NATURE

No. 3924 SATURDAY, JANUARY 13, 1945 Vol. 155

CONTENTS

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

All rights reserved. Registered as a Newspaper at the General Post Office

DEMOBILIZATION OF UNIVERSITY STUDENTS

UP to the time of writing, no pronouncement has been made by the Government in regard to the release from the Armed Forces of university teachers, or of students to resume their interrupted studies. The national importance of dealing with this matter without delay was discussed at some length in an article in *Nature* of December 23, in which we emphasized the necessity of arriving at a satisfactory solution of the problem of the demobilization of students, and one which would ensure that the Government would not have to face misguided criticism of giving favoured treatment to a particular class of men.

The resumption by the universities of a large part of their normal activities in October 1945—if the military situation permits—is a matter of vital public interest ; for there is abundant evidence of the difficulties which are likely to arise from the continued interruption of the supply of university graduates, especially in the faculties of arts and economics. The number of trained men likely to be available from these faculties, in the next few years, for the public services, for commerce, industry and for the teaching and other professions, has been reduced almost to the vanishing point. The question of the release of university teachers from temporary war-time posts in the Civil Service is already being dealt with by means of the committee appointed under the chairmanship of Lord Kennett to consider and decide applications from universities and colleges for the release of such of their staff from Government employment as they consider to be more urgently needed at the present time in their academic posts. It is to be hoped that arrangements for according a high degree of priority of release—in suitable cases—to university teachers now serving with the Forces will soon be made, for the re-staffing of the universities must obviously precede the acceptance by them of additions to the student body.

It seems to be generally agreed that in releasing students from military service, the national interest would be best served by giving the first opportunity of completing their university education to students of the highest intellectual ability. The test of intellectual ability by success in an examination is admittedly not infallible ; but it is no doubt generally the case that the best and most promising men are to be found among those who have gained such awards as open scholarships or exhibitions at universities, State scholarships, or certain other scholarships awarded on a highly competitive basis. In the national interest, these are the men who should be sent back to their studies at the first opportunity, so that their services may be available to the nation in the early post-war years.

Before deciding on any scheme for the release of men for university study, its effect on the universities and colleges should be carefully considered. Many more scholarship holders go to Oxford and Cambridge than to the newer universities, and a scheme for

giving priority of release to men who have won scholarships would set free considerable numbers of students already entered at one or other of the older universities, and relatively few already accepted by the universities of the provinces. If we take the figures for recent pre-war years published in the returns from universities to the University Grants Committee, it appears that the average annual intake, by all the universities of Great Britain, of men students (exclusive of those entering faculties of medicine, which class will doubtless continue to be reserved) was in round figures about 9,000. In view of the destruction by enemy action of university and college buildings, including libraries, laboratories and hostels, and of the difficulties of getting together, in a short time, adequate and competent staffs, it seems unlikely that the universities could manage to provide in their non-medical faculties for a larger entry than 9,000 men (together with the normal proportion of women) in the initial year of peace. An estimate of the number of students who would be eligible for release, in view of their having won scholarships or other high awards in open competition, is not easy. Some will have become casualties or prisoners of war, or perhaps be unwilling to return to academic study after an interval of several years; but it seems probable that there might be about 2,000 scholars wishing to return to their studies at Oxford or Cambridge, possibly 1,000 for the colleges of London, and about another 1,000 who have gained admission and open awards to other universities of Great Britain. If these men were demobilized in time to enter their universities in October next, they would provide Oxford, Cambridge and London with about two-thirds of their normal annual entry of non-medical students; but the average entry from this source to the other universities would be only about one-fifth of the normal pre-war number. The total number so released from the Forces for university study would be about 4,000, and it is perhaps unlikely that, with all the claims which will be pressed upon the Government for Class B releases, a larger number of university students could be spared in time to enter upon university courses at the beginning of the Michaelmas term. But it is certainly desirable that the number should be sufficient to enable the provincial universities to approximate to their normal activity by starting the coming session with a reasonable number of students in each of their faculties.

If the military situation should allow of a greater total number of releases for October next than can be satisfied from the open scholarship class, it would appear to be reasonable for any margin to be filled by the release of other men who have completed part of their university course before entering on their war service, and concerning whom the universities have some information and grounds for discriminating relative merit and ability. Clearly the selection of individuals as suitable for immediately taking up their interrupted studies could best be made by the universities themselves; but the final selection from those judged to be qualified should be decided by considerations of age and length of service in each case.

In addition to the desirability of arranging that the universities should be able to open for the session 1945–46 with a reasonable number of students, there is the necessity that they should be assisted to organize themselves so that, if war in the European theatre has ended, they may be ready to deal with a normal number of students in all faculties in the Michaelmas term of 1946. Most universities are only able to deal with students who join their courses at the beginning of a session, and releases for university study should be arranged so that the men will be ready to commence work by the end of the month of September. Clearly, a generous allocation of Class B releases might be made to university students in August 1945 on the ground that it would be inexpedient to make any further releases for university study until August 1946. In this respect the problem of the demobilization of students is quite different from that of arranging for the release of men who can return to civilian employment at any period of the year.

The advantages which students gain by residence in a college or university hostel during their academic courses have been strongly stressed in many quarters recently, and universities are rightly pressing upon grant-giving bodies the need for increased residential facilities. From the national point of view, the scheme of releasing from the Armed Forces and from other national service, in the first instance, those students who are in the open scholarship class, has the advantage of making use of most of the available university residences in the country; for a large proportion of the men so released would already have gained admission to one or other of the colleges at Oxford or Cambridge. But it should be stressed that the primary qualification for early demobilization would be proved ability to profit by advanced education, and the promise of becoming qualified to play an important part in the national life, not that the man would be returning to a particular university.

In considering the question of demobilization from the point of view of its effect on the universities, it must be remembered that the number of places available for men released from national service depends on the number of students allowed to enter universities direct from school, and on the number of those at present in residence to whom deferment of military service is granted. If the arrangements for granting deferment to students entering the universities in October next should prove to be less generous than those now in operation, the effect may be that, in spite of releases from national service, a considerable reduction in the total numbers of men in attendance at university courses will occur. This reduction would be most marked in those universities which have large faculties of science and engineering, and which have been assisting the national effort by concentrating on the training of technical specialists in subjects in which the acute shortage a few years ago was a hindrance to the effective prosecution of the War. It may now be right to reduce the output of trained scientific men and engineers in favour of an increased supply of specialists in other branches of university study; but the problem is complicated

and difficult, and involves a nice balancing of the probable future requirements of the nation against the military needs of the moment. The latter will doubtless change in the course of the year, and the best method of dealing with the matter would seem to be by keeping in being the existing joint recruiting boards at the several universities, and using them to direct the activities of all male university students, not only those of technical and scientific subjects. This would provide a ready means of adjusting periods of deferment to suit changes in the national situation. But in thus controlling the numbers admitted to university courses, and the length of course permitted in different subjects, it should be borne in mind that for the production of a trained scholar or technician, a long period of uninterrupted study is most desirable. It would appear to be in the national interest that all the more able students should now be directed to follow the full normal university courses in their subjects.

When Germany has been defeated and demobilization on a larger scale begins, the universities may find themselves flooded by applications for admission from men released in Class A, as well as those in Class B whom we have been considering. All would desire that as many men from the Forces as are suitable should be given the opportunity of further education at the university level. To provide for this it may prove to be necessary to delay the entry of young boys, direct from school, by sending them first to do a year of national service in accordance with a deliberate national policy on the lines suggested in the Norwood Report. It is certainly undesirable that such a congestion of students should occur in universities as would necessitate the continuation, even for a few years, of the inelastic organization of courses which has been necessary in many cases in dealing with the inflated numbers of students reading certain scientific subjects during the last few years.

WELSH FARMING

The Agriculture of Wales and Monmouthshire

By Prof. A. W. Ashby and I. L. Evans. Pp. iv+300. (Cardiff: Press Board of the University of Wales, 1944.) 15*s*.

IT was a very happy arrangement that Principal Ifor Evans and Prof. A. W. Ashby should combine to prepare a book on the agriculture of Wales. They have confined themselves mainly to the period for which official statistics are available, namely, from 1867 to the present time, and Prof. Ashby's wide knowledge of this branch of the subject has enabled him to avoid the pitfalls into which a less expert writer might have fallen. Ifor Evans knows the human side, and has been able to add the descriptive detail that puts life into the official figures.

The authors are fortunate in their period. In the early part, Welsh farming was mainly subsistence farming; each family ran its holding and produced the food needed: wool also was produced for clothes, and with the aid of a few craftsmen settled in the villages all the ordinary needs of life were supplied. The centres of the communal life were the chapel and the local Eisteddfod, and there were various activities associated with these that brought the young people together. Actual cash transactions were few, limited to rent, rates, and an occasional special event, and these were met by the sale of cattle or of sheep. Petty cash for special household needs was obtainable by those near a market, but not everyone was in this position. I well remember the market at Carmarthen in 1891–92, to which the country-women came dressed in their tall-crowned hats, shawls, bodices and a bulky array of drab-coloured petticoats; they brought with them eggs, poultry and butter, the chief characteristic of which was its great variation in quality, no two samples ever being alike, but all being poor. The pitiful thing, however, was the low level of prices, for there was no organized marketing and the sellers did not wish to take their produce home unsold. It was a peasant community, and its problems could find a parallel in any of the peasant countries of Europe.

Then came the great change. From the early days of this century the subsistence farming gave place to farming for the great markets of England and South Wales. Things were produced for sale, and not for home consumption; the people ceased to be peasants and became small farmers. The change took a long while; indeed the authors do not think it was complete until 1939. They trace in great detail the changes involved. Livestock and livestock products became more important and arable crops less: the reduction in these, especially grain, is very graphically shown. Unfortunately, the change was accompanied by a general abandonment of liming, which had previously been common; the early agricultural advisers were not blameless here, for they too often thought that the basic slag they were busy introducing could take the place of lime.

Once Welsh agriculture was fairly on the sales basis, its history was not unlike that of English farming; it was subject to the same economic factors, enjoyed temporary prosperity during the two Wars and suffered from the severe slump that came in between. The livestock figure for 1916 marks a record high level which was only just passed in 1937, while that for 1920 is the lowest in the present century. But the authors are careful to note and explain the differences between Welsh and British farming, which are numerous.

The Welsh farm still remains essentially a family affair: farmers and their relatives accounted for more than 60 per cent of those engaged in agriculture in the last census (1931). Even so the number of 'male relatives' working on the farms decreases, and the staff tends to reduce itself to the farmer, his wife and his children. One difference from English practice is brought out: when the parents die, the inheritance is divided equally among all the children; whoever takes the farm has to buy out his brothers and sisters, and this may land him in debt, with awkward consequences. Yet the system works, for in a sample survey, 75 per cent of the farmers were sons of farmers, while only 11 per cent were sons of farm workers and 7½ per cent sons of other manual workers.

The authors state, with some reserve, that nearly half the arable land and pasture of Wales was in 1931 in farms of 50–150 acres, and less than one quarter in farms of 150 acres and more. These two groups of farms employed less than one half the total number of full-time farmers.

Livestock, especially milch cattle, are now the central feature of the farming, and this has empha-

sized the need for improving the grassland. There is a steady rise in the proportion of cows and heifers, and a fall in that of older cattle for meat production. This has of course led to a marked increase in milk production.

So far as actual numbers go, sheep are the most important element in Welsh live-stock, and, as for cattle, the number was lowest in 1920 and highest in 1939. As in England, however, a diminishing number live more than one year, the taste for fat mutton having gone; most are killed or sold as lambs, and only the breeding ewes are kept. The lowland farmers have devoted much attention to the production of early lambs.

Pigs have always furnished much of the meat of rural Wales, but they too now enter into commerce, especially for bacon production.

The change-over from subsistence farming to farming for the market meant of course that the farmers became liable to all the risks of competition from outside, to the vagaries of prices which lay right beyond their control, and to other troubles. On the other hand, the young people prefer the new life, and however much on sentimental grounds one may regret the passing of the old, one must admit it had many bad features. Farmers now have more scope than in the old days; they can benefit by organization—by co-operation and better marketing. They can take fuller advantage of agricultural education and research, and make better use of improved methods and appliances than was formerly possible. Co-operation has not developed as much as it might; 'societies' supplying requisites have proved more popular than those dealing with produce. Welsh farmers, however, have always been keen on education: indeed, the College at Aberystwyth is in part a tribute to their interest. The Welsh farms and villages have always supplied a high proportion of excellent students. It is therefore all the more surprising to read that agricultural education and advice, as organized by the Welsh counties in the 1930's, did not exercise any noticeable influence on more than 20–33 per cent of the agricultural population.

The volume is so well documented that the appendixes extend to well over one hundred pages while the text covers one hundred and seventy pages. But these appendixes are full of valuable information not easily obtainable elsewhere, and they include an extensive set of statistics with annotations, for all of which students will be deeply grateful.

The authors have accomplished with great distinction a difficult task and they have set a standard to which other writers on the agriculture of a region will do well to aspire.

One good book always evokes the desire for another. Would it be possible for the Honorable Society of Cymmrodorion and the Press Board of the University of Wales, which have produced this book so well, to give us a history of Welsh agriculture going back to the most ancient times? Early records may be scanty, yet the National Library has a big collection of manuscripts from which something might be gleaned. One would expect the earliest agriculture to have some relation to the early farming on the open lands of the south of England: but had it? In any event, where did the old varieties of cereals come from—Hen Gymro, Ceirch Llwyd, Ceirch du bach, Haidd Garw, and others? They certainly were not indigenous, nor were the old Welsh animals.

E. JOHN RUSSELL.

THE INTERNATIONAL PETROLEUM POSITION

Peace, Plenty and Petroleum

By Benjamin T. Brooks. (Science for War and Peace Series.) Pp. vi+197. (Lancaster, Pa.: Jaques Cattell Press, 1944.) 2.50 dollars.

THIS review of the present position of the American petroleum industry may not prove particularly palatable to those nurtured on the pleasant theory that undiscovered reserves in the United States amount to "some comfortable astronomical figure", to quote the author's own words. Indeed, it will be a hard task for a nation which has for many years produced 65 per cent of the world's oil to adjust its independent viewpoint and face the fact that its domestic production is no longer adequate to its own needs. America has become an oil-importing country, and if present trends within the industry continue, she will become increasingly dependent on foreign supplies.

Furthermore, the author is of opinion that even with the cessation of hostilities, shortage of crude oil will persist. Petroleum is the basic essential of all forms of modern warfare; without it, navy, air force and army would be immobilized. Production has, however, been pushed to an artificial peak to supply the amount of fuel sought by the U.S. Petroleum Administration for War; but the record figure of 4,200,000 barrels a day attained in the summer of 1943 cannot be maintained indefinitely. The yield of a majority of fields has been increased beyond the optimum economic rate of flow, and estimated reserves have correspondingly diminished. Recent decline in the rate of discovery of new resources aggravates the seriousness of the position, particularly when it is apparent that exploration activity has not shown a parallel decline. Figures published by Mr. E. L. De Goyer, deputy administrator of the Petroleum Administration for War, show that in 1937, when the discovery-rate first showed a decline, 2,224 wild-cat wells were drilled, while in 1942, 3,045 wild-cat wells were drilled.

It is not thought likely that shortages of crude oil in the United States will be met for some time to come by the manufacture of substitutes. Only when price-levels of crude petroleum and its products are substantially higher than at present will it be commercially feasible to produce fuels in quantity from shale oil, coal, water gas or alcohol, and in any event manufacture of such substitutes on the scale required could scarcely be improvised in war-time. Immense new fields have been discovered and developed in other countries, particularly during the past ten years, and it seems reasonable to suppose that domestic shortages in the United States will be made up by importations from Venezuela, Colombia, Mexico, and possibly from Saudi Arabia, Iran, Iraq and the U.S.S.R. Thus the success of American oil companies operating abroad has become a matter of national importance, and, according to the author, "it is not too much to say that the much derided dollar diplomacy has come back into our [U.S.] State Department with some new improvements".

The book is, by design, thought-provoking and challenging. At a time when a series of international conferences regarding the world's oil is envisaged and when the United States is beginning to plan a foreign oil policy, the author feels that the public is entitled to know the full story of the petroleum industry to

date. Under various chapter headings he reviews economic problems concerning oil in world power politics, difficulties and hazards of foreign oil production and the part which oil seems destined to play in the post-war world. In addition, there are informative chapters on petroleum substitutes, the geographical distribution of oil, chemistry of petroleum and the growth of the petroleum industry.

Mr. B. T. Brooks is well qualified to write a book of this character, having had thirty-two years experience in the petroleum industry. The book is written primarily for the American public, but there are many in Great Britain who will find it interesting, and indeed it is highly desirable that problems facing the American petroleum industry should be fully understood here. There is no doubt that as 'co-importers' of foreign oil, Great Britain and the United States will have many problems to face before international agreement is reached on the best method of exploiting world resources of petroleum. The author suggests that "international co-operation after the war will evidently involve a world rationing of such things as petroleum, with quotas, at least to certain nations. International agreements regarding oil means Britain and the United States, and possibly Russia, and this in turn means that private companies must operate within the frame-work of such government agreements. It means a kind of world-wide oil cartel, with the blessing of our own and other governments, although with the foreign policy makers laying down the rules."

A CRITIQUE OF PASTEURIZATION

The Case Against Pasteurization of Milk

A Statistical Examination of the Claim that Pasteurization of Milk Saves Lives. By John P. Bibby. Pp. 71. (London: Staples and Staples, Ltd., 1944.) 1*s*. net.

THE three main theses of this booklet (written as a critique of Prof. G. S. Wilson's book "The Pasteurization of Milk") appear to be (1) that "exposure to light infection" by active tubercle organisms is the best way to induce human resistance to tuberculosis; (2) that the regular consumption of raw milk infected with bovine tuberculosis is a feasible way of developing such resistance, and that the encounter with infective material should take place at an early age—in short, that the consumption of tubercle-infected milk by young children is to their ultimate benefit; (3) that pasteurization not only does us the disservice of preventing this "exposure to light infection" but also seriously damages the milk nutritionally, "devitalizing it at source", an impairment that, it is stated, can be to some extent corrected by adding vitamin D to the diet.

No one would contest Mr. Bibby's view that serious tuberculosis in man should be combated in every possible way, but the logical corollary to his theses (1) and (2) is that the owners of tuberculin-tested herds who at present receive 4*d*. premium for each gallon of milk produced should be penalized and not rewarded. The premium should, presumably, be paid for milk 'lightly infected' with *M. tuberculosis*. Cows with tuberculous udders—doubtless not *too* severely infected—would appear to be a national asset as an insurance against human tuberculosis. Still more should this apply to the lactating tuberculous woman; one wonders whether Mr. Bibby would knowingly put a young child of his own to the breast of a tuberculous wet-nurse?

