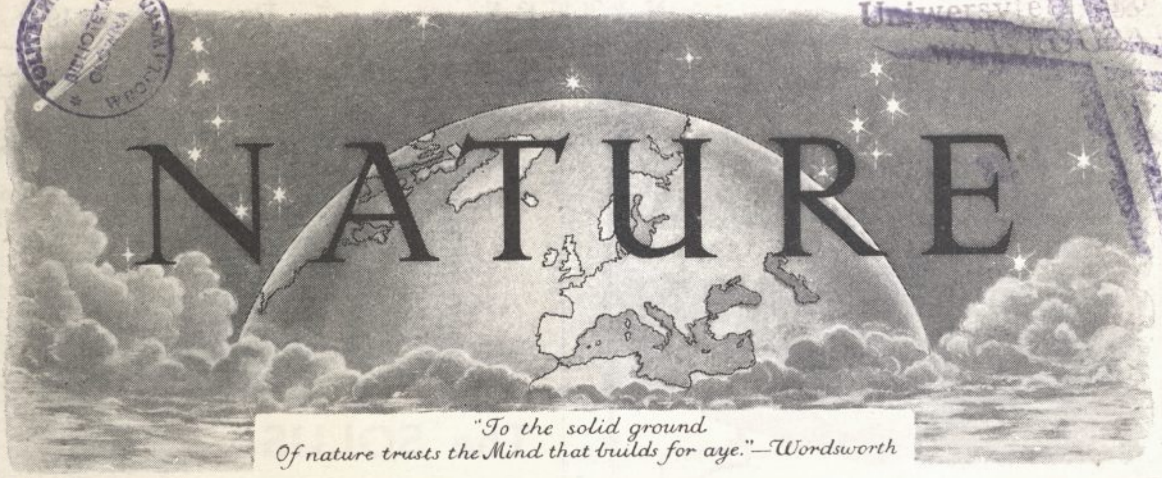

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BRITISH AGRICULTURE IN WAR-TIME

IT is all too true that as civilized life develops, its problems multiply and become more difficult to solve. In primitive agriculture man had but to contend with elemental forces that opposed him when he began to grow food, instead of merely hunting for it or gathering it. In modern agriculture we have not only to adjust our environment to the needs of particular crops and animals and to conserve soil fertility, but also to concentrate production in delimited areas to help maintain large industrial populations that live off the land, if not upon it. We have also to organize transport and distribution through a medley of middlemen and vested interests without causing the cauldron of social unrest to boil over. In war-time these problems are aggravated by disorganization of labour and transport, and by the vital need of producing as much food as possible in proximity to consuming centres.

Owing to the neglect of agriculture, to the huge growth of the industrial population, and to developments in submarine and aerial warfare, Great Britain is now at pains to maintain her food supplies ; and the difficulties of to-day are greater than those experienced in 1914, because since then we have lost some $2\frac{1}{4}$ million acres of arable land and about one quarter of our agricultural workers, large areas of grassland have become derelict, death duties have deprived the land of capital and unpredictable prices have badly handicapped the progressive farmer. Our shipping, overseas investments, and exports have all declined. On the other hand, science applied to agriculture has shown how yields of many crops, including grass, can be increased, and how numerous plant and animal pests can be controlled ; farm labourers are better paid, and the output efficiency per worker has increased ; the number of agricultural tractors has increased by 44 per cent since September 1939 ; so far, there has been very little reduction in livestock numbers, and good stocks of essential foodstuffs have been stored, for man if not for beast.

The chief agricultural problem of the moment is the production of more home-grown human food, and closely related thereto are the problems of feeding-stuffs, prices, and labour. The weekly wage of the farm worker has been raised to a minimum of 48*s*., and although 70,000 workers left the land for other pursuits in the first ten months of war, this leak has now been sealed. Unremunerative prices have long been the bugbear of the farming community, and to-day price-fixing at profitable levels is vociferously demanded. Notwithstanding efforts of the legislature to make farming profitable by means of the Wheat Act of 1932, sugar-beet subsidies, and marketing boards run by producers, the outlook for farming has remained precarious, and ever mindful of his bad experience when the Corn Production Act was repealed in 1921, the farmer is naturally anxious for the future. There can be no argument that in peace-time *efficient* farming must be made remunerative ; but too great and too frequent insistence on having good prices now, when many are sacrificing far more than their worldly wealth, is apt to alienate the sympathy of the urban electorate, upon whose votes the future prosperity of farming will depend. There is, however, no question that our farmers may be relied upon to pull their weight in the present emergency ; and they will be encouraged by the recent assurance of the Minister of Agriculture that the present system of fixing prices in advance will be continued throughout the War and for one year afterwards.

The provision of fodders and feeding-stuffs for livestock is especially important, because it affects the dietary of the whole nation. Thanks to a favourable climate, we produce sufficient grass and hay for nine months' supply, but the production is seasonal and the gap is filled largely by importing 'concentrates' (cereals, cereal offals and oilcakes) to the tune of about 9 million tons a year. These concentrates occupy much shipping space and involve currency payments abroad. Munitions of war and food for direct human consumption being of prior importance, we must now seek to compensate restricted imports of concentrates by growing more fodder at home, by eliminating wasteful feeding, and by reducing flocks and herds consonant with diminished imports. Now increased production of home-grown fodder competes with food production for direct human consumption, and it is well known that feeding man through animals involves great loss of nutrients; for example, it takes 10 lb. of concentrates to provide 1 lb. of butter, and up to 20 lb. of wheat to produce 1 lb. of beef. Hence, in war-time, arable land growing human food is more important than grass or arable land growing food for stock.

One of the meritorious achievements of the Ministry of Agriculture has been the ploughing-up of more than two million acres of grassland in the first nine months of war, a good proportion of which has been used for growing oats and wheat. It is now planned to break up a further million acres of grassland, the selection of which will be much more difficult than the first two millions. No definite guidance has been given as to how newly broken land is to be cropped. The cropping must depend to some extent on the local conditions, but it seems reasonably certain that the bulk of it will be devoted to growing cereals, and increasing the acreage under potatoes, which so far have been somewhat neglected, leaving comparatively little for growing roots and other animal fodders. Some leeway may be made up by growing kale and catch crops of rape, rye, late-sown barley, etc., and, in general, higher yields can be obtained by a more liberal use of nitrogenous and phosphatic fertilizers. Various suggestions have been made for increasing supplies of home-produced feeding-stuffs, such as utilization of all slaughter-house offals, predigestion of straw with alkali, and ensiling a million tons of grass for winter feed, but Dr. Norman Wright has already shown (NATURE, Aug. 24, p. 251, and Nov. 30, p. 712) that little substantial help can be expected from these sources, or even from the adoption of minimum standards of feeding ordinary rations.

The Minister of Agriculture has recently stated that during this winter allocations of feeding-stuffs not grown on the farm will probably be reduced to 70 per cent of normal supplies for dairy cattle, to about one half for other cattle and sheep, and to one third for pigs and poultry. This ruling is in line with the policy followed in Great Britain and in Germany during the War of 1914–18, and by Germany in Denmark and Holland at the moment; it means a gradual slaughtering of livestock (except milch-cows), pigs and poultry being the first to suffer.

There is, however, something to be said for the view, shared by many, that pigs or poultry, or both, should have precedence over beef-cattle. The late Mr. Christopher Turnor, whose death is a great loss to British agriculture, recently stated that for more than ten years he had produced "excellent grass-fed beef and mutton on heavy clay pasture, properly treated, without using any imported cake or concentrates whatever". It would be encouraging to think that this practice could be, or would be, followed at all generally; nevertheless, it suggests one means of helping to maintain our best beef-cattle and sheep. It therefore looks as if the Briton's dietary will gradually shift, at least during the war years, towards lactovegetarianism; and there is little doubt that the national health would not suffer thereby. A large proportion of our adult population, in particular sedentary folk and those who neither toil nor spin, could well give up half the meat they normally eat, and thrive on a dietary supply of s•me 60 gm. of protein a day (instead of the usually accepted 100–120 gm.), provided, of course, that other nutritional elements, especially vitamins and minerals, were consumed in adequate amounts.

The severe troubles of British agriculture, which began when cheap wheat from North America began to flood our markets in the late eighteen seventies, have never been boldly tackled by Government, and they have been aggravated by the intractable individualism of the farmer. Lack of vision on the part of our rulers has been the keynote of most of our lack of successes. In agriculture the need has always been for a comprehensive long-term policy, and one which would be compatible with war-time as well as peace-time conditions; instead of it, we have been treated with what Lord Bledisloe calls "hectic legislative patchwork". The outbreak of war in 1914 found us unprepared in almost every department of State, including agriculture. It was not until 1917 that the newly created Food Production Department began its successful labours ; but even this, as Sir Thomas Middleton has recently told us, was handicapped by the delay in adopting a policy. Delay and makeshift are the inevitable concomitants of lack of vision ; and the story has been repeating itself to some extent during 1939–40. Although the present War began to brew in 1933, practically the only serious preparatory step taken in the agricultural field was the creation of the Food (Defence) Department, which reported in 1938. Up to June 1939, only 150,000 acres of grassland had been broken up for arable production, and tractors were in short supply for war-time purposes. The Government had indeed subsidized the use of lime and basic slag in the interests of soil fertility, but these were home productions, and so the opportunity to increase the reserves in the soil of those nutrients which are mainly imported was missed ; and scarcely a beginning had been made with the drainage of water-logged land. The allotment movement, which reached its zenith during 1918–19, was allowed to languish, and no stimulus was given to increased production of vegetables, especially of onions and carrots, which were mostly imported. No plans were made to develop the results of research, conducted by private interests, on ensilage, the use of straw as fodder, or that of urea or ammonium bicarbonate for rectifying protein deficiency in the rations of milch cattle.

This list of omissions is not complete, and the recital of it is distressing, but it will serve to indicate the lamentable shortcomings of past agricultural administrations. The faculty of foresight or prevision is not one that is easily developed ; it is, however, a distinguishing feature in the mental equipment of the gifted scientific research worker, and it may therefore be suggested that the inclusion within the administrative body of one or two outstanding men of this type might prevent the recurrence of past ineptitudes. It may be that there is little transfer of insight and predictive ability from scientific research to politics and sociology ; experiment alone can decide, and it is worth trying. The fact that the few scientific men who have been elected to Parliament in the past have failed to leave their mark on policy is no evidence to the contrary, because it is not knowledge of science that is the essential qualification—useful though this may be—but sound judgment and ability to look ahead. Improvisation has its place in the casualty ward and on the music-hall stage, but in the sphere of political control it is weak and dangerous. In agriculture at least we must have insight, foresight, and long-term planning.

NUTRITION IN THE HOME

The Nation's Larder and the Housewife's Part Therein

A set of Lectures delivered at the Royal Institution of Great Britain in April, May and June 1940, by Prof. J. C. Drummond, Maj.-Gen. Sir Robert McCarrison, Sir John Orr, Sir Frederick Keeble, Dr. L. H. Lampitt, Prof. V. H. Mottram, Dr. J. C. Spence ; with a Supplement by Dr. Franklin Kidd. Pp. xii + 146. (London : G. Bell and Sons, Ltd., 1940.) 2*s*. 6*d*. net.

"THE Nation's Larder" offers to the inquiring housewife much food for thought, perhaps not very easy for her assimilative capacity. A preface by the President of the Royal Society and a letter from the Minister of Food stimulate an appetite for the substantial courses to follow.

It is agreed that in days long past the British peasant's larder was most satisfactorily stocked with a few simple sustaining foods, dairy produce, coarsely ground meal, potatoes, green and root vegetables. In recent years the larder was more variously but less adequately filled, and the nation's health and teeth have suffered from the consumption of *sophisticated* foodstuffs. War enforces a reversion towards a debased form of peasant's diet, debased because the bread and cereals of which it substantially consists have been deprived of essential ingredients. The majority of the British public are content with white bread, and the few who want wholemeal now have difficulty in getting it. There is an official scheme to reinforce white flour with synthetic vitamin B_1 (aneurin) and calcium, but that will not restore the protein, the iron and other minerals, and vitamins A, B_2 and E removed in milling.

There are two ways of reforming a bad diet. The best method, that advocated by Sir Robert McCarrison, is to rebuild it on the lines of the peasant diet. Another less satisfactory method is to keep the bad diet and supplement it with those foods misleadingly called *protective*. The classification of foods into three groups, energy producing, body building and protective, as adopted by Prof. Mottram on pp. 99 and 100, is with good reason adversely criticized by Dr. Spence on p. 113, in his most helpful section on the feeding of children. *Whole*some foods like dairy produce, whole seeds and vegetables are not only protective but also energy giving and body building. The artificial grouping into three classes would be meaningless had not certain refining processes, such as the roller milling of grain, the preparation of concentrated sugar and of pure fats and oils, created a new class of *unwhole*some foods which serve solely as fuel and do not feed the living tissues of the body. A grave error on p. 100, repeated again on p. 108, is the omission of that most protective group of foods, *whole* seeds and their products. These, the peasant's mainstay, are insufficiently stocked in the larders of to-day.

As a method of supplementary feeding suitable for ill-nourished mothers and school children, several of the authors commend the 'Oslo breakfast', a peasant type of meal of wholemeal bread, fruit, salad, raw carrot, milk, cheese, yeast, etc. But why go so far afield for a model while in our country there is that excellent working model the 'Glossop lunch' used successfully by Dr. Milligan, medical officer of health for Glossop, before Oslo breakfasts became famous.

Despite the merits of the peasant diet there is no justification for refusing to profit by the benefits which applied science, industry and commerce offer. Canning and chilling of foodstuffs, their transport from overseas and preparation in bulk by factories can now be achieved with less loss of nutritive value than home produce suffers in distribution and kitchen handling. The supplement by Dr. Franklin Kidd on the artificial preservation of food is of great interest.

The provision of a diet fully adequate for the health of every family will, says Sir John Orr, enable us to carry through post-War reconstruction with the minimum of strife. For the development of home food production, Sir Frederick Keeble and Sir Robert McCarrison stress the need for better attention to the land. Crop yields can be doubled in quantity and improved in nutritive value if the soil is properly fed and aerated.

Every corner of the nation's larder and its sources of supply are thus carefully scrutinized, but apart from her function as milch cow the housewife's part therein is ill-defined. In fact it seems that as cook-housekeeper she should be superseded by the large-scale caterer, for Dr. Lampitt insists on the advantages of communal feeding "to cater for a million is to save the nation's wealth". VIOLET G. PLIMMER.

ANATOMICAL EMBRYOLOGY

A Manual of Embryology
The Development of the Human Body. By Prof. J. Ernest Frazer. Second edition. Pp. x+523. (London : Baillière, Tindall and Cox, 1940.) 30*s*.

STUDENTS of the development of the human embryo will welcome the new edition of Prof. J. E. Frazer's "Manual". The general plan and scope of the work has not been altered by the changes and additions which have been made since it first appeared. It is a book which keeps close to its subject-matter—human embryology for the medical student and anatomist. Thus Prof. Frazer eschews both histology and comparative morphology. Of the anatomical facts which come within its purview, the book gives an account which is not only comprehensive and thorough, but also in several respects original. The author in his preface points out that in several places his descriptions will be found to diverge from embryological orthodoxy, and emphasizes that these divergences are the result of his own extensive researches. The work is, in fact, an original contribution as well as a text-book, and it will therefore be doubly interesting to the advanced worker. It is, however, unfortunate that no references are given, so that the student may find it difficult to distinguish the more original and controversial parts from the more conventional; but this is a comparatively minor danger which can easily be surmounted if the book is used under the guidance of a teacher.

There are several other reasons why the book is scarcely suitable to serve a student as his fundamental text-book. The very fact that it is partly a presentation of original research has had the more or less inevitable result that the allocation of space, and the fullness of the treatment of different subjects, has been influenced by the interest they hold for the author. For example, one notices a very excellent discussion of the derivatives of the pharynx, which is on quite a different level of completeness from the descriptions of the eye and inner ear. Moreover, there are some parts of the subject in which it is at present probably impossible to give a completely satisfactory account without more comparative material than the author allows himself. Examples are the earliest stages of development and implantation, in connexion with which a consideration of the recent work of Streeter and the Baltimore school must be considered as almost a necessity ; and the formation of the placenta is a topic for which comparative material is even more than usually illuminating.

One may doubt, indeed, whether it is possible to draw any general principles from a study of development which confines itself strictly to human material. Certainly our understanding of the basic anatomical processes at work during embryogenesis has in recent years been advanced mainly by studies on other forms. The demonstration of the reality and importance of cell streams is a case in point. For a complete account of embryology, suitable to provide the main guide to a young student, some consideration of these fundamental processes is essential.

