwise the electric conductivity of glass surfaces appears to be the same as that of wool. The energy band system is therefore a property of suitably adsorbed water molecules. Water molecules adsorbed at interfaces must be common in biochemistry where cell wall surfaces are abundant, and it may be that electronic transfer of energy takes place along layers adsorbed at these interfaces.

S. BAXTER.
A. B. D. CASSIE.
Wool Industries Research Association,
Torridon, Headingley,
Leeds, 6.
Aug. 29.

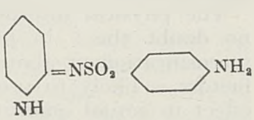
[1] NATURE, 148, 157 (1941).
[2] Marsh, *Trans. Far. Soc.*, 29, 173 (1933).
[3] Dorsey, "Properties of Ordinary Water Substances", Reinhold Publishing Corpn. (1940), p. 374.

Constitution of a Sulphonamide

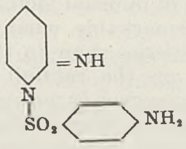
Crossley, Northey and Hultquist[1] consider that 2-(*p*-aminobenzenesulphonamido) pyridine has the constitution I below and not II or III mainly on the grounds that it is unchanged after prolonged boiling with concentrated caustic alkali solution.



I



II



III

This stability to caustic alkali[2] appears to me to be evidence against formula III and this view is supported by the synthesis of this sulphonamide from 2-halogeno pyridines and *p*-acetamido or *p*-amino benzene sulphonamides by the Ullman method[3]. The possibility, however, that this compound is a tautomeric mixture of the forms II and III must not be overlooked. Further evidence for the above view is afforded by the behaviour of 2 (*p*-aminobenzene-sulphonamido)-pyridine on treatment with chloroacetamide in alkaline solution when *p*-aminobenzene sulphonyl α-pyridylglycineamide is obtained. This, on hydrolysis with caustic alkali gives *p*-aminobenzene sulphonyl α-pyridylglycine which on further treatment with hot dilute mineral acids gives the hitherto-undescribed α-pyridylglycine. This is a well-defined substance very soluble in water and sparingly soluble in alcohol ; these characteristic glycine-like properties are quite different from those of the well-known isomeric compound, α-pyridoneimide-N-acetic acid obtained from α-amino-pyridine and chloracetic acid[4].

This latter compound on decarboxylation is known to give N-methyl-α-pyridoneimide ; the interrupted study of the properties of α-pyridylglycine, including its de-carboxylation, will shortly be resumed.

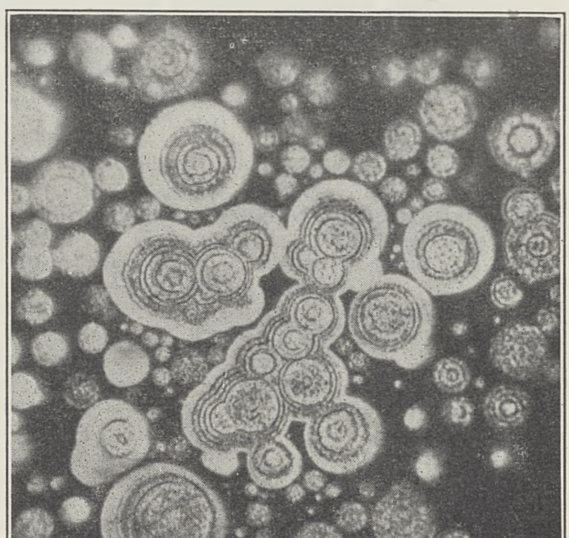
M. A. PHILLIPS.
May & Baker, Ltd.,
Dagenham,
London.
August 25.

[1] *J. Amer. Chem. Soc.*, 62, 372 (1940).
[2] See, for example, Phillips, *J. Chem. Soc.*, 10 (1941).
[3] Phillips, *loc. cit.* ; English Patents Nos. 512145 and 530187.
[4] Tschitschibabin, *Ber.*, 57, 2092 (1924) ; Reindel and Rauch, *ibid.*, 58, 393 (1925) ; 59, 2921 (1926).

'Onion Skin' Structure of Carbonyl Iron

THE 'onion skin' structure of carbonyl iron is well known to those who are familiar with powder metallurgy technique. W. D. Jones in his book "Principles of Powder Metallurgy" states that this structure is probably due to interruptions in the decomposition of iron carbonyl vapour.

Recently while examining a pressed compact of carbonyl iron we came across a remarkably fine



× 1250

specimen of 'onion skin' structure which was revealed after the usual metallographic polishing followed by etching in 1 per cent Nital. The accompanying photograph shows the structure observed.

C. E. RICHARDS.
E. V. WALKER.

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Aug. 26.

Measurement of Physical Fitness

IT is desirable to direct attention, once again, to the need for devising and standardizing an objective measure of physical fitness.

The advantages which would result from the employment of a method of assessing the fitness of physique independently of subjective impressions have long been recognized. Little, if any, consideration has, however, been given to the following aspects of the problems involved.