But even if it were possible to effect satisfactory immunization against tuberculosis by the oral route—a dubious assumption—medical and public opinion would insist that the method should be controlled. Definite numbers of organisms of standard virulence would have to be used, and if the milk to be given to young infants were to be thus artificially infected, it would have to be free from the risk of producing other diseases at the same time, that is, it would have to be previously pasteurized or from absolutely disease-free herds. Moreover, if individual immunity could be acquired in this way, it would have to be acquired in each generation—a grim prospect.

One comment on thesis (3) is not unfair. If the nutritional case against pasteurization has to depend on the selection of statements from early experimenters whose work has not stood up to modern re-investigation, then it is poor indeed. In discussing the effect of pasteurization on the nutritive value of milk, the author quotes nothing later than 1931; this is not done in ignorance, for much of the more recent work, which uniformly does not support this thesis, is quoted in Prof. Wilson's book.

H. D. KAY.

VIRUS DISEASES

Virus Diseases in Man, Animal and Plant

By Gustav Seiffert. Translated by Dr. Marion Lee Taylor. Pp. ix+332. (New York: Philosophical Library, Inc., 1944.) 5 dollars.

THIS edition of Seiffert's work is a translation by Marion Lee Taylor. The book is divided into five main sections. Section A is a 'General Division' in which the main properties of viruses are discussed; Section B gives a brief review of "Certain and Questionable Virus Diseases of Man, Mammals and Birds"; Section C deals with virus-like organisms such as the Rickettsiæ, bacteriophages, *Bartonella* and the agents of pleuropneumonia and agalactia; Section D is concerned with filtrable bacterial forms, and in Section E a short and incomplete description of the laboratory methods of virus investigation is given. In view of the wide scope of the book, it is possible in the space allotted to consider only the superficial aspects of the different subjects under review.

The original German version was undoubtedly a useful contribution to the literature on viruses, and probably fulfilled the aim indicated in the preface, namely, "to furnish an introduction for the many who wish to occupy themselves more closely with the virus problem, to make possible by references to literature further penetration into the subject. . . ." This present edition is, however, unlikely to serve any useful function. It is an almost literal translation from the German by someone who does not appear to be particularly conversant with either the viruses or the virus-diseases. In consequence, the contexture is difficult to follow owing to the close adherence to the original German construction, and many terms, unfamiliar to the British bacteriologist, have been included. Furthermore, although numerous references to original papers are given, all concern articles written prior to 1938. There has been no attempt to bring the edition up to date. R. W. F.

THE GAS INDUSTRY: YESTERDAY AND TO-MORROW*

By DR. E. F. ARMSTRONG, F.R.S.

History of Gas Lighting

AS a provider of one of the four basic necessities of life (food, shelter, clothing and warmth), gas is a leader among British industries. It carbonizes annually 20 million tons of coal, making more than 1,700 million therms of gas. It is the nation's third biggest ratepayer, one of its largest employers of capital (£200 million), its seventh largest direct employer of labour.

It is a hundred and fifty years since William Murdoch in 1792 first lighted up his house at Redruth with gas generated from coal in an iron retort in his back yard. He also had a gas lantern constructed, with the jet attached to the bottom of the lantern and a bladder of gas underneath, with which he lighted himself home at night across the moors when returning from his work to his house at Redruth. Many years later (in 1818), when Murdoch was at Manchester for the purpose of starting one of Boulton and Watt's engines, he was invited, with Mr. William Fairbairn, to dine at Medlock Bank, then at some distance from the lighted part of the town. "It was a dark winter's night," wrote Mr. Fairbairn, "and how to reach the house over such bad roads was a question not easily solved. Mr. Murdoch, however, fruitful in resources, went to the gasworks (then established in Manchester), where he filled a bladder which he had with him, and, placing it under his arm like a bagpipe, he discharged through the stem of an old tobacco pipe a stream of gas which enabled us to walk in safety to Medlock Bank."

Murdoch was followed by Samuel Clegg, who installed gas in factories and other buildings and produced many inventions calculated to make its use practicable. Together with F. A. Winsor, his efforts led to the foundation of the first gas company, the Gas Light and Coke Company, which to-day is still the largest in the world. Gas became the fashion, and by 1829 there were already some two hundred large and small companies.

Lighting was its primary function in those days—what a boon it must have been. It made street lighting possible and did much to put down crime. At first the extremities of pipes had small apertures; later came the batswing and fishtail burners, followed in 1850 by the Argand burner with an air regulator. Suggs invention of the governor, a pressure-controlling device, nearly doubled the light given by the street lamps.

Just a century after Murdoch's start, gas lighting was given new vigour by the discovery of the incandescent gas mantle, which made use for the first time of the heating and not of the illuminating ingredients of gas. This discovery came just as the new electric light was becoming a competitor. I well remember as a boy my father telling us at breakfast of a dinner party at Joseph Swann's the previous night in his dining-room lighted by electricity, the first to be so equipped.

I must resist the temptation to trace the historic development, allowing myself only one incident which refers to the Royal Institution. In 1818 a committee was appointed "to take into consideration the expediency of lighting the Institution with gas instead of oil". Those were leisurely days and nothing appears to have been done until 1828, when another committee was appointed which "recommended the use of Portable Gas for lighting the library and lecture theatre on Friday evening meetings". This supply lasted until 1834, when the Portable Gas Company went out of business. Coal gas from the street mains was substituted. But this bare statement hides Faraday's personal contact with the Portable Gas Co., begun, no doubt, at the time of the first committee. It was in the gas provided by the Portable Gas Co. that he discovered benzene in 1825: it was not until twenty years later that its presence in coal tar was proved. So the attempts of the Royal Institution to be up to date and use gas to light its rooms was responsible for one of the greatest discoveries in organic chemistry.

Prior to the advent of the incandescent mantle, it was the 'illuminating' ingredients of gas that mattered, and the strict supervision of quality carried out in accordance with the City of London Gas Act of 1868 expressed this illuminating value in terms of standard candles. When heating became the criterion of quality, these illuminating constituen s ceased to be of importance, and in 1904 a Board of Trade Committee recognized the calorific value of gas; though it was not until 1920 that the change from an illuminating to a calorific value standard was made law. Gas was henceforth charged for not by volume but by calorific value expressed in therms.

By this time technical development both in the refractory materials used to construct the retorts and in the art and practice of carbonization made it possible to use higher temperatures so as to obtain a greater yield of gas per ton of coal. This is still the goal of every gas engineer. Such gas has calorific value, but has largely lost its illuminants. The change, therefore, encouraged good technical practice and opened the way to the modern use of gas as a heating agent.

But before I leave lighting I must make some reference to street lighting, because this is a field in which gas still holds its own. For internal lighting the convenience of the switch and considerations of decoration have enabled electricity largely to replace gas even at the expense of the quality of the light and its effect on eyestrain. Some of the best street lighting in London before the 'blackout' was by gas burned in high-pressure incandescent lamps. A convenient comparison, which shows the advance made, is in terms of candle-power per cubic foot of gas consumed per hour. In 1899, using flat-flame burners, this was 2·5; the substitution of mantles in 1902 made it 14; a figure increased to 19 when the mantles were inverted in 1913; finally, in 1931, high-pressure lamps brought the figure up to 42·5. The lamps in Whitehall gave an illumination of 2,500 candles in a direction at right angles to the surface of the mantle.

Manufacture of Gas

I myself think of the gas industry in two parts: one, the manufacture of gas and the technical skill and future developments associated with it; the other, the distribution of the gas, its burning in suitable appliances and the service given to the consumer.

The making of gas is a highly specialized and skilled operation, especially in a large gas works. There has been continuous progress, and although to-day the thermal efficiency of gas-making is 80 per cent, the gas engineer has never been more active in seeking

*Royal Institution discourse delivered on November 24.

new means of advance for the future. The two main desiderata at the moment are the lowest possible price for gas and the maximum economy in the use of coal.

One approach is completely to gasify coal, that is, not to make coke for sale. Many undertakings turn part of their coke by treatment with steam into water gas. This is a convenient way of adding to the make of gas at the time of peak loads. An alternative involves a pressure process of gas-making, the coal being carbonized in presence of hydrogen. The process takes place in two stages, the first forming a gas rich in methane together with a primary tar and some carbonaceous residue. This residue is fed to a producer operating under pressure and supplied with oxygen and steam in which the hydrogen requisite for the first operation is produced. There is a possibility, according to Dr. E. V. Evans, of producing from 1 ton of any coal—value 300 therms—some 210 therms of gas, together with a tar which can be hydrogenated to petroleum products and also compressed hydrogen. This possibility—the making of methane from coal—is being followed up with the full energy of the Gas Research Board.

Yet another process under study by the Board involves the production of methane catalytically at low pressures. Success in this process would replace some of the gas oil required when water gas is manufactured, and give some control over coke production; but it would not enable the use on gas works of any kind of coal.

A suggestion is to gasify the coal underground, as is said to be done in the U.S.S.R. There is little information available, and no evidence that this process is a success or that it is applicable to British conditions. It has been tried with poor seams, probably uneconomical to work as coal, and gives a gas of low calorific value.

Much can be done by selecting those seams of coal most suited for gas-making. The Fuel Research Board is making a careful survey of the coal of Great Britain, having regard to its suitability for particular purposes. The best form of fuel economy is to use each type of coal where it gives the best results. Unfortunately, such ideas do not commend themselves to the officials who now control these matters: to them coal is coal.

The making of gas resolves itself into the devising of plant in which, during the treatment of coal by heat, the conditions of cracking are such that satisfactory yields of the desired products are obtained.

Coal is a complex hydrocarbon of definite molecular structure; when it is carbonized, nascent hydrocarbon oils are distilled from it which are then decomposed and hydrogenated. The chemist has sought to gain an accurate picture of what is taking place in the retort, so that the engineer may apply this knowledge to practice and obtain the maximum number of therms from a ton of coal—which is to-day about 75. Such factors as the size of the charge of coal into the retort, rapid or slow carbonization and very many technical considerations have all been studied. One of the main objects is to avoid cracking the volatile products and so producing more than a minimum of free carbon. Such studies have also to include the physical characteristics of various coals.

I have alluded to this work so as to make it clear that carbonizing coal is not a rule of thumb operation, but one based on much scientific study, of which the principles are now well understood.

Carbonizing in all its branches is a continuous struggle on the part of the maker of refractories to provide bricks and retorts which will have a long life at high temperatures so as to meet the demands of the users. Much research is going on in this direction.

Distribution of Gas

Now a word on the distribution side, for it is an important and costly item in the supply of gas to every home. The providing, laying and servicing of gas mains is a highly developed technique. Obviously the more customers which can be supplied per mile of main the better; ribbon development, with supply to scattered customers, is more costly. There is a limit to the distance to which a gas main can be carried economically without a substantial user of the gas en route. This has brought up the question of the co-ordination and grouping of separately controlled units, each working in a restricted area, into larger centralized companies linked up to ring-main distribution systems giving a supply of constant quality, purity and pressure. The gas engineer is fully alive to the importance of these three criteria, and although perhaps he has sometimes been at fault in the past, in this respect he will not be found so in the future.

The householder, however, is not interested in gas until she begins to use it. For this purpose appliances are required, appliances which are becoming more complex and more costly and therefore impossible for the ordinary consumer to buy. Hence the development of hire purchase and simple hire systems by the gas undertaking, and the servicing of these so that they are in perfect order. To obtain regulated heat to-day for cooking, space heating, water heating or other purposes, nothing more is required than to turn on a tap and light the gas with a match or other means. The consumer saves all his own personal labour and trouble; he has to keep no stocks in his coal cellar. The undertaking supplies serviced heat, and this is what is really being paid for. Comparisons of the cost of coal and gas per therm have no meaning whatsoever. Coal has to be carried, the ashes removed, the dirt cleaned and the purchase financed months in advance of use. It is this service which is to-day, and still more to-morrow, the function of the gas industry. New and more economical forms of appliances are being devised, and they have to be decorative as well as efficient—not always the most easy combination. The useful geyser has been replaced by the instantaneous water heater; the modern cooker is a triumph of labour-saving and efficiency; the gas fire has all the virtues except that of portability.

It is not my task to explain modern gas appliances, but I do want to direct attention to the latest development of heating by the non-aerated-gas type of burner sometimes called luminous heating.

Before the War, only some gas undertakings extracted the benzol from coal. It is now compulsory. Gas no longer therefore contains any constituent that burns with a smoky flame, and hence 'excess' air mixed with the gas in the burner is not required to burn it. Enough air is drawn into the flame at the aperture to burn the gas completely. Such flames are silent in operation, they are not cooled by excess air and have many advantages both in cookers and gas fires. Other advantages are immunity from back lighting, less choking of jets by dust and less need for maintenance attention. This type of heating marks definite progress.

Gas Tariffs

The method of charging for gas is one of moment to both supplier and consumer. To-day gas is measured

by meter, and the quantity used is charged for on the basis of its calorific value, that is, by the therm. Gas is essentially the poor man's fuel, and the prepayment meter has made it easy for him to obtain it in small amounts as desired for cash. Larger consumers have their meters read quarterly and have that amount of credit.

Actually a far more satisfactory method of charge capable of leading to progressive development would be similar to that adopted for the telephone and by the electrical industry. In both these there is recognition of the service rendered by having the commodity on tap : a fixed annual charge covers the overhead charge of the service and enables the commodity charge to be low. This would mean that extra use of gas above a minimum becomes cheap and therefore attractive. As it is, most of the small users of gas are unremunerative to the industry. An attempt to alter this state of things in London met with considerable opposition probably because the ground was not sufficiently prepared for its wisdom to be understood. Dr. E. V. Evans, the acknowledged technical leader of the gas industry, outlined a little more than a year ago an ideal scheme for a unit community involving the co-operation of the two services gas and electricity, for the development of an ideal balanced fuel-supply. It incorporated a fixed charge for the ordinary dwelling house of 40*s*. per annum and a supply of gas at 6*d*. for the first 300 therms and 4*d*. a therm afterwards. The charge to the domestic consumer must include payment for the services given him ; whereas the charge to industry is for a convenient heating material in bulk and does not include services. It can be directly related to the cost of coal.

The Relationship of the Gas and Chemical Industries

A problem of interest for the future is the position of the gas industry as a source of raw materials for the chemical industry, in particular the new synthetic chemical industry from which so much is hoped in the days to come. In the past, much of the organic chemical industry has been built up on tar products—notably benzene, toluene and naphthalene ; but the demands of chemists have only taken a little of the tar made, so that other uses have had to be found for the bulk of it. This problem has been largely solved by the use of tar on the roads—not haphazard, but in the form of tar carpets scientifically designed.

The motorist has taken the surplus benzol at a price which includes the tax on imported petrol : this demand is resulting in all the benzol being scrubbed out of gas. This can only take place if the price paid for it represents the value of the benzol as therms in the gas and the cost of separating it. The chemical industry wants cheap benzol and is reluctant to pay the equivalent of the hydrocarbon duty on it.

Gas also contains ethylene, while its main constituent is methane. Are these worth more to chemical industry than to gas as therms ? Since Great Britain has only a very small oil-refining industry, it largely lacks the two carbon compounds from which most organic syntheses start. The problem is, Shall the gas industry concern itself only with its legitimate business, the making and distribution of gas, or shall it be in with the synthetic chemical industry and help to make basic raw materials for it ? Only the future can answer. Personally, I hold the view that a gas works should be the place in which all coal should be processed, some to make gas for the domestic consumer and for industry, some to make methane, benzol, and other raw materials for chemical industry, and some to make petroleum hydrocarbons. The balanced interlocking of the various processes would lead both to economies in the use of coal, almost Britain's only raw material with a thermal value, and bring about a cheapening of the various products enumerated. Vision for the future is required; but at a moment when an influential Government committee is inquiring into the future of the industry, its potentialities as a scientific coal-processing industry should be given full consideration.

SEED-BORNE FUNGI

ON October 28 the British Mycological Society met in Birmingham to discuss certain seed-borne fungal diseases. The programme was arranged by the Plant Pathology Committee of the Society.

The first two papers dealt with fungi parasitizing the seeds of British grasses, and Dr. Mary Noble, in an interesting account of the blind seed disease of ryegrass, directed attention to its effect in reducing the germination of seeds, especially those of the modern 'leafy' or 'indigenous' strains. Since these leafy strains normally seed much less profusely than the commercial types, this added loss is especially serious. The disease is known in New Zealand, where it has caused considerable damage in some recent seasons, and is now widespread in Britain.

The identity of the causal fungus has been the subject of much confusion. The imperfect stage was first erroneously ascribed to Pullularia, while the perfect stage was originally described as an inoperculate discomycete of the Helotiæ, but the close similarity of the blind seed fungus to the rye parasite *Phialea temulenta* of Prillieux and Delacroix was observed by Dr. Noble and her colleagues at Edinburgh. Subsequent investigation of the anatomy of the apothecium supported the view that the two fungi were identical, and this was finally proved by Dr. Neill in New Zealand, who examined some of the original material of Prillieux and Delacroix. In addition to rye and *Lolium* spp., *P. temulenta* has been found infecting *Festuca arundinacea*, *F. rubra* var. *fallax*, *Cynosurus cristatus* and other grasses ; but its commercial importance so far is confined to the ryegrasses. Infection occurs at flowering time, that is, in late June in Great Britain, at a point on the ovule just below the stigma. Large numbers of conidia are produced externally, but hyphæ penetrate more deeply and may completely destroy the embryonic structure. Blind seeds result from rather later infection after the embryonic tissues and the endosperm have been differentiated. Still later infection may result in the production of conidia, but the embryo escapes and the seeds remain viable. Blind seeds are sown with healthy ones, and, provided they are not more than 1½ inches under the soil, give rise to stalked apothecia just as the ryegrass is coming into flower. The production of apothecia continues for about three weeks, and thus both early and late strains of ryegrass are subject to infection. Cool wet weather favours infection, as under these conditions the dissemination of pollen is reduced while the glumes open repeatedly and entrance of the fungus is facilitated.

Since *Phialea temulenta* penetrates so deeply into the seed the disease cannot be controlled by fungicidal dusts, and the only practical way of cleaning large

stocks of seed is to store them for two years, during which time the fungus dies out. In Scotland in 1944 a trial service was set up along the lines of one already functioning in New Zealand, under which growers were invited to send in samples of heads before harvest. These were examined for the disease and a reply sent to the grower within two days advising him as to whether his crop was worth saving for seed or not. This is a great help, as it saves the useless work of harvesting diseased seed, and the crop can be converted into hay.