The foregoing remarks are, however, not so much criticisms of Prof. Frazer's book as descriptions of the limits of the field with which he deals. Within those limits the book can be heartily recommended. It is an excellent, if not entirely orthodox, work of reference for the biologist who finds himself in need of embryological information, and it will be stimulating and illuminating supplementary reading for the student. C. H. Waddington.

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharge in Gases

By Prof. Leonard B. Loeb. Pp. xviii+717. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 42s. net.

IN recent years the subject of electrical discharge in gases has entered upon a new and active phase. The burst of activity which was followed by J. J. Thomson's first classical treatise early in this century was ultimately slowed up because the presence of gas essential to the phenomena was in itself a stumbling-block, since it introduced variables not capable of independent experimental control. The focus of attention thus passed in subsequent years from self-maintained discharge to the relatively simpler phenomena in high vacua, with most valuable consequences, both theoretical and experimental. The position then reversed itself in that it was in the details of mechanism of high vacuum phenomena that our knowledge became so much more definite. The time was then ripe for a return to the more complicated problems arising from the introduction of gas at relatively high pressures ; helped no doubt by industrial applications of glow discharge much new data has been accumulated during recent years and a critical treatise in the English language embodying these results and relating them to the familiar early work was much needed. Prof. Loeb's volume supplies this need, and the treatment is helped by the fact that the author himself has personally carried out or directed valuable researches on many of its aspects.

The volume opens with a description and discussion of measurements of the mobility of ions, later followed by a special chapter on electron mobility and a very full treatment of recombination. The problems of electron energy distribution, the theory of probes, ionization by collision, the part played by positive ions are all fully discussed, as of course it is necessary that they should be in leading up to the remaining third of the book on disruptive, corona, arc and glow discharges.

There will be few readers who will not find new material in this work and to most it will prove to be full of information, much of which may have passed unnoticed by them in its original form in scientific journals.

It is still true, of course, that in many of these phenomena, with which all physicists are familiar in broad outline, no finality can yet be said to have been reached. The author himself prefers to call his work a monograph rather than a textbook, and adds that in a book of this nature he figuratively lays the cards on the table, presenting the reader with facts and conflicting views and throwing "the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance".

But the reader will perhaps feel in consequence that the work is in some parts a little overloaded with controversial detail and a touch of special pleading for the acceptance of the author's results or conclusions rather than those of other workers. On the other hand, nothing is more exasperating to the non-specialist, seeking information, than the other type of handbook, not uncommon, which gives him all the published data, without that analysis of conflicting results from which he can then make his own choice.

Sufficient has been said to indicate the value of this work to any physics library. There remains only one point on which the reviewer wishes to express his personal views. The author states in his preface: "In writing a book of this scope it is obvious that too much emphasis cannot be spared for style or for a detailed consideration as to the best organization in presenting the material. The need is for a critical compilation of the state of physical knowledge in the various fields to-day." One can appreciate the task of analysing and correlating the mass of data provided in this volume. But to the reader himself style and presentation of material are very important, and he may feel that had the author been in a position to spare the time, the volume could have been pruned without loss of conciseness and with some improvements in its arrangement. Again, the use of italics for purposes of emphasis is valuable. But when it is used fifty times in ten pages (pp. 419–428, taken at random) its effect on the reader may not be quite what the author intended.

AN INTRODUCTION TO MATHEMATICAL ANALYSIS

Advanced Calculus

By Dr. C. A. Stewart. Pp. xviii + 523. (London: Methuen and Co., Ltd., 1940.) 25*s*.

WITH the ever-widening scope of modern mathematical analysis and its many ramifications, it is quite impossible to include, in a single volume of reasonable size, an adequate and exhaustive discussion of the calculus in its more advanced stages. It therefore becomes necessary, in planning a thoroughly sound course in the subject, to consider several important aspects of the vast field confronting a modern writer. The limitation of space renders the selection of subject-matter fundamentally dependent upon the aim of the course, which may or may not be related to the content of specific examination syllabuses. Logical development, too, may lead to the inclusion of many topics which, at present, may only be of academic interest, while others, of greater practical value, may have to be omitted. The experience and training of the writer may also have, more or less, a bearing on both these considerations.

With such thoughts in mind, it is interesting to turn to Dr. Stewart's volume, in which a good course, especially useful to students reading for mathematical honours, is thoroughly well laid out. The author fully appreciates his difficulty in selecting from such a vast field for, in his preface, he states: "Although this book is intended for students who have already acquired some knowledge of the elements of the calculus, it must be regarded merely as an introduction to the more advanced parts of the subject."

Although the subject-matter of a first course is included, the earlier concepts, regarded as intuitively obvious in many cases, are later re-examined in order that they may be satisfactorily founded upon a rigorously valid basis. Space has, however, only permitted the author to deal with those fundamental theorems which are essential to the developments considered or are likely to be needed in important applications. The first five chapters are devoted to the usual rigorous course in calculus up to the integration of functions of one variable. Then follow chapters on Jacobians; indeterminate forms, maxima and minima; vectors, twisted curves and tensors; multiple integrals; functions of a complex variable, conformal representation and contour integration; infinite series, products, expansions, infinite integrals and non-convergent series, and finally, Bernoullian polynomials, gamma and beta functions, the formulæ of Binet and Gauss, and Dirichlet's integral. Only the simplest theorems relating to the theory of sets, Lebesgue integration, finite differences, tensors, one–one correspondence, analytic continuation, etc., have been given. Importance is rightly attached to the approximate forms of functions, approximate integration and summation of series, but here again space has only allowed fundamental results to be dealt with.

From this very brief outline it will be seen that the scope of the course is wide. It has been skilfully planned and clearly presented, the diagrams deserving a special word of commendation. Many worked examples, often connected with important applications, are provided, and each chapter is supplied with appropriate exercises for the student's practice. Answers to these, where relevant, are also given.

It will be observed that no attempt has been made to include the theory of differential equations or of the functions that arise directly from them. It is hoped, however, that Dr. Stewart will consider the possibility of providing a companion volume devoted to this essential subject for, in the modern exploration of analysis, there is a tendency to overlook the supreme practical importance of this branch of mathematics, which really forms the very foundation of the higher stages of applied science. Such a volume would certainly be needed to supplement much of the present course by students reading for honours in science, notably physics.

SCIENCE AND NATIONAL WELFARE*

By Sir William Bragg, O.M., K.B.E., F.R.S.

Many events conspire to make the past year notable in the history of the Royal Society. Reference has been made to the majority of them in the Annual Report of Council, usefully supplemented by the Notes and Records which we continue to owe to our past Treasurer, Sir Henry Lyons. I do not propose to speak of them in detail, but on this occasion it does seem fitting to give further attention to one or two general matters of lasting interest.

One of these is personal. Fellows will have noted the long list of those whom we have lost, and the great names which the list contains. I have felt as I have been reading it that I have turned over the last leaves of a chapter that stands by itself. The present generation is quick to honour the names of J. J. Thomson and Oliver Lodge; but they cannot remember, as we older men can, the brilliant years when these men and their contemporaries were writing the chapter's first pages. What they wrote was eagerly read, their lectures were heard with rapt attention; they were the pioneers, and the men of science of that time, nearly half a century ago, streamed after them. All that is now a memory. The years have slipped away since their work was done, and we now look back on it as a separate entity, a noble event in the history of science, and of British science in particular.

There is no vestige of sadness in such a retrospect, nor any trace of feeling that our pride must be founded only on what has passed. I am sure that all those who like myself can recall the long years, and compare those that have gone by with those that are still ours, will say happily and proudly that our young men of to-day are maintaining in full force the tradition that they have received. They are writing a new chapter; and it is a chapter of a novel importance, because as they extend our record of the facts of Nature they find themselves compelled at the same time to consider a new problem—the relation of those facts to society and to the government of nations. Let me express my admiration of the willingness, vigour and ability with which the newer generation gets to work.

This same novelty is enlarging the range of work of our Society and is a second matter to which we are compelled to give serious attention. Our fellows have constantly given their services to public interests; it has often been pointed out that they are to be found in association with almost every department of government. But this year new moves have been made which may, and I hope will, lead to developments of the highest importance. The Report contains a notice of the recent formation of a Scientific Advisory Committee over which Lord Hankey presides, with a reference which in effect directs it to consider the advances of science in their relation to national welfare. The Committee reports to the Cabinet through its chairman. A Committee of similar nature but lesser scope was set up a few months ago to consider the scientific aspects of the food policy of the Government: it consists of well-known authorities on nutrition, agriculture and economy, with myself as chairman. This Committee reports to the Lord Privy Seal, and so to the Cabinet Food Policy Committee over which the Lord Privy Seal presides. The significant feature of these Committees is their close and direct association with the Cabinet, the central body that governs the nation.

Hitherto men of science have been appointed man by man to various Government departments so that they might act as useful items in departmental machinery. The new Committees are not parts of any executive body and have no executive power of their own. They exist to make recommendations, which must of course be practical and take full account of difficulties of execution. But they are not hampered by traditions, nor by set habits; they have time and freedom to consider the whole field of scientific knowledge and its possible influence on practice. The Scientific Advisory Committee, the more important of the two, is particularly well fitted to watch all occasions and opportunities for the employment of science in the service of the nation, and also for the continuous encouragement of that employment. The president of the Society and the two principal secretaries are in close touch with every branch of science; through the fellows of the Society which they serve they have a unique view of scientific progress. The three secretaries of the

* From the presidential address to the Royal Society, delivered on November 30.

principal Research Councils of the Government, dealing with industry, agriculture and health, are in close touch with the chief national activities.

Thus a great opportunity is opened after long expectation; and the Royal Society is largely responsible for the development of that opportunity. We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within.

We remember that it is science itself, not men of science, that we are trying to lift to the high places. In that respect our movement is not selfish. We do not claim that men of science shall be entrusted with authority because they are men of science: we do claim that authority shall be exercised in the light of a knowledge which grows continuously, and with continual effect on politics, on industry, and on thought itself. If at present the only way to bring this knowledge into use is to treat men of science as consultants, let us take that way. But we shall be taking the better way if in all ranks of the State, and especially in those that have authority and set an example, we can arouse a general appreciation of the position of, and a constant understanding watchfulness on, the increase of knowledge and the uses that are made and can be made of it. It cannot be said that the general aspect of the nation towards the increase of knowledge is satisfactory. Science has become an integral part of our educational system, yet the changes that have been made are often ridiculously like the casting of sacrifices to following wolves. Science is not a devouring monster, but a means of service; it is a knowledge, gained by an irresistible tendency of man to examine his surroundings. It may be rightly or wrongly used. There is a prime danger if those who are in the position to use it rightly shut their eyes to its presence and its power, like an army which relies on bows and arrows when its enemies know how to use machine guns.

It is not universally or even sufficiently understood how important natural knowledge has become. It is true that in a vague way the nation is brought by the happenings of war to guess at the meaning of scientific research in every kind of enterprise. But still it would be difficult for most people to grasp the significance, much less the meaning, of the description of a fact like this: that the Royal Air Force could not carry out its operations without the knowledge resulting from the studies of cathode rays and electrons made by our physicists, which is equivalent to saying that by this time we might well have lost the War. Similar cases of cause and consequence could be quoted in numbers; they happen to be found more readily in relation to the sciences that deal with inorganic materials than those that deal with organic processes, and the military demand for physicists has been great because they are wanted to put physical discoveries into practice. But this discrimination is only accidental and temporary, and in fact the whole range of science is equally concerned.

Since experimental science has assumed such a commanding influence on all our affairs, so that we run the risk of great perils if we take no account of it, and leave its uses to others, let us say, less well disposed than ourselves, and, on the other hand, have opportunities of great benefit if we use it rightly, it becomes a first duty to direct our steps accordingly. Just as in former times schools and colleges were founded to train men for the service of Church and State, in ways which were appropriate to that high end, so now we have to see to it that the men are produced by our educational systems who can appreciate and act up to a new state of affairs. This can be done without jettisoning any of the fine instruction which has been a proud feature of our older systems.

I think that this is not essentially a matter of the rearrangement of school time-tables, or the building of scientific laboratories, though such tactical methods must have their due consideration. This is a personal matter, as has been the case with every great human movement. We have not to force the use of new tools, but to encourage and develop a new appreciation and a new attitude. Our best method, as ever before, lies in our own actions. If we, in the continually increasing contacts of men of science with public affairs, can show that we have something of great value to contribute, and that we give it freely, placing our individual interests below those of a greater purpose; if we try to understand the motives and principles of those whom we meet who may not see our vision, just as we may fail to appreciate theirs, then by so doing we have the best chance of bringing about the changes that we desire. It is the personal contact of the man of science, especially with those who are charged with duties to the nation, that is the moving force. That is where these new associations of science with government may mean so much, and shall mean it, if our devotion can achieve its purpose.

VENTILATION OF AIR RAID SHELTERS

BY J. S. WEINER

DEPARTMENT OF INDUSTRIAL PHYSIOLOGY, LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

THE occupancy of air raid shelters presents, actually or potentially, many of the whole range of problems with which the practice of ventilation is concerned. The term 'ventilation' is here used to include heating and other air-treatment; it may be defined as 'the provision of air hygienically and physiologically adequate in quantity and quality'. In air raid shelters conditions arise which tend to reduce the efficiency of ventilation very considerably. While on one hand, the supply of air is hampered in a number of ways by safety requirements, the demand tends at the same time to be greatly increased. Structural alterations to places used as air raid shelters usually require the blocking or baffling of the natural airways; lighting restrictions interfere further with ventilating arrangements; the danger of gas attack may reduce the available air supply merely to the air capacity of the shelter. The fitting of ventilating appliances may entail some structural weakening of a refuge; and the dependence of most large plants on outside power is also a potential source of weakness. Furthermore, since in shelters the ordinary density of living-room occupancy is much exceeded, satisfactory standards of ventilation are distinctly more difficult of attainment.

The specific problems of ventilation in air raid shelters may be appreciated, first by a discussion of the general requirements for adequate ventilation, and secondly, by an examination of the practical measures available to implement these particular requirements. The great variety in situation and capacity of shelters, and the lack of data of actual atmospheric conditions and circumstances of occupancy, even of a few types, restrict the scope of the discussion to rather broad generalizations. Although research over the last twenty-five years has added greatly to the scientific basis of ventilation, it will be clear that many matters to be mentioned here stand in need of thorough investigation. It is to be hoped, therefore, that the Horder Committee will set under way a comprehensive inquiry into shelter ventilation which will serve both as the prerequisite to effecting improvements and as means to valuable new information.

The general requirements for satisfactory ventilation with reference to air raid shelters may be considered under the following headings.

THERMAL COMFORT

The older ideas on the subject of ventilation laid great stress on the carbon dioxide in the air. But it is now well recognized that in ill-ventilated and crowded rooms the excessive warmth and stagnation constitute the chief causes of discomfort. Nevertheless, conditions may well arise in which the concentration of carbon dioxide is of paramount significance in regard to the adequacy of the air supply.

For comfort, the air should be cool rather than hot, dry rather than damp, moving rather than still, and variable in movement rather than uniform and monotonous[1]. The feeling of warmth experienced is related to four physical factors which influence the rate and mode of heat exchange between the body and the environment. These are: the dry bulb temperature of the air, its relative humidity, the mean (radiant) temperature of surrounding surfaces and the rate of air movement. The interrelationship between these factors and the sensation of warmth and comfort has been studied by workers in Great Britain and the United States[2,3], and has recently been reviewed by Bedford[4]. Some or all of the factors have been combined either in indexes which give due weight to each component or in the direct measurements of specially designed instruments. In air raid shelters it is probably best to measure the separate factors and then to use formulæ which give a combined assessment, if this is required. The separate measurements will usually give the clue to the most useful course of action, and in many cases combined indexes or special apparatus offer no advantage over the simpler readings.

In the evaluation of the separate or combined factors influencing warmth recent work[5] is capable of useful application to the conditions in air raid shelters. From an inquiry in which more than 1,500 sedentary workers, normally clad and doing light jobs, were concerned, data have been assessed showing the influence of the separate factors mentioned above on the conditions necessary for comfort. When the air was relatively still, the radiant heat from surroundings small, and the relative humidity about 50 per cent, 86 per cent of the opinions showed that conditions of comfort exist within the zone of 62–68° F. dry bulb temperature. Higher air or radiant temperatures and relative humidity increase the sensation of warmth, but they can be counteracted by the increased cooling effect of air movement. Cold sensations, on the other hand, may be due to increased air movement, to low temperatures of surfaces, or low air temperatures, and accordingly may be countered by higher air temperatures, or sources of radiant heat, and slightly by increased humidity. These findings relate to persons, mainly sitting, and doing very light work while wearing ordinary indoor clothing. In air raid shelters where people are at liberty to wear extra clothing to maintain bodily warmth, temperatures somewhat below those of the working 'comfort zone' will probably be endurable.