The grading of recruits to the Services in the pre-enlistment medical examination is, as is well known, to a very large extent over-determined by subjective, qualitative impressions. Cases occur in which initial grading is too high and de-grading has to take place after the soldier has spent some time in a unit for which he is unfit. Many cases occur, no doubt, in which grading is too low. Statistical considerations alone lead one to suspect that there must be great regional differences in the proportions allocated to given medical categories and in the proportion of total rejects in any area. One may suppose that some physicians, not unnaturally, lower their standards of grading in order to provide more front-line men, and the effect is to give too generous a picture of health and virility in the men whom they examine.

There are in existence techniques of assessing physical fitness which, although admittedly subject to improvement, would nevertheless almost certainly add to the validity of the current qualitative procedures and act as a check on their accuracy. Moreover, it should be possible to raise the value of the qualitative estimates by appropriately weighting the constituent elements, for example, sensory acuity, or cardiac condition, according to their regression on physical fitness as measured independently. The statistical problems are very similar to those that arise in the marking of scripts in examinations.

The time is surely ripe for a survey of fitness in the army at different age-levels. It is not unreasonable to attach a biological validity to the concept of physical fitness and to regard it as connoting the 'integrative action' of the organism as a whole, resulting from the efficient functioning of the component physiological processes, the neuro-muscular system, the endocrines, the sense organs and so forth. Apart from social and economic disturbances in selection, physical fitness so defined and measured should, in theory, approximate to a normal distribution. Indeed, the concept is analogous to the notion of general ability as measured by psychological tests. The former should be both easier to measure and possess greater validity.

Such an investigation as is here proposed would provide information on the effects of different periods and types of training upon physique. Furthermore, since the medical history of each soldier is known, much would be added to our knowledge of constitutional predisposition to disease. From the eugenic point of view alone the task is worth undertaking.

JOHN COHEN.

A Peculiarity in Rainfall Variability

A SOMEWHAT perplexing and highly interesting peculiarity in the regimen of rainfall variation is this: all over the world, there is a much greater degree of uniformity in the relative variability of annual rainfall expressed as a percentage of the normal than in the absolute variability expressed as the actual deviation from the normal in inches or millimetres. As regards Great Britain, the late Mr. Carle Salter pointed out in his "Rainfall of the British Isles" that though the percentage variability is rather greater in the dry eastern than in the wet western districts, it is of the same order of magnitude everywhere, which of course implies that the actual differences in the quantity of rain from year to year are much larger in the wet parts. In fact, the deviations in the actual amount of rain above and below normal increase so systematically with the rainfall itself that they swamp the percentage values and become quite useless in comparative statistics.

Take, for example, a plus or minus variation of only 10 per cent, which is almost equally common all over Great Britain: this signifies so large a difference as 20 inches of rain between the wetter and drier year at a place, say, in Cumberland, with an average rainfall of 100 inches, as contrasted with the trivial range of 4 inches at a place on the coast of Essex with an average of only 20 inches; whereas if Nature worked more nearly by the absolute rule than by the percentage rule, a 10 per cent variation at the drier place should be balanced by a 2 per cent variation at the wetter. Evidently, in the natural scheme a few inches more or less of rain a year which appear conspicuous at a dry place count for little at a wet place, and in dry and wet years the total rainfall is not lowered or raised by similar actual amounts everywhere but by similar proportional amounts.

The physical interpretation of the peculiarity is no doubt this: in places of heavy rainfall, any intensification or abatement of the normally acting factors is likely to produce a proportionately large effect in actual quantity of rain, which will not be the case in dry places, though in some parts of the world there are erratic dry climates where very exceptional years of abnormally heavy rainfall point to the operation of unusual factors.

In general, it is remarkable what little interest writers on rainfall statistics show in the dependence of actual variability on the rainfall itself, merely remarking on the convenience or necessity of working with percentage values, as though this dependence were axiomatic and there was nothing more to be said. The proposition, however, is not self-evident to the preclusion of physical discussion. Even V. Conrad, who in a paper published in the *Monthly Weather Review* of January, 1941, demonstrates mathematically the close relationship between absolute variability and the magnitude of the rainfall itself, does not pause to reflect why this should be the case, but immediately goes on to show that the percentage method of studying rainfall variability which is a necessary consequence is not a perfect measure of true variability because at very low annual rainfalls below 10 inches, the percentage values change unduly rapidly with trivial differences in the rainfall itself.

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13 Christchurch Hill,
Hampstead, N.W.3.
August 31.