Single-spore (ascospores or macroconidia) isolations of *P. temulenta* give cultures of two types: (*a*) mainly conidial with a smooth shiny type of growth, or (*b*) mycelial in which the surface of the colony is rough, due to the development of white aerial hyphae. It is just possible that this mycelial form may be the well-known *Lolium* endophyte, but so far no proof has been obtained that the blind seed fungus can infect its host systemically. The various endophytes of *Lolium* were discussed by Miss K. Sampson in her paper on "Some Endophytic Fungi of the Grasses". Darnel (*Lolium temulentum*) has long been known to carry an endophytic fungus situated just outside the aleurone cells of the seed, and *Lolium remotum* and *L. multiflorum* also have endophytes which appear to be of a similar nature. In *L. perenne* two types are distinguished. The first occurs in indigenous perennial ryegrass in Great Britain but not by any means in every plant. It was isolated and cultured at Aberystwyth in 1937, and Neill (1941) in New Zealand, by different methods, also cultured a fungus which appears to be identical. Neill observed sporodochia and microconidia very similar to those produced by the blind seed fungus. This again suggests the interesting possibility that this *Lolium* endophyte may be a non-fertile strain of *Phialea temulenta*, but there is still the difficulty that nobody has yet shown that the blind seed fungus can cause systemic infection in *Lolium*. The second *L. perenne* endophyte has only been studied at Aberystwyth, and is distinguishable from the first by its mycelial characters and by the comparative ease with which it can be cultured. Its microconidia seem more characteristic of Sclerotinia than of the Endoconidium type figured by Neill for the first *L. perenne* fungus. It seems that we still need to clear up many points in relation to the fungi parasitizing *Lolium* spp., but the information given by Dr. Noble and Miss Sampson at this meeting suggests that appreciable progress has been made in this direction. The choke disease of grasses caused by *Epichloe typhina* was also mentioned by Miss Sampson. We know that the disease is carried by the seed in certain species, notably *Festuca rubra* and *F. ovina*; but so far it has never been demonstrated in the seed of cocksfoot (*Dactylis glomerata*), one of the most seriously affected grasses in Great Britain.

Dr. Millard gave an interesting account of broccoli canker (caused by *Phoma lingam*) in the West Riding of Yorkshire, where many small growers save their own seed and therefore run into trouble since the disease is seed-borne. These local strains have become infected, but they are suited to the district, and growers are loth to import recognized varieties from other parts of the country which often do not acquit themselves so well in Yorkshire. In order to clean up these local strains, Dr. Millard for some years has accepted from growers seed stocks which are freed from *Phoma* by immersing them for twenty-five minutes in a hot water bath at 50° C. Germination may be depressed a little but in practice this has not proved serious unless the seed was old. Stocks have been cleaned and propagated at Askham Bryan and handed back to the growers in a perfectly clean condition. The value of this service to the market gardener needs no emphasis.

A case of seed-borne club root (*Plasmodiophora Brassicæ*) on swedes was described by Dr. L. G. G. Warne, of Manchester. Dr. Warne was able to infect a clean sample of seed with washings from an infected one, a thing which has not been done before. We do not know how widespread seed-borne club root is and it probably does not occur very often, but the fact that the possibility has been demonstrated is of great interest to plant pathologists and gardeners generally.

An account of seed examination at the Pathology Laboratory of the Ministry of Agriculture and Fisheries, Harpenden, was given by Dr. A. Smith, who explained that practically all the samples are from consignments intended for export to countries requiring a certificate of health based on an examination of the seeds.

More than four thousand samples were examined in the year covering 1939–40, the great majority being vegetable and flower seeds. The War has cut down this export considerably and few agricultural seeds are exported to countries requiring certificates. The main causes of rejection are *Ascochyta* in peas, *Septoria* in celery and parsley, and halo blight in dwarf beans, but occasional samples of other diseased seeds are encountered. The presence of *Ascochyta* in seed peas was responsible for the rejection of 23 per cent of all peas examined for export purposes between 1925 and 1943. Considerable rejections of peas for marsh spot have also occurred, but, since it has been realized that this is not a communicable disease, affected peas may be exported provided they are likely to give a sound plant. In the same period 23 per cent of all samples of celery seed have been refused certificates because of the presence of *Septoria* pycnidia on the seed. An even greater percentage of parsley has been so rejected, namely, 31 per cent. Comparative figures for halo blight (*Pseudomonas phaseolicola*) are not available, but in recent years the percentages rejected have varied from 5 per cent to, in one year, as much as 25 per cent of the samples submitted.

All seed-borne diseases are not recognizable from an examination of the seeds themselves nor can they all be detected on incubation. Some diseases, for example, certain bacterial and virus diseases, as well as certain downy mildews in the seed coat, must perforce escape detection. Freedom from these can only be assured by an inspection of the growing crops.

Among seeds examined for purposes other than export may be mentioned a sample of onion seed which showed the presence of *Botrytis Allii* as a seed-borne disease.

G. C. Ainsworth exhibited maps showing the world distribution of certain seed-borne fungi from the series of "Distribution Maps of Plant Diseases" now being issued by the Imperial Mycological Institute. He emphasized that seed-borne diseases are often a particularly suitable subject for legislation and this aspect was briefly discussed in connexion with fungi the range of which is, or is not yet, co-extensive with that of the host.

The importance of seed-borne diseases was stressed in an interesting discussion that followed the papers, and the meeting certainly proved successful in providing an opportunity for useful comment on this very topical problem. J. H. WESTERN.

IMPORTANCE OF POTATO VIRUS X IN THE GROWING OF POTATOES

By DR. KENNETH M. SMITH, F.R.S.,
AND
DR. ROY MARKHAM,
Plant Virus Research Station, School of Agriculture, Cambridge

VIRUS diseases are estimated to cause a loss in Great Britain of one million tons of potatoes a year, and this in spite of the importation of large quantities of seed potatoes; for example, last autumn and winter the Government imported 400,000 tons of seed potatoes from Scotland and Ireland.

There are three potato viruses which are of importance from the grower's point of view; they cause leaf-roll, severe and mild mosaic respectively. The first two diseases are aphis-transmitted and are infrequent in the best seed-growing areas of Scotland, where the aphis vector is uncommon. When these diseases do appear, they are easily visible and can be eliminated by careful roguing. With regard to virus X, which gives rise to mild mosaic, the situation is different. This virus, which occurs in strains of varying virulence, is present in a very high proportion of the best Scotch seed potatoes, not excluding those with a Stock Seed certificate. It is indeed scarcely an exaggeration to say that all the Scotch stocks of Kerr's Pink are infected with virus X. With the exception of a few varieties of potatoes, notably King Edward and Epicure, together with one or two others of less commercial importance, which react with a necrotic disease (top necrosis), the disease caused by virus X is extremely mild and often consists only of a faint and transitory mottling of the leaves. It is impossible, therefore, to say by inspection alone whether this virus is present or not, except in the severer strains, and roguing cannot be relied upon to eliminate the virus.

All the evidence suggests that virus X is not insect-transmitted, but Loughnane and Murphy[1] have demonstrated that it can spread from diseased to healthy plants in the field by contact of the haulms. In view of the widespread distribution of this virus, however, it is possible that other means of spread exist, and co-operative experiments are now being carried out in different parts of England and Wales to investigate this question.

Although the majority of Scotch seed potatoes are considered healthy, they are not virus-free; for that, as we hope to show, is not the same thing at all. As we have mentioned already, it is not possible to say by inspection alone whether a given potato plant is virus-free. Several careful tests must be carried out under controlled conditions in a glasshouse before that conclusion can be reached. Briefly, the tests consist first of inoculation to various plant species which are particularly sensitive to the several potato viruses (indicator plants), and secondly of grafting to susceptible varieties of potato. If all these tests are passed successfully, then the potato plant in question can be pronounced virus-free; and here we may remark, incidentally, that very few Scotch seed potatoes will pass these tests.

Where then can virus-free potatoes be found? At the Plant Virus Research Station at Cambridge are nucleus stocks of all the commercially popular potato varieties which have been grown in insect-proof glass-houses and rigorously tested for virus infection each year. These stocks were originally built up by Dr. R. N. Salaman, and since his retirement in 1939 they have been carried on and added to by us. There are, therefore, available small stocks of these potatoes which are definitely virus-free, including such varieties as Kerr's Pink and Up-to-Date which cannot be obtained elsewhere in this condition.

Obviously, however, such nucleus stocks are not going to benefit the seed potato trade unless they can be increased to an extent not possible with glasshouse culture. This multiplication is now being undertaken in co-operation with the National Institute of Agricultural Botany, and the procedure is as follows: the nucleus virus-free stocks of some twelve popular varieties were planted and grown under expert supervision in the best seed potato districts of Northern Ireland. As soon as a sufficient bulk of tubers was raised, the next step was to grow them in still more complete isolation. This has been achieved by planting the tubers on a small island—Islay by name—off the west coast of Scotland, where no other potatoes are grown. It is hoped that in about two years time several thousand tons of virus-free seed potatoes will be available.

Periodically samples of tubers are returned to Cambridge from Ireland for re-testing, and in 1944 1500 tubers which had been grown out of doors for three seasons were tested. Of these the great majority was still virus-free, though a few tubers of a particular line of Majestic potatoes were X-infected. We have reason to believe that some of these Majestic tubers might have been already infected before their dispatch to Ireland. This stock of Majestic was discarded. It seems clear from this and other experimental work that virus X spreads very slowly in the field; potato virus workers in Eire[2] have maintained certain potato stocks free of virus for several years by growing the plants in isolation and out of contact with each other.

RESULT OF ANALYSIS FOR VIRUS CONTENT OF EIGHT VARIETIES OF SCOTCH STOCK SEED POTATOES.

Variety	No. of tubers tested	No. of X-infected tubers
Arran Peak	Four	One
Arran Victory	Twelve	Twelve
Eclipse	Thirty-six	Thirty-six
Gladstone	Four	None
Great Scot	Nine	Nine
Kerr's Pink	Twelve	Twelve
Majestic	Fifteen	Five
Sharpes' Express	Twelve	Four

It should be noted that these tubers were from plants specially selected as healthy by a competent potato inspector in an attempt to increase the virus-free stocks at Cambridge.

Since the visible effects of the mild strains of X, which are the commonest, are so slight, the question may rightly be asked whether it is worth while to raise and maintain virus-free, and particularly X-free, potato stocks. In other words, does infection with virus X reduce the yield? This is the whole crux of the matter. Scott[3] in Scotland has carried out trials to investigate reduction of yield by virus infection. As his healthy control plants he used Stock Seed Certificate tubers and compared these with infected plants of four categories: (1) negligible mottle; (2) mild mosaic; (3) border-line severe mosaic; (4) severe mosaic. Scott's results showed that the least severe infection—negligible mottle—reduced the yield by about 13 per cent as compared

with his 'healthy' plants. Since it is probable that Scott's healthy plants were also X-infected (see our analysis of Stock Seed tubers), what he was actually doing was correlating reduction in yield with severity of symptoms. The question that really needs answering is: Does the presence of virus X in a given potato variety materially reduce the yield when there is little or no visible adverse effect upon the plant itself? There seems little doubt that there is a considerable reduction in yield. Bald[4] in Australia has published some results of experiments on these lines. He made yield trials on Up-to-Date potatoes, grading the severity of strains of X present in twenty-five families on the basis of their symptoms on an indicator plant (*Datura*). Bald estimated that the yield from completely healthy plants should be some 12 per cent higher than that from plants infected with the mildest strains of virus X.

Taking advantage of the opportunity offered by the 1,500 tubers from Ireland previously mentioned, all of which had been tested and found to be virus-free, a comparatively extensive yield trial was carried out at Cambridge. The potatoes used consisted of one early variety, one second early, three early main crops and four late main crops.

The potatoes were planted in sixty plots, each of four rows of ten half-tubers, and the middle two rows only of each plot were weighed on sampling. As soon as the plants were six inches above ground, half the plants were inoculated with a very mild strain of X derived from some Stock Seed Arran Peak potatoes. This strain of virus was deliberately chosen for its mildness and was by no means the most severe of those isolated from tubers having a Stock Seed certificate.

Some weeks later, twenty-five of the inoculated plants were selected at random and tested for the presence of virus, and all gave a positive reaction for virus X. It thus seems fair to assume that the inoculations had been effective, although it was not possible during the summer to pick out the inoculated plants by inspection.

On harvesting and weighing the tubers, it was found that the yield from the inoculated plants was 12 per cent below that of the virus-free plants, a difference which is highly significant. All the varieties showed reduction in yield from infection by virus X, but the data are not sufficient to differentiate varietal reaction with certainty. During the season, 105 of the healthy plants which were afterwards harvested were tested and found to be still virus-free.

These results seem to prove that infection with virus X, even with those strains which are normally passed over by the Scotch potato inspectors, results in a considerable loss of crop.

What evidence we have suggests that the elimination of potato virus X from the Scotch seed potatoes is by no means impossible. Since it appears that the spread of virus X in the field is slow and there is little evidence of its infiltration into a crop completely free from the start, the solution apparently lies in a gradual replacement of the X-infected Stock Seed, and in this process we hope that the stocks built up by the Plant Virus Research Station in conjunction with the National Institute of Agricultural Botany may play their part.

[1] Loughnane, J. B., and Murphy, P. A., *Sci. Proc. Roy. Dublin Soc.*, **22**, 1 (1938).

[2] Clinch, P., Loughnane, J. B., and Murphy, P. A., *Sci. Proc. Roy. Dublin Soc.*, **22** 17 (1938).

[3] Scott, R. J., *Scott. J. Agric.*, **23**, No. 3 (1941).

[4] Bald, J. G., *Aust. Coun. Sci. Indust. Res. Bull.* 165 (1943).

SOIL CONSERVATION IN THE BRITISH COLONIAL EMPIRE

A RECENTLY published article, "Soil Erosion and Soil Conservation in the Colonial Empire", by H. A. Tempany, G. M. Roddan and L. Lord (*Emp. J. Exp. Agric.*, 12, 121; 1944), brings the story of soil conservation in the British Colonies up to date. Much of the story is by now well known, and should be still better known, for it concerns closely the future welfare and sometimes the very existence of British Colonial territories. The menace of soil erosion has perhaps been somewhat exaggerated in the past; if so, it has been done with good reason, for the action necessary to remove the menace has only been taken after the people and more particularly the government authorities in London and the Colonies were thoroughly aroused by fear of catastrophe. Soil erosion is still prevalent and increasing throughout Africa, Ceylon, the West Indies and the Mediterranean Dependencies, but the fear of it seems to be abating. It has been shown that erosion can be controlled by apparently simple measures. As yet there are few areas where it has been completely controlled, but the knowledge that it can be has engendered confidence that it will be, and there is a tendency now to play down the menace, which in fact is neither greater nor less than it was.

The War has had a certain, not entirely unfavourable, influence on the progress of soil conservation. It has seriously depleted staffs and held up the construction of anti-erosion works which are often urgently needed; but at the same time it has helped to eliminate one of the root causes of soil depletion and erosion, namely, agriculture for export in a world market. The immediate effects of the War on soil-conservation programmes have undoubtedly been serious, but the long-term effects in promoting a change in methods of land utilization may be beneficial.

Many Colonial administrations now take a direct part in soil conservation, either through government-operated soil-conservation boards or committees, or by propaganda, education and the granting of subsidies for anti-erosion work. An important function of government is to promote co-operation between different departments (for example, of agriculture, forestry, public works, etc.), for soil conservation is the concern of the whole community. The authors give several instances where such co-operation is being realized with great advantage to the land. An important recent factor has been the provision of money from the Imperial Treasury through the Colonial Development and Welfare Fund for soil-conservation works.

Short accounts are given of the state of erosion and of the counter-measures being taken in each of the Colonial dependencies. The first impression given is that soil conservation is much the same everywhere. The following quotation refers to Basutoland, but the words are repeated with little variation in describing conservation measures in most of the other Colonies.

"The measures adopted comprised the laying out of contoured, broad-based terraces and the introduction of ploughing along the contour, the construction of earth-dams to check gully erosion and provide additional water-supplies for stock, combined with the planting of grass and trees to stabilize

contour banks and to assist the silting up of gullies, and the fencing of the banks of dams and of plantations to prevent damage by live stock. . . .

"Combined with these measures there must be improved methods of agriculture based on the introduction of mixed farming in place of the existing system. It is considered that the maintenance of crumb structure in the soil should be the aim and that this can only be maintained by suitable agricultural methods".

Many of the Colonies are still at the early contouring stage of soil conservation, at which the most urgent need is to construct mechanical barriers to run-off water and eroding soil. Some have reached the 'strip-cropping' stage, where contour cultivation is combined with an appropriate variant of ley farming, with the purpose of maintaining a crumb structure which will enable the soil to resist erosion with less absolute reliance on engineering constructions. Particular note may be taken of the remarkable success in restoring soil condition and fertility on exhausted land, achieved in Uganda by strip-cropping with elephant grass. Simultaneously, and not only in Uganda, local inhabitants are increasingly appreciating the value of livestock as an integral part of farming and not merely as a symbol of wealth.

Throughout the British Colonial Empire, agriculture is evolving at an accelerating pace from primitive, shifting cultivation to settled, intensive systems. There is danger now, as there has been always, that evolution may get out of hand; but at least we know what the goal is, we can even define it in terms of the physical properties of a fertile, erosion-resistant soil, and we know what agricultural operations will or will not advance the goal. The task of the future will be to synthesize the separate favourable operations into workable systems of land use. The engineering problems of soil conservation have been solved; the agricultural problems are well on the way to solution; and last, but by no means least, the complex social problems still remain to be solved.

OBITUARIES

Sir Charles Vernon Boys F.R.S.

CHARLES VERNON BOYS was born at Wing in the county of Rutland on March 15, 1855, the son of the Rev. Charles Boys. Wing continued to be his home for many years, and it was in his father's garden there that Boys thirty-three years later made with his radio-micrometer his well-known experiments on the heat received from the moon and stars.

At the beginning of his delightful little book on "Soap Bubbles and the Forces which Mould Them", Boys tells how his interest in science was first awakened. "To G. F. Rodwell, the first Science master appointed at Marlborough College, this book is dedicated by the author as a token of esteem and gratitude, and in the hope that it may excite in a few young people some small fraction of the interest and enthusiasm which his advent and his lectures awakened in the author, upon whom the light of Science then shone for the first time."