In air raid shelters all four factors are liable to considerable and sometimes independent variation, according to the outside thermal conditions, the rate of air change, the warming effect of the occupants, the length of occupancy and the heat transmission coefficients of the walls. In warm weather with inadequate ventilation and depending on the number of occupants, air temperatures of shelters will tend to rise to uncomfortable limits; this effect will probably be of less magnitude in underground shelters, since the walls remain appreciably cooler than the air[6]. The capacity of the ventilation and surroundings of shelters for removing bodily heat so as to prevent its undue accumulation is clearly one important criterion in assessing the permissible number of occupants and the length of stay. This basis has been adopted in the official publication referred to below.[13]

In cold weather the heat of metabolism of the inmates makes an important contribution to the warming of the shelter. If fresh air supply is poor or is deliberately reduced, the temperature may even become unpleasantly warm. But the closing up of all openings as a means to increased warmth interferes with other important objectives of ventilation. Hence extra warming must be sought rather in higher radiant temperatures or in heating the incoming air.

In inadequately ventilated air raid shelters, the continuous addition to the atmosphere of moisture from the expired air of the occupants will tend to raise the relative humidity. But as the walls of underground shelters are some degrees cooler than the air, the rise in humidity will be slowed by the surface deposition of moisture[6]. This will probably hold true also for surface shelters in cold weather. Nevertheless, accumulation of moisture in some circumstances may constitute an important contributory cause of discomfort. At temperatures above 70° F. with relative humidities above 70 per cent feelings of clamminess arise[5]. Below the lower limit of the comfort zone increased humidity is of less importance. Hence the necessity for dealing with this source of discomfort, by proper spacing, increased air change, and in some situations by absorption of moisture by dehydrating agents. Besides the comfort zone laid down by Bedford and his index for combining the various factors—'equivalent warmth'—the American 'effective temperature' scale which combines the effects of dry-bulb temperature, humidity and air movement[2,3] may be a useful one to adopt in shelters. The winter comfort zone in terms of effective temperature for British subjects is about 54–68° F.[5] The summer comfort zone is probably about 6° higher.

FRESHNESS

The environmental factors which contribute to the impression of stuffiness or freshness have recently been analysed by Bedford and Warner[7]. Observations have shown that one of the important factors is the rate of movement of the air; at velocities below 20 ft./min., feelings of stuffiness are likely to arise. Not only the average velocity but also the variability of the air currents are important. The relative humidity should be kept below 70 per cent. Stuffiness can also be produced by the combination of cool walls and warm air. Yet another cause is the existence of temperature gradients, higher at head-level than at foot-level. In air raid shelters all these factors are likely to operate, unless adequate ventilating measures are instituted. High relative humidity, cool wall and warm air combinations, temperature gradients, were all noted in a recent investigation in shelters[6].

FREEDOM FROM ODOURS

In satisfactory ventilation, the cubic space per person and the supply of fresh air are arranged to keep the air free of objectionable odours. In fact this has been a main criterion of adequate fresh air supply for almost a century. American workers[8] have lately shown that the amount of fresh air required per person varies according to the amount of cubic space available; the ventilation requirement increases as the space per person decreases, and is also closely related to personal cleanliness. In ordinary circumstances 1,000–1,200 cub. ft. per head per hour will give good results. A reasonable lower limit would probably be about 600 cub. ft.

In air raid shelters objectionable odours arise from a variety of sources, and are to be associated with primitive sanitary arrangements, the presence and preparation of food and the crowding of the occupants. The sensitivity to odours varies considerably, and the harmful effects attributable to odours are probably only indirect, as for example, loss of appetite leading to other disturbances.

Measures to mitigate the nuisance include adequate spacing, and standards of air supply or air changes, and also the use of deodorants or volatile substances which 'mask' the smell complained of.

Oxygen and Carbon Dioxide

Although the old practice of prescribing standards of ventilation according to the concentration of carbon dioxide was based on a misplaced emphasis on the ill-effects of this gas, in air raid shelters the concentration may quite easily reach levels undesirable in themselves and indicative as well of gross inadequacy in comfort and epidemiological standards. The sensitivity to high carbon dioxide percentages in the inspired air varies among individuals, but beyond 2–3 per cent panting and distressed breathing are the early signs of the physiological effort made by the body to prevent the carbon dioxide tension of the blood from rising outside tolerable limits. With carbon dioxide above 6–7 per cent, symptoms of carbon dioxide excess become serious. In places where the carbon dioxide due to combustion and respiration is not being removed fast enough, progressive lowering of the oxygen content will also prevail.

High carbon dioxide concentrations will affect the body first; but the oxygen deficiency will in due course prove even more serious. At a concentration of 12–13 per cent oxygen, oxygen lack will be superimposed on the carbon dioxide excess. The sealing-off of shelters in a gas attack represents a situation where oxygen supply and carbon dioxide removal may assume an importance even beyond the dissipation of heat, since in underground shelters the rise in air temperature is not as rapid or as serious as that of carbon dioxide[6]. In a fully occupied shelter with all openings blocked, signs of distress became manifest after two hours, and absorption of carbon dioxide and release of extra oxygen from cylinders were necessary to prevent the ill-effects.[6]

Hence, for those shelters which are to be sealed against gas attack and are not provided with mechanical ventilation with filtration, careful calculation must be made of the rate of accumulation of carbon dioxide to set limits to the number of occupants and time of occupancy. In this connexion, 1 per cent carbon dioxide should be regarded as an upper limit, whilst in assessing 'ordinary' ventilation on this basis, 20 parts per 10,000 should not be exceeded. For the purpose of this calculation in the case of sealed shelters, the production of carbon dioxide can be taken at about 0·6 cub. ft. carbon dioxide per hour for a man sitting quietly. In determining the available air on the basis of the volume of the shelter, the fittings and volume due to the bodies of the occupants should be deducted, for in crowded shelters the proportion of non-available space is fairly high. In a steel shelter of gross capacity of 1,210 cub. ft., 200 cub. ft. had to be deducted for fittings and the bodies of the forty-five occupants[6]. An upper limit of 20 parts per 10,000, it can be calculated, means an air supply of about 400 cub. ft. per hour per person.

Spread of Infection

The floor space and air supply influence not only the standards of comfort, freshness, and freedom from odour, but also the spread of communicable disease. Two modes of spread are recognized: dissemination by exhaled droplets and the aerial transmission of infective particles.

In both types space is of obvious importance. Vernon[9] mentions that for school children at least 180 cub. ft. per head is desirable and in theatre and assembly rooms not less than 90 cub. ft. In shelters in which 50 cub. ft. per person only may be available, it is clear that air exchange and treatment of the air will have to be adequate to compensate for the reduced accommodation.

What standards of fresh air supply should prevail to reduce the number and contacts of infective particles is not accurately known. A comparison between 900 and 1,700 cub. ft. of air per hour per person showed no effect of reduced ventilation on the incidence in respiratory illnesses amongst school children[10]. The ventilation prevailing in air raid shelters will fall in most cases well below the London County Council standard of 1,000 cubic feet per hour (the official recommendations allow very much lower standards). Air change may even become nil when air raid shelters are sealed off from gas attack.

Hence the use of air disinfectants becomes a most important measure for supplementing the available space and air supply. The relative merits of various air disinfectants have been the subject of recent research which indicates promising results from the use of several phenolic germicides and hypochlorite solutions[11].

The necessity of proper warming or cooling of shelters is of obvious importance also in relation to infection. Sudden chilling, due to cold walls, on one hand, and warm and humid atmospheres acting on the mucous membrane of the breathing passages, on the other, favour increased susceptibility to infection.

Dustiness

The presence of dust can contribute to bacterial pollution of the air. As an irritant to the nose and chest it can be responsible for sneezing and coughing, which in crowded shelters will be a main source of infective matter.

PRACTICAL CONSIDERATIONS

The attainment of satisfactory conditions of ventilation depends in practice, as the foregoing discussion of the basic physiological and hygienic principles has emphasized, on the mutually interdependent factors of spacing and air supply, and on the employment of various measures of air treatment. A two-fold approach to the problem of improving the situation in air raid shelters is thereby suggested: the allocation of space per person in relation to the available or projected facilities of fresh air supply and, secondly, the complementary institution of a number of procedures of air treatment.

A clear distinction must be made between the different systems of ventilation, since the particular arrangement available is the main factor determining the eventual occupancy. 'Mechanical' ventilating systems employ fans and accessory mechanical appliances for changing the air; in 'natural' systems the air is exchanged under the influence of naturally occurring pressure differences due to fires and other heating arrangements combined with the ordinary disposition of windows, doors and other openings. In air raid shelters the further distinction must be made, in either case, as to whether or not protection against poison gas is a feature of the ventilating system. In the case of 'naturally' ventilated shelters, protection against gas implies that the shelter can be made gas-tight, and consequently the limit of the available 'pure' air is represented by the volume of the shelter.

In a sealed shelter it is, of course, quite feasible to replenish the used air from cylinders of compressed oxygen or air as well as to remove accumulating carbon dioxide by means of a suitable absorbent. This *regenerative* method, which can scarcely be of widespread use, is well worth considering as an emergency measure in control posts[6]. Protection against gas may also be provided in mechanical systems of ventilation by means of suitable filters.

In general, it may be said that the permissible accommodation should be determined according to which of the four arrangements obtains, natural or mechanical, in either case whether gas-protected or not. In the case of mechanical systems it is obvious that the design and capacity of the plant permit immediate application of standards based on the hygienic considerations outlined above. The number of occupants in a shelter with known mechanical ventilation is readily stipulated. For naturally ventilated shelters it is, of course, very difficult to indicate in advance the details of suitable arrangements of doors, windows, space, etc. Here, pending direct investigation of the shelter itself, occupancy must be on the basis of a reasonable floor space, while accessory measures must be vigorously employed. When dealing with naturally ventilated shelters intended also to be sealed off, definite standards can be laid down beforehand, based on the dimensions of the shelter. As we have seen, it is easy to calculate the rate of accumulation of carbon dioxide and the density and time of occupancy before maximum standards are approached. In addition, the rate of increase of air temperature can also be estimated, so that the necessary surface area for heat dissipation up to a limiting temperature can be stipulated.

In accordance with these four situations, the official recommendations would appear to give reasonably good general guidance, although the standards in most cases are admittedly minimal. Air Raid Precautions Memorandum No. 10[12] lays down that in shelters naturally ventilated (and to accommodate more than twelve persons) there must be per person:

Not less than 6 ft. sq. of floor area.

Not less than 50 cub. ft. capacity.

Not less than 25 sq. ft. of all walls backed by earth.

These standards may be reduced to $3\frac{3}{4}$ sq. ft. floor area per person provided the shelter is ventilated mechanically at a rate exceeding 450 cub. ft. of air per person per hour.

The first set of provisions, having regard to the hygienic requirements set out above, would require the most efficient cleaning, disinfecting, and other local treatment of the air to counteract the low rate of ventilation and minimal spacing. First-hand investigation would indicate how sufficient in practice natural ventilation proves in the larger shelters inhabited on this basis. The value of accessory measures in relation to these standards should be ascertained in the light of practical experience, and both the standards and these measures improved if necessary.

The standard for mechanical ventilation of 450 cub. ft. per hour, even though a higher degree of crowding is permissible, would appear superficially more in accordance with general practice. Nevertheless, accessory measures, such as aerial disinfection and the allaying of dust are of first-rate importance.

For sealed (unventilated) and gas-protected mechanically ventilated shelters, standards of accommodation have been laid down in relation primarily to heat dissipation and carbon dioxide accumulation. These are set out quite comprehensively in Air Raid Precautions Handbook No. 5[13]. Depending on the dimensions of the room, the number of occupants permitted for 3 hours and 12 hours occupancy is shown in relation to sealed shelters or air supplied mechanically at 150 cub. ft. and 450 cub. ft. per hour. The square feet of area allowance per person under these conditions are in general much more satisfactory as regards hygienic requirements, particularly protection from spread of infection. It might almost be suggested that all shelters should be assessed for occupation on the basis of the eventuality of gas attack. On the official standards, and in ordinary circumstances, standards of spacing and air change would be universally of a much safer order.

Whatever the conditions, there can be no doubt of the importance of utilizing every available method of improving the properties of the air by local and 'emergency' measures.

With regard to freedom from infection, such measures include the thorough cleaning of the shelters with soap and water, or the treatment of the floor with spindle oil, the removal of dust by vacuum cleaning, and, most important, the use of air disinfectants. Although other precautions, such as medical inspection, isolation of suspected cases and prophylactic inoculation are of great importance, their discussion is perhaps out of place here. The wearing of face masks in overcrowded shelters would seem to offer a good measure of protection against droplet infection and would seem well worth a trial. Such masks should not prove uncomfortable even for long periods if worn loosely, much in the style of a veil.

With regard to conditions of comfort and freshness, a number of useful measures may be suggested. In shelters in which the air is too warm, care must be taken that the natural air flow is not being obstructed. Wherever possible all openings should be used to their maximum advantage, and in cold weather unpleasant draughts along the floor can be avoided by the judicious placing of screens near the doors. The incoming air may be assisted by locating a source of heat under a chimney pipe or the emergency exit. An oil lamp used in this way would also provide some lighting and warmth. Oil-stoves and electric radiators, or other heating appliances should be installed where air or wall temperatures are excessively low. A radiant source will be most useful where very low wall temperatures obtain. No braziers or slow combustion stoves should be used owing to the very great danger of carbon monoxide poisoning.

Discomfort due to stagnation of air and high air temperatures can be reduced considerably by stirring the air. Where electric fans are not obtainable an improvised fan may be operated after the fashion of the punkah. Stirring of the air will help to dispel undesirable temperature gradients and so reduce the sense of stuffiness.

Proper sanitary accommodation as well as restriction on preparation of food in the shelter itself are of first importance in dealing with smell nuisance.

[1] Report of the Health of Munition Workers' Committee (H.M. Stationery Office, Cmd. 9065).

[2] Houghton, F. C., Teague, W. W., and Miller, W. E., *J. Amer. Soc. Heat. Vent. Engrs.*, **32**, 315, 473 (1926).

[3] Yaglou, C. P., *J. Indust. Hyg.*, **9**, 297 (1927).

[4] Modern Principles of Ventilation and Heating. (London: H. K. Lewis and Co. 1937).

[5] Bedford, T., "The Warmth Factor in Comfort at Work". Indust. Health Res. Bd. Rept. No. 76. (H. M. Stationery Office, 1936).

[6] Report on Occupancy Tests of Air Raid Shelters for Factory Workers. (London: H. K. Lewis and Co. 1939).

[7] Bedford, T., and Warner, C. G., *J. Hyg.*, **39**, 498 (1939).

[8] Yaglou, C. P., Riley, E. C., and Coggins, D. I., *Heating, Piping and Air Condit.*, **7**, 65 (1936).

[9] "Principles of Heating and Ventilation". (London: Ed. Arnold and Co., 1934).

[10] New York Commission on Principles and Practices of School Ventilation. (Columbia University, New York, 1931.)

[11] Twort, C. C., Baker, A. H., Finn, S. R., and Powell, E. O., *J. Hyg.*, **40**, 253 (1940).

[12] Air Raid Precautions Mem. No. 10. Provision of Air Raid Shelters in Basements. (H.M. Stationery Office, 1940.)

[13] Air Raid Precautions Handbook No. 5. Structural Defence. (H.M. Stationery Office, 1939.)

RECENT IMPRESSIONS OF WAR-TIME AMERICA

By DR. JOSEPH NEEDHAM,
UNIVERSITY OF CAMBRIDGE

AS the result of long-standing invitations to attend the Second Conference on Differentiation and Growth at Salsbury Cove, Maine, and to lecture at the Californian universities (Stanford and Berkeley) on my own subject, I spent a period of five months (June–October) last summer in the United States, during the course of which I visited some twenty universities and colleges. I was glad to take the many opportunities which offered themselves of speaking on the present position of science in Europe. In this I dealt both with the situation of science in British democracy at war, the organization of the scientific contribution to the national effort against the Nazi-Fascist powers, the effects on the universities and similar institutions, etc., and with the nature and origin of the Nazi attack on all free international science and scholarship.