The Relations between Science and Ethics

It was an excellent idea to base a general discussion on the relations between science and ethics on Dr. Waddington's stimulating and lucid account of the subject[1]. What has been most striking about the comments which have been made on it is the failure which some of the commentators exhibit to understand his view of the nature of the evolutionary process. The persistent existence of the lowest forms of life (to which Prof. Ritchie directed attention), or the fact that parasites may achieve a high degree of adaptation to environment at the cost of profound degeneration, or the continuation of evolution (in Prof. R. A. Fisher's phrase) "in the teeth of a storm of adverse mutations", have nothing to do with the inescapable fact that, during biological evolution, the degree of complexity and organization has increased. With the appearance of man, the maker and user of tools, the speaker, the moulder of his surroundings, this process, the outward and visible sign of which has been a progressively greater independence of the organism *vis-à-vis* its environment, reached its culmination. Thinkers such as Herbert Spencer (whom some of the contributors go out of their way to attack), were perfectly correct in viewing social evolution as continuous with biological evolution. In social evolution we cannot but see a more or less continuous rise in level of organization parallel with the increasing size and complexity of human communities, culminating in the conception of the world co-operative commonwealth now dawning upon the minds of men. Though there have been backslidings innumerable, there have also been points higher than the main curve of human social evolution sweeping its way across the graph of history.

Some of the contributors seem to be still under the influence of the Darwinian preconception which saw nothing in animal life but the struggle for existence, a concept which, as Engels carefully pointed out, had been introduced from Malthus's analysis of the predatory characteristics of capitalist society. But there were others beside Spencer who showed the one-sidedness of the idea of Nature red in tooth and claw. Kropotkin pointed to the very value of animal associations in this struggle, and Henry Drummond (a much misunderstood thinker) successfully traced the beginnings of social altruism downwards to the numerous phenomena of parental care and even to the donation of part of the self for the succeeding generation in every reproductive act. Drummond even went so far as to say that the goal of evolution was love and the good life, an assertion which his biographer described as "grotesque", but which we can scarcely think so if we recognize, as we must, the highest levels of human co-operative social life as themselves the products of evolution.

This, I take it, is what Dr. Waddington means by saying that the evolutionary process itself supplies us with a criterion of the good. The good is that which contributes most to the social solidarity of organisms having the high degree of organization, which human beings do in fact have. The original sin which prevents us from living (in Prof. Joad's phrase) "as Christ enjoined" is recognizable as the remnants in us of features suitable to lower levels of social organization, anti-social now. There is, of course, the incidental difficulty of continually modifying the letter of the teaching of the great ethical 'mutants' to fit changing techniques and increasing knowledge without losing their spirit.

From this point of view, the bonds of love and comradeship in human society are analogous to the various forces which hold particles together at the low colloidal, molecular, and even sub-atomic levels of organization. Henry Drummond actually dared to say this. If such an idea is accepted, Prof. Joad's insistence that we must have some extra-natural criterion of ethical values ceases to have any point. The kind of behaviour which has furthered man's social evolution in the past can be seen very well by viewing human history; and the great ethical teachers, from Confucius onwards, have shown us, in general terms, how men may live together in harmony, employing their several talents to the general good. Perfect social order, the reign of justice and love, the *Regnum Dei* of the theologians, the Magnetic Mountain of the poets, is a long way in the future yet, but we know by now the main ethical principles which will help us to get there, and we can dimly see how these have originated during social and biological evolution. Prof. Stebbing is perplexed as to whether we ought to call evolution morally admirable or morally offensive; it is surely neither. The good is a category which does not emerge until the human level is reached.

For the benefit of Prof. Ritchie, I may add that whatever label or docket in Prof. Broad's book is attached to the views here expressed is a matter of relative indifference to me. They certainly cannot be called original. Many others have appreciated the emergence of ethical relationships and their interpretation in the light of scientific thought.

Joseph Needham.

Caius College,
Cambridge.

[1] Nature, 148, 270 (1941).

A scientific statement is essentially an expression of relations derived from and applicable to experience: it is therefore easy to determine whether a statement is scientific or not by considering its relation to experience. Dr. Waddington's statement "The real good cannot be other than that which has been effective, namely, that which is exemplified in the course of evolution", is clearly not derived from experience, for it does not express anything found by observation. Nor is it applicable to experience; when we try to apply it to any actual ethical problem (for example, "Is it morally good to bomb German cities?") it is found to be useless.

I do not believe that Dr. Waddington intends to be among the apriorists, but actually his so-called scientific ethical principle belongs to the company of Eddington's inviolable laws and Milne's cosmological principle. It provides one more example of the widespread abandonment of science in the name of science. HERBERT DINGLE.

Imperial College,
S.W.7.

Leadership of Science

THE leadership of science is vital to the preservation and rebuilding of civilization. No less vital, as the recent admirable editorials in NATURE have urged, is a unity of aspiration and effort on the part of the United States and the British Commonwealth of peoples. To create now a moral and intellectual unity of the English-speaking peoples is to lay the foundation of that mighty union of democracy, the prayer of Longfellow and the message of Roosevelt, upon which hangs age-long weal or woe for mankind. The leadership of science must exert itself most fruitfully when integrated with that immense work of political creation. Indispensable to such a synthesis is the saturation of the 'man in the street' with the spirit and aspirations of science, together with a lively comprehension in broad outline, of what it is doing from day to day. Not until science replaces football pools in popular interest will the common person be fit to sustain civilization or the men of science in a position to lead it. Notable work in popular education has been done by many gifted thinkers. But the situation calls for something more organized and comprehensive, corresponding to the world which science has brought into being, where continents and peoples are linked in ever greater interdependence.