From 1873 until 1876, Boys was a student at the Royal School of Mines. In his Guthrie Lecture, delivered before the Physical Society of London in 1934, he mentioned that he was for a short time at a colliery, and that he was brought back to South Kensington by Guthrie, who made him his private assistant and gave him a life membership of the Physical Society. His connexion with that Society always remained a close one; he succeeded Guthrie as its demonstrator in 1886 and continued to be its demonstrator and librarian until 1898; he was later to become its president and was its second Duddell medallist. It was to the Physical Society that much of his work was communicated, including his first paper on "A Condenser of Variable Capacity and a Total Reflection Experiment". This was published in 1879, and in the title Boys is described as "Lecturer for the term on Natural Science at Uppingham School". In this and the following year papers were published by Boys and Guthrie on "Magneto-electric Induction" and by Boys himself "On an Integrating Machine". The latter was the first of many papers dealing with practical mathematics, including one on "An Elliptograph" published in his eighty-ninth year.

Boys was demonstrator of physics at the Royal College of Science, South Kensington, from 1881 until 1889, when he became assistant professor. Much of the work for which Boys is best known was carried out or begun during the years 1887–90. A preliminary note on the radio-micrometer was communicated to the Royal Society on February 24, 1887. In the tests of the method there described, he had used spun glass for the suspension of his radio-micrometer. In a note added a month later, he states that he has since found a method of producing fibres immensely superior to those of spun glass. These fibres of fused quartz obtained by his bow-and-arrow method were described in a paper, read before the Physical Society a little later in the same year, on the production, properties and some uses of the finest threads. The many uses of threads of fused quartz made possible by their perfect elasticity and great strength are there pointed out. An account of the perfected radio-micrometer was given to the Royal Society in the following year. He found a suitable application for the instrument in an investigation "On the Heat of the Moon and Stars", begun in September 1888 and published in the *Proceedings of the Royal Society* two years later. Boys found the radio-micrometer amply sensitive for the comparison of the heat received from different small areas of the moon's surface; it gave no certain indication of any heat received from even the brightest stars, although able to detect the heat received from a candle flame more than a mile away.

In 1889, Boys communicated to the Royal Society his ideas on improvements in the Cavendish experiment to determine the constant of gravitation, pointing out the advantages of reducing the scale of the apparatus; the use of a fibre of fused quartz for the suspension made it practicable to carry this reduction very much further than would otherwise have been possible. Boys' final measurements of the Newtonian constant of gravitation were carried out in the Clarendon Laboratory, Oxford, and published by the Royal Society in 1894. He had succeeded in reducing the length of the torsion rod from which the attracted masses were suspended from the six feet of the original Cavendish experiment to less than one inch; the measurement was more accurate than any previously made of the constant of gravitation.

From indications which he had observed of the high electrical insulating power of quartz fibres, Boys was led to make investigations on quartz as an insulator, which were published in 1890. Besides proving the great merits of quartz as an insulator,

these experiments gave very strong indications that some at least of the leakage of electricity from a charged body suspended in a closed vessel is not through the insulating support but by conduction through the air.

An account of experiments with a soap bubble was given by Boys to the Physical Society in 1888, and in December 1889 and January 1890 he delivered the Christmas Lectures before a juvenile audience at the Royal Institution, which formed the basis of his well-known book on soap bubbles referred to at the beginning of this notice. In this subject Boys found ample scope for the exercise of his wonderful ingenuity and manual dexterity.

Notes on photographs of rapidly moving objects and on the oscillating electric spark formed the subject of a communication to the Physical Society in 1890. He gave a popular lecture at the Edinburgh meeting of the British Association in 1893 in which he showed photographs of rifle bullets in flight and the air waves accompanying them. In a note communicated in 1937 to the Royal Society of Edinburgh, of which he had recently been elected an honorary fellow, he directs attention to the high speed of rotation given to a mirror by very simple means in these early experiments. He had used the rotating mirror to measure times as short as one hundred millionth of a second, and by its aid had found how to get an illuminating spark which lasted for only one thirteen-millionth of a second.

It was in 1888, in the midst of this wonderfully active period of his scientific life, that Boys was elected a fellow of the Royal Society ; he was awarded a Royal Medal in 1896 and the Rumford Medal in 1924.

In 1897 Boys became one of the Metropolitan gas referees. He greatly improved the methods of gas calorimetry, and the calorimeter described by him in the *Proceedings of the Royal Society* in 1903 was adopted as the standard instrument for testing London gas ; it came into general use in gas-works throughout Great Britain. He devoted much thought during many years to the planning of a still better gas calorimeter ; but it was not until 1934 that he finally arrived at a design which completely satisfied him. This was described in his Guthrie Lecture of that year. Boys tells in this lecture that the idea underlying one important part of the mechanism came to him in a dream. "I was sufficiently impressed by it to get up at six and go to Victoria Street, where I blew in glass the bulb and tube you now see". He was then in his eightieth year.

It is not surprising that Boys, after his experiments with electric spark discharges, should take an interest in the development of a lightning discharge. With the object of investigating this subject, of finding, for example, at what part of its path the discharge begins and the speed with which it extends itself, he constructed in 1900 a moving-lens camera, of which he gave a short description in *Nature* of November 20, 1926. Although he was in the habit of carrying this camera about with him, it was not until twenty-eight years after its construction that, while staying with Loomis in America, he succeeded in getting his first photograph which showed the progressive development of a lightning discharge. Boys must have been interested in lightning for at least half a century when this photograph was taken, for in the issue of *Nature* mentioned above he gives a most interesting account of observations of a distant thunder cloud which he had watched at Wing in 1876. For every flash seen in the rain cloud or below, and simultaneously with it, one or more very slender flashes of typical lightning (in one case as many as seven) were observed to shoot upwards into the clear sky.

In spite of the handicap of the loss of one eye and very defective vision in the other, Boys continued his varied scientific activities until the end of his long life ; when he was eighty he published little books on the natural logarithm and on weeds. It was in this year that he received his knighthood.

Boys does not appear to have been greatly interested in theoretical physics. His delight was in designing, constructing and manipulating apparatus for physical measurements of the highest accuracy, and in overcoming experimental difficulties which to most would have seemed insuperable. He was a really great experimenter, and his methods of working were original and often unconventional. He appears to have been equally original and unconventional in ordinary life.

Boys married in 1892 Marion Amelia, daughter of the late Henry Pollock, and they had one son and one daughter ; the marriage was dissolved eighteen years later.

Boys died on March 30, 1944, in his ninetieth year.

C. T. R. WILSON.

Mr. J. A. Gaunt

NEWS has recently reached Great Britain of the death of Mr. J. A. Gaunt on January 4, 1944 ; he died from myelitis as a prisoner of war in Hong Kong.

Gaunt entered Trinity College, Cambridge, from Rugby as a scholar in 1923, and had a distinguished undergraduate career, obtaining a mark of distinction in the Mathematical Tripos in 1926 and sharing the newly instituted Mayhew Prize. He then started to work on theoretical physics under the late Sir Ralph Fowler and soon became one of the most promising members of the rapidly expanding school which was being established at Cambridge in the latter half of the 1920's.

Gaunt's first paper was on the stopping power of matter for α-particles and was completed by March 1927. He next turned to statistical mechanics and extended some work by Fowler and by Eddington on stellar atmospheres. For this work, published under the title "The Debye-Hückel Theory and Stellar Atmospheres" (*Mon. Not. Roy. Ast. Soc.*), he was awarded a Rayleigh Prize in 1928. He then returned to the more congenial topic of quantum mechanics and wrote a number of short papers in rapid succession on such subjects as the theory of Hartree's self-consistent field and the relativistic theory of an atom with many electrons.

These early papers of Gaunt's were useful contributions to a rapidly growing subject, but his most important work is contained in two long and rather formidable papers published in the *Phil. Trans.* during 1929 and 1930, the first being on the triplets of helium and the second on continuous absorption.

The problem of calculating the triplet separations in helium was first tackled by Heisenberg, using non-relativistic quantum mechanics. The calculation is more difficult for helium than for heavier elements, since for helium the usual approximate theory is inadequate, retardation and other relativistic effects being of comparable importance to the spin-orbit and spin-spin interactions. When Dirac's relativistic theory of the electron appeared it was possible to

extend Heisenberg's work, and Gaunt was first in the field. His work has been superseded by that of others, notably by that of Breit, based upon a more thoroughgoing derivation of the fundamental equations from quantum-electrodynamics, but Gaunt made a very substantial contribution to a difficult problem.

In the 1920's the calculation of the absorption coefficient of matter for radiation was of great importance in astrophysics. Kramers' formula, based upon the old quantum theory and the correspondence principle, was in violent disagreement with the value of the absorption coefficient required according to the current astrophysical theories. It was therefore of considerable importance to calculate what the absorption should be according to wave mechanics. This was first done by Oppenheimer, who obtained a formula substantially different from Kramers'. Gaunt, who was working on the same problem, discovered an important mistake in Oppenheimer's calculations and rehabilitated Kramers' formula. He also extended Oppenheimer's work considerably.

These two long papers were completed in little more than twelve months work, and show Gaunt's great ability to handle complicated mathematical problems. It is remarkable that Gaunt should have been able to achieve so much in a single year, since he had already determined to give up theoretical physics for what he considered to be more important work. He was elected a research fellow at Trinity in October 1929, but never resided. Instead, he left England and went, under the auspices of the Church Missionary Society, as an assistant master at St. Stephen's College, Hong Kong, where he taught mathematics, English and Scripture to Chinese and Siamese boys. He acquired a good knowledge of Chinese, and his pupils liked and admired him, but were genuinely perplexed how a man of such ability came to be their teacher.

Gaunt never lost his interest in physics and found time to read such papers as were sent out to him by friends. Music gave him great pleasure, as did the opportunities he had for travel in China, especially in the mountainous regions. When the shadow of war hung over the Colony, Gaunt joined the Volunteer Defence Corps as a gunner, and took part in the brief struggle.

Gaunt was somewhat reserved with most people, but he had a strong sense of humour and a ready sympathy in the everyday affairs of life. It must have cost him much to make the sacrifice of going to China, but it was done with perfect cheerfulness, in obedience to his conviction of the supreme importance of Christianity. A. H. WILSON.

WE regret to announce the following deaths :

Prof. R. Bennett Bean, professor of anatomy in the University of Virginia during 1916–41, known for his work on the distribution, development and evolution of man, on September 3, aged seventy.

Lieut.-Colonel J. W. F. Brittlebank, C.M.G., president of the Royal College of Veterinary Surgeons during 1926–28, on December 18, aged sixty-eight.

The Rev. E. Tickner Edwardes, well known for his popular writings on bees and on general natural history, on December 31, aged seventy-nine.

Dr. J. Fitch King, professor of chemistry in Williams College, Williamstown, Massachusetts, on August 29, aged forty-nine.

NEWS and VIEWS

Prof. A. N. Whitehead, O.M., F.R.S.

THE award of the Order of Merit to Prof. A. N. Whitehead, of Harvard University, announced in the New Year Honours, will be widely acclaimed. Prof. Whitehead was first known as a mathematician, though of an unusual kind. Mathematics for him meant the "development of all types of formal, necessary, deductive reasoning" (preface to "Universal Algebra", 1898). This phase of his career culminated with the publication of "Principia Mathematica" (1910–12). It was afterwards, as most of us thought, that he turned to philosophy—with a remarkable contribution to the theory of knowledge in 1919–20, and later with a complete system of metaphysics expounded in a series of well-known works. It has been pointed out by Prof. V. Lowe (essay in "The Philosophy of A. N. Whitehead", 1941) that there was no sudden change; the philosopher was implicit in the mathematician, as could be seen in a paper of 1905.

Whitehead's later works have been much read and quoted—often misread and misquoted. That is the fate of a writer who is at times obscure, at times brilliantly epigrammatic. It is characteristic of his attitude to emphasize the need for abstract thought and also the fallacies that arise from it; the need for rule and order in life and also that mere order means futility. Whitehead's essays on the aims of education are too little known. Nobody has argued more persuasively for the value of history in education. As is more widely known, few have viewed human history with so keen and comprehensive an eye, and so wide and fine a sympathy.

Organization of Science in Great Britain

AN interim memorandum from the sub-committee on the future scope and organization of science in Great Britain which has been issued by the Parliamentary and Scientific Committee urges as an immediate measure the appointment by the Government of a committee, with the widest powers of securing information, to review the existing position of industrial research and development in British industry, and to plan a programme (covering, say, the next five years) aimed at remedying the most important defects and gaps in that field, so far as the national interest is concerned. Such a review would involve consideration of existing national resources at home, the probable economic position of Britain in the post-war world, and the lines along which the immediate, vigorous and large-scale application of scientific knowledge is likely to yield the most fruitful results. In this connexion the sub-committee stresses the necessity for special attention to scientific research on the treatment of coal. The review would also involve investigation into the points at which British industry in general, and certain industries in particular, have failed in the past to utilize scientific knowledge, the loss to the national interest which has resulted from this failure and the steps which

can be taken to prevent the recurrence of similar failure. The sub-committee does not consider that a review of this type, involving specialized technical knowledge of a number of different industries, combined with a particular appreciation of the facts affecting the position of Great Britain in the world economy, could be adequately carried out by any existing agency. While the proposed committee should take its evidence in secret, an early and informative report is regarded as essential, first as a means of bringing home to industry and the public the realities of the existing situation, and secondly, to afford a basis for settling the plan of action required to recover and maintain the industrial strength upon which our future as a nation depends.

Newton and His Portraits

MR. F. E. BRASCH, of the United States Library of Congress, has selected some of the best portraits of Newton for publication in *Scripta Mathematica* (8, 199; 1941). The earliest is by Sir Peter Lely, and is supposed to show Newton (who was born on Christmas Day, 1642, Old Style) as he appeared in 1665 (the year of the Great Plague), but there is grave doubt whether Newton sat for this. The first portrait that can be guaranteed authentic is by Sir Godfrey Kneller, and is dated 1689, two years after the publication of the "Principia". The other portraits all show Newton as president of the Royal Society, a position he held from 1703 until his death in 1727. One is by William Gandy (1706), four by Johann Vanderbank (1720, 1725, 1726 and 1726 again), and one by an unknown artist. There are also photographs of a bas-relief attributed to Wedgwood, of a bronze statue by the American sculptor C. E. Dallin (1897), and of the reconstruction in Wellesley, Mass., U.S.A. of the actual parlour from Newton's house in Leicester Fields, St. Martin's Street, London.

In another article (*Science*, 99, 437; 1944), Mr. Brasch gives us some information about the influence of Newton on Russian science. For some unknown reason, Newtonian ideas were ignored in Russia long after they had been accepted in France, Germany and other countries. Indeed, it was not until quite recently that the formal recognition of his work became evident. His "Optics" was translated into Russian in 1927, and the "Principia" in 1936. However, the celebrations of the tercentenary of Newton's birth left nothing to be desired. They were on an impressive scale, much exceeding those in Great Britain, and culminated in the founding of fifteen Isaac Newton studentships.

Texas Meteor Cloud

OSCAR E. MONNIG has described the effects of a fireball observed on May 20 over Texas (*Sky and Telescope*, September). It travelled from west to east and left a meteor cloud; photographs, some of which are reproduced, were taken by different people. Unlike some fireballs, this one did not leave a persistent train; two minutes after Ray Dudley, in the middle of Pampa, had taken a photograph, he was able to secure another one which showed a great change, not only in the brilliance of the meteor cloud, but also in the amount of diffusion that had taken place. The sun had set 40 minutes in some places and 20 minutes in others when it was seen, and as it was visible for a radius of more than 300 miles, it must have been a very imposing object at first. Atmospheric resistance slowed down its speed, which was almost below that of incandescence 13 miles north-west of Pampa. Attempts to find fragments of the fireball, which almost certainly disintegrated (though there is no record of a report due to disintegration such as is often heard with fireballs) have so far been unsuccessful, but it is hoped that some of the debris will be obtained. A provisional path has been computed, and it appears that it became visible at a height of 56 miles, the dense cloud being formed at a height of 23 miles (this latter is considered very accurate), and its direction of flight was at an angle of about 45° to the horizon.

Insect Pest Resistance in Plants

THE Imperial Bureau of Plant Breeding and Genetics, Cambridge, has issued a Bibliography on Insect Pest Resistance in Plants (*1s. 6d.*). The sources drawn upon include publications from the British Commonwealth, the main European countries, the United States and various South American countries, the U.S.S.R. and Japan. In all, there are more than 550 references arranged according to subject, the chief of these being cereals, roots and tubers, cotton, sugar-cane, fruits and vegetables. Nematodes are dealt with in a special section. Many of the publications included have been abstracted in *Plant Breeding Abstracts*, and in many instances the original publications cited are available at the Bureau or in some co-operating library, and further information can therefore, if necessary, be obtained on application to the Bureau. It is believed that the bibliography will be of practical assistance not only to the breeder and the geneticist, but also to all who are interested in the solution of the important problem of the fundamental basis of insect or nematode resistance among crop plants.

Poliomyelitis in Argentina

THE July issue of the *Boletín de la Oficina Sanitaria Panamericana* contains an instructive article by Dr. G. Bayley Bustamante, assistant professor of public health, Buenos Aires, dealing with the last outbreak of poliomyelitis in the Argentine (October 1942–May 1943 with 1,948 cases). This was probably the largest outbreak, although epidemics were reported in 1909, 1911, 1916–17, 1919–20, 1924–25, 1932–33, 1934–35 and 1936, mostly in the Buenos Aires and Rosario Area, with smaller outbreaks and sporadic cases in the rest of the country; but paralytic cases figure in the statistics in 1941. There were 355 cases (189 in the Province of Santa Fé), which was an increase on the usual yearly figures. The 1942 epidemic in the southern suburb of Buenos Aires then extended into the city and to the rest of the province, with the peak in November and December; it increased along the coast after January and moved northward. The incidence was highest in the Buenos Aires sector. Half the cases were in children aged 1–3 and another 10 per cent in those less than 1 year. The death-rate ranged from 3·5 to 23–25 per cent, usually being 10 per cent. Of the eight large Argentine epidemics, four began in February and one each in June, September, October and November. The 1942–43 epidemic had its peak in October–November (spring); the year had been characterized by a hard but short winter, an early warm spring and a very hot and dry summer.

Leprosy in the Dominican Republic

ACCORDING to Dr. Guillermo Iliviera (*Bol. Of. San. Panamer.*, 22, 987; 1943), medical superintendent of the National Leprosarium of the Dominican Republic, 212 cases of leprosy have been treated there during the period 1922–42, or are still confined there. 142 were men and 70 women. There were 75 deaths and 23 births. 147 cases were from the southern zone, while 44 were from the northern zone; the central area was practically free from the disease. Estimating the total number of lepers in the Republic both in and out of the leprosarium at 224, one obtains a ratio of one leper per 8,500 inhabitants, which is much lower than that of India (1 per 3,000) and Japan (1 per 1,000).