There was, I came to feel, a very real need for this approach, in the United States no less than in Great Britain, for unfortunately the works of the Nazi writers who provide the theoretical justification for the attack on science have never been translated, are difficult to obtain either in

America or Great Britain, and hence are practically unknown in either country. Yet only by some acquaintance with the works of such men as Spann, Klages, and Blüher in philosophy; Marr, Jung, Haiser, Moeller-Brück, etc., in sociology; Brohmer in biology; Jaensch, Hommes, Krannhals and Schulze-Soelde in racialism; Rosenberg and Krieck in what can only be called Nazi "mythology"; Stapel and Freyer in ethics; and Leonard and Stark in the history of science—can one hope to appreciate the full iniquity of the power that has destroyed free science in Germany, laid waste the universities of Poland, now overshadows the centres of learning in the countries of western and northern Europe, and against which the British people alone now stand, backed by the people of the great sister nation of the United States of America.

In this approach, I analysed the sociological origin of Nazi-Fascism, growing up as it did in the "fear field" between the socialist East and the democratic capitalist West, bent on world domination, and bound by its own necessity to a more efficient militarism than any hitherto known. Hence its attack upon international science took the various familiar forms.

(1) Anti-intellectualism, for when the ideals of a State can no longer be commended to the people in rational terms, irrational emotionalism must be fostered, and all scientific scepticism combated.

(2) Racialism, the greatest scientific fraud yet perpetrated on humanity, for the units of the military machine must be convinced that they belong to a "master-race" fated to dominate adjacent "subject-races". This has involved not only the flouting of all scientific anthropology, but also the "principle of racial conditioning of scientific knowledge" according to which no valid scientific results have ever been produced except by "Aryans" and "the concept that twice two make four is somehow differently tinged in the minds of a German, a Frenchman, a Negro or a Jew" (Hommes).

(3) *Wehrwissenschaft*, the concentration of support for science only on destructive applications, and the withdrawal of funds, effort, and men from pure science—a process that has reduced Germany from a first-class scientific country to a third-class one in seven years.

(4) The leadership principle, contrary to all that we have come to know of human nature through twenty centuries, and based on the fallacy of "biologism", the idea that human society can be treated as if it were of the same order of complexity and organization as animal associations.

The reception accorded to these discussions in the United States was extraordinarily friendly and enthusiastic. It was noticeable, however, (especially where the audience was composed mainly of older people) that there was sometimes a preference for discussing the situation of science in Great Britain, and how help could best be given, rather than the nature of the threat to European science on the Continent. This may indicate a tendency in some Americans to throw Nazi-Facism together with all the European tyrannies that Americans have been traditionally accustomed to hate, and this in turn might lead to the conclusion that in the long run it would be better for America to accept the *fait accompli* of a fully Nazified Europe and 'do business' with the governors of it, just as Americans have had to do in the past with many regimes of which they personally disapproved.

In spite of the fact that Mr. Roosevelt, whose firm foreign policy has been so important, has been re-elected, this tendency will probably develop, and it is being fostered by the Vichy French and other "spurious continental nationals" in America who are being used as stalking-horses by the Nazis. I did what I could to counter it by pointing to the havoc made by Nazis in international science and the impossibility of American democracy being able to live for long in a world the rest of which, including probably South America, was dominated by victorious Nazism.

At the same time there are certain points of the policies of British Governments up to the present at which American criticism is often directed. There is a strong minority in the United States who intensely deplore the failure of Britain to come to a thorough understanding with the U.S.S.R. Furthermore, there is a general feeling among Americans that in spite of all that may be said to the contrary, justice is not being done to India. It is feared, moreover, that the conventional classical training of many of those in public positions responsible for the conduct of the present War does not fit them for appreciating and using to the full the capacities of British scientific workers both for offensive and defensive action.

One point which must be referred to here is the remarkable and charming enthusiasm with which Americans welcome English visitors to their campuses at times like this. As time went on, I came across an unexpectedly strong feeling that there might be a certain number of older scholars, perhaps rather in the humanities and some branches of mathematics than in the sciences (where some relation to the war effort is likely everywhere), having little or no teaching duties owing to the War, who might be evacuated to American campuses, on indefinite leave of absence from their own Universities, and on their normal emoluments, there to pursue their researches in

The Faraday Society

A GENERAL DISCUSSION
on
THE OIL/WATER INTERFACE

will be held jointly with the PHYSICAL SOCIETY at the Rembrandt Hotel, South Kensington, London, S.W.7, on Thursday, 9th January, 1941, from 11 a.m. to 4 p.m.

The following have promised to send contributions:

Dr. A. E. Alexander (*Cambridge*): (*Title not yet received*).

Dr. J. F. Danielli (*Cambridge*): "Cell Permeability and Diffusion across the Oil/Water Interface".

Dr. W. Dickinson (*Liverpool*): "The Effect of *p*H upon the Electrophoretic Mobility of Emulsions of Certain Hydrocarbons and Aliphatic Halides".

Dr. A. C. Frazer (*London*): "The Structure and Properties of Fat Particles in Human Serum".

Dr. G. Growney (*Liverpool*): "Electrophoresis of Complex Particles as a Function of *p*H: Effect of Stearic Acid in Ester Particles".

Dr. G. S. Hartley (*Winterslow*): "Interfacial Activity of Branched Paraffin-Chain Salts".

Dr. A. King (*London*): "Factors in the Stability of Oil in Water Emulsions".

Dr. R. C. Pink (*Belfast*): (*Title not yet received*).

Dr. J. Powney and Dr. L. J. Wood (*London*): "Some Anomalies between Interfacial Adsorption and Electrophoretic Mobility".

Dr. J. H. Schulman (*Cambridge*): (*Title not yet received*).

There will be a short adjournment for luncheon in the Hotel at about 1 p.m. (price 5*s*.). In order that accommodation at luncheon can be reserved, application should be made, by members of either Society, and by visitors by postcard addressed to the Secretary, The Faraday Society, 13 South Square, Gray's Inn, LONDON, W.C.1, NOT LATER THAN MONDAY, 6TH JANUARY, 1941.

SPECIAL GENERAL MEETING AND ANNUAL GENERAL MEETING of the FARADAY SOCIETY

At 4 p.m. on the same day at the same place will be held a Special General Meeting followed by the Annual General Meeting, preliminary notice of which was given in the October 1940 issue of the Transactions.

BY ORDER OF THE COUNCIL.
G. S. W. Marlow,
Secretary.

13 South Square,
Gray's Inn, LONDON, W.C.1.
(Tel.: CHANCERY 8101.)

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peace and quiet, and to act with British Government backing, as goodwill representatives from the Anglo-Saxon civilization of the Old World to that of the New. Prof. H. S. Taylor and Prof. O. Veblen of Princeton were especially prominent in proposing some such scheme. It remains to be seen whether anything will come of it. At the same time it should also be mentioned that American sympathy for the British cause is so great that if at some later date owing to destruction of laboratories by bombing it should be necessary to evacuate a good many British men of science to the New World, nothing could exceed the welcome they would receive from their American colleagues.

It will be generally admitted that the part which the United States is playing and will play in this War will (with that of the U.S.S.R.) go far in deciding the future of the world. Only by drawing on American arms production can we hope to put an end to the activities of Europe's newest and worst tyranny. Hence the extreme importance of Anglo-American relations. Unfortunately, it is not in accordance with the facts to assume that the enemy is not extremely active in putting his case, such as it is, in the United States. Although Nazism is genuinely unpopular there, there are many arguments of a fifth-column nature which are sedulously put about by Nazi agents (for example, that the Union of Europe is being achieved, and that the people are glad to have it so, if Britain would only cease her opposition) and British activity in countering this and presenting the true facts in America is on a ridiculously small scale. No one more than the Americans themselves would like to see a very great extension of our information services in the United States. But whatever is to be done should be done quickly, for the enemy never lets grass grow under his feet, and now that the isolationist-supported presidential candidate has been defeated, the enemy's efforts will be redoubled.

It would not be too much to say that upon Anglo-American, no less than upon Anglo-Soviet, relations hangs the outcome of the present conflict ; and Anglo-American contacts of scientific men, with their closely joined traditions, and their common detestation of the Nazi menace to international science, are calculated most happily to improve them.

OBITUARIES

Dr. F. W. Edwards, F.R.S.

FREDERICK WALLACE EDWARDS was born at Fletton, Peterborough, on November 28, 1888. His unexpected death, following a comparatively short illness, occurred in November 15.

From the Cambridge County School, where Edwards had already displayed a marked attraction to both botany and zoology, he entered Christ's College, Cambridge, in 1906, and commenced reading for the Natural Science Tripos under Sir Arthur (then Dr.) Shipley. He graduated in 1909, was admitted the degrees of M.A. in 1925 and Sc.D. in 1931. For many years a fellow of the Royal Entomological Society of London and an honorary or corresponding member of numerous scientific bodies, he was elected a fellow of the Royal Society in 1938.

In 1910, Edwards joined the staff of the Department of Zoology in the British Museum, being appointed Assistant in the Entomological Section, thus realizing an ambition he had cherished from childhood ; in 1937 he was promoted to be a deputy keeper of the Department of Entomology which had been created in the interval. He was given charge of the mosquitoes, the crane-flies, and the British collection. His industry and ability quickly won him a larger share of responsibility, and he extended his care to the whole of the Nematocerous Diptera. The selection of Edwards for this post was a peculiarly fortunate one. It was intended to carry on and extend the work of F. V. Theobald, the last volume of whose Catalogue of Mosquitoes (inspired by the work of Manson and Ross and the needs of tropical medicine) had appeared only a few months earlier, and it succeeded beyond all expectations.

Almost immediately Edwards flung himself wholeheartedly into the task, and from the very first his papers showed a mastery of his subject and a critical faculty scarcely to be expected so soon ; within two years he had already published ten valuable contributions on the systematics of the Culicidæ of Africa, the Oriental region and Great Britain, including much needed synopses of all the known African species and their larvæ. Inevitably the African fauna made the most insistent calls upon his attention, and a long series of papers published in the *Bulletin of Entomological Research* kept both entomological and medical men in that continent abreast of the taxonomy of the family, the whole subject being brought comprehensively up to date in the last volume of the "African Mosquitoes" (published by the Trustees of the British Museum (Natural History)) now in the press. It was Edwards' one anxiety when taken ill that this volume should be complete, and it will prove a fitting coping-stone to his labours in this sphere.

It would be wrong, however, to assume that Edwards confined himself in the main, or even at all, to this important family of Diptera. Though the acknowledged master of them, he sometimes confessed that he was rather tired of them and their 'importance' and preferred other groups less insistent in their claims but more attractive in their purely scientific appeal, such as the fungus-gnats (Mycetophilidæ), crane-flies (Tipulidæ), the Blepharoceridæ, the remarkable larvæ of which cling to stones in torrential streams, fossil Diptera and the British fauna as a whole. On all these groups and many others he published freely and indeed by the end of 1932 over 270 titles stood to his credit, represented by more than 3,000 pages of print. As a testimony to his industry it is perhaps worth mentioning that to provide some of the illustrations in these papers he himself prepared 1,800 drawings and 400 photographs in his spare time. Since then very many more have been added.

In the course of his work Edwards visited many museums on the Continent and in America, studying the collections of earlier dipterists whose descriptions were only to be elucidated by the critical examination of their material. In addition, however, he led two successful expeditions. The first, to Patagonia, Chile and the Argentine, was to some extent inspired by a desire to test Wegener's hypothesis concerning continental drift, by means of a comparative study of the dipterous fauna of that region with those of Australia and New Zealand. It led to a far-reaching account of the "Diptera of Patagonia and South Chile" which has already run to more than 2,000 pages and awaited only Edwards' summary and conclusions, now sadly lost to us. The second sprang from a desire to investigate the relationships existing between the faunas of the isolated high mountain groups of East Africa, and was concentrated mainly on Mount Ruwenzori. The first fruits of this equally successful expedition have already been published.

As a colleague both in the field and the Museum, Edwards was an inspiration, almost a source of amazement. His early years at the Museum, where he found himself working with a colleague temperamentally his antithesis and employing methods of a bygone generation, were succeeded by the testing trials to which his conscientious objections to warfare forced him. There was, however, never a word of complaint or hint of bitterness ; instead, he devoted himself with ever-growing intensity to his work. The fruits of his labour it is quite beyond the scope of this brief notice to catalogue, nor are they all to be seen in his published writings. There can be few dipterists the world over, be they professionals or amateurs, who would not acknowledge him as a leader, and freely admit themselves in his debt as much for friendly help and advice as for the more formal help of his synopses, catalogues and revisions. Working on an order of insects in which novelties are a commonplace, it would have been easy for him to become a 'describing machine' ; as it was, he described upwards of 2,000 new species, but always these descriptions were incidental to constructive taxonomic work on larger units of classification. Hence in practically every group of Nematocerous Diptera studied by Edwards it is to him that one turns for means of identification. This is particularly true of the British fauna, the known extent of which he increased by some 500 species, nearly all of his own collecting. His untimely death when at the zenith of his career and with every prospect of many years of increasing productiveness is for dipterists little short of a tragedy.

N. D. RILEY.

Dr. S. P. McCallum

THE many friends of Dr. S. P. McCallum, demonstrator in physics at the University of Oxford, have heard with much regret of his death on November 16.

Dr. McCallum was well known for his many activities. He was in the New Zealand Army that fought in the War of 1914–18, and in 1920 he came to Oxford as a Rhodes scholar. He had a distinguished undergraduate career and obtained a first class in the final honours examination in physics and afterwards a research degree. He was elected to a fellowship at New College in 1928 in recognition of his research work, and shortly after to a University demonstratorship in physics.

Dr. McCallum's scientific work on the conductivity of gases was done at the Electrical Laboratory, Oxford. The investigations he made of the coefficients of ionization of electrons in monatomic gases are of much importance in the theory of conductivity. His work on the effects of impurities in gases and the remarkable differences which he observed in the forms of luminous discharges in different gases are also of much interest.

Dr. McCallum excelled as a teacher, and the personal interest he took in his pupils was very much appreciated. He also assisted in the general work of the University. For many years he was Junior Bursar of New College, and last year he was a University proctor. He will be greatly missed, not only on account of his scientific work, but also on account of his general interest in College and University affairs.

WE regret to announce the following deaths :

Prof. Emile Argand, professor of geology, mineralogy and palæontology in the University of Neuchâtel, aged sixty-two.

Mr. C. V. Bennett, past president of the Institution of Gas Engineers, on November 18, aged fifty-three.

Dr. Wilhelm Haberling, professor of the history of medicine in the Düsseldorf Academy of Medicine, aged seventy.

Prof. F. H. Herrick, emeritus professor of zoology in the Western Reserve University, on September 11, aged eighty-one.

Dr. P. A. T. Levene, emeritus member of the Rockefeller Institute for Medical Research, on September 6, aged seventy-one.

Colonel T. S. Sinclair, formerly member of Parliament for Queen's University, Belfast, on November 25, aged eighty-one years.

NEWS AND VIEWS

The Royal Society: Election of Officers

AT the anniversary meeting of the Royal Society held on November 30, the following officers and members of Council were elected: *President*, Sir Henry Dale, director of the National Institute for Medical Research; *Treasurer*, Prof. T. R. Merton, formerly professor of spectroscopy in the University of Oxford; *Secretaries*, Prof. A. V. Hill, Foulerton research professor, and Prof. A. C. G. Egerton, professor of chemical technology in the Imperial College of Science and Technology; *Foreign Secretary*, Sir Henry Tizard, rector of the Imperial College of Science and Technology; *Other members of Council*, Prof. P. M. S. Blackett, professor of physics in the University of Manchester; Prof. F. T. Brooks, professor of botany in the University of Cambridge; Dr. C. G. Darwin, director of the National Physical Laboratory; Dr. A. N. Drury, Huddersfield lecturer in special pathology, University of Cambridge; Dr. H. J. Gough, director of scientific research, Ministry of Supply; Prof. J. B. S. Haldane, Weldon professor of biometry in University College, London; Prof. I. M. Heilbron, professor of organic chemistry in the University of London (Imperial College); Prof. O. T. Jones, Woodwardian professor of geology in the University of Cambridge; Prof. R. T. Leiper, professor of helminthology in the University of London (London School of Hygiene and Tropical Medicine); Sir Thomas Middleton, chairman of the Agricultural Research Council; Prof. L. J. Mordell, Fielden professor of pure mathematics in the University of Manchester; Dr. C. F. A. Pantin, reader in invertebrate zoology in the University of Cambridge; Prof. H. S. Raper, Brackenbury professor of physiology in the University of Manchester; Prof. E. K. Rideal, professor of colloid science in the University of Cambridge; Dr. F. J. W. Roughton, University lecturer in physicochemical physiology in the University of Cambridge; Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University of Bristol.

Sir Henry Dale, C.B.E., Pres. R.S.