Nothing less is needed than a pooling of the common stock of contemporary thought and achievement in science presented in a form assimilable by the common person.

But if science really does transcend frontiers, if Anglo-American unity is not a fantasy, why do we need dispersed and divided plans of educating the public in scientific matters just where the common approach bids to be most potent ? Why cannot British and American men of science give a lead to the spirit of union, to thinking in terms of 'us' rather than of 'we' and 'they', which, as rightly suggested[1], is more important than cut and dried schemes of amalgamation? Should not men of science be the first to give an example of "pooling experience for the growth of mutual understanding", to use NATURE's words ? Speaking for the common person, I say we want to know what American men of science are doing, as the common person in America doubtless wants to know the same of British men of science.

The collaboration of British and American men of science as a body in issuing a periodical publication, say, monthly, of scientific news and progress in popular form, is capable of becoming the greatest move ever made towards the enlightenment of humanity in the mass. The leadership of science in the direction of a world planned for freedom and abundance for all cannot afford to conceive its duty of education in relation to obsolescent conceptions of nationalist sovereignties. The man in the street, if he is to think at once internationally and scientifically, needs the assistance of a new sort of creative journalism which shares those qualities.

H. BREWER.

18 Langham Road,
Cambridge.
Sept. 7.

[1] NATURE, 148, 233, 263 (1941).

"The West Highlands and the Hebrides"

IN the review in NATURE of August 16 of the above book by Dr. Harker, which was recently published posthumously, attention is directed to certain omissions in a Table of Formations which was added to Dr. Harker's original manuscript. Perhaps I may be allowed to explain that the Table was drawn up as an adjunct to the stratigraphy as set out in the text, in order to serve as a handy means of reference for the non-professional reader, for whom the book was primarily written, and also for geologists not conversant with the local details. As a matter of fact, Dr. Harker found occasion in the text to refer to almost all the geological systems and their subdivisions, and in this way has drawn a picture of the stratigraphy which is essentially complete. Since he did not mention certain subdivisions of the Jurassic system which are represented somewhat meagrely, namely, the Kimmeridgian (which is specially referred to in the review), and the Corallian, Callovian and Cornbrash, these were purposely omitted from the Table of Formations. Similarly, the Durness Limestone was placed in the Cambrian, because this long-established British custom was followed by Dr. Harker in the text. It appeared to raise too many complications, and indeed to be unnecessary in this book, to direct attention to the fact that the custom requires modification.

May I take this opportunity to correct one omission ? The New Red Sandstone of Arran was not subdivided by Dr. Harker into Permian and Trias. It became necessary to do so, since a previously published map showing this differentiation was being used as an illustration of the geology of the island. A footnote on p. 7 was therefore added, in which a recent identification of Permian lavas was mentioned. It should have been made clear, since it has so happened that the publication of the book has antedated that of the research paper concerned, that the identification was made by Dr. D. Leitch, of the University of Glasgow.

J. E. RICHEY.

H.M. Geological Survey,
Edinburgh.

Huygens' Pendulum Clock

THE interesting article by Mr. A. E. Bell on the "Horologium Oscillatorium" in NATURE of August 30 rather suggests that this was Huygens' first book on the pendulum clock. He published a description, with plates, of the clock in "Horologium" (The Hague, 1658) though without reference to the scientific principles. The book is very rare and is not generally known. Part 1 of the "Horologium Oscillatorium" repeats its contents.

Huygens' specially constructed marine clock was actually tried at sea, and received a favourable report. The report, by Major Holmes, "A Narrative concerning the success of Pendulum Watches at Sea for the Longitude", is in *Phil. Trans.*, 1, 13–15 (1665).

G. H. BAILLIE.

c/o The British Tabulating Machine Co., Ltd.,
New Icknield Way,
Letchworth, Herts.

TIN THROUGH THE AGES

AN EXPERIMENT IN MUSEUM SYNTHESIS

By Dr. F. J. North
National Museum of Wales

A GALLERY in the National Museum of Wales at Cardiff is used exclusively for temporary exhibitions, of which there may be three or four in any one year. The present exhibition, "Tin through the Ages in Arts, Crafts, and Industry", was designed to dispel the notion that because we describe an inferior musical instrument as tinny, and dismiss something paltry and ill-conceived as a 'tin pot' affair, tin is therefore a metal of no importance. The subject-matter has been so treated as to demonstrate the connexion between a great variety of apparently unrelated things, with the view of discovering continuing threads in the story of human progress ; this reverses the usual museum practice, which tends to emphasize the difference between groups of cognate objects and to confine synthesis to the material within a group.

A handbook* has been prepared to provide a running commentary to the gallery, but since it summarizes the story which each of the exhibits has to tell, without actually describing them, it will serve as an outline of man's indebtedness to one of the most useful of all metals, independently of the exhibition itself.