Performance of Cable Terminations

IN a paper read by D. B. Irvin before the Institution of Electrical Engineers in London on November 8, the performance, over the period of twelve years ended 1943, of the cable terminations on the British Grid system at voltages between 3·3 kV. and 132 kV. is reviewed, and the causes of breakdown are examined. For the period under review, termination failures account for approximately 40 per cent of the total cable circuit faults and they are classified as follows: design 39, workmanship 2, design or workmanship 18, maintenance 9, and system conditions 12. Failures on 6·6, 11 and 33 kV. circuits predominate. The failures attributed to design and workmanship were mainly due to imperfect stress control, inadequate internal clearances, compound migration, and presence of moisture; the incidence of these is discussed in the paper. The fundamental characteristics required of a cable termination are: (*a*) ability to withstand the electrical stresses associated with normal and emergency conditions of the voltage of the system and the occasional high-voltage impulses to which it will be subjected in service; (*b*) ability to carry the maximum rated current of the circuit and the maximum fault current of short duration to which the circuit is liable; (*c*) retention of its initial electrical and mechanical qualities without deterioration, during the statutory life of the cable circuit in which it is incorporated; and (*d*) economic cost to the user. Sectional drawings are included showing improved designs of sealing ends for various sizes and types of cables for voltages ranging from 3·3 to 132 kV., and the salient features of these are discussed briefly.

Design of A.C. Turbo-Generators

IN a paper read by G. A. Juhlin on December 7, before the Institution of Electrical Engineers in London, on the standardization and design of A.C. turbo-type generators, the possibilities of complete unification of designs, an alternative of mechanical interchangeability, and the standardization of requirements, which is the first step in either of these directions, are considered in turn. The author discusses standardization of design, future development, and standardization of requirements, which latter is the really valuable part of the paper. The conclusions arrived at are that for both commercial and technical reasons complete unification of designs must be regarded as impracticable under present conditions, and it seems very doubtful whether the alternative of mechanical interchangeability would be feasible.

Announcements

DR. F. W. ASTON has been awarded the twenty-first Duddell Medal of the Physical Society, in recognition of his invention and development of the mass spectrograph.

PROF. G. M. BENNETT, University professor of chemistry at King's College, London, since 1938, has been appointed Government chemist in succession to the late Sir John Fox.

THE title of emeritus professor of geography in the University of London has been conferred upon Prof. E. G. R. Taylor, in recognition and appreciation of her distinguished services to the University and to her subject.

FOLLOWING on the recent appointment of Prof. J. A. Scott Watson as chief education and advisory officer to the Ministry of Agriculture and Fisheries, the Minister, in preparation for the setting up of a National Agricultural Advisory Service, has appointed the following senior education and advisory officers as from January 1: Mr. F. Rayns, Dr. W. K. Slater and Dr. H. V. Taylor. Mr. Rayns's appointment is on a part-time basis, and he will continue to act as director of the Norfolk Experimental Station, Sprowston. He is succeeded as executive officer to the Norfolk War Agricultural Executive Committee by Mr. J. C. Mann, who was deputy executive officer of the Committee.

THE Therapeutic Research Corporation has elected the following officers for the year 1945: chairman of Board of Directors, Lord Trent (Boots Pure Drug Co., Ltd.), in succession to Mr. H. Jephcott (Glaxo Laboratories, Ltd.); deputy chairman, Dr. F. H. Carr (The British Drug Houses, Ltd.); chairman of Research Panel, Mr. F. A. Robinson (Glaxo Laboratories, Ltd.), in succession to Dr. A. J. Ewins (May and Baker, Ltd.); deputy chairman, Dr. C. H. Kellaway (Wellcome Foundation, Ltd.), in succession to Mr. F. A. Robinson (Glaxo Laboratories, Ltd.).

IN view of the importance which civil air transport will assume after the War, the Council of the Institution of Civil Engineers has decided to form a sixth Engineering Division to be known as the "Air Transport Division", to deal with such aspects of air transport as airports (land and sea), airfields, operational buildings and facilities, hangars, and signalling and other appliances in connexion with safety in flying. Until such time as a fully constituted divisional board has been elected, Mr. M. G. J. McHaffie has been appointed chairman of a provisional board.

THE twenty-seventh election to Beit Fellowships for Scientific Research will take place on or about July 7, when not more than three fellowships will be awarded. Candidates may be of any nationality but must be of European descent by both parents; and must be of university degree standing. Forms of application and all information may be obtained, by letter only, addressed to the Registrar, Imperial College, South Kensington, London, S.W.7, to whom they must be returned on or before April 6.

AT a meeting of the Physical Society to be held at the rooms of the Royal Society on January 19 at 5 p.m., a lecture on "Imperfections of Crystal Lattices as investigated by Study of X-Ray Diffuse Scattering" will be delivered by Dr. A. Guinier, of the Laboratoire d'Essais, Conservatoire National des Arts et Métiers, Paris.

LETTERS TO THE EDITORS

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

Dextran as a Substitute for Plasma

As is well known, we have in blood, plasma and serum adequate media for the treatment of shock, for example, in cases of serious loss of blood or contusions. During the present War, however, it has proved impossible completely to supply the large requirements of these materials. It is therefore natural that physiologists and chemists are seeking for substances the aqueous solutions of which can replace the expensive and delicate blood or plasma.

In the course of the War of 1914–18, Bayliss[1] attempted to employ solutions of gum arabic for purposes of infusion. Later, other substances such as gelatin, polyvinyl alcohol, pectin, polyvinylpyrrolidone and others were tested to this end. The infusion of these colloids has, however, been attended by certain difficulties. Some of the substances tested have antigenic properties, whereas others cannot be broken down by the organism, for which reason they are stored in the organs, especially in the liver.

The conditions to be fulfilled by a foreign colloid in order that it may exercise a therapeutic effect in cases of shock are, in brief, as follows:

In all cases of shock, both in bleeding and in contusions and burns, it is essential to increase the volume of the circulating blood by the infusion of a liquid. This cannot be done satisfactorily with solutions of crystalloids. The infused liquids must instead contain colloids that exert the same colloidal osmotic pressure as the plasma proteins, or 300–400 mm. water. A condition for the exertion of this pressure by the colloids is that they must be of such a molecular size that they cannot pass through the walls of the capillaries.

The colloid must be suited to repeated intravenous injection in large quantities. It must also be completely atoxic and devoid of antigenic properties.

The solutions must not have a high viscosity. The viscosity should preferably be of the same order as that of the blood.

Finally, the substance should be of such a nature that the body can gradually rid itself thereof, so that it does not remain long in the blood and is not stored in the organs.

A substance not previously tested for this purpose and apparently fulfilling the requirements listed above is the neutral polysaccharide dextran. Dextran is a water-soluble high-molecular carbohydrate which is formed in solutions of sugar infected with the bacterium *Leuconostoc mesenteroides*. It has been possible to show that the dextran molecule is built up of glucose units, linked together in long, more or less branched chains[2]. The molecular weight of dextran may be very high, of the order of magnitude of many millions[3,4,5]. By partial hydrolysis dextran preparations of lower molecular weight, for example, of the order of 100,000–200,000, can be made[6]. The partially hydrolysed dextran, like the original substance, is inhomogeneous with respect to molecular weight.

By well-controlled partial hydrolysis it is possible to prepare dextran solutions for purposes of infusion in which the solute has a suitable molecular weight and which do not give rise to injuries or reactions even after repeated large infusions. The sedimentation reaction, however, is increased after infusion (which has also been observed after infusion of, for example, gum arabic). The viscosity and colloidal osmotic pressure of the 6 per cent solutions employed (with 1–3 per cent sodium chloride) are of the same order as those of blood[1,7].

The solutions can be autoclaved and the preparation distributed in concentrated solutions or in the form of dry powder.

If a normal infusion dose is injected intravenously into a dog, the dextran concentration in the blood falls to zero in the course of three to four days. During the whole of this period dextran can be detected in the urine. The dextran ejected with the urine has a lower molecular weight than that originally injected. Even after repeated large infusions, no storage in the organs can be demonstrated histologically[6,7].

As dextran is broken down by the organism, glucose and relatively low-molecular fragments of dextran are presumably formed, which can pass the kidney filter and be expelled with the urine.

The therapeutic effect was investigated experimentally in cases of shock from bleeding, histamine shock and contusion shock developed artificially in rabbits and cats. Rapid and lasting effects on the blood pressure, heart action and respiration were always registered[6].

The experiments on animals giving favourable results, a clinical investigation was therefore commenced, at first on a limited scale. As the first clinical tests also gave promising results, and as there is reason for supposing that dextran is better suited as a plasma substitute than, for example, gum arabic, polyvinylpyrrolidone or pectin, it was considered justified to set in train a more thorough clinical investigation. An account of this will be submitted at a later stage.

We wish to thank Prof. Arne Tiselius for helpful advice and Profs. T. Svedberg and A. Westerlund for the provision of laboratory facilities. The research has been carried out with grants from A. B. Pharmacia, Stockholm, and Svenska Sockerfabriks A.B., Malmö.

ANDERS GRÖNWALL.
BJÖRN INGELMAN.

Institute of Physical Chemistry,
University of Uppsala.

[1] Bayliss, W. M., *J. Pharm. Exp. Therap.*, 15, 29 (1920).
[2] Levi, J., Hawkins, L., and Hibbert, H., *J. Amer. Chem. Soc.*, 64, 1959 (1942).
[3] Grönwall, A., and Ingelman, B., *Acta Physiol. Scand.*, 7, 97 (1944).
[4] Ingelman, B., and Siegbahn, K., *Ark. Kem. Min. Geol.*, 18B, No. 1 (1944).
[5] Ingelman, B., and Siegbahn, K., *Nature*, 154, 237 (1944).
[6] Grönwall, A., and Ingelman, B., *Acta Physiol. Scand.*, in the press.
[7] Grönwall, A., and Ingelman, B., *Nordisk Medicin*, 21, 247 (1944).

Reactivity of the Sulphur Linkage in Wool

WHEN a wool fibre is rubbed lengthways between finger and thumb, it migrates in the direction of the root end because the surface consists of a series of overlapping scales. Similarly, when a fabric containing wool fibres is rubbed in presence of aqueous media, the fibres migrate and cause the material to shrink. Such shrinkage is usually prevented by treating the fabric with compounds which are capable of forming a gelatinous degradation product of keratin on or under the scales of the fibres. A survey

of the properties of these compounds suggested[1] that any reagent which is capable of causing disulphide-bond breakdown should make wool fabrics unshrinkable if it is applied under conditions such as to restrict its action to the surface of the fibres. Confirmation of this deduction has since been provided by the discovery of methods for conferring an unshrinkable finish on wool by means of sodium hydroxide[2], sodium sulphide[3], and alkaline solutions of mercaptans[4].

Further evidence that disulphide-bond breakdown is the essential cause of unshrinkability has now been obtained by comparing the action of chlorine, sulphuryl chloride and sodium hydroxide on untreated wool and wool in which some of the disulphide bonds are replaced by more resistant cross-linkages. The most simple method of preparing wool containing a large number of stabilized cross-linkages is by treatment with dilute sodium hydroxide solution in the cold for several hours. Some of the disulphide bonds are thereby replaced by $-CH_2-S-CH-$[5] and $-CH=N-$[6] cross-linkages, the presence of which is indicated by the fact that fibres (human hair) immersed in 0·1 *N* sodium hydroxide solution for six hours or more at 22·2° C. are incapable of supercontraction in boiling sodium bisulphite solution, whereas corresponding untreated fibres contract 23·8 per cent under similar conditions.

For the purpose of these experiments, therefore, two 2·5-gm. patterns of an all-wool flannel were immersed in 2 litres of 0·1 *N* sodium hydroxide solution for 10 hours at 22·2° C., the solution being renewed after the first five hours to prevent undue accumulation of sodium sulphide. After being washed in running water overnight, one of the patterns was removed and treated with 4 per cent chlorine (on the weight of the wool) in a buffer solution at *p*H 4. The fabric was then treated with 1 per cent sodium bisulphite solution, neutralized with 0·5 per cent sodium bicarbonate solution, and finally washed in running water overnight. An untreated pattern of flannel was chlorinated in the same way, and the three patterns, with a sample of untreated flannel, were milled together by hand in 5 per cent soap solution. The resulting shrinkages are given in the accompanying table, which includes corresponding data for 2·5-gm. patterns treated either for 1 hour at 22·2° C. with 100 c.c. of a 2·5 per cent (v/v) solution of sulphuryl chloride in carbon tetrachloride, or for three hours at 22·2° C. with 10 c.c. of a 7 per cent solution of sodium hydroxide in butyl alcohol made up to 100 c.c. with white spirit.

Treatment	Percentage shrinkage in area of patterns treated with 0·1 *N* sodium hydroxide for:	
	10 hours	24 hours
Untreated	30·6	31·7
Chlorinated	9·2	4·3
Sodium hydroxide	26·4	27·5
Sodium hydroxide and chlorinated	20·7	18·0
Untreated	30·8	32·6
Sulphuryl chloride	5·9	−0·9
Sodium hydroxide	27·1	26·8
Sodium hydroxide and sulphuryl chloride	26·8	13·0
Untreated	36·3	37·9
Sodium hydroxide dispersion	5·1	3·5
Sodium hydroxide	28·1	27·7
Sodium hydroxide and the sodium hydroxide dispersion	15·6	24·4

A second series of experiments was carried out with patterns which had been treated with 0·1 *N* sodium hydroxide solution for 24 hours at 22·2° C., with renewal of the solution after ten hours treatment. In all cases, the shrinkages are based on the wetted-out areas of the patterns immediately before milling.

The ability of the fabric to acquire an unshrinkable finish is reduced very considerably by previous treatment with 0·1 *N* sodium hydroxide solution, even though all the disulphide bonds of the wool are not converted into more resistant cross-linkages. It must, therefore, be concluded that disulphide-bond breakdown is the main, if not the only, cause of the unshrinkability imparted to wool by chlorine, sulphuryl chloride and sodium hydroxide. The results have the further importance of revealing that strict control of those operations in which wool is exposed to the action of alkalis, notably in scouring, is essential if satisfactory and reproducible results are to be obtained in practice with the above reagents.

W. J. P. NEISH.
J. B. SPEAKMAN.

Textile Chemistry Laboratory,
University, Leeds.
Nov. 28.

[1] Speakman, Nilssen and Elliott, *Nature*, **142**, 1035 (1938).
[2] Freney and Lipson, *Aust. Coun. Sci. and Indust. Research, Pamphlet* No. 94 (1940). Tootal Broadhurst Lee Company, Limited, Hall and Wood, Brit. Pat. 538,396.
[3] Parker, Farrington, Stubbs and Speakman, Brit. Pat. 539,057.
[4] Arthur and Goebel, U.S. Pat. 2,238,672.
[5] Speakman and Whewell, *J. Soc. Dyers and Colourists*, **52**, 380 (1936). Horn, Jones and Ringel, *J. Biol. Chem.*, **138**, 141 (1941).
[6] Phillips, *Nature*, **138**, 121 (1936). Speakman, *Nature*, **138**, 327 (1936).

The Food Finding of Wireworms (*Agriotes* spp.)

THE apparent efficiency with which wireworms (*Agriotes obscurus*, *lineatus* and *sputator*), when in an active feeding phase, find crop plants on which to feed is very striking. It is displayed even though these plants may not be particularly closely spaced and at first occupy only a very small proportion of the total soil surface. This makes it appear improbable that random wandering either on or in the soil could offer a complete explanation. Yet in spite of this, and of the enormous literature on wireworms, there seem to be no studies on record which throw any clear light on the methods by which the food is found. The potential importance of such knowledge as a basis for the elaboration of trapping methods needs no emphasis, and it was largely for this reason that the work here described was undertaken. It is hoped that the first paper dealing with these investigations will shortly be in the press. The object of this letter is to summarize certain broad conclusions which have so far emerged.

It is now well established (see D. S. Falconer[1]) that wireworms under suitable conditions of temperature and humidity will come up to wander on the surface of the soil. Accordingly, preliminary investigations with olfactometers of various types were made. No evidence was found that wireworms are capable of orientating themselves to the airborne odours of favoured food plants. This being so, work proceeded on the assumption that wireworms can orientate themselves in the soil by means of some substance or substances emanating from plant roots or other tissues and dissolved in the soil water.

Responses of wireworms in the soil were investigated by means of two types of apparatus, one which tests

INTRODUCTION TO PHYSICS

By HARLEY HOWE

Professor of Physics, Cornell University

559 pages, 9 × 6, Illustrated, 22s. 6d. net

UNUSUAL precision of statement and clarity of concept make this new book admirably suited as a course in physics for non-technical students. A thoroughly articulated presentation of the subject is maintained, adhering to the traditional order in Mechanics, and to the general order of Mechanics, Sound, Heat, Electricity and Light. The discussions are related to everyday experience or to simple proposed demonstrations when familiar experience is too complex. Trigonometry is not used. A feature of the text is the wealth of exercises, questions and problems, and summaries.

The approach to electricity emphasizes the practical aspects of the subject, and currents are stressed throughout the entire discussion. Static electricity is introduced for its essential vocabulary; magnetism is made incidental and is described as a result of intra-atomic currents.

McGraw-Hill Publishing Co. Ltd.

Aldwych House, London, W.C.2

Telephones: MAYfair 6682 (4 lines)

Telegrams: ABINITIO, WESDO, LONDON

SOTHEBY & CO.

(ESTABLISHED 1744)

34-35 New Bond Street, London, W.1

will hold the following sale on JANUARY 22nd & 23rd, 1945, commencing at 11 a.m. precisely, each day.

ON VIEW AT LEAST TWO DAYS PRIOR

Unillustrated catalogues may be had, price 3d. per copy, post free, prepaid

PRINTED BOOKS

A few Illuminated Manuscripts, etc.

COMPRISING

ENGLISH AND FRENCH LITERATURE, ITALIAN MANUSCRIPTS, WORKS ON ITALIAN ART, ETC.

The Property of Henry Harris, Esq.

RARE ENGLISH AND GERMAN WORKS ON ENTOMOLOGY

THE PROPERTY OF THE LATE W. R. SHELDON, ESQ.

RETURNE FROM PARNASSUS, 1606 AND FOUR IMPORTANT MSS. BY WALTER PATER

The Property of the late W. H. Woodward, Esq.

Oriental Miniatures and Manuscripts; Works on French and English Painters; French 18th Century Illustrated Books; Bibliography; Works on India and the Far East, Oriental Art, etc.

ARNOLD BOOKS

Handbook of Industrial Radiology

By Members of the Industrial Radiology Group of the Institute of Physics, edited by **J. A. CROWTHER, M.A., Sc.D., F.Inst.P.** viii + 204 pages, fully illustrated and documented. 21s. net.

Deals with the application of X-rays to Heavy Metals, Light Metals and various other materials, the design of X-ray equipment, X-ray protection, gamma radiography, and the response of photographic materials to X-rays.