SIR HENRY DALE, the new president of the Royal Society, is now director of the National Institute for Medical Research, and was formerly director of the Wellcome Physiological Research Laboratories (1904–14). For ten years (1925–35) he was one of the secretaries of the Royal Society. Over a long period, and with a succession of collaborators, he carried out important researches on the effects of histamine, an amine derived from ergot. For this work he was awarded a Royal Medal of the Society in 1924. This was extended to the isolation of histamine and acetyl-choline from animal tissues. Much of his later work was devoted to the discovery of the part played by these and other substances in a large number of important physiological and pathological processes. Closely related researches were being carried out in 1924 by Prof. Otto Loewi, then of the University of Graz, and Dale and Loewi were chosen to share the Nobel Prize for Medicine for 1936. In the following year, Sir Henry was awarded the Copley Medal of the Royal Society. As head of the National Institute for Medical Research, Sir Henry has directed a large number of investigations both within and outside his own special field. Numerous investigators from many countries have worked under his guidance.

Science and the National Welfare

SIR WILLIAM BRAGG's presidential address to the Royal Society, delivered at the anniversary meeting on November 30, did not include the customary survey of a branch of science with which the president himself is particularly familiar, and it can well be understood that such a survey at the present time might have been impolitic, as well as occupying time of the president which is fully occupied in other directions. But Sir William did give an impression of the increasing part which science is taking in promoting the national welfare (see p. 731 of this issue). After a brief reference to the men of science—pioneers of modern developments—who have died during the past year, he paid a glowing tribute to the younger men who have followed in their steps, maintaining worthily the tradition they have received by the acquisition of new knowledge, and in addition, grappling with its relation to society and to government. This newer aspect of scientific activity has been reflected also in the Royal Society. Whereas formerly many fellows of the Society have given their services to Government departments as required, and will no doubt do so in the future also, men of science now have, in the Hankey Committee, appointed a short while ago, a small body of leaders in direct touch with the Cabinet. The Society is represented on the Committee by its president and two principal secretaries, and has thereby accepted the responsibility of seeing that scientific developments and science itself are brought into the counsels of the nation; and Sir William continued, "We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within."

So Sir William Bragg laid down the office which he has held so worthily for the past five years. His presidency, which began in the years of peace, has extended over a period of growing anxiety for the progress of science, for the very existence of civilization itself, through the first year of a war between nations in which the whole of the forces of science are being mobilized by the combatants; and the appointment of the Hankey Committee is a recognition of this fact. But though it has required a world-wide catastrophe to raise science to the 'high places' of Government, Sir William has the satisfaction of knowing that the end for which he has striven so worthily has been achieved; it is the task of his successors in office to see that the full weight of scientific knowledge is brought to bear on all the manifold problems, both in peace and war, with which the rulers of Great Britain are confronted.

The Universities' Debt to Greece

THE Vice-Chancellor of the University of Cambridge presided at a public meeting held in the Regent House on November 23 to support the cause of Greece in the War. He was accompanied by the Greek Minister, the Provost of King's College (Mr. J. T. Sheppard), Sir Frederick Maurice (principal of Queen Mary College, London), the regius professor of Greek (Prof. D. S. Robertson), the Lord Lieutenant (Mr. C. R. W. Adeane) and the Mayor of Cambridge (Mr. E. O. Brown). The Vice-Chancellor (Mr. E. A. Benians, master of St. John's College) spoke of the sympathy and regard with which Greece is regarded in Great Britain, and particularly in the ancient universities of the country. "Wherever universities exist," he said, "they live and work in a light first kindled on the soil of Greece. To that source they trace the freedom of mind and spirit, without which they cannot fulfil their true functions."

H E. the Greek Minister also addressed the meeting, which passed a resolution, put by Mr. Sheppard, in the following terms: "We, Cambridge residents meeting under the chairmanship of our Vice-Chancellor, being conscious of the inestimable debt which every civilized nation owes to Greece, salute in her the source and pattern of our own free institutions, teacher of wisdom from of old, and faithful mother still of arts and sciences. Mindful also of the special ties which bind the University of Byron to the living memory of Greek heroes, we desire to place on record our profound and grateful admiration for the magnificent loyalty and courage with which the Greeks, who have so often withstood alien invaders, have dared again to take up the challenge in order to preserve for the Greek nation its own hard-won independence and to secure for the future of mankind that spiritual freedom which the world first learnt from Greece." The resolution concluded by asking the Greek Minister "to convey to friends in Greece, particularly to the members of the University of Athens, this token of our loyal friendship, of our faith in final victory and of our pride that the British Commonwealth of Nations strives and will strive with Greece for the same cause."

La France Libre

IN France, in common with the other German-occupied countries, there is no longer any freedom of expression, which is the essential fundamental of true art, literature and science, and all that contributed to the high place which that country held in the world of learning is now suppressed. A few of the French intellectuals have escaped and on them will depend the carrying on of the torch of French culture and learning. In order to do this a monthly journal has been founded entitled *La France Libre* in which the records of work and expression of free thought of these exiles from France will be conserved. By this means free French learning and free French thought will be co-ordinated and kept in being until that time when France is restored to her former freedom and prestige; and indeed it can only be through efforts such as this, and of other intellectual exiles from the oppressed countries, that the individual science and culture of the nations of Europe will survive.

The journal has the support of leading British men of science and of letters, headed by Sir William Bragg, past-president of the Royal Society, and expressions of sympathy have been received from members of universities and learned institutions all over the British Isles, Canada and the United States. The first number, which was published on November 15, contains an article on "La Communauté universelle de la Science" by Sir Richard Gregory and twelve others covering a wide sphere of interest. The journal is addressed to all Frenchmen and all those who love France, and is deserving of every support. It is not to contain propaganda. The price is 2*s*. a number or one guinea a year; all particulars may be obtained from *La France Libre*, 15 Queensberry Place, London, S.W.7.

Social Progress

IN a paper "What is Social Progress?" contributed to a symposium on social progress in the *Proceedings of the American Academy of Arts and Sciences* (**73**, 457–472; 1940) Prof. L. J. Henderson points out that terms like justice and social progress are useless for clear thinking because they have no accepted fairly clear meaning and can only be given an arbitrary definition at the cost of strong persistent emotional opposition. Social change, however, is a fact, but there is no logical or scientific test of the desirability of social changes except in relation to an end or purpose for which the test is utility. Prof. Henderson suggests that, in a given place, at a given time, for a given end, there may be an optimum rate of change of a given thing and some day this will be a subject ripe for careful study. The conditioned reflexes of men, as they are at any given time and in any given place, will be seldom negligible. More often than not, when the end is survival they will be again, as they have so often been, in the forms we name loyalty, the bonds of family, the sense of kinship, love of country and religious devotion, powerful social forces, and dangerously lacking when in default. Prof. Henderson suggests that among the innumerable effects of science on society, some must be harmful, according to any definition, now or hereafter, to many individuals and to some societies. Moreover, the effects of science upon society may well be only implicit functions of the state of science, but explicit functions of the rate of scientific development. The same scientific development proceeding rapidly may have one effect, proceeding slowly another quite different effect.

A second paper in the symposium, by Crane Brinton, points out that not only the word 'progress' but also almost every important word we try to use in performing logical operations on problems in the social sciences is subject to limitations, if less extreme, through lack of precise meaning. Mr. Brinton, reviewing the various meanings which progress has borne, refers first to the sense of improvement in a process or technique. Then there is the sense derived from theories of organic evolution developed in the last century or so, and finally the sense of moral or social progress. He points out that so long as the notion of progress is closely associated with our immediate notions of the difference between what is and what ought to be, progress will probably remain one of the most important ethical abstractions in common use. In a third paper, Prof. E. B. Wilson suggests that no scientific meaning can be attached to such a term as social progress until social science has advanced considerably further as a science, and social studies are unlikely to become scientific so long as the *mores* of our social scientists place brilliancy so far ahead of patience and generalities so far ahead of specification. We need a handbook of the social sciences which tells us what is true under what restrictive conditions. Until such coherent growth has begun and gained considerable momentum we shall probably not have the background on which to say what is social progress, and when social science has thus advanced we shall be talking rather in terms of various sorts of social progress and social retrogression.

The City and South London Railway

On November 11 the City and South London Railway celebrated its jubilee. The one outstanding criticism of this railway which could have been made was that the designers of the new line built for conditions then existing, and failed to take into account the changes that would occur in a few years' time. For example, the tunnel diameter was much too small, so were the first locomotives, the trains and the cars. The diameter had to be increased in 1922, and extensions were made for the railway between Stockwell and King William Street. It would appear that the railway made too timid a beginning. The *Electrical Times*, which also began its career about fifty years ago as *Lightning*, has referred to its earlier criticisms of the railway, and points out that perhaps its promoters dared not venture too far on what, after all, was an experiment without precedent; for the City and South London was the first electric tube railway ever built.

The new rolling stock has been designed to obtain the maximum amount of seating capacity consistent with comfort, and also allows a very much greater standing space than the old rolling stock. It has not been possible to introduce the new stock gradually, as part of the improvement of this railway is the moving of the conductor rail from its original position centrally between the running rails to the standard position laid down by the Ministry of Transport, namely, 16 in. outside the running rail; 6,445 yd. of new conductor rail have been laid. In order to reduce noise to a minimum, the running rails have been welded into 315-ft. lengths, involving 544 welded joints. Noise-absorbing shields are also being experimented with. These shields are fitted between the lower portion of the coaches and the tunnel walls. The City and South London is London's shortest tube railway. It is only 1 mile 46 chains long, and forms part of the quickest route from the heavily populated south-western suburbs to the very heart of the City. The journey only takes five minutes. The line was opened in August 1898, and carries an average of 30,000 passengers daily, most of them during the business rush hours. Nearly 40,000 yards of cables and wires have been laid in the course of the improvements.

Fitting Schoolboys for the World of Work

"Guidance Programs for Rural High Schools", by Mr. Paul Chapman (Washington, D.C. 10 cents), is a bulletin belonging to the 'Occupational and Guidance Service' established by the U.S. Office of Education in response to a widespread demand. It has been revised after critical comment on a limited edition and shows once more the great elaboration of American education. High schools in rural districts have comparatively few pupils; but, as the foreword points out, they are important for society as a whole, because "no large city in our Nation is producing enough children to maintain its population". Local conditions impose differences of training and the two models noticed in detail from New York State are much larger than the average rural school. But one of them is described as "basically agricultural" and both can supply selections of things worth doing. All schools of the sort can go in for "occupational information, the personal inventory, counselling, exploration, use of training facilities, placement, and follow-up". This last word means close attention to pupils after they have left school.

To keep all these activities going lays a heavy burden on teachers. At Nyack School "counselors" have a great deal to do. They interview employers and make a monthly report. Personal data are supplied concerning pupils seeking work; former students have a two-page questionnaire sent to them; and their employers are expected to say how they are getting on. It is evident that this wide vigilance must produce good results and reduce the number of misfits who are "everything by starts, and nothing long". If all teachers did anything like as much, they might steady those restless adolescents who do little good for themselves or anybody else and often end on the dole. The programmes offered go right to the root of unemployment, but they demand a good deal of time and patience.

Ferns of Wales

Interest in the British native flora and in the study of botany in general is so admirably stimulated and encouraged by the excellent series of exhibits in the National Museum of Wales that the descriptive handbook of Welsh ferns by Mr. H. A. Hyde, keeper of botany, and Mr. A. E. Wade, assistant in the Department, is assured of a wide welcome (Welsh Ferns: a Descriptive Handbook. By H. A. Hyde and A. E. Wade. Pp. x+132+11 plates. Cardiff:

National Museum of Wales and the Press Board of the University of Wales, 1940. 5s.). Like its two predecessors dealing with the botany of Wales, published by the Museum, it is a most useful volume, and both text and illustrations leave little to be desired. The introduction conveys all that the student needs to understand the fern's life-history, and in the more detailed descriptive portion the keys and descriptions, aided by the clear text figures skilfully drawn by Miss E. A. Jenkins, should enable anyone to identify and discover all there is of interest in our native ferns. Now that so many name changes have taken place, one would have welcomed the inclusion of some of the old names—now synonyms—with which older botanists are more familiar.

Utilization of Sun Power

GENERATION of electrical energy direct from the sun's rays has been feasible for many years, but in most cases the price is quite prohibitive. Up to a few years ago, such installations took up so much space and required such a high expenditure per horse-power on apparatus that projects suggested were not inviting. Most engineers took this view and regarded them as only of academic interest. Recent advances in the treatment of aluminium, in vacuum jacketing, in flash boilers and in mechanism for following the sun on its daily course have put a different aspect on the problem of solar steam-raising plant. Dr. C. G. Abbot, secretary of the Smithsonian Institution, Washington, D.C., who is well known for his solar investigations, now states in the course of an article covering some six pages (*J. Amer. Inst. Elect. Eng.*) that power from the sun can be obtained at 0·5 cent per h.p., which is the pre-War equivalent of one farthing. He estimates that at this price such schemes can give a good return on investment. Even if we apply the corrective factor which is usually necessary in estimates by enthusiasts and raise the farthing to ½d. or ¾d., sun-power is obviously becoming a business for hot climates, and developments are worth watching.

Health of New Zealand

ACCORDING to the Director-General of Health, in 1939 the death-rate of New Zealand with a population of a little more than 1,500,000 (including 80,000 Maoris) was 9·20 per 1,000 population (excluding the Maoris) and the infantile mortality (with the same exclusion) 31·14 per 1,000 live births. The birth-rate was 18·73 per 1,000 of population. Heart disease was the principal cause of death, and cancer, from which there were 1,815 deaths, came next. The incidence of infectious diseases was low, but their notification among the Maoris had increased. The nutrition of the majority of school children was satisfactory, but there was still some evidence of subnormal nutrition. Maternal deaths due to pregnancy or childbirth other than deaths from septic abortion numbered 85, a death-rate of 2·95 per 1,000 births, as compared with 2·80 for England and Wales in 1938. There were 147 cases of puerperal sepsis notified. The rise in the number of deaths due to this cause has been attributed to the wrongful use of sulphonamides resulting in a granulocytosis. The maternal mortality among the Maori women, a large number of whom are still delivered by native methods, was 4·13 as compared with 5·41 the previous year.

Health on Gibraltar

THE report for 1939 of Major R. A. Mansell, the medical officer of health of Gibraltar, of which a summary appears in the *British Medical Journal* of November 2, states that among the civilian population the birth-rate was 20·85 per 1,000 and the death-rate 14·25, which were both larger than in most English towns. The infantile mortality, which has been rising steadily in recent years in association with gross overcrowding, was last year 79·36 per 1,000 births and was the highest since 1928. On the other hand, Gibraltar has been singularly free from epidemic disease. During the year there were only 93 cases of notifiable infectious diseases, the lowest number for half a century, and more than a third of these were chicken-pox. There were ten deaths from pulmonary tuberculosis, the prevalence of which is causing the medical officer some disquiet.

Bibliography of Seismology

THE *Bibliography of Seismology*, covering ninety-eight items for the period April, May, June 1940, published by the Dominion Observatory at Ottawa and compiled by Ernest A. Hodgson, has just been received. It is an invaluable reference work and contains items from most countries concerning studies of individual earthquakes, seismological apparatus, seismic prospecting, rock bursts, travel-time tables, tunamis, and many kindred subjects. A list of six patents for apparatus chiefly in connexion with seismic surveying is listed. All are American patents. References are given to seismological and geophysical publications in the *Proceedings of the Royal Society*, in NATURE, in the *Geophysical Supplement of the Royal Astronomical Society* and other British periodicals.

Announcements

IT was announced in the *London Gazette* of December 3 that the King has approved the award of the George Cross to Dr. A. D. Merriman, part-time experimental officer in the Directorate of Scientific Research, Ministry of Supply, "for conspicuous bravery in connexion with bomb disposal."

BY German decree the University of Leyden and the Technical High School at Delft have been closed owing to the "generally anti-German attitude of the undergraduates, and sabotage of the anti-Jewish measures". All professors of the Faculty of Laws of the University of Utrecht have been sent to concentration camps in Germany, while several professors of the Catholic University at Nijmegen, and of the Commercial High School at Rotterdam, have been arrested because of their loyalty to the House of Orange and openly admitted preference for a democratic system of government. A number of students at all these institutions have been arrested, fined, or sent to concentration camps.

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.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Absorption of Cosmic Ray Protons in Lead

At the suggestion of Prof. P. M. S. Blackett, we have recently investigated the absorption of cosmic ray protons in lead with a cloud chamber situated in a laboratory with a light roof.

The experimental arrangement is shown schematically in Fig. 1. Counters *A*, *B*, *C*, connected in coincidence, are placed above and below the vertical cloud chamber, *Ch*. Below *C* is a lead plate (*s*) 2 cm. thick, and a bank of counters *D* connected in parallel. *ABC* and *D* are connected to an anticoincidence set[1]. No particle which can penetrate *s* (that is, no proton of energy greater than $1 \cdot 5 \times 10^8$ ev. is recorded.