A gratifying feature of the exhibition has been the readiness with which (often in difficult circumstances) manufacturers have provided examples of their products and photographs of their plant. Half a dozen museums, too, have contributed material, and my own indebtedness to the Tin Research Institute is considerable.

The story begins with the minerals in which tin is present, and with comparisons between ancient and modern methods whereby they are isolated from their ores, but the major part of the exhibition is concerned with the utilization of the metal, its alloys and its compounds.

When man began to experiment with copper as a substitute for stone in the manufacture of weapons and tools, and realized that the presence of a certain other metal—we call it tin—produced something—we call it bronze—that although harder than copper alone was more easily cast and manipulated, he made a discovery which, by giving him better and more abundant implements, greatly accelerated the progress of civilization ; and tin has played an important part in nearly every subsequent development that has tended to widen man's physical and intellectual horizons.

Strangely enough, the range of articles made from tin alone has always been limited. A few ancient objects of cast tin have been found in Egypt, while collapsible tubes for tooth-paste and wrappers for cheese are made of pure tin, but its importance has always depended mainly upon its capacity for extending the applications of other metals. It is an essential, and often the principal, constituent of many alloys in addition to those included under the general name bronze : pewter, solder, printing metals, bearing metals, organ pipe metal, dental metals, and fusible alloys all owe their special characters in part or entirely to tin.

The Romans knew that a tin lining to vessels of copper or bronze made them more suitable as receptacles for food and water. This use of tin, which has continued throughout the ages and has been applied to iron and steel as well, depends upon its readiness to combine with other metals and its capacity for resisting corrosion, and it shows that the importance of the metal is not to be judged by the quantity that is used, for the coating of tin is exceedingly thin. In the common 'tin can', for example, the protective layer is no more than one ten thousandth of an inch in thickness, and all the advantages we derive from tinned foods (to mention only one kind of commodity that is put into tins) we owe to this extremely attenuated film of tin. That this thin film can be effective is even more surprising, when we realize the strains and stresses to which the tinplate is subjected in the machines that convert it into cans and in the plant that fills and seals them.

One exhibit shows that tin is the principal constituent of pewter, and specimens from Roman to recent times illustrate the way in which its different varieties have been cast, spun, or beaten into vessels for ornament and for use ; another, entitled "Tin in Printing", illustrates the role of tin in printing metals, since the invention of movable types began to make knowledge the heritage of the multitude instead of the monopoly of the few.

It is tin which determines the properties of the varieties of solder ; innumerable articles, affecting every phase of human life, are commercial possibilities because of the ease with which soldered joints can be made, and we owe the effective distribution of water, gas and electricity to the solder which ensures the continuity of the conducting elements. As with the other alloys, the past and present uses of solder are illustrated by specimens and photographs, and the metallurgical explanation of its behaviour is simply described with the aid of diagrams and photomicrographs.

Tin is an essential, although not usually an abundant, constituent in the so-called fusible metals. At one time they were curiosities, as when used for making spoons that melted in hot tea ; later they found practical applications in the sprinklers which caused water to be sprayed in a room where a fire had developed, and nowadays they are employed in many engineering processes, as for example, in bending thin-walled tubes, like those for conveying oil and water in aeroplanes : the tube is filled with molten alloy, bent after the metal has solidified, and then immersed in hot water or in a steam bath so that the alloy can be melted and drained away.

Of outstanding interest is the part which tin has played in 'bearing metals', since the days when it was realized that the development of frictional heat in an engine was diminished by the introduction of a lining

* "Tin through the Ages, in Arts, Crafts and Industry", Handbook to a Temporary Exhibition, July–December 1941, by F. J. North, (National Museum of Wales, Cardiff). Pp. 38. 3*d*.

or bearing of bronze where one metal part moved in close contact with another. Later on, other alloys of tin provided still better bearing metals, and nowadays some of them contain more than 80 per cent of tin.

Many uses have been found for compounds of tin, as, for example, in producing rose tints for ceramic decoration, the white background for majolica and delft, the glaze of modern sanitary fittings, and the enamel of refrigerators, thus adapting to modern requirements a practice dating back at least to Babylonian times.

The foregoing notes show that a heterogeneous collection need not of necessity be haphazard, for with specimens ranging from part of a Roman pump to an electric kettle, and photographs ranging from Egyptian tomb-pictures to a pea-cannery, it is possible to complement the more usual kind of museum exhibit, based upon a desire to separate things which belong to different ages, or were put to different uses. This aspect of the exhibition can be illustrated by reference to one section only, that relating to bronze: approach from an archæological point of view leads to exhibits showing the kinds of implements that Bronze Age man could make, how they were related in time, and how they became more and more efficient, particularly in the direction of better fixture to their hafts: here the museum story usually ends, for iron superseded bronze, and Iron Age cultures demand consideration, and that there is any connexion between the palstave and a machine-component cast in bronze does not appear.