Ions, Electrons and Ionizing Radiations

By **J. A. CROWTHER, M.A., Sc.D.,** Professor of Physics at the University of Reading. *Seventh Edition.* xii + 356 pages, with 117 diagrams. 12s. 6d. net.

"It easily keeps its place as one of the best descriptions of Atomic Physics now in the field."—*Trans. of Faraday Society.*

General Astronomy

By **Sir HAROLD SPENCER JONES, M.A., Sc.D., F.R.S.,** Astronomer Royal. *Second Edition.* viii + 437 pages, 115 diagrams and 28 plates. 15s. net.

"We can confidently recommend the Astronomer Royal's book as the most up-to-date and comprehensive review of astronomy at present available in the English language."—*Discovery.*

Sound: A Physical Text-Book

By **E. G. RICHARDSON, B.A., D.Sc.,** Senior Lecturer in Physics, King's College, Newcastle-on-Tyne. *Third Edition.* viii + 348 pages, 118 illustrations. 18s. net.

"To be unreservedly commended as a suitable introduction to advanced study and research."—*Trans. of Faraday Society.*

An Introduction to the

Modern Theory of Valency

By **J. C. SPEAKMAN, M.Sc., Ph.D.,** Lecturer in Chemistry, University of Sheffield. viii + 158 pages. *Second Edition.* 5s. 6d. net.

"The striking feature of the book is its simplicity. It can be strongly recommended as a very lucid introduction."—*School Science Review.*

Applied Chemistry for Engineers

By **E. S. GYNGELL, Ph.D., B.Sc.,** Head of the Chemistry Dept., Technical College, Derby. viii + 320 pages, 135 diagrams. 15s. net.

"Although written for engineers, it should be read by every student of chemistry who wishes to acquire an insight into something more than the purely theoretical side of his science."—*Nature.*

Detailed Prospectuses and Catalogue on request.

EDWARD ARNOLD & CO.
41 & 43, MADDOX ST., LONDON, W.1

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

CITY OF LIVERPOOL

APPOINTMENT OF DIRECTOR OF MUSEUMS

(Comprising the following Departments each under a Keeper: Geology, Botany, Vertebrate Zoology, Invertebrate Zoology, Ethnology, Shipping, and Archaeology.)

The Council of the City of Liverpool invite applications for the appointment of Director of Museums at a salary of £900 per annum, increasing to £1,000 per annum after two years' service.

The age of applicants must not exceed 50 years.

Applications submitted by persons at present engaged on national service and unable to take up the post immediately will receive consideration.

The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937, and the Standing Orders of the City Council, and will be determinable by three calendar months' notice on either side.

Forms of Application and particulars of the Duties and Conditions of the Appointment may be obtained from me, and applications, accompanied by copies of three recent testimonials, must be addressed to me, endorsed "Director of Museums," and received on or before Wednesday, February 28, 1945.

W. H. BAINES,
Town Clerk.

Municipal Buildings,
Dale Street, Liverpool, 2.

THE QUEEN'S UNIVERSITY OF BELFAST

JUNIOR LECTURESHIP IN CHEMISTRY

Applications are invited for the Junior Lectureship in Chemistry in the University. The salary attached to the office is £400 per annum. The appointment in the first instance will normally be for a probationary period of three years, but at the end of this period he will be eligible for promotion to the grade of Lecturer at a salary of £525, rising to a maximum of £600 per annum. The successful candidate, if not already a member of the Federated Superannuation system for Universities, will be required to become one; he will be expected to take up duty on Oct. 1, 1945, but candidates who are on approved National Service may be allowed to defer doing so until released from such duties. Nine copies of applications and testimonials should reach the undersigned on or before April 30, 1945.—Further information may be obtained from:

RICHARD H. HUNTER.
Secretary.

THE QUEEN'S UNIVERSITY OF BELFAST

CHAIR OF CHEMISTRY

The Senate will shortly proceed to the appointment of a Professor of Chemistry in the University. The salary attached to the office is £1,200 per annum, and the successful candidate, if not already a member of the Federated Superannuation System for Universities, will be required to become a member; he will be expected to take up duty on Oct. 1, 1945, but if he is on approved National Service he may be allowed to defer doing so until released from such duties. Nine copies of applications and testimonials should reach the undersigned on or before March 31, 1945.—Further particulars may be obtained from:

RICHARD H. HUNTER.
Secretary.

THE QUEEN'S UNIVERSITY OF BELFAST

CHAIR OF MATHEMATICS

The Senate will shortly proceed to the appointment of a Professor of Mathematics in the University. The salary attached to the office is £1,200 per annum, and the person appointed, if not already a member of the Federated Superannuation System for Universities, will be required to become a member. Nine copies of applications and testimonials should reach the undersigned not later than March 31, 1945.—Further particulars may be obtained from:

RICHARD H. HUNTER,
Secretary.

Polyglot Translation Service Ltd., 287 Terminal House, London, S.W.1. Telephone: SLOane 7059. Translations of every description from and into all languages.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR

SCHOOL OF AGRICULTURE

Applications are invited for the post of ADVISER IN AGRICULTURAL ZOOLOGY. The appointment is in the Scientific Officer Grade of the Advisory Scheme of the Ministry of Agriculture. Salary £400 to £680 per annum, according to qualifications and experience, plus war bonus. Three copies of application, accompanied by copies of three testimonials, should be submitted not later than Saturday, January 20, 1945, to the Acting Registrar, School of Agriculture, University College of North Wales, Bangor, from whom further particulars may be obtained.

UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF METALLURGY

A Mathematical Physicist is required to join a small research team working on problems connected with welding; the work will be both theoretical and experimental, and will deal with the investigation of stresses in metal lattices. The investigator will be permitted to use his research results in applying for a higher degree. A salary of about £300 is offered.—Applications, with references, should be sent before Jan. 20 to the undersigned.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF METALLURGY

Applications are invited for the post of Lecturer in Metallurgy, at a salary up to £450 per annum, according to qualifications. The appointment will be temporary in the first instance. Consideration will be given to graduates in Chemistry or Physics who have had some metallurgical experience.—Applications should be made to the undersigned before Jan. 30, 1945.

C. G. BURTON,
Secretary,

The University,
Edmund Street, Birmingham, 3.

SOUTH-EASTERN AGRICULTURAL COLLEGE WYE, ASHFORD, KENT

Applications are invited for the post of Assistant to the Advisory Chemist for the South-Eastern Province under the scheme of the Ministry of Agriculture and Fisheries. The appointment will be in the Temporary Senior Scientific Assistant grade, with a commencing salary of £300 p.a. (male), £240 p.a. (female), plus war bonus.—Further particulars may be obtained from the Acting Principal, to whom applications, together with copies of three recent testimonials, should be addressed not later than Jan. 30, 1945.

DERBY TECHNICAL COLLEGE

NORMANTON ROAD, DERBY

The Governors of the College will proceed to the appointment of the HEAD OF THE PHYSICS DEPARTMENT. Salary scale £480—£25—£680, plus £52 war bonus.

Further particulars and application forms may be obtained from the undersigned, to whom they should be returned not later than Monday, Jan. 22, 1945.

W. ALFRED RICHARDSON,
Principal.

Plant Engineer required by a firm in Middlesex, not more than 40 years of age. Must have general scientific educational background, degree in physics or mechanical engineering. Some precision engineering experience essential. The successful applicant would be required to undergo a detailed course of training in film processing. Ultimate responsibility would be maintenance of complex and specialized plant and control of associated engineering staff of approximately 150. Salary £800 to £1 000, depending on experience.—Applicants should write, quoting C.2321XA, to the Ministry of Labour and National Service, Central (Technical and Scientific) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before Jan. 27, 1945.

Scientific Apparatus Manufacturers and LABORATORY FURNISHERS in London area have the following staff vacancies with good future prospects: TECHNICAL REPRESENTATIVE of University standard in science or with extensive trade experience, with personality and initiative. Applicant should be prepared to undergo 6—12 months' training in our internal organization. ASSISTANT BUYER for section of Buying Department purchasing electrical components and light engineering parts for assembly. Applicant should have sound electrical knowledge, business experience, and be capable of carrying out instructions from Production and Designs Departments. May be required to undergo preliminary training in workshops. ASSISTANT ESTIMATING CLERK with secondary education, matriculation standard in science, or with laboratory experience giving a broad knowledge of scientific apparatus. A person previously employed as a laboratory assistant or technician would be suitable. Good handwriting essential. ASSISTANT STOCKKEEPERS (two), of good education, preferably with scientific knowledge. Persons previously employed as laboratory assistants or technicians would be suitable.—Write, giving full particulars, including age and salary required, to Staff Manager, Box No. 283, T. G. SCOTT & SON, LTD., 9, Arundel Street, London, W.C.2.

Senior Technical Manager required by Paint and Varnish Manufacturers to supervise production, research, and development of well-known Company. Applicants must have organizing ability and intimate knowledge and experience of modern developments. The position is a progressive one and the commencing salary not less than £1,000 per annum. Applications (in confidence) should indicate past experience in the Trade, together with details of scientific training. Candidates whose services may not be available till after the end of the war are invited to apply.—Write, Box 7768, Frost-Smith Advertising, 64 Finsbury Pavement, E.C.2.

Works Chemist required by large manufacturing concern in Midlands to control production processes and raw materials. Metallurgical knowledge essential. Salary £450 to £500 per annum, according to qualifications and experience.—Applicants should write, quoting F.3459XA, to the Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before Jan. 23, 1945.

A well-known firm of Invalid Food Manufacturers in the London area requires a qualified Analytical Chemist, age 40-45, with a knowledge of food bacteriology and experience in the analysis of raw materials and finished products, accustomed to factory process control.—Applicants should give full details of experience, qualifications, and salary required to Box 294, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Two Assistant Chemists required for Laboratory investigating Colonial raw materials. Must have B.Sc. degree (1st or 2nd-class Hons. Chemistry). Experience in analytical or research work an advantage. Age limit 30. Salary £275 p.a., with annual increments of £18, plus war bonus (at present £60 p.a.). Appointment temporary with a view to permanent pensionable employment.—Further information from Establishment Officer, Imperial Institute, London, S.W.7.

Secretarial Post required by experienced woman, knowledge Chemistry, Metallurgy, expert shorthand-typist.—Reply to Box 293, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

For Sale: Mercury Vapour Lamp' Phillips Valve Model Rectifier, 3 Resistances, Choke Coil, Ammeter, vibrationless teak and oak table, specially fitted for above, with metal screening for micro-photography.—Apply, St. Andrew's Hospital, Dollis Hill, London, N.W.2.

Wanted: One copy of "Nature" for April 17, 1937.—Replies to Wallace & Tiernan, Ltd., Power Road, London, W.4.

Microscopes, of all descriptions, only a few available, second-hand, perfect condition. Send details of your requirements, enclosing 8d. stamp.—Telephone or correspondence only: Chards, Forest Hill, S.E.23 (Spring Park 1628).

CAMBRIDGE BOOKS

BIOLOGICAL REVIEWS

OF THE CAMBRIDGE PHILOSOPHICAL SOCIETY

Edited by H. MUNRO FOX

"Biological Reviews" appears quarterly and embodies critical summaries of recent work in special branches of biological science addressed to biological readers.

Vol. XIX. No. 4. October, 1944. 12s. 6d. net.

Contents: Pigments in the Coelenterata. By D. L. Fox and C. F. A. Pantin.
Theoretical aspects of bacterial chemotherapy. By Henry McIlwain.
Bacterial growth. By C. N. Hinshelwood.

WHAT IS LIFE?

The Physical Aspect of the Living Cell

By ERWIN SCHRÖDINGER

There is no doubt about the extent of interest directed upon this oldest of questions. Both in physics and biology advances have lately been notable for the increasing importance allowed to the study of particles, of minute masses, and minute forces; chemistry and physics have for some time met at this level; chemistry and biology already share common ground; in this book the physicist brings his particular approach to the subject, with an epilogue on determinism and free will. 6s. net.

TEXT-BOOK ON SPHERICAL ASTRONOMY

By W. M. SMART

Fourth Edition, 21s. net.

In this new edition the data resulting from the most recent determination (1941) of the solar parallax have been incorporated, and a few residual errors and misprints have been corrected.

"The best available account of the subject of spherical astronomy both for learner and teacher."—The Oxford Magazine.

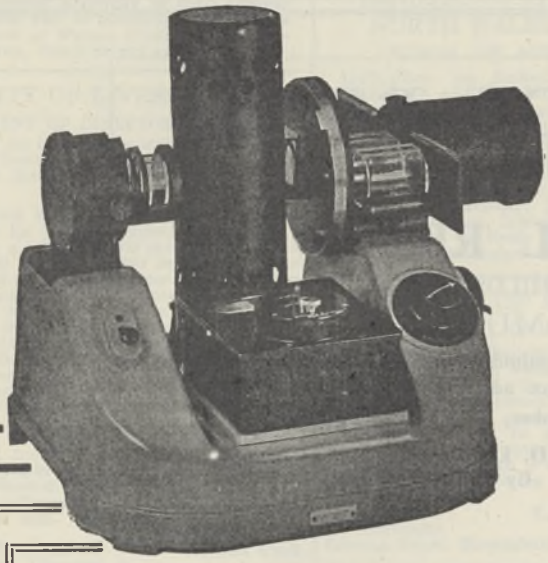
A TREATISE ON THE THEORY OF BESSEL FUNCTIONS

By G. N. WATSON

Second Edition, 60s. net.

The first edition of this book has been out of print for some time, and in this new edition minor errors and misprints have been corrected; and the emendation of a few assertions (such as those about the unproven character of Bourget's hypothesis) which though they may have been true in 1922, would have been definitely false had they been made in 1941.

CAMBRIDGE UNIVERSITY PRESS



THE SPEKKER ABSORPTIOMETER

A PHOTOELECTRIC INSTRUMENT FOR COLORIMETRIC METHODS OF CHEMICAL AND BIOCHEMICAL ANALYSIS

FOR ESTIMATION of metals, sugar solutions, phosphates, hæmoglobin, blood sugar, carotene, pH values, bacteriological solutions, etc.

Used by Szigeti for oxy- and methæmoglobin (*Biochemical Journal*, **34**, 1460, 1940).

OPTICAL AIDS TO CHEMICAL ANALYSES

Instruments which substitute definite scale readings for visual comparisons of colour or intensity

ADVANTAGES :

- Readings obtained in a few seconds.
- Independent of personal errors.
- Compact and portable.
- Few optical parts to keep clean.
- Independent of fluctuations of mains voltage.
- No batteries or amplifiers to maintain.

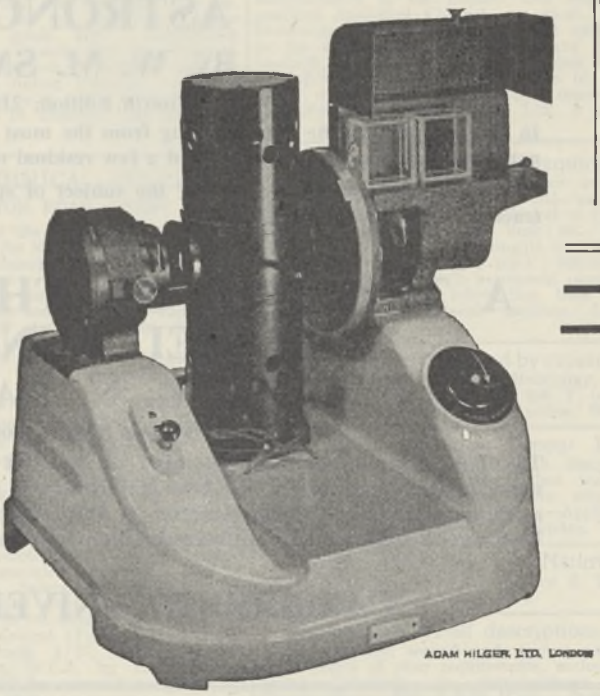
THE SPEKKER FLUORIMETER

Measures photoelectrically the fluorescence produced in solutions.

Renders fluorimetry quantitative.

Suitable for the thiochrome test for Vitamin B_1 (Jansen, *Rec. Trav. Chim.*, **55**, 1046, 1936) and Weisberg and Levin's method for Vitamin B_2 (*Ind. Eng. Chem.*, **9**, 523, 1937).

CAN READILY BE CONVERTED TO A SPEKKER ABSORPTIOMETER



SOLE MAKERS:

ADAM HILGER LTD.

98 St. Pancras Way Camden Road

LONDON · N.W.1 – ENGLAND

Phone: **GUL**liver **5571** (5 lines)

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

the biting reaction and the other a soil choice chamber which tests the ability of the animals to aggregate in solutions or suspensions of test substances in sand or soil. In the first apparatus the number of bite marks on a series of baited filter papers, compared with those on a control set exposed simultaneously, gives a numerical measure of the biting response to a given substance or extract. In the second apparatus the figure obtained is the number of wireworms aggregating in a given time under constant temperature conditions in one of the compartments of the choice chamber. All the aggregation tests mentioned in the present communication were carried out in sand. By means of these methods it was first shown that extracts of potato, carrot, beet and other food plants will cause wireworms to aggregate or to bite or both. *A. lineatus* and *A. obscurus* cannot be distinguished in the larval stages; but no differences have yet been found between the responses of these species and those of *A. sputator*.

Aggregation and biting are apparently distinct responses and are elicited by different classes of chemical substances as follows. Biting is elicited by sugars, fats and polypeptides and also to some extent by tannin and polyhydric alcohols. If one gram of a substance is dissolved in x c.c. of water to reach the threshold of either biting or aggregation, then the 'activity' of that substance is defined as $\log_{10} x$. The activity of sucrose was found to be 2. The number of bites made on a given area of filter paper soaked in 2 per cent glucose formed a roughly normal curve when plotted against *p*H. The maximum (40 wireworms, 24 hours, 23° C.) was approximately 1,000 at *p*H 6–8, falling to 0 at *p*H 0 and 14. The threshold was not affected by *p*H.

Aggregation was first studied by observing the response of wireworms to pure sugars. The sugars examined were found to have an activity of 2, the same as that for biting. The aggregation reaction to a plant extract was analysed in the following way. Potatoes were ground and the juice pressed out, spun to remove starch grains and filtered through kieselguhr. The activity of this juice was 6. The sugars in the juice, found to be 1 per cent, would only account for an activity of 0 on a logarithmic scale, so that some other active substance or substances must have been present. After boiling and filtering, followed by boiling with 2·5 per cent of charcoal, a colourless protein-free solution of activity 6 was obtained. The addition of two volumes of alcohol gave a copious inactive precipitate, and a third volume precipitated colourless rhombic active crystals. These proved to be asparagine, which has an activity of 9. Glutamine has the same activity. The distribution of asparagine and glutamine in potatoes has been examined by A. Neuberger and F. Sanger[2]. The means of their results in six varieties are respectively 0·26 per cent and 0·21 per cent of the fresh weight. This range would account for our observed activity of the juice, whether the activities of asparagine and glutamine are additive or not. Aggregation is also caused by a variety of compounds related to asparagine, including aspartic acid 11 and malic acid 9. The lower fatty acids were found to be inactive but their amides are active.