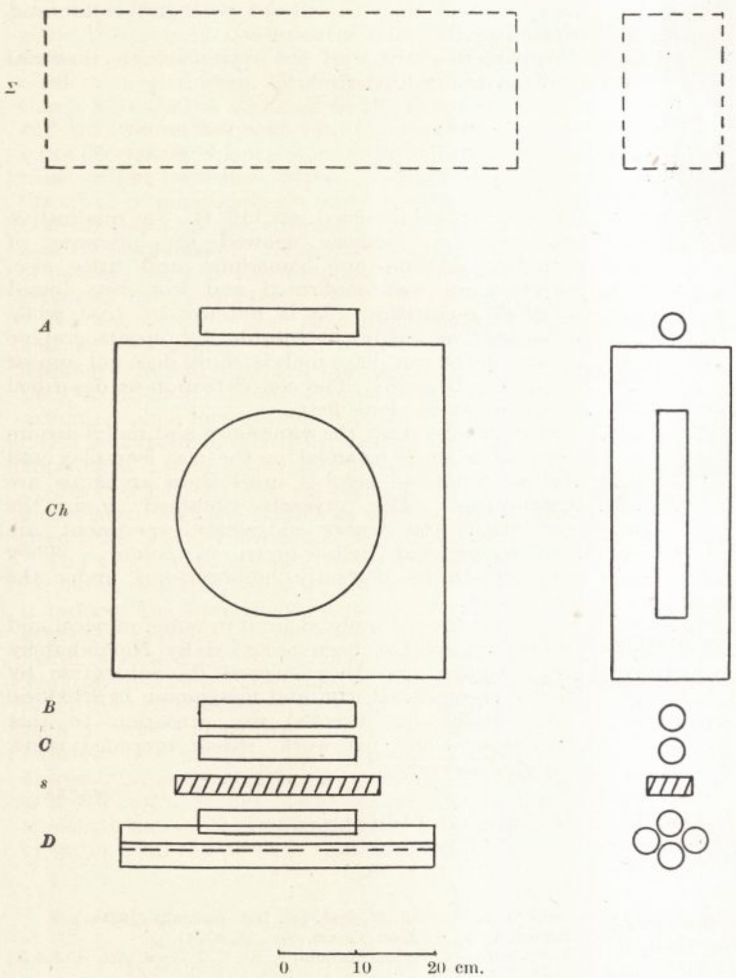

Fig. 1.

Protons are therefore observed only in the energy range in which they can be distinguished clearly from fast electrons and mesons. Slow electrons and mesons can be excluded for other reasons. Photographs and counts were taken alternately with (*a*) no lead ($\Sigma = 0$). and (*b*) 20 cm. lead ($\Sigma = 20$ cm.) above the apparatus. The results are given in the accompanying table, Only one proton, illustrated in Fig. 2, is found in 370 hours for $\Sigma = 20$ cm., whereas 8–12 protons are found in the same time for $\Sigma = 0$. The two figures quoted for $\Sigma = 0$ mean that of twelve tracks thought to be due to protons, eight are unambiguous. The figures for $\Sigma = 0$ compare favourably with those found by other workers[2].

The interpretation of the results depends partly on the assumed place of origin of the protons and partly on the form of their spectrum.

(1) If the protons observed in the cloud chamber come from a beam incident on the 'top' of the atmosphere, we compare in the experiment protons which initially have ranges (*a*) of 90–92 cm. lead, and (*b*) 110–112 cm. lead. Protons of this range have energies of the order of 2×10^9 ev. By analogy with the meson spectrum, one would expect the proton spectrum in this region to be fairly uniform, so that one would expect almost equal numbers of rays in both range groups. The fact that far fewer are observed with $\Sigma = 20$ cm. would mean that cosmic ray protons are absorbed strongly in lead.

(2) On the other hand, the results can equally well be explained if it is assumed (*a*) that the observed protons come from a group of protons of relatively short range; for example, less than 10 cm. lead, and (*b*) *either* more protons are found in air than in lead *or* the radiation producing the protons is filtered out by the lead (Σ). This latter would be true if the protons were produced by photon disintegration.

Some results of Anderson[2] are more in agreement with hypotheses (2) rather than (1). It appears, then, that the protons do not come from a beam incident on the 'top' of the atmosphere.

On one other point we would like to comment briefly. Both counts and photographs show that far fewer electrons are observed below 20 cm. lead than in air. These electrons are probably made up of (*a*) meson disintegration electrons, (*b*) meson knock-on

Σ (cm.)	Arrangement	Counts			Photographs					
								Analysis		
		Number	Time (hours)	Rate (c.p.h.)	Total number	Time (hours)	Rate (c.p.h.)	Singles	Showers	Blanks
0	ABCD	5257	802·7	6·6	2535	372·3	6·8	1622	219	694
	ABC	2457	85·8	28·7						
20	ABCD	1648	588·0	2·8	1042	369·2	2·8	589	103	347
	ABC	1094	52·0	21·1						

electrons, and (*c*) electrons from large cascade showers. The effect of lead will be to decrease the contribution of (*a*), since disintegration electrons are of short range ($\sim$2 cm. lead), and probably to decrease the contribution of (*b*) since,

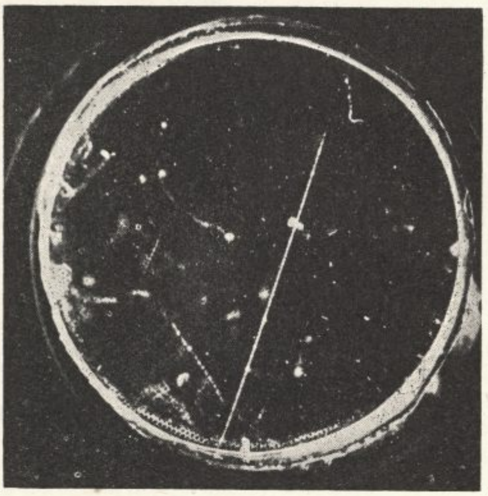

Fig. 2.

as Dr. L. Jánossy has pointed out to us, the meson will accompany the knock-on electron and thus prevent the electron from being recorded. Even if the contribution of (*c*) is the same, the total effect of the lead will be to reduce the number of electrons.

G. D. ROCHESTER.
M. BOUND.

Physical Laboratories,
University,
Manchester.
Nov. 15.

[1] Circuit unpublished. We are indebted to Dr. B. Rossi for the use of the anti-coincidence set.

[2] Anderson, C., *Phys. Rev.*, **50**, 263 (1936); Brode, R. B., Macpherson, H. G., and Starr, M. A., *Phys. Rev.*, **50**, 581 (1936).

[3] *vide* Anderson, *ibid.*, Heitler, W., Powell, C. F., and Fertel, G. E. E., NATURE, **144**, 116 (1939).

Occurrence of Vanadium and Molybdenum in Clays

THE occurrence of vanadium in clays has been known for some time, the amounts varying from a chemical trace to about 14 per cent[1,2,4]. Mellor devised a method for determining vanadium in the presence of titanium, but the surest test is a spectrographic one. Generally the percentage is less than 1 per cent and it is not known in what form it occurs. Callister[1] in Australia noted that vanadium compounds in kaolins are not water-soluble until the clay has been heated to temperatures of above a 1,000° C. I have found similar properties in South African clays. Many fire and building bricks made from clays of Karroo age exhibit a greenish-yellow or canary-yellow efflorescence, after weathering. The efflorescence is readily soluble in hot water. This efflorescence contains vanadium and molybdenum. Molybdenum is a much rarer constituent and is not easily detected in clays, by ordinary methods. In fact the only method appears to be, to heat large lumps of the material to temperatures of about 1,000° C. and then to extract with hot water and crystallize the salts in solution.

A partial analysis of the water soluble material from an under-fired firebrick gave:

MoO_3	0·08 per cent
SO_3	1·01 per cent
CaO	0·28 per cent

the sample being dried at 110° C. A qualitative spectrographic analysis showed the presence of abundant sodium and vanadium and little else. Molybdenum was confirmed and iron was found in small quantities. It is noteworthy that while vanadium is easily detectable by spectrographic means, in the raw clay, molybdenum does not appear in the spectrogram. The concentration as described above must be done first.

It is possible that the vanadium and molybdenum compounds are contained in the clay complex and are not rendered soluble until these minerals are broken up. The crystals obtained from the calcination and water extraction treatment are birefringent and yellow-green in colour. They appeared to be perfectly homogeneous under the microscope.

The presence of molybdenum in mine, mineral and surface waters has been recorded by Novokhatsky and Kalinin[3], and they suggest its adsorption by freshly precipitated iron and manganese hydroxides.

Mr. Berkowitz directed my attention to this efflorescence, and his work, which preceded mine, had similar results.

V. L. BOSAZZA.

University of Witwatersrand,
Johannesburg.
Oct. 13.

[1] Callister, R. C., Bull. 27, Inst. Sci. Ind. Australia (1924).

[2] Palmer, L. A., *J. Amer. Ceram. Soc.*, **12**, 37–47.

[3] Novokhatsky, I. P., and Kalinin, S. K., *C.R. Acad. Sci. U.S.S.R.*, **24**, 278 (1939).

[4] Bourry, J., "A Treatise on the Ceramic Industry" (1926).

Hydration of Carbon Dioxide and its Influence on Germicidal Activity of Hypochlorite Aerosols

WE are interested in the suggestion put forward by E. O. Powell in his recent communication[1], in which he stated that the effective bactericidal life of hypochlorite aerosols is dependent on "the velocity of changes occurring between the collision of carbon dioxide molecules in the air with droplets of the aerosol and the appearance of the corresponding H ions". The hydration process, it was suggested, might be slow compared with the former, thus becoming the rate-controlling factor in the bactericidal action of the aerosol.

When using an aerosol produced from a solution containing 1 per cent NaOCl, 16·5 per cent NaCl and 0·05 per cent Na_2CO_3, we were unable to detect any difference in the killing rate or the mean percentage kill (over a 30 min. period) of aerially dispersed *E. coli*; whether the tests were carried out in normal atmospheres, those to which 1 per cent carbon dioxide had been added, or from which the carbon dioxide had been removed[2]. (Our conditions may not have been entirely free from carbon dioxide, but the concentration must have been very much reduced.)

If the hydration of carbon dioxide is a slow process and the liberation of free HOCl dependent on this alone, then it might be expected that the hypochlorite aerosol would show a slow initial rate of kill which accelerates with time. Our experiments have shown that a good kill is obtained in the first five minutes and that the subsequent rate becomes slower; this is not necessarily in opposition to Powell's mechanism, which might take place within five minutes and have the effect of maintaining a fairly constant concentration of HOCl in the droplet owing to loss of the acid by evaporation. Evaporation of the water will, of course, reduce the amount of carbon dioxide absorbed by the droplet.

We have shown also that hypochlorite aerosols become decreasingly effective in acid, neutral and alkaline solution, although the neutral solution gave the best all-round results when the persistence of the action is taken into account. It was also found that HOCl as vapour is relatively ineffective. The action appears to depend upon the presence of free HOCl in the droplet, but not on either ClO^- or H^+ ions alone, since alkaline NaOCl or weakly acid solutions (free from NaOCl) are much less effective.

The addition of glycerol to hypochlorite solutions for use as aerosols seems to be of doubtful utility; it reduces the bactericidal activity of the mist, but generally increases its persistence, the increase given being governed by the particle size of the droplets. We have attributed the effect of glycerol to its effect upon the evaporation of water from the droplet. In bulk it was found that the presence of glycerol reduces the stability of hypochlorite solutions, especially if some acid is also present. The presence of a salt (for example, NaCl) has an effect somewhat similar to that of glycerol by retarding the evaporation of water from the droplet.

A. H. BAKER.
S. R. FINN.

Portslade Research Laboratories,
South Street,
Portslade. Nov. 1.

[1] Powell, E. O., NATURE, **146**, 401 (1940).
[2] Baker, Finn and Twort, *J. Hyg.*, **40**, 560–582 (1940).

Ionospheric Observations during the Solar Eclipse of October 1

DURING the total solar eclipse of October 1 ionospheric observations were made at three points in South Africa by the following three institutions: Cruft Laboratory, Harvard; Commonwealth Solar Observatory, Canberra; Bernard Price Institute for Geophysical Research, Johannesburg.

The results have revealed a marked ultra-violet light effect in the F_2 region. The maximum electron density in that region showed a decrease of about 20 per cent, reaching a minimum about 30 minutes after totality. There was no evidence for corpuscular effects. The behaviour of the E and F_1 regions was similar to what has been observed at previous eclipses.

J. A. PIERCE (Cruft Laboratory).
A. J. HIGGS (Commonwealth Solar Observatory).
E. C. HALLIDAY (Bernard Price Institute).
Oct. 14.

Termination of Optic Fibres in the Lateral Geniculate Body

IN a recent letter[1], Prof. Le Gros Clark directed attention to the evidence that crossed and uncrossed fibres of the optic tract each terminate in three alternating layers of cells in the lateral geniculate body in the monkey. Hitherto, however, this has been an inference based on the indirect evidence of transneuronal atrophy. It has now been finally established in this laboratory by the study of axonal and bouton degeneration, following section of one optic nerve. Seven days after this operation, the corresponding cell laminæ of the lateral geniculate body are filled with enlarged and grossly degenerating terminal boutons which are so conspicuous that they can readily be observed under low magnifications, and the affected laminæ thus contrast strongly with the normal laminæ.

P. GLEES.

Department of Human Anatomy,
University of Oxford.

[1] NATURE, **146**, 558 (Oct. 26, 1940).

Molecular Fields of Force

MY article on "Molecular Fields of Force"[1] contains a misrepresentation of Prof. J. E. Lennard-Jones's work on this subject, which I much regret and wish to correct. In referring to the degree of ambiguity in his molecular models inferred from gas data, I stated that it remains uncertain whether the distant field is attractive or repulsive; this applies only to the determinations from viscosity data (and then only in certain cases); but not to his main and more important determinations from the equation of state. It is on these that he has based his valuable *applications* of the force-data, to explain many physical properties of solids and liquids as well as vapours.

S. CHAPMAN.

Imperial College of Science and Technology,
South Kensington,
London, S.W.7.
Nov. 25.

[1] NATURE, **146**, 607 (1940).

RESEARCH ITEMS

International Standards for Biological Assay

AN inquiry on the assay of gas gangrene antitoxin (perfringens) carried out under the auspices of the Department of Biological Standards of the State Serum Institute, Copenhagen (League of Nations. *Bulletin of the Health Organisation*, **8**, No. 6, 797–912 (1939). Biological Standardisation, iv), reached the following conclusions. Perfringens antitoxins show the same activity when assayed against different toxins, if the toxins contain one and the same predominant antigen. The hæmolysin content influences the assay when the ratio minimum lethal dose/minimum hæmolytic dose exceeds 100. Intravenous assays on mice give results corresponding to those obtained intracutaneously on guinea pigs when pure ζ or ζ,α toxins are used. There is a relation between the activities of a perfringens antitoxin determined *in vitro* (hæmolysis) and *in vivo* only if pure ζ toxins are used in both tests. A perfringens toxin suitable for estimating the ζ antibody content in perfringens antitoxins has been prepared in Copenhagen and is at the disposal of institutes. The international unit for gas gangrene antitoxin (Sardelli) is defined as 0·1334 mgm. of the dry stable Washington preparation. Contributions towards the international standard preparations for (1) the gonadotropic substance of pregnancy urine; (2) the gonadotropic substance of pregnant mares' serum and (3) the lectogenic (crop-gland stimulating) substance of the anterior pituitary gland have been assayed in a number of different laboratories and the results analysed by C. W. Emmens of the National Institute for Medical Research, Hampstead, London. The international units for these three substances are respectively 0·1, 0·25 and 0·1 mgm. of the international standard mixtures. Suggestions for the use of these standards in biological assays are given.