When, however, we add to the archæological information what modern methods of examination have taught us about the properties of alloys, we realize that the improvements in early implements ran concurrently with man's increasing knowledge of the materials he used; we connect up the oldest of metallurgical practice with the newest of metallurgical theory and research, and in our stride we can take in all the things for which the varieties of bronze have been employed—bells and guns, statuary and friezes, measures and machine-parts, and even the wire cloth on which paper is made.

We find that although the modern foundryman can deal with tons whereas his predecessor could only handle pounds, the principles on which he works are just the same. Bronze Age man discovered the principles of all the methods of casting that are used to-day, and learned to make metal reproductions of his moulds that could be used again and again, thus speeding up production and ensuring uniformity of results. Nowadays permanent moulds are made of steel, not bronze, and powerful machines force the molten metal into cavities more complicated than the old-time workers either needed or could have made; nowadays we call it die-casting, but the principle is the same, and so are the advantages claimed—speed of production and uniformity of result.

The experiment seems to have justified itself because the archæologically minded visitor, caring little for modern machinery, has discovered that in his ancient bronzes he has the beginnings of a story that is still in the process of writing; and the engineer, not a whit interested in axes and palstaves, has found that when he tries out a new method for 'babbitting' a connecting rod, he is contributing to a story of which the opening chapters belong to a period so remote that they have to be reconstructed, not read.

An exhibition like this shows how arbitrary are the conventional dividing lines between cultural and academic studies on one hand, and science and industry on the other, and how unsubstantial are the lesser dividing lines within these groups. Material that one would expect to see in a 'trade show' is displayed in the same gallery, and often in the same case as the 'cultural' objects normally associated with a museum, but there is no apparent incongruity either in the arrangement of the specimens, or in the ideas they are intended to suggest.

Taking a dictionary definition of culture as "a state of intellectual and artistic development", it would seem that museums can do much to show culture what it owes to industry, and, by illustrating the methods and results of industrial research (not merely the products of industry), to show that industry is itself specialized culture, for as Pope once put it, all are, indeed, but parts of one stupendous whole.

EXHIBITION OF PHOTOGRAPHY

THE eighty-sixth annual exhibition of the Royal Photographic Society of Great Britain was opened at the Society's Galleries, 16 Princes Gate, S.W.7, on September 5, by the Right Hon. J. T. C. Moore-Brabazon, the Minister of Aircraft Production. This is the second exhibition that has been organized under war-time conditions, and it would be foolish to pretend that it has not suffered in any way.

The Pictorial Section is up to strength, and appears to have maintained its high peace-time standard of quality, and it is gratifying that even this year most of the Dominions and the United States are represented.

The Scientific Section unfortunately suffers from a marked absence of exhibits from abroad. Photography is much used in Great Britain for scientific and industrial purposes, but few examples seem to find their way to the exhibition. It is also regrettable that few university laboratories in the country carry out research directly related to photography, though they certainly make use of it as a tool. In past years exhibits from abroad, such as the illustrations of ultra-high-speed photography of Edgerton and Germeshausen, and illustrations of the use of photography in research on cosmic rays and atomic particles, have been a feature of the Scientific Section. However, apart from these absentees, all branches of the section are represented by exhibits of high standard. There are examples of both low- and high-power photomicrography, the latter being illustrated by two striking examples of diatoms.

The number of exhibits illustrating the use of photography in medical work clearly shows the value of this application of photography. Many of the photographs taken for demonstration purposes are made during the course of surgical operations, and the operator is beset with many difficulties, such as obtaining sufficient light and suitable modelling to show up the desired features without interfering with the course of the operation. Other examples show the value of the combination of a schematic diagram of an organ and actual photographs of the object. The use of infra-red photography for rendering fine detail of structure in relatively thick sections of fossil stems of plants is illustrated by a number of examples.

Radiographs are well represented, the subjects being mainly of medical interest. The Rodman Medal, which is awarded for the best exhibit of a non-pictorial nature with special reference to radiography or photomicrography, has been given to R. M. Leman for his "Radiograph of Arum Lily" and "Radiograph of Larch". These were presumably taken with soft X-rays, and a relief effect has been obtained possibly by combining a positive and a negative of different contrasts and slightly out of register. The effect is certainly very pleasing from a pictorial point of view.

The remainder of the Scientific and Technical Section consists of a number of exhibits grouped under the name of "Survey and Record Photography". These are largely records of carvings, interiors of churches, etc., of which there are some excellent examples to be seen, and in these times such records assume a greater importance. The outstanding example of record work is the series of ten photographs, by H. Bedford Lemere, of famous London buildings, most of which have been seriously damaged by enemy action within the last twelve months. This exhibit has gained the Hood Medal. The Natural History Section is well filled and contains examples of all kinds, botanical, birds in their natural habitats (always a popular subject), and mammals, mainly feline, photographed in captivity. Natural history photography attracts a number of amateurs who master the technique of photography in order to apply it to their hobby. The pictorialist enjoys his search for good composition ; the photographer of Nature gets his excitement in another way, an excitement akin to that of the hunter. There is a photograph of the grey hare appearing out of a burrow set in trackless wastes of snow, and one can imagine the preparation and care necessary to obtain such a photograph.