The activity of all active substances falls suddenly to zero below the threshold concentration, above which there was no detectable response to a gradient. While sugars cause both reactions, some other active substances elicit only one of the responses; thus asparagine does not cause biting, nor triolein nor casein aggregation. There must therefore be at least two types of chemo-receptor, the stimulation of one of which leads to aggregation, and of the other to biting. The sensitivity of the former is comparable to that of olfactory receptors, for an activity of 11 means that the wireworms respond to a concentration of 1 in 10^{11}, while the sensitivity of the latter is similar to that found in organs of taste.

The finding of food by wireworms when in friable soil is probably in the main klinokinetic. This may be envisaged as follows. Wireworms show vertical movements in the soil governed by such factors as moisture content, temperature and season. In addition to this, when in an active feeding phase, they also wander at random in the soil. This may carry them into a region where active substances of plant origin are present in the soil moisture in quantity above the threshold. Their behaviour remains unaffected until they pass *out* of this region, when they show increased turning movements which would bring them back into it again—upon which they once more proceed through it. By this means they are kept within the favourable region, where their wandering continues until some substance which releases the biting response is encountered and feeding begins. This method of orientation, or something very similar to it, is well known for a number of invertebrates (Ullyott[3], Fraenkel and Gunn[4]); but so far as we are aware, this is the first instance in which it has been shown to operate in the food-finding of a soil-dwelling animal. The efficiency of the method in soil will, of course, depend on several factors which are now being studied, such as the rate of secretion of active substances by plant roots, the rate of their bacterial decomposition, the extent to which they are adsorbed on the soil particles, the texture of the soil and the magnitude of the water movements within the soil.

W. H. THORPE.
A. C. CROMBIE.

Sub-Department of Entomology,
Zoological Department,
Cambridge.

R. HILL.
J. H. DARRAH.

Biochemical Laboratory,
Cambridge.
Nov. 14.

[1] Falconer, D. S., *J. Exp. Biol.*, in the press.
[2] Neuberger, A., and Sanger, F., *Biochem. J.*, **38**, 662 (1942).
[3] Ullyott, P., *J. Exp. Biol.*, **13**, 253 (1936).
[4] Fraenkel and Gunn, "The Orientation of Animals" (1940).

Periodic Spawning of 'Palolo' Worms in Pacific Waters

THE Mbalolo, *Eunice viridia*, is a marine annelid found in several places in islands of the Western Pacific. In Fiji I know of two and have heard of a third place in which the periodic 'rising' takes place. One such spot is between the shore and the fringing reef at the village of Tokou, in the island of Ovalau.

Another is in the Yasawa islands off the north-west coast of Viti Levu, and I have heard that there are one or more spots in the Lau group, which forms the eastern limits of the Fiji Islands. It also occurs in the Samoan group, where it is known as Palolo; and probably elsewhere.

During my period as commissioner, stationed at Levuka, I have seen the 'rising' at Tokou on several occasions. Nearly every year there are two risings,

the first known as *Mbalolo lailai* (small Mbalolo) and the second as *Mbalolo levu* (large Mbalolo); 'large' and 'small' do not refer to the size of the worm but to the quantity of the worms. Occasionally there is no *Mbalolo lailai*.

In a normal year the *Mbalolo lailai* appears about the end of October and is followed by the second, and main, rising about two or three weeks later. The main rising always occurs at dawn, and, literally, the worm comes up with the sun. It is, also, always at the time of high water.

The worm, when it comes to the surface, is headless, and it is known that the head remains alive in the reef. The parts shed are from ten to fifteen inches long when they reach the top of the water and continue to wriggle.

There was an old Fijian living in the village of Tokou who was a foreteller of the day of rising, and I used to apply to him for information as to when I should take part in the event. To do so required some preparations: a boat and crew with dip-nets ready at the village; somewhere to sleep until about 04.00, when one had to prepare to move out; lanterns, torches and so forth. The information obtained from the prophet was not always reliable. On the other hand, my experience was that when he said he was certain, it was so.

The uncertainty occurred when the usual date—connected with the phases of the moon, no doubt—had gradually got further and further from the normal. Whatever the actual explanation of the date of spawning, the fact remains that the Mbalolo makes its annual rising at an approximate date by the calendar year but at an actual date by the moon and tide. When the difference becomes more than a few weeks, the date combines solar influence and the appropriate lunar and tide conditions. Records have been kept in Levuka, Fiji, for some seventy years, but I have not yet been able to have access to them.

To attend a 'rising' is an unforgettable event. With the necessary preparations made, I have boarded my boat at 04.30 after a sleep in the village and paddled out to a position about half-way out to the main reef, which skirts the shore at this spot at a distance of about a mile. Then torches are shone into the water vertically from the boat's side to see if there are any indications. If it is the right day, small stray bits of the worm make their appearance, and nets are got ready. Then, when the first light of dawn appears, great funnels of worms burst to the surface and spread out until the whole area is a wriggling mass of them, brown and green in colour.

When the tropical sun rises perpendicularly from the sea the catch is in full swing, and hundreds of boats, canoes and punts are filling up kerosene tins and jars by the simple process of dipping them out with nets.

The worms also provide an annual feast for the fish; for all round and between the boats big fish and sharks cruise quietly along, gulping them in, and take no notice whatever of the boats or their occupants.

As the sun makes itself felt, a change begins to occur in the length of the worms. They begin to break up into shorter and shorter bits, until some three hours after sunrise the entire surface of the sea shows nothing more than patches of scum.

Mbalolo is rightly prized as very good eating and, if one can forget what it looks like before being cooked, is delicious. Fijians—and I have known Europeans to do likewise—eat some raw, when perhaps it may resemble oyster; I could never bring myself to try. In its raw state it is said to have a stimulating effect on fecundity. The Fijians also say that a dish of it eaten in any form will protect a person from all sickness until the Christmas Day following.

A curious fact is that all fish caught in the neighbourhood of the rising are poisonous to human beings for about ten days or a fortnight after the event.

WILLIAM BURROWS.

United Service Club,
London, S.W.1.
Nov. 19.

The C_{20} Unsaturated Acids of Animal Fats

ESTER-FRACTIONATION analysis of certain animal depot and milk fats has shown the presence of small amounts (1–3 per cent) of unsaturated C_{20} acids[1]. These acids have generally been regarded as highly unsaturated[2,3] and probably similar to the corresponding liver glyceride fatty acids. Experimental difficulties in purifying the residual ester-fractions (in which the C_{20} acids accumulate, along with polymerized or partially oxidized acids) have prevented more exact identification.

The amount of C_{20} acids determined from the polybromide number is, however, usually much less than the amount of C_{20} acids calculated from the saponification equivalent[4]. Recent work suggests that highly unsaturated acids constitute only a small part of the C_{20} unsaturated acids. Cramer and Brown[5], by crystallization of a C_{20} concentrate, provided evidence for the presence of C_{20} acids of lesser unsaturation than arachidonic acid in human depot fat. Baldwin and Longenecker[6] used the isomerization technique of Mitchell *et al.*[7] to indicate that human milk fat contains 2–5 per cent of an eicosadienoic acid.

In a communication to the *Analyst* not yet available here, we have presented evidence that the C_{20} unsaturated acids of the depot fat from pigs fattened solely on skim milk largely consist of acids with less than three double bonds. This conclusion has been confirmed by examination of 4 kgm. of pig back fat. The C_{20} ester fractions consistently retained about 15 per cent of C_{18} unsaturated esters after repeated fractionation in a highly efficient column. Isomerization by treatment with caustic potash in ethylene glycol and spectroscopic examination of the resulting soaps (using the method of Mitchell *et al.* (*loc. cit.*) and the constants given by Kraybill and Beadle[8]) confirmed the presence in these fractions of an eicosadienoic acid (about 0·2 per cent of the total fat), with smaller amounts of eicosatetraenoic acid.

Crystallization of 25 gm. of the C_{20} unsaturated acids yielded 10 gm. of acids, in which isomerization did not reveal more than 5·4 per cent of di- and polyethenoid acids. From the saponification equivalent (306) and the iodine value (87·9), it may be concluded that this fraction is mainly eicosenoic acid (saponification equivalent 310, iodine value 81·9).

The C_{20} unsaturated acids of pig depot fat have been thought to be derived from the diet[2,9]; but until the corresponding food fats have been examined for eicosenoic and eicosadienoic acids, the origin of these acids remains uncertain. The analyses recorded

by Hilditch and co-workers for cow milk fat[3,10] are not, however, inconsistent (as judged by saponification equivalents and iodine values of residual ester fractions) with the presence of one or both of these acids in this fat. Indeed, Bosworth and co-workers[11,12] tentatively claimed the presence of these acids in cow milk fat, a claim which seems to have been neglected by subsequent investigators.

Linoleic, linolenic and arachidonic acids are known to be essential in the nutrition of rats[13,14]. The possibility of the physiological importance of eicosadienoic acid is of great interest. Work on the constitution of these acids is in progress.

P. B. D. DE LA MARE.
F. B. SHORLAND.

Chemistry Section,
Animal Research Division,
Department of Agriculture,
Wellington, N.Z.
Oct. 16.

[1] Hilditch, "The Chemical Composition of Natural Fats" (London: Chapman and Hall, 1941), 60 *ff.*
[2] Hilditch, Lea and Pedelty, *Biochem. J.*, **33**, 493 (1939).
[3] Hilditch and Longenecker, *J. Biol. Chem.*, **122**, 497 (1938).
[4] Hilditch and Pedelty, *Analyst*, **64**, 640 (1939).
[5] Cramer and Brown, *J. Biol. Chem.*, **151**, 427 (1943).
[6] Baldwin and Longenecker, *J. Biol. Chem.*, **154**, 255 (1944).
[7] Mitchell *et al.*, *Ind. Eng. Chem.* (Anal. Ed.), **15**, 1 (1943).
[8] Kraybill and Beadle, *J. Amer. Chem. Soc.*, **66**, 1232 (1944).
[9] Shorland and de la Mare, *Emp. J. Exp. Agric.*, in the press.
[10] Hilditch and Paul, *Biochem. J.*, **30**, 1905 (1936).
[11] Bosworth and Brown, *J. Biol. Chem.*, **103**, 115 (1933).
[12] Bosworth and Sisson, *J. Biol. Chem.*, **107**, 489 (1934).
[13] Burr and Burr, *J. Biol. Chem.*, **86**, 587 (1930).
[14] Hume *et al.*, *Biochem. J.*, **34**, 879 (1940).

Effect of Hydrogen Ion Concentration on Cation Exchange in Clay Salts

THE lyotrope series is usually observed in the exchange of cations from clays and permutites[1,2]. Deviations from this series have also been reported[3,4]. These have been attributed to the structural peculiarities of the clays[2,3] and variations in the hydration of cations[4]. Differences in the relative effects of Ba++ and Ca++ ions in the interaction of hydrogen clays with neutral salts and bases have been observed[5,6,7], depending on the prevailing *p*H of the system. Symmetry values[3] of a number of clay salts against various electrolytes (chlorides) have been measured with and without adjustment of the *p*H of the system at a constant value by the addition of the requisite amount of hydrochloric acid. When a constant *p*H is not maintained, deviations from the normal lyotrope series often occur, especially in clays containing montmorillonite as judged from X-ray analysis. The deviations disappear when the symmetry values measured at a constant *p*H ranging from 6·0 to 7·0 are compared. At a constant *p*H between 3·0 and 5·0, all the cations examined give the same symmetry value, and the cation effect as envisaged in the lyotrope series altogether disappears.

At a low *p*H (3·0), hydrochloric acid alone gives a higher symmetry value than when used in conjunction with the salts. Al+++ ions are likely to be exchanged at this *p*H for the cations of the added salt[9]. No appreciable exchange of aluminium at this *p*H would occur if hydrochloric acid alone were added[10]. The lower symmetry value observed in the presence of salts can be explained if one takes into account the Al+++ ions exchanged for the cation of the salt.

Further work is in progress.

This work has been carried out with the aid of a grant from the Imperial Council of Agricultural Research, India.

J. N. MUKHERJEE.
S. K. MUKHERJEE.

Physical Chemistry Laboratories,
University College of Science and Technology,
92 Upper Circular Road,
Calcutta.

[1] Jenny, *Koll. Beih.*, **23**, 429 (1926).
[2] Wiegner, *Trans. 3rd. Internat. Cong. Soil Sci.*, **3**, 109 (1935).
[3] Jenny, *J. Phys. Chem.*, **36**, 2217 (1932).
[4] Schachtschabel, *Koll. Beih.*, **51**, 199 (1940).
[5] Mukherjee, Mitra and Mukherjee, S., *Trans. Nat. Inst. Sci. India*, **1**, No. 10, 227 (1937).
[6] Mukherjee, S. K., and Ganguli, *Ind. J. Agric. Sci.*, in the press.
[7] Mitra, Mukherjee, S. K., and Bagchi, *Ind. J. Agric. Sci.*, **10**, Part 2, 303 (1940).
[8] Unpublished work of Mr. S. N. Bagchi.
[9] Mukherjee and Chatterjee, *J. Indian Chem. Soc.*, **12**, 105 (1942).
[10] Unpublished work of Dr. B. Chatterjee.

A Labour-saving Method of Sampling

IF a fraction p of a population have the attribute A, then it is well known that if m members out of a sample of N have this attribute, the best estimate of p is $\frac{m}{N}$, and its standard error is $\sqrt{\frac{m(N-m)}{N^3}}$ or $p\sqrt{\frac{1-p}{m}}$. Supposing, therefore, that we want our estimate of p to be correct within a standard error of 10 per cent of its value, we must count a sample containing $100(1-p)$ members with the attribute A. If we do not know p roughly beforehand we do not know how large to take our sample. For example, if we wish to estimate the frequency of a type of blood corpuscle, and count 1,000 blood corpuscles in all, we should get such values as $20 \pm 1{\cdot}3$ per cent, or $1 \pm 0{\cdot}31$ per cent. The former value would be needlessly precise for many purposes. The latter would not differ significantly from an estimate of 2 per cent.

The standard error is almost proportional to the estimated frequency if we continue sampling until a fixed number m of the minority with attribute A have been counted, and then stop. Supposing the total number in the sample is now N, we cannot use $\frac{m}{N}$ as an estimate of p. It can, however, be shown that $\frac{m-1}{N-1}$ is an unbiased estimate of p, with standard error very approximately $\frac{1}{N}\sqrt{\frac{m(N-m)}{N-1}}$, or $p\sqrt{\frac{1-p}{m-2}}$, which is nearly proportional to p when this is small. Thus to get a standard error of about 10 per cent of the estimate we should have to count until we had observed a number m of the rarer type A, which only varies from 102 when p is very small, to 72 when it reaches 30 per cent. If we were content with a standard error of $0{\cdot}2p$ we could take a quarter of this value, and so on.

My friend, Dr. R. A. M. Case, has for some time employed a method substantially equivalent to the above in his haematological work, and found it to result in a considerable saving of labour.

Full details will be published elsewhere.

J. B. S. HALDANE.

Department of Biometry,
University College, London. Dec. 7.

Adsorption Colorimetry as an Analytical Technique

ADSORPTION of coloured substances on white adsorbents has hitherto been used either to demonstrate qualitatively the existence of the substance in a mixture or as a preliminary to elution in the quantitative assay of the substance.

In devising a simple method for the quantitative estimation of mepacrine (atabrin) in urine, a technique has been adopted which I have called 'adsorption colorimetry'. When a measured quantity of suitable white adsorbent is used, the intensity of colour produced under standard conditions is proportional to the quantity of mepacrine in the urine or in an extract of the urine. The adsorbent may easily, and with sufficient accuracy, be measured with a small scoop made by drilling a hole into a piece of wood and calibrating with a powder of known specific gravity. For mepacrine, the most satisfactory adsorbent is powdered silica gel. This may be used either directly, by adding a measured quantity to a known volume of urine for a given time, or indirectly, by adding it to an ether or chloroform extract of alkalized urine. In this way, it is possible to estimate concentrations as low as 1 mgm. per litre or less; with the common concentrations of 5 mgm. per litre or more, the error is less than 20 per cent.

This technique may obviously be extended to the estimation or detection of other coloured substances. Again, with silica gel, it has been found possible to detect bile pigments in urine in concentrations lower than those detected by the iodine or Gmelin tests; the technique is much simpler than, and the sensitivity about equal to, the Fouchet or similar adsorption methods.

Other coloured substances not adsorbed by silica gel may be adsorbed by other powders. For example, riboflavin is adsorbed by a white preparation of fuller's earth, and preliminary tests indicate that with this adsorbent an adaptation of the method of adsorption colorimetry should be capable of assaying rapidly and with reasonable accuracy and sensitivity the riboflavin content of substances of biological interest.

With fluorescent substances such as mepacrine, the sensitivity of the method may be increased one hundredfold by 'adsorption fluorimetry', that is, by viewing the adsorbent in ultra-violet light. This should make it possible to evolve a method for the estimation of mepacrine in blood, in which the concentration is much lower than that in the urine.

Details of the technique as applied to the estimation of urinary mepacrine and to the detection of bile pigments in urine will be published elsewhere.

JOHN YUDKIN.

C/o D.D.M.S.,
Northern Command,
C/o G.P.O.

Structure of Stipitatic Acid

Birkinshaw, Chambers and Raistrick[1] have described stipitatic acid, a metabolite of the mould *Penicillium stipitatum*, to which, after lengthy examination, they could ascribe no reasonable structure. The evidence they give, however, does seem to indicate a unique structure for the compound. The evidence is as follows:

(1) Stipitatic acid (*A*), $C_8H_6O_5$, is a dibasic acid, solutions of the disodium salt of which are deep yellow. It contains three active hydrogen atoms and gives a deep red ferric chloride reaction. It has no ketonic or reducing properties and is optically inactive. It dissolves unchanged in concentrated hydrochloric or nitric acid, being precipitated on dilution. (*A*) itself is cream coloured.

(2) (*A*) is unchanged by bromine in acetic acid; in water it forms a loose addition compound. In 80 per cent acetic acid a monobromostipitatic acid is formed, similar to (*A*) in its properties.

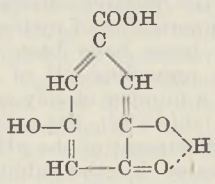
(3) (*A*) is easily converted by alkali fusion to the isomeric 5-hydroxy*iso*phthalic acid, in very good yield.