Production of *pertussis* Antitoxin

EXTRACTS of *Hæmophilus pertussis*—the causal bacterium of whooping-cough—are toxic; they kill guinea pigs when a suitable dose is injected into a vein, and they produce necrotic lesions when injected into the skin of a rabbit. Investigation by independent workers of the problem whether the toxin can give rise to an antitoxin has led to conflicting opinions, and thus a recent paper by D. G. Evans (*J. Path. and Bact.*, **51**, 49–58; 1940) is of interest, especially since he, in collaboration with H. B. Maitland, had previously failed to obtain positive results. Evans now finds that rabbits, when immunized subcutaneously with the toxin, give definite evidence of having acquired immunity to it and that, moreover, the serum of such rabbits is capable of neutralizing both the necrotic and the lethal action of the toxin. A toxic substance with similar properties is extractable from *H. parapertussis* and *Brucella bronchoseptica*, and it has been found that 'pertussis' antitoxin is able to neutralize each of these toxins, a result which confirms the view that the micro-organisms from which they are derived are closely related to *H. pertussis*. An antibacterial serum against *H. pertussis* can be prepared in experimental animals by inoculating them intravenously with the whole organism or extracts from it, but this form of therapy has not been entirely effective in the prophylaxis and treatment of whooping-cough; nor has the serum from convalescent patients proved its value. The author considers that an antitoxic serum of high potency should be given a trial as a preventive and remedial agent in this disease.

Sunspots and Insect Epidemics

THE probable existence of some regularity in the fluctuations of animal numbers has been investigated by several workers. The results of such inquiries have not always been convincing, mainly perhaps on account of the difficulty of collecting sufficient detailed accurate records. D. Stewart MacLagan (*Proc. Univ. Durham Phil. Soc.*, **10**, 175–199; 1940) has collected data relative to severe insect outbreaks in Britain. A historical study during the past hundred years of outbreaks of such insects as flea-beetles, cutworms, leather-jackets, antler moth and diamond back moth has been made. On epidemiological grounds it is claimed that the frequency of outbreaks of the species just enumerated is correlated with the periodicity of sunspots. The years of maximum frequency are nearly synchronous with epochs of sunspot maxima. The connexion between sunspots and outbreaks is considered to be climatic; the favouring circumstances it is claimed are probably increased humidity and more intense ultra-violet radiation. The article concludes with a bibliography of seventy papers.

British Pyrenomycetes

MESSRS. G. R. Bisby and E. W. Mason have performed a very considerable service to British mycology in compiling a "List of Pyrenomycetes recorded for Britain" (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 127–243; 1940). Taxonomy of all the Ascomycetes is still at a very low level, and any contribution is valuable. The present paper is more than the mere list implied by its title: it is a systematic evaluation of the Pyrenomycetes, and should pave the way for more detailed work upon the group, so urgently needed at present. The classification of Saccardo has usually been followed, and accordingly the Laboulbeniales, Gymnoascales and Perisporiales take their place along with the more obvious Pyrenomycetes. Detailed references are given, and an index to genera and species makes for easy consultation. It is greatly to be hoped that the superstructure of specific descriptions will follow this taxonomic foundation.

Triploid Sugar Beet

H. Peto and J. W. Boyes (*Canad. J. Res.*, **18**, 273–282; 1940) have shown that triploid sugar beet resulting from the cross $4x \times 2x$ differs considerably in sugar content from diploid beets. The root weights of triploid beets exceeded those of diploids by 12·2 per cent, in sugar content by 14·9 per cent and in dry top weights by 17·8 per cent. The decrease in sugar percentage for each 100 gm. increase in weight was 0·34 per cent for the diploids and 0·17 per cent for the triploids. The economic possibilities of triploid sugar beet appear promising.

Temperature Differences in Lakes

IN "Temperature Measurements in Vänern and Götaälv", Angström and Jacobson (*Med. fran. Stat. Met. Hydro. Anst.*, **7**, No. 6; 1940) describe the work done at the instance of the Swedish Royal Board of Waterfalls through a commission appointed in 1929 for investigating certain problems of ice formation in connexion with the regulation of Lake Vänern. The work consisted of a study of the variations of vertical temperature gradient in the course of the seasons and the influence thereon of wind; the measurement of the temperature gradient extended from the vast and not very deep lake itself down to the mouth of the Göte River, where the salt water of the Skagerrack often flows as a bottom current in the reverse direction to that of the overlying fresh water. It was only in the latter region of the river that large gradients were found, with temperature differences between the bottom and the surface of more than 1° C., while in the lake the largest gradients were found only in the summer, late July providing differences of the order of 10° C. between the bottom and the surface where the depth is 35 metres. In contrast to deeper lakes, where the minimum temperature of the deeper layers at the time of ice-formation is often 4° C., the minimum in Vänern is then very nearly 0° C. at all depths. The observations explained the remarkable fact previously observed, that after the lake has been frozen over and covered with deep snow the temperature of the river often rises, so that the river becomes clear of ice during the later parts of periods of great cold. This is clearly due to the checking of outward radiation by the ice and snow over the lake, which permits heat from the ground beneath the lake to cause the temperature of the water to rise. This heating from below was the cause of occasional differences of more than 2° C. between the bottom and surface layers of the lake in winter, to be found only when the ice cover is thick. This publication concludes with an extensive bibliography of the subject covering the period 1900–32.

Thiophosphoryl Chlorofluorides

THIOPHOSPHORYL fluoride, PSF_3, is a colourless spontaneously inflammable gas, discovered by Thorpe and Rodger in 1888 and obtained by heating phosphorus sulphide and lead fluoride. H. S. Booth and M. C. Cassidy (*J. Amer. Chem. Soc.*, **62**, 2369; 1940) have now prepared the two chlorofluorides $PSFCl_2$ (b.p. 64·7°) and PSF_2Cl (b.p. 6·3°) by the action of antimony trifluoride on thiophosphoryl chloride, $PSCl_3$, in presence of antimony pentachloride as a catalyst. Thiophosphoryl fluoride is also formed. PSF_2Cl, like PSF_3, is spontaneously explosive in certain concentrations in air. Thiophosphoryl chloride exists in two solid forms, freezing at −40·8° and −36·2°.

Convective Equilibrium and Solar Limb Darkening

A. D. THACKERAY has published a paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940) in which he shows the consequences of assuming convective equilibrium in the solar atmosphere when k, the mass-absorption coefficient, varies as p. The result of the analysis shows that both the darkening to the limb and also the distribution of energy in the spectra of disk and spot can be represented by the assumption of radiative equilibrium, or equally well by the assumption of convective equilibrium. In the latter case, however, it is necessary to assume that $k \propto p$ and also that γ is 4/3. These conditions may be realized at a certain level of the reversing layer or photosphere; but it must be admitted that they may not be true for the higher layers which affect the limb observations. In addition, there is no particular reason for adopting 4/3 as the value of γ, which represents the lower limit for a whole star. It is suggested that it would be interesting to repeat the calculations for other values of γ. An important conclusion on the equilibrium of sunspots is worthy of notice. Minnaert and Wanders made use of Milne's adiabatic hypothesis and applied two tests—the variation of the ratio spot/disk (1) from centre to limb, and then (2) in different wave-lengths. They concluded that neither of these tests was satisfied by the assumption of convective equilibrium in spots, but that both were satisfied by the assumption of radiative equilibrium. Minnaert and Wanders assumed the relation $k \propto p/T^{3/2}$, but on the assumption of convective equilibrium used by Thackeray he found that the facts could be equally well explained by assuming that spot and disk are both in convective equilibrium, or alternatively, that they are both in radiative equilibrium. Observations did not support the hypothesis that wave-length variations result from a convective spot and radiative disk, or from a radiative spot and convective disk.

Spectrum of Bright Chromospheric Eruptions

IT is well known that bright chromospheric eruptions on the sun produce definite effects on the atmosphere of the earth. From the nature of the effects it is inferred that the solar influence is transmitted by ultra-violet light and that the ultra-violet intensity in the eruption is of the order of a thousand times that normally emitted from the sun's surface. As it is impossible to photograph the short-wave radiation which is suspected of causing the ionospheric disturbance, owing to the earth's atmosphere, its nature must be a matter of conjecture. C. W. Allen, assuming that such great changes in ultra-violet spectrum would imply some corresponding effects in the spectral regions that can be seen and photographed, has described the results of his investigations on eruption spectra (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The observations were made with the 3-prism spectrograph of the Commonwealth Solar Observatory in conjunction with the sun telescope. The eruptions were set on the slit to give the brightest emission in $H\alpha$ or $H\beta$, and 116 emission lines were detected and tabulated in various discontinuous regions of the spectrum from 3922 A. to 6700 A. On comparing the intensities of the eruption lines with those of the flash spectrum, it was discovered that all Fe lines and all low *E.P.* Fe lines are strongly enhanced in eruptions. The enhancement of the former is also detected in metallic prominences and 'hot spots' (this name has been given by Cillié and Menzel to regions of the flash spectrum which have shown signs of unusual excitation), but this does not occur with the low *E.P.* Fe lines. It is a matter of some interest that in long-period variables of classes Me and Se several low-level Fe lines are emitted, while bright Fe^{+} lines are also present. It is possible to explain the small variations detected in the intensities of Fraunhofer lines from areas in eruption if the excitation temperature of the reversing layer is increased by about 100° K.

MEDAL AWARDS OF THE ROYAL SOCIETY*

COPLEY MEDAL

THE COPLEY MEDAL has been awarded to Prof. PAUL LANGEVIN.

Prof. Langevin was one of the band of young pioneers who, in the closing years of the last century, were engaged in exploring the field which had been opened up by J. J. Thomson's discovery of the electron. He spent a year (1897–98) at the Cavendish Laboratory, and his Paris Dr. ès Sc. thesis (1902) is dedicated to J. J. Thomson. The thesis, a notable one, was entitled "Recherches sur les Gaz Ionisés". It dealt mainly with the recombination and mobilities of ions, their coefficients and the relations between them. It is a standard work on this subject. In it he also devised and applied new and elegant methods of measuring these quantities which were an advance on all their predecessors and have not since been improved upon to any appreciable extent. Related to this, and coming later, were important contributions to the theory of the diffusion of gaseous ions and its relation to ionic mobilities.

Langevin's greatest achievement is the foundation of the electron theory of magnetism. The theories of paramagnetism and of diamagnetism are still very much as he made them and left them more than thirty years ago.

There are few branches of contemporary physics which he has not illuminated and improved by his writings, and his work generally has the qualities of breadth, clearness, elegance and completeness which stamp the master.

He has had a great international influence. He has been a prominent figure at all the meetings of the conferences arranged by the Institut International de Physique Solvay since they started in 1911. On the death of Lorentz he was chosen to succeed him as president of the above Institut.

He was awarded the Hughes Medal in 1915 and elected a Foreign Member of the Society in 1928.

[See NATURE of November 30, p. 715.]

RUMFORD MEDAL

The RUMFORD MEDAL has been awarded to Prof. KARL MANNE GEORG SIEGBAHN.

Prof. Siegbahn, member of an old Swedish family, is, in the field of X-rays, what Rowland was in the field of ordinary optics sixty years ago. He has introduced high precision into X-ray measurements. For example, the most accurate wave-length measurements in 1913 were those of Moseley, with an accuracy of about 1 per cent. By a brilliant succession of improvements in methods, design, inventions and technique, Siegbahn by 1924 had improved this to 0·001 per cent—a factor of 1,000.

Siegbahn is not only a great physicist, he is also a great engineer. He has made inventions and improvements in almost every useful type of apparatus connected with X-ray measurements, pumps, gratings, X-ray tubes, ruling machines, etc.

Among his many achievements are the determination of the structure of the *L* series of X-ray spectra, the discovery of the anomalous dispersion of X-rays (with Hjalmar), the accurate and direct measurement of the grating spaces of calcite and rock salt, and the selection rules for the frequencies of X-ray absorption edges. In conjunction with Larsson and Waller he was the first to deviate X-rays with a prism. They developed this method until they could obtain by it measurements of refractive indexes for X-rays which are of quite surprising accuracy.

In recent years he has been much occupied with the development and improvement of methods of measurement of 'ultra-soft' X-rays, the region between about 10 and 500 A., and with conspicuous success. This covers the gap between the ordinary X-ray region and the optical region of radiation.

He and his students have also been much interested in the values of the fundamental constants of physics and have made important contributions to our knowledge of them.

He has written a masterly book on the spectroscopy of X-rays. An extraordinarily large proportion of the information in it is due to the work of himself and his students. He has created an outstanding school at Uppsala and Stockholm, which now represents most of the physics of Sweden.

He was awarded the Hughes Medal in 1934.

A ROYAL MEDAL has been awarded to Prof. PATRICK MAYNARD STUART BLACKETT.

Prof. Blackett is especially distinguished for his work on cosmic rays and the particles connected with them.

The early work which first brought his name into prominence was concerned with the disintegration of nitrogen by α-particles; arising out of the experimental observations was the convincing proof that the disintegration process originated in the actual capture of the α-particle by the nitrogen nucleus.

The demonstration of cosmic-ray showers was one of Blackett's early successes with direct Wilson chamber photographs; but perhaps his most spectacular discovery—made simultaneously by Anderson in America—was that, in a large cloud chamber controlled by the tripping of counters, tracks appeared which could only be explained as due to a new particle—the positive electron. The importance of this discovery in the light of Dirac's theory was immediately realized by Blackett and his co-worker Occhialini, and important results have emerged.

Blackett also—in collaboration with Chadwick and Occhialini—extended the work on the positive electron, and it was soon found that there were sources other than cosmic rays. With the same collaboration Blackett was also instrumental in showing that quanta of sufficient energy could produce a pair of electrons, and this production was related to the so-called nuclear absorption of γ-rays—a phenomenon previously known but until then unexplained.

Blackett has followed up his cosmic-ray work and has published a number of very interesting papers dealing with various aspects of these rays. He has measured their energy, inferring therefrom a cosmic-ray energy spectrum; he has observed, with an extraordinarily high degree of accuracy, the scattering and energy loss of cosmic-ray particles in their

* From the remarks made by Sir William Bragg in presenting the medals for 1940.

passage through metal plates and has discussed the nature of the penetrating component of cosmic rays. Two papers on this topic appeared in the *Proceedings of the Royal Society* for 1938.

Lastly, reference must not be omitted of Blackett's important experimental contributions to our knowledge of the heavy electron—the particle which seems destined to be of such importance in the understanding of the more familiar nuclear particles.

A ROYAL MEDAL has been awarded to Dr. FRANCIS HUGH ADAM MARSHALL.

Dr. Marshall's earlier research work (1903–7) on the œstrous cycle, corpus luteum, and removal and grafting of ovaries laid the foundations for all the modern discoveries concerning the internal secretions of the sex organs.

The publication of his large text-book on the "Physiology of Reproduction", in 1910, stimulated work on this subject throughout the world, not only on points of scientific interest but also in regard to the application to medicine and to questions of fertility and milk secretion in the domestic animals. He was engaged on a third edition of this book when war broke out. He is generally acknowledged to be the father of this subject, and but few papers on this branch of science to-day are published without some reference to his work.

Arising out of his research, and that of his pupils, the importance of the anterior pituitary as a source of internal secretions, affecting not only the sex organs but also other body functions, has been recognized, and has led the way to an enormous volume of research work in recent years throughout the world. It is one of the subjects in which the greatest advances have been made in recent years.

Recently, his research has been concentrated on the exteroceptive factors, such as light, ultra-violet irradiation and nerve stimuli, which affect the sex organs by way of their effects on the anterior pituitary. This work explains the physiological basis for the seasonal and other changes which occur in reproductive activity. He summarized this aspect of the subject in the 1936 Croonian Lecture on "Sexual Periodicity and the Causes which Determine It", besides adding new matter.

DAVY MEDAL

The DAVY MEDAL has been awarded to Prof. HAROLD CLAYTON UREY.

Prof. Urey's first important piece of work consisted in carrying out extensive, accurate, spectroscopic measurements on diatomic and polyatomic molecules. This led him in 1931 to take up a detailed investigation on the abundance of natural isotopes of hydrogen, nitrogen and oxygen. During the next few years he succeeded in isolating deuterium and calculating the comparative thermodynamic properties of deuterium, hydrodeuterium and hydrogen. In 1934 he accomplished the first synthesis of deuteromethane.

Deuterium or 'labelled' hydrogen has proved of great value in investigating the mechanism of many organic and biologically important reactions, and its use has been the precursor of the modern general isotopic exchange reactions. A number of deutero derivatives have been prepared by Urey and his co-workers, and their entropies, vapour pressures and exchange equilibrium constants have been experimentally determined and compared with the theoretical values anticipated.

This isolation of deuterium from ordinary hydrogen and establishment of the thermodynamic, spectral and physico-chemical difference between it and pure hydrogen, as well as in the compounds containing deuterium and hydrogen, is a remarkably complete piece of work, for which Urey received the Nobel Prize.

More recently Urey has taken up the problem of the separation of the other important, naturally occurring isotopes : those of nitrogen, oxygen and carbon. He has examined their quantity distribution in Nature and employed exchange methods for the enrichment of one species.

DARWIN MEDAL

The DARWIN MEDAL has been awarded to Prof. JAMES PETER HILL.