The Colour Photography Section has suffered seriously this year, which is scarcely surprising, considering the difficulty of obtaining colour film. The transparencies are chiefly taken with miniature cameras on Kodachrome, Dufaycolor and Agfacolor films, while the colour prints on paper are reduced to six examples, three each on Wash-off Relief and Tritone. The lantern slide exhibit is mainly confined to natural history subjects, and both these and the purely 'pictorial' slides are well worth seeing. The slides are mounted in viewing boxes in a darkened room, and clearly illustrate the advantage of the transparency over the paper print due to the greater range of tones that can be reproduced by the former.

In the opinion of many, the most effective photographic reproductions are to be seen in the stereoscopic section, which contains some hundred transparencies, of which about half are in colour. The combination of the extended tone reproduction of the transparency with the stereoscopic effect, and in some cases colour, can produce a realism that may not satisfy the modern pictorialist, but can be very attractive to those who like to see things as they are.

The Exhibition as a whole, which is open to the public daily (except Sunday) from 10 a.m. until 5 p.m. until October 25, is well worth a visit. Though there are some notable absentees among the regular exhibitors, the Ministry of Information has supplied a series of more than a hundred British official photographs illustrating some applications of photography in depicting various phases of the Navy, the Army, the Air Force, in the manufacture of munitions, in home defence, and for propaganda and Press purposes.

LIGHTNING OVER-VOLTAGES IN UNDERGROUND CABLES

THE occurrence of lightning over-voltages on underground cables is ordinarily supposed to be impossible except when a cable is connected to an overhead line. In this case surges initiated in the latter may be propagated into the cable. In a recent paper by Dr. H. Einhorn and Prof. Goodlet of the University of Cape Town*, new facts are adduced which prove that the ordinary opinion is untenable. They describe some curious faults on underground telephone cables experienced during the lightning season in the vicinity of Johannesburg which cannot be explained in the general way. Briefly described, breakdowns occurred between the outer cores and the lead sheath and armouring of telephone cables buried to depths up to three feet in dry sandy soil. All the faults occurred during the lightning season, and faults were most frequent in the worst storm areas traversed by the cables.

In one case voltages up to 1,000 volts were measured (by electrostatic voltmeter) between cable-end and earth during a storm. The faults could therefore with certainty be ascribed to lightning ; the potential of the cable sheath must in some manner become raised relative to the cable cores. The problem the authors set themselves is to find out how this occurred and investigate possible remedies.

Direct strokes to earth are first considered. If a lightning flash of current I strikes an overhead conductor of surge impedance Z somewhere in a span, a travelling wave of amplitude $\frac{1}{2}ZI$ is propagated along the line in both directions away from the fault. Our knowledge of the propagation of electric disturbances along bare buried conductors is not extensive but is sufficient to allow us to picture events as happening in a similar manner, modified by the considerable leakage into the ground. Tests indicate that if an impulse voltage is suddenly impressed upon a long buried conductor the "effective surge impedance" (defined as the ratio of instantaneous voltage to instantaneous current) will fall from an initial maximum value of the order of 100 ohms down to the ohmic earth resistance of the conductor.

The attenuation of waves along uninsulated buried conductors is very rapid, being usually complete in a distance of less than 100 m., so that reflexion pheno-

* *J. Inst. Elec. Eng.*, **88**, Part 2, No. 4 (Power Engineering) (August 1941).

mena are seldom important. An impulse current fed in at one point of a buried conductor will therefore raise its potential to a maximum of about 50 kv. per kiloampere of current entering the conductor.

The formation of fulgurites proves that a lightning flash can penetrate a considerable distance into the ground, and therefore a direct stroke to a conductor buried only 2 ft. below the surface is not an impossibility.

Appreciable potentials may also arise due to earth-current voltage gradients if a flash strikes the ground anywhere in the vicinity of the cable. A similar effect has recently been investigated in connexion with power-system earth faults.

The increase of potential of the ground around substations, under fault conditions, is liable to cause breakdown of the dielectric of light-current cables entering the area when the cores of these cables are maintained at substantially earth potential. The cables can be protected against this hazard by insulating the sheath from earth for a certain distance from the substation.

The authors give a simple theory of the potentials induced on the ground-surface beneath a thundercloud. The separation of charges within the cloud surface occurs relatively slowly and is not accompanied by any sudden field changes at the ground surface. An approximate expression is found for the instantaneous value of the potential of the ground surface. If C is the capacity and R the resistance to earth of the ground surface, the product CR is constant irrespective of the distribution of the conduction and displacement currents in the ground.

An experimental arrangement of apparatus is then described showing the possibility of inducing potentials on buried conductors. A 12-stage 220 kv. portable impulse-generator is fed from a 200/30,000-volt single phase transformer with variable primary voltage over a half-wave thermionic rectifier. The impulses are applied over a water resister to a 2-ft. diameter metal plate, suspended above a bakelite cylinder filled with sand or garden earth. The crest value of the applied surge voltage is measured by means of 15-cm. remote control spheres. Embedded in the sand is a 9-in. brass disk connected to a 2·5 cm. sphere gap which is screened against the top plate and ionized by means of a mercury-arc quartz lamp.