(4) With diazomethane in ether, (*A*) gives two isomeric, neutral, trimethyl derivatives. With methanolic hydrogen chloride it gives a dimethyl derivative, soluble in sodium hydroxide, but not sodium bicarbonate, solutions. With methyl sulphate and alkali it forms a dibasic monomethyl derivative the disodium salt of which is deep yellow in solution.

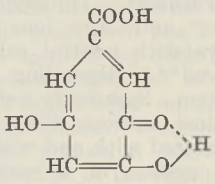
(5) With acetic anhydride and sodium acetate, (*A*) forms a monobasic diacetyl derivative; an isomeric but dibasic compound is formed with acetic anhydride and sulphuric acid.

(6) Decarboxylation of (*A*) with copper in quinoline gives a monobasic acid $C_7H_8O_3$, solutions of the salts of which are deep yellow; it gives a blood-red ferric chloride reaction and with diazomethane a neutral dimethyl derivative.

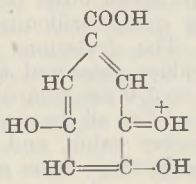
(7) Catalytic reduction over platinum oxide gives a crude non-aldehydic product with half the acid equivalent of (*A*); from it tetrahydrostipitatic acid can be isolated as its dinitrophenylhydrazone.



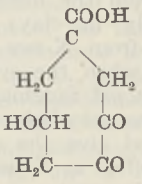
(I)



(II)



(III)



(IV)

The stability of (*A*), particularly to bromine (2), indicates the presence of an aromatic structure; bridged ring structures are thus eliminated from steric considerations. Benzenoid or oxygen-ring structures do not explain the very facile conversion to hydroxy*iso*phthalic acid (3). There remains a seven-membered ring structure in which an α-di-

ketone group will provide the second acid function and undergo benzilic acid rearrangement on alkali fusion. When the appropriate triketo*cyclo*heptenecarboxylic acid is written in the dienol forms (I) and (II), the possibility of resonance between them by hydrogen bond chelation becomes evident; such a compound would be expected to show abnormal stability and lack of ketonic function. Moreover, the ketol group, from analogy with β-diketones, should show acidity, and the resonating ion, colour. The solubility in strong acid to a hybrid of (III) and its tautomer parallels the analogous behaviour of indophenol. The ready decarboxylation of (*A*) and the properties of the product are at once explained. Tetrahydrostipitatic acid (7) is probably (IV); cyclic α-diketones often give monoketonic derivatives.

The isomeric trimethyl derivatives (4) correspond to (I) and (II); in the dimethyl derivative, where the ketol and ester groups are esterified, the enolic hydroxyl is still weakly acidic. In the monomethyl derivative the lone hydroxyl is methylated (cf. the methylation of hydroxybenzoic acids).

The monobasic diacetyl derivative (5) will have the two hydroxyls protected, while the isomeric dibasic compound is presumably a nuclear acylated monoacetate; phenols are sometimes acetylated in the nucleus by acetic anhydride-sulphuric acid.

If stipitatic acid actually has the resonating structure (I) or (II), it represents a new type of aromatic system; the parent *cyclo*heptatrienolone might be termed 'tropolone'. This system would be closely analogous to azulene, while the hydrogen chelation as part of an aromatic system has long been known in the porphyrins. *Cyclo*pentadienolone may prove to have an analogous structure. An attempt to synthesize an analogue of (I) with the carboxyl replaced by methyl, by condensation of mesityl oxide with ethyl oxalate in presence of two moles of potassium ethoxide in boiling ether, unfortunately gave the isomeric benzene derivative.

M. J. S. DEWAR.

Dyson Perrins Laboratory,
University, Oxford.
Nov. 14.

[1] *Biochem. J.*, **36**, 242 (1942).

Preparation of Thin Sections of Synthetic Resins and Wood-Resin Composites, and a New Macerating Method for Wood

VARIOUS softening methods have been used in preparing sections of hard material for microscopic examination; but none of these has been found effective for so-called 'improved wood' made up of wood veneers impregnated with phenol-formaldehyde or other resin and compressed and bonded at a high temperature. The microscopic examination of synthetic resins and materials incorporating such resins is of value in revealing the nature and distribution of fillers, colouring matter and reinforcements, and other features of the internal structure. It has also been found useful as a means of identifying the different kinds of resin used as adhesives in plywood[1]. In order to prepare microscope sections of the harder forms of these materials, some investigators have had recourse to the petrologists' method of grinding and polishing thin sections for examination by transmitted light, and the metallurgists' method of examining a polished surface by reflected light.

It has now been found that a mixture of 1 part by volume of glacial acetic acid with 2 parts by volume of hydrogen peroxide (20 volumes) at 60° C. and atmospheric pressure has a softening action on fully cured phenol-formaldehyde and urea-formaldehyde resins and on wood-resin composites. After being treated in this way for periods of 24–48 hours, solid blocks of resin and of various types of 'improved wood', up to ½in. cube, have been sectioned without difficulty in a Reichert sledge-type wood microtome.

A modification of this treatment, using equal parts by volume of glacial acetic acid and hydrogen peroxide at 60° C. for 48 hours, has the effect of decomposing or disintegrating urea-formaldehyde resin. Phenol-formaldehyde resins are softened to the extent that 'improved wood' incorporating such resins is broken down and the wood itself is macerated. Incidentally, this method has certain advantages over standard methods of macerating ordinary wood for microscopic examination.

It is known that acetic acid in the presence of oxidizing agents has a delignifying action on wood[2], but this process does not appear to have been employed before in microscopic technique either for wood, resin or composite materials.

The effect of varying the proportions of the two reagents and the temperature and pressure during the reaction is being investigated further.

G. L. FRANKLIN.

Forest Products Research Laboratory,
Princes Risborough, Bucks.
Dec. 4.

[1] Rendle, B. J., and Franklin, G. L., *J. Soc. Chem. Ind.*, **62**, 11 (1943).
[2] Wiltshire, W. A., *Proc. Papermkrs' Assoc. G.B.I., Tech. Sect.*, **24**, 347 (1943).

Age of the Baker's Hole Coombe Rock, Northfleet, Kent

SINCE the Abbé Breuil published his view[1] that the palæolithic 'floor' at Baker's Hole, Northfleet, belongs to the Levallois I–II stage of his classification, some Pleistocene workers[2] have been inclined to follow him in correlating the superincumbent Coombe Rock with the cold phase which produced the *Rissien* solifluxion of the Somme succession.

The stratigraphical evidence at Baker's Hole is that an undisturbed 'floor' of implements rests on a bench at about 30 ft. above O.D. (which is elsewhere buried by 50-ft. Terrace deposits), and is directly succeeded by the Coombe Rock[3,4]. The precise position which we assigned to this deposit in our suggested Thames sequence[5] depended partly on the identification of the 'floor' as Lower Levalloisian. The fact that the Lower Crayford Brickearths of the 50-ft. Terrace have yielded an industry identified by Breuil[6] as Middle Levalloisian (Levallois III), together with the evidence published by Burchell[3], led us to the conclusion that the Coombe Rock antedated the Taplow-Crayford aggradation, and corresponded to the apparent coombe rock below the 50-ft. Terrace gravels exposed in the Taplow Station pit[7].

One of us (K. P. O.) has recently had occasion to handle all the material found by F. C. J. Spurrell in the part of the Northfleet 'floor' which was exposed in the Tramway Cutting west of the Ebbsfleet, and now preserved in the Geology Department, British Museum (Natural History). A number of features of this industry, including the occurrence of cordate hand-axes along with the tortoise-cores and flakes

with faceted butts, suggest that it should be compared, not with Levallois I–II of the Somme cultural sequence[8], but with Breuil's Levallois V[9]. It is particularly noteworthy in this connexion that one of the hand-axes is clearly a bifacially trimmed Levalloisian flake.

Mr. A. D. Lacaille, of the Wellcome Research Institute, informs us that on the basis of the material from the Northfleet 'floor' which he has seen in Spurrell's collection, he fully supports a revised identification of the industry. There are several possibilities[10]; but if the Northfleet industry *is* early Upper Levalloisian, rather than Lower Levalloisian, the "Baker's Hole Coombe Rock", or at any rate that part which is found in the Tramway section, must be considered as representing a later period of solifluxion than that which Breuil equates with the Riss glaciation.

Since several stages of the Levalloisian culture appear to have coincided with conditions conducive to the formation of solifluxion deposits, it is to be expected that difficulty will be experienced in dating sheets of coombe rock which happen to be associated with incompletely defined industries of the Levalloisian complex. For this reason we feel that a caveat should be entered regarding the age of the main solifluxion deposit in the Northfleet district, pending fuller elucidation of the Levalloisian complex in south Britain. We wish also to emphasize that any revised dating of the Northfleet industry does not necessarily involve so-called Northfleet types from other sites (for example, Brundon[11]) which may well be Lower Levalloisian.

The Levalloisian cores and implements collected by Spurrell[12] at the base of the Crayford Brickearths have also been seen. The evidence for their being Middle Levalloisian, rather than, say, a provincial facies of Upper Levalloisian, cannot be said to be absolutely conclusive in the present state of our knowledge of the British Levalloisian succession. Until the question of whether they are younger or older than the Northfleet industry is settled beyond all dispute, the stratigraphical implications of revised dating of the latter cannot be very usefully considered. Clearly, however, the possibility has to be borne in mind meanwhile that the Baker's Hole Coombe Rock post-dates at least part of the Crayford Series.

It is hoped that the whole matter can be gone into more fully when the sections can be re-visited and when all the collections of material from Northfleet and Crayford can be re-examined and compared.

K. P. OAKLEY.

Department of Geology,
British Museum (Natural History),
London, S.W.7.

W. B. R. KING.

Sedgwick Museum,
Cambridge.

[1] *Geol. Mag.*, 17 (1932).
[2] Oakley, *Quartär*, 2, 56 (1939). Paterson, *Trans. Roy. Soc. Edin.*, **60**, 408 (1940-41).
[3] Smith. *Archaeologia*, **62**, 515 (1911). Burchell, *Archaeologia*, **83**, 67 (1933).
[4] Breuil, *Rev. Géog. Phys. et Géol. Dyn.*, **7**, 269*ff*, Fig. 43 (1934).
[5] *Proc. Prehist. Soc.*, 2, 61 (1936).
[6] *Geol. Mag.*, 17 (1932).
[7] Breuil, *op. cit.*, Fig. 41.
[8] Breuil and Kozłowski, *L'Anthropologie*, **42**, 44, Fig. 15 (1932).
[9] *ibid.*, 33, Fig. 6, No. 1; 36, Fig. 9, Nos. 2 and 4.
[10] *Trans. S.E. Union Sci. Soc.*, **48**, 31 (1943).
[11] Moir, *Proc. Prehist. Soc.*, **5**, 5 (1939).
[12] *Quart. J. Geol. Soc.*, **36**, 544 (1880). Cf. Chandler, *Proc. Prehist. Soc. E. Anglia*, 2, 240 (1916). Kennard, *Proc. Geol. Assoc.*, **55**, 139 (1944).

Distribution of Numbers and Distribution of Significant Figures

IN an earlier note[1] it is shown that the distribution of first digits of the numbers in a table will obey a logarithmic law provided that a certain sum can be replaced by an integral. We shall here discuss this approximation in more detail. The notation used will be the same as before, $f(x)$ giving the distribution of the numbers and $F(p)$ the distribution of the significant figures. We shall also introduce the distribution of the logarithms of the numbers; setting $y = \ln x$, we have for the fraction of entries with logarithms between y and $y + dy$:

$$\varphi(y)\,dy = e^y f(e^y)\,dy = f(x)\,dx; \quad . \quad . \quad . \quad . \quad (1)$$

$$\int_{-\infty}^{\infty} \varphi(y)\,dy = 1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

We then have, by equation (5) of the preceding note,

$$F(p) = \frac{1}{p \ln A}\,\psi(\log_A p), \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where

$$\psi(q) = \sum_{m=-\infty}^{\infty} f(A^{m+q})A^{m+q} \ln A = \sum_{m=-\infty}^{\infty} \varphi((m+q)\ln A)\ln A \quad . \quad . \quad (4)$$

Thus $\psi(q)$ is the approximation to the integral in (2) by the trapezoidal rule; the spacing of the selected ordinates is $\ln A$, and their position is determined by q. We see that

$$\psi(q+1) = \psi(q), \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

so that it suffices to consider values of q between zero and unity; no other values would be required for use in (3), anyhow. Also

$$\overline{\psi(q)} = \int_0^1 \psi(q)\,dq = 1, \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

and

$$\text{if } x f(x) = \frac{1}{x} f\left(\frac{1}{x}\right), \text{ then } \psi(q) = \psi(-q). \quad . \quad (7)$$

When applicable, this last relation is very helpful in determining ψ by computation.

If $\psi(q)$ were identically equal to 1, the logarithmic law would hold exactly. Functions $\varphi(y)$ for which this is true for a particular base A can readily be constructed, but it seems evident that no function can satisfy this condition for arbitrary A.

The idea that the broadness of the distribution essentially determines the closeness with which $\psi \equiv 1$ needs careful examination. If we make the distribution $f(x)$ broader by a factor α, by replacing it with the distribution $\frac{1}{\alpha} f\left(\frac{x}{\alpha}\right)$, we find that the maximum value of $|\psi - 1|$ is unchanged. The function $\psi(q)$ is simply replaced by

$$\psi_\alpha(q) = \psi(q - \log_A \alpha); \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

the sizes of the errors are unchanged, and they merely occur at different values of q.

Thus the value of $|\psi - 1|_{\max.}$ is determined only by the form of the function $\frac{1}{\alpha} f\left(\frac{x}{\alpha}\right)$, and not at all by the value of the scale-factor α. Values of $|\psi - 1|_{\max.}$ for $A = 10$ for several distribution functions have been obtained by computing ψ numerically from (4) and are given below. Of these, (*b*), (*c*) and (*e*) are not inconsistent with data obtained from counting

in tables, though (*b*) seems not to fit quite so well as the assumption $\psi \equiv 1$ (logarithmic law).

	Function	$\lvert \psi - 1 \rvert_{max.}$ $(A = 10)$
(*a*)	$\frac{2}{\sqrt{2\pi}a} e^{-x^2/2a^2}$	0·33
(*b*)	$\frac{2a}{\pi(a^2 + x^2)}$	0·0557
(*c*)	$\frac{4a}{\pi^2} \cdot \frac{\ln(x/a)}{x^2 - a^2}$	0·00152
(*d*)	$\frac{1}{a} e^{-x/a}$	0·115
(*e*)	$\frac{a}{(a + x)^2}$	0·0065

For $A = 100$ the values of $\lvert \psi - 1 \rvert_{max.}$ become much larger; 0·24 for (*e*) and 0·11 for (*c*); thus (*c*) alone is not clearly inconsistent with the scanty data from counts on this basis.

Since the accuracy of the approximation $\psi \cong 1$ is not improved by increasing the scale factor α, we are led to try mixing together distributions of type $\frac{1}{\alpha} f\left(\frac{x}{\alpha}\right)$ with various values of α. If we assume that in the final mixture a fraction $\frac{1}{\beta} g\left(\frac{\alpha}{\beta}\right) d\alpha$ of the entries comes from distributions with values of α between α and $d\alpha$, then the fraction between x and $x + dx$ will be $\frac{1}{\beta} h\left(\frac{x}{\beta}\right) dx$, with

$$\frac{1}{\beta} h\left(\frac{x}{\beta}\right) = \int_0^\infty \frac{1}{\alpha} f\left(\frac{x}{\alpha}\right) \frac{1}{\beta} g\left(\frac{\alpha}{\beta}\right) d\alpha. \quad . \quad . \quad . \quad (9)$$

If, in particular, $g(x) \equiv f(x)$, then we shall call h the 'iterate' of f. In our table the Cauchy function (*b*) is the iterate of the Gaussian (*a*), (*c*) is the iterate of (*b*), and (*e*) is the iterate of (*d*). It is evident from the table that iteration does rapidly decrease the value of $\lvert \psi - 1 \rvert_{max.}$.

The relation (9) of iteration corresponds to the following relation between the distributions $\psi(q)$ connected with f, g, h by formulæ of the type of (4):

$$\psi^{(h)}(q) = \int_0^1 dr. \cdot \psi^{(g)}(r) \psi^{(f)}(q - r). \quad . \quad . \quad . \quad . \quad (10)$$

If we represent each distribution $\psi(q)$ by a Fourier series,

$$\psi(q) = \sum_{-\infty}^{\infty} a_n e^{2\pi i n q}, \; a_{-n} = a_n^*, \quad . \quad . \quad . \quad . \quad . \quad (11)$$

then (10) gives

$$a_n^{(h)} = a_n^{(g)} \cdot a_n^{(f)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

In particular, iteration of a distribution function corresponds to squaring each Fourier coefficient a_n. One can show readily that since $\psi(q)$ is nowhere negative, $a_n < 1$ for all n; thus it is evident that iteration repeated a sufficient number of times will make $\lvert \psi - 1 \rvert_{max.}$ arbitrarily small. If one assumes that only one harmonic exists—that is, $a_n = 0$, $n \neq n_0$—then it can easily be seen that the value of $\lvert \psi - 1 \rvert_{max.}$ for the iterate is half the square of the value for the original function. This relation holds within about 2 per cent for the cases given in the table; the appearance of the computed curves of $\psi(q)$ shows that only the first harmonic is important in the cases in hand.

The fact that the close agreement between the trapezoidal sum and the integral in cases like (*c*) and (*e*) is not at all to be attributed to broadness of the distribution is seen very forcibly in the process of computing the sums numerically. In all cases considered, at least two thirds of the sum comes from the largest two terms, and at least seven eighths from the largest three. For three of the sets of ordinates computed for case (*c*) numerical integrations were performed by Weddle's rule, and the fractional errors found were 0·00612, 0·01224 and 0·01905—four, eight and twelve times the maximum error of the trapezoidal rule for ordinates at the given spacing.

The remarkable affinity between certain functions such as (*c*) and (*e*) and the trapezoidal rule enables us to write approximate relations of a peculiar sort. For example, from (*e*) we get

$$\frac{1}{\ln Z} \cong \frac{1}{4} + 2 \sum_{k=1}^{\infty} \frac{Z^k}{(1 + Z^k)^2}, \quad . \quad . \quad . \quad . \quad . \quad (13)$$

for Z real and greater than unity but not a large number. This is never exactly true, but the error becomes small very rapidly as Z is decreased. For $Z = 10$, the error is 2/3 per cent; for $Z = 4$, it is 0·004 per cent; and for $Z = 2$, it is not more than about 10^{-7} per cent and cannot be