Over a long series of years Prof. Hill has carried out researches on the development of various mammals, particularly as regards the embryonic membranes and placenta, and added greatly to our knowledge of this subject. Many of his conclusions have clear evolutionary implications, as for example that marsupials are descended from oviparous ancestors with meroblastic ova. In his Croonian Lecture of 1932 Prof. Hill summarized his researches on the embryology and embryonic membranes of the Primates. The views of primate evolution based on development which he then put forward are in accord with those of Elliot Smith founded on brain anatomy, and of W. K. Gregory on morphological and palæontological evidence.

In collaboration with T. T. Flynn, Prof. Hill has lately (1939) published the first part of extensive researches on the development of monotremes, both Ornithorhynchus and Echidna, which will be of great value in helping to assess the origin and relationships of these egg-laying mammals.

Prof. Hill's research work is of first-class quality, being trustworthy and carried out with extreme care and the best techniques ; it has never been scamped and is rich in original results over a wide field, most of the conclusions having a direct bearing on evolutionary questions.

Few living biologists have contributed more towards the solution of problems bearing on the interrelationships of the main groups of the Mammalia and on the phylogenetic history of the Primates, a subject with which Charles Darwin was so much concerned.

SYLVESTER MEDAL

The SYLVESTER MEDAL has been awarded to Prof. GODFREY HAROLD HARDY.

G. H. Hardy is the author, or part author, of more than three hundred mathematical papers, two books, and several of the Cambridge Mathematical Tracts.

Much of his work has been directed to the building up of the technique of modern mathematical analysis, and the simplicity with which the routine aspects of new work can now be presented is due very largely to fundamental results established by him.

It is characteristic of much of his work that it has stimulated others and has proved to be the starting-point of important developments. His work in collaboration with J. E. Littlewood on Tauberian theorems is an example. From an isolated classical result a subject was created which to-day would require a treatise for its exposition.

His most outstanding contributions to the advance of mathematical knowledge have been in the theory of the Riemann zeta-function and the theory of numbers. The achievement of which, it is believed, he himself is most justly proud is the invention of the 'circle method'. This is a technique of much beauty and generality, which brings great refinement of mathematical analysis to bear on a wide class of unsolved problems in the theory of numbers. The method has been elaborated and improved by other mathematicians, but on its account alone the name of Hardy must for all time rank high among the masters of his subject.

No appreciation of the services of Hardy to the advance of mathematics would be complete which did not attempt to assess the value of his personal influence. Throughout his career he has been the driving force behind a vigorous group of younger research workers. A very considerable proportion of the pure mathematical research now being published in Great Britain is traceable more or less directly to his interest and encouragement, or to the inspiration of his earlier work. His unstinted service during many years to the detailed work of the London Mathematical Society, and the freedom with which his experience and advice are available to all, have established him in a unique position in the regard of British mathematicians.

HUGHES MEDAL

The HUGHES MEDAL has been awarded to Prof. ARTHUR HOLLY COMPTON.

Prof. Compton has made a number of important contributions to physical science in the field of X-rays and elsewhere. Of late years he has been one of the leaders in the study of cosmic rays.

The experiments of Young and Fresnel early in the nineteenth century proved that light certainly had undulatory properties. But in the present century facts have been emerging, notably in connexion with photo-electric action, which are impossible to reconcile with the assumption that light can be described only as an electromagnetic wave of the classical type. These difficulties disappeared if light of frequency ν is assumed to be dynamically equivalent to a collection of particles of energy $h\nu$ (h is Planck's constant).

It occurred to Compton that from this point of view the interaction between radiation and free electrons is very simple, and in fact is the simplest interaction which radiation can undergo. Associated with the energy $h\nu$, according to the electromagnetic theory, there is momentum $h\nu/c$ (c is velocity of light). The interaction is thus reduced to a very ancient problem, that of the encounter of two infinitesimal billiard balls with known energies and moments. As the radiation moves with the velocity of light, in most cases the electron can be treated as if it were at rest. It is then obvious that in the collision the electron will acquire energy from the radiation, and the conservation of momentum requires that if the electron moves off in a certain direction the radiation will travel in a certain other direction. But reduction of energy of a quantum of radiation means increase in wave-length, and this increase will be a predetermined function of the direction of the 'scattered' radiation and of the direction of motion of the 'recoil' electron.

Compton published these conclusions in 1922. In 1923 he established the change in wave-length, first qualitatively by Barkla's absorption coefficient methods and then quantitatively with the X-ray spectrometer. In the succeeding years he investigated the energies of the recoil electrons as a function of their direction of motion and showed that the correlation, predicted by the theory, between the direction and energy of the recoil electrons on one hand and the direction and change of wave-length of the radiation on the other did in fact occur. This correlation is of fundamental importance in the general theory of the interaction of radiation with matter.

BIOLOGICAL APPLICATIONS OF SYNTHETIC CHEMISTRY

PROF. J. W. COOK, formerly at the Royal Cancer Hospital, who recently succeeded the late Prof. George Barger as regius professor of chemistry in the University of Glasgow, opened the winter session of the evening meetings in Edinburgh of the Pharmaceutical Society with a lecture on "Some Biological Applications of Synthetic Chemistry".

Prof. Cook said that many new facts have been recorded regarding the natures and the functions of substances which play vital parts in the process of life, and large numbers of these substances have been prepared artificially. Many rare compounds, not known in Nature, and yet possessing powerful biological activity, have arisen from the creative efforts of the synthetic chemist. The spectacular results which followed the introduction of the sulphonamide drugs were the outcome of purely chemical investigations. There is no doubt that prontosil, with its colourless prototype sulphanilamide, is destined to be regarded as one of the greatest boons to mankind conferred by this present age. Of the many thousands of sulphonamides that have now been prepared and examined, none surpasses sulphanilamide in efficacy against streptococcal infections. A later product, M. and B. 693, a sulphapyridine, has robbed pneumonia of much of its terror, and the analogous thiazole derivative has been claimed as effective against infections due to staphylococcus. These claims have not, however, been substantiated by tests carried out in Great Britain.

Much progress has also been made in other branches of chemotherapy ; new products are constantly being evolved which have therapeutic and pharmacological properties resembling, and sometimes exceeding, those of natural plant products. Carefully planned researches, such as those of the Drug Addiction Committee of the United States Public Health Service, should receive every possible encouragement. The very rapid decline in the use of cocaine as an addiction drug, after the discovery of synthetic substitutes such as procaine, gave a stimulus to efforts to solve the problem of drug addiction with the opium alkaloids, and the efforts of the American investigators have been concentrated on a study of the pharmacology of a wide range of morphine derivatives and of numerous classes of synthetic compounds having structural features in common with some of those of the morphine molecule.

The chemotherapy of tubercular infections, Prof. Cook said, is now receiving increasing attention. Sir Robert Robinson has recently summarized progress made in this field, pointing out that in tuberculosis, as in leprosy, a suitable therapeutic agent should provide a means of penetrating or breaking down the waxy envelope which surrounds the bacilli of these infections. The active component of chaulmoogra oil, long used in the treatment of leprosy, is known to be a *cyclo*pentenyl fatty acid. Many synthetic analogues of chaulmoogric acid also possess leprocoidal activity, and the nature of these substances gives support to the view that they owe their activity to a capacity to effect impairment of function of the fatty envelope of the organisms.

Prof. Cook also reviewed in the course of his lecture the progress made in the past ten years in the chemistry of the vitamins and the members of the sterol class, including several groups of hormones. Most of the known vitamins, he said, have been isolated in a state of chemical purity, and the principal ones have been prepared synthetically; in addition, the biological role of several of them has been partially elucidated. The pure crystalline vitamin A was isolated for the first time only a few months ago. The other principal fat-soluble vitamin, known as vitamin D, is now available commercially in chemically pure form. Ascorbic acid, or vitamin C, is now available as a synthetic product. Incidentally, it has been claimed that vitamins A and C increase the body's resistance to infection; this, said Prof. Cook, is now disputed, although it seems likely that vitamin A, by maintaining the tone of the mucosa, renders these less liable to attack by pathogenic organisms. The principal members of the vitamin B complex have been synthesized and considerable insight gained into their biological function. Two other vitamins which have yielded their secrets to chemical investigation in recent years are vitamins E and K. The availability of the pure synthetic vitamins will hasten the solution of problems concerned with their biochemistry and mode of physiological action.

Remarkable progress has also been witnessed in the chemistry of a group of hormones which are related in molecular structure to each other and to cholesterol, which, Prof. Cook said, may be regarded as their biochemical progenitor. Except in the case of the œstrus-producing hormone, total synthesis has not yet been achieved, but members of these groups have been converted into common degradation products, and the steroid hormones have all been prepared artificially from cholesterol or other sterols. Deoxycorticosterone, the most active of the life-maintenance hormones of the adrenal cortex, has been isolated from ox adrenals and is now prepared artificially in considerable amount. It is concerned in the maintenance of the sodium chloride balance in the blood and has been found effective in the treatment of wound shock; for this reason its availability at the present time is of particular importance.

CONTROL OF INFECTION IN WAR WOUNDS

THE treatment and care of war wounds is essentially a bacteriological problem, as, indeed, experience in the War of 1914–18 made evident. The chief lethal micro-organisms that are found in infected wounds are *Streptococcus pyogenes* and the group of anærobic bacilli which cause gas gangrene. Researches within recent years into the causation of puerperal fever have shed light upon the origin of pathogenic streptococci in war wounds; in both cases the chief source of infection is regarded as being droplets of secretion that contain these microbes and that are expelled from the throat of those who nurse and treat the patients; the measure of the risk is given in the statement that 2–5 per cent of adults harbour *Streptococcus pyogenes* in the throat. Suitable masks should, therefore, be worn by all those who dress war wounds.

The danger from the intrusion of streptococci into wounds is likely to be much lessened by the administration of drugs of the sulphonamide group, although further experience is needed to define clearly the limits of their usefulness. The prophylaxis of gas gangrene is best attained by the early and adequate surgical cleansing of the wound and by the use of specific antitoxins corresponding to the chief types of pathogenic anærobe. The precise role of chemotherapy in combating infections caused by the gas-gangrene group of bacteria is still undetermined; recent experiments with laboratory animals indicate that the most favourable results will be obtained from combined sulphapyridine and antitoxin treatment. Tetanus antitoxin, which confers a passive immunity, still retains its place as an invaluable prophylactic agent; active immunization with tetanus toxoid—a non-toxic modification of tetanus toxin—was adopted last year as a voluntary method of protection for men in the Army and the Royal Air Force.

A small book on the subject, edited by W. H. Ogilvie and modestly styled a war primer ("War Primer on Wound Infection": its Causes, Prevention and Treatment. By W. H. Ogilvie, Robert Cruickshank, Lawrence P. Garrod, L. E. H. Whitby and G. A. H. Buttle. Pp. 96. (London: The *Lancet*, 1940.) 2*s*. 6*d*. net.) is the work of five recognized authorities, each of whom deals with a particular aspect of the treatment of civil and military wounds. The discussion is arranged under the chapter-headings: the problems to be solved; biological aspect; bacteriology; antiseptics; chemotherapy; surgical principles; and surgical procedures. The present state of knowledge has been set forth by the authors in a succinct and well-balanced manner. The facts they state and the conclusions they have reached deserve to be studied with the greatest care by everyone whose duty it is to assist in treating war wounds.

CULTIVATED CROPS IN EARLY ENGLAND

INVESTIGATIONS of a Danish committee appointed to inquire into the origins and development of agriculture in prehistoric Denmark have developed into a large-scale examination of recorded discoveries of prehistoric grain in northern Europe. In the course of this investigation, which has the support of the Rask-Ørsted Foundation, Dr. Hans Holbœk, on behalf of the Committee, visited a number of museums in England, Scotland and Ireland in 1939 for the purpose of examining the remains of prehistoric plants or their impressions on clay vessels from prehistoric and early archæological sites.

Pending fuller publication in collaboration with Prof. Knud Jessen, when that becomes possible, Dr. Holbœk has prepared a preliminary report on his examination of British prehistoric and Anglo-Saxon pottery in the Museum of Archæology and Ethnology in the University of Cambridge, which was completed only shortly before the entry of the Germans into Denmark (*Proc. Prehist. Soc.*, N.S. **6**; 1940).

The impressions found and indications of character, summarily stated, are as follows:

Emmer and spelt (*Triticum monococcum* Sch.). In bronze age barrows and the Late Bronze Age settlement of Mildenhall Fen in the form of impressions of grain and spikelets. *T. monococcum* L., the closely related small spelt, is also represented. Impressions of the threshed spikelets are characteristic.

Common wheat and club wheat. Distinguishable from emmer grains by their more rounded forms. As the evidence exists only in the form of charred grains or impressions, it is rarely possible to distinguish the race. In Cambridge there is only one impression of common wheat (*T. vulgare*), which comes from an Early Iron Age settlement (Abingdon), and the race seems to have been rare in early England.

Barley. As with wheat having a tough axis, the race of barley is difficult to identify. The prehistoric barley of northern Europe is the six-rowed form (*Hordeum polysticum* Doll.). It would appear that barley was always the chief grain of the Cambridge area. Naked and husked grains occur with equal frequency in the Bronze Age, but the husked form was almost completely predominant in Anglo-Saxon times.

Oats (*Avena sativa*). All impressions in the Cambridge material are of threshed oats, that is, without the husks and separated from glume and stem. Oats, presumably brought to Europe in the form of seeds, have been identified in the central European Bronze Age, and possibly were brought to Britain by the Romans. At Cambridge they are noted only in the Anglo-Saxon material.

Flax (*Linum usitatissimum*). Two flax seed impressions were found in the Anglo-Saxon pottery. In central Europe it is found in late Neolithic times, in Denmark from the Early Iron Age, and in Ireland on a site in Limerick of probably ninth–tenth century A.D.

Woad (*Isatis tinctoria*). Identified from impressions of the flat-winged fruit. In northern Europe it was cultivated so early as the Iron Age. The Cambridge evidence is of Anglo-Saxon date.

Investigations in other parts of Britain have established the fact that the knowledge of grain growing had already reached the British Isles in the latter part of the Stone Age.

FORTHCOMING EVENTS

Monday, December 9

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. W. G. East: "The Severn Waterway in the XVIIIth and XIXth Centuries".

Tuesday, December 10

CHEMICAL ENGINEERING GROUP in conjunction with the INSTITUTION OF CHEMICAL ENGINEERS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. A. B. Manning will open a Discussion on "The Salvage of Waste Materials in the Chemical Industry".

ROYAL ANTHROPOLOGICAL INSTITUTE (also for Members of the ROYAL CENTRAL ASIAN SOCIETY) (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—M. August Muhlenfeld (Director, West Indian Division, Netherlands Colonial Office): "The Badui: a Primitive Tribe of Eastern Java".

Wednesday, December 11

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. J. S. Nicholl: "Road Transport".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Mr. A. L. Bacharach: "Some Nutritional Problems of War and Peace".

Friday, December 13

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. S. Lall: "Industrial Development in the Indian Provinces".

APPOINTMENTS VACANT

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

ASSISTANT MASTER TO TAKE PHYSICS AND MATHEMATICS—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middx. (December 14).

GRADUATE TEACHER OF MECHANICAL ENGINEERING SUBJECTS—The Principal, Hendon Technical Institute, The Burroughs, Hendon, London, N.W.4 (December 14).

ADMINISTRATIVE ASSISTANT (MAN) FOR HIGHER EDUCATION—The Education Officer, Education Offices, Katherine Street, Croydon (December 16).

LECTURER IN PHYSICS AND MATHEMATICS—The Principal and Secretary, Harris Institute, Preston (December 21).

GRADUATE LECTURER IN THE MECHANICAL ENGINEERING DEPARTMENT of the Royal Technical College, Salford—The Director of Education, Education Office, Chapel Street, Salford 3.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 12: Organic Halogen Compounds. Pp. ii+6. (London: H.M. Stationery Office.) 2*d*. net. [611

Other Countries

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 11: Malayan Agricultural Statistics, 1939. By D. H. Grist. Pp. xii+102 tables. (Kuala Lumpur: Department of Agriculture.) 1 dollar. [411

U.S. Department of the Interior: Office of Education. Vocational Division, Bulletin No. 203 (Occupational Information and Guidance Series No. 3): Guidance Programs for Rural High Schools. By Paul W. Chapman. Pp. vi+58. (Washington, D.C.: Government Printing Office.) 10 cents. [411

Transactions of the Academy of Science. Vol. 30, No. 3: The Cytological Structure of the Hypothalamic Nuclei in relation to their Functional Connections. By Homer Dale Kirgis. Pp. 65–86. (St. Louis, Mo.: Academy of Science.) 50 cents. [511

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