Three different embedding materials were investigated: air-dried sand, moisture-content 0·05 per cent (by weight), specific resistance greater than 10^9 ohm-cm.; garden soil specific resistivity about 10^5 ohm-cm., and steam-wetted sand which had a resistivity of about 4×10^5 ohm-cm.

The conclusion is drawn that for dry sand the induced voltage is purely a matter of capacitances, and is practically independent of the wave front. With garden earth no effect due to the charging stroke could be observed within the possible working range. With steam-wetted sand the potential induced by the charging stroke was measurable and was clearly proportioned to the impulse crest voltage.

The theory given and the results of the experiments suggest that potentials can be impressed on conductors buried in the ground under a thundercloud and indicate an upper limit to their magnitude.

It is suggested that a cable laid in low resistivity soil will not experience induction trouble. Considerable attention should therefore be paid to soil aridity when choosing a cable route. Whether plant growth affects the moisture content of the soil to any appreciable depth is uncertain.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

TUESDAY, OCTOBER 7

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Dr. V. Zachary Cope: "The Influence of War on Surgery".*

FRIDAY, OCTOBER 10

PHYSICAL SOCIETY (in the Physics Department of the Imperial College, Imperial Institute Road, London, S.W.7), at 4 p.m.—Prof. J. T. MacGregor-Morris: "Recent Work on the Use of Photo-electric Rectifier-Type Cells in Photometry".

APPOINTMENTS VACANT

(*not included in the monthly Books Supplement*)

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

LIBRARIAN—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (October 8).

LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (October 8).

ASSISTANT LECTURER IN GEOGRAPHY (MAN OR WOMAN)—The Registrar, University College, Nottingham (October 13).

HEADMASTER of Stockport Grammar School—The Clerk to the Governors, Stockport Grammar School, Mile End, Stockport (October 15).

CIVIL ENGINEERING ASSISTANT—The Clerk to the River Ouse (Yorks) Catchment Board, 7 Langcliffe Avenue, Harrogate (endorsed 'Engineering Assistant') (October 15).

INSPECTOR OF SCHOOLS (WOMAN)—The Director of Education, Guildhall, Hull (October 18).

LECTURER-IN-CHARGE OF MECHANICAL ENGINEERING—The Principal, Aston Technical College, Whitehead Road, Birmingham 6.

GRADUATE LECTURER WITH QUALIFICATIONS IN MATHEMATICS, PHYSICS, OR ENGINEERING—The Principal, Technical College, Kendrick Hall, Stroud, Glos.

REPORTS AND OTHER PUBLICATIONS

Great Britain and Ireland

Tin Research Institute. Publication No. 105: The Spectrographic Analysis of Tin-Lead Soldiers. By D. M. Smith. Pp. 8. (Greenford: International Tin Research and Development Council.) [179

British Rubber Producers' Research Association. Publication No. 11: Studies in the Sterol Group, 43: The Unsaponifiable Portion of the Acetone Extract of Plantation Rubber. By I. M. Heilbron, E. R. H. Jones, K. C. Roberts and P. A. Wilkinson. Pp. 4. Publication No. 12: On Measuring the Efficiency of a Tractor by its Fuel Consumption. By E. W. Russell and H. J. Hine. Pp. 13. (London: British Rubber Producers' Research Association.) [179

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 139: The Soils of Tasmania. By C. G. Stephens. Pp. 40. (Melbourne: Government Printer.) [179

Bulletin of the American Museum of Natural History. Vol. 78, Art. 2: Results of the Archbold Expeditions, No. 34: Development and Enemy Recognition of the Curve-billed Thrasher *Toxostoma curvirostre*. By A.L. Rand. Pp. 213–242. Vol. 78, Art. 3: New American Syrphidæ. By C. H. Curran. Pp. 243–304. Vol. 78, Art. 4: A Study of *Orycteropus gaudryi* from the Island of Samos. By Edwin H. Colbert. Pp. 305–352. Vol. 78, Art. 5: Results of the Archbold Expeditions, No. 35: A Review of the Genus *Hipposideros* with Special Reference to Indo-Australian Species. By G. H. H. Tate. Pp. 353–394. (New York: American Museum of Natural History.) [179

Smithsonian Institution: Bureau of American Ethnology. Bulletin 130: Archæological Investigations at Buena Vista Lake, Kern County, California. By Waldo R. Wedel; with Appendix: Skeletal Remains from the Buena Vista Sites, California, by T. D. Stewart. Pp. viii + 194 + 57 plates. (Washington, D.C.: Government Printing Office.) 55 cents. [179

Smithsonian Miscellaneous Collections. Vol. 99, No. 8: Check-List of the Terrestrial and Fresh-Water Isopoda of Oceania. By Harold Gordon Jackson. (Publication 3593.) Pp. 36. (Washington, D.C.: Smithsonian Institution). [179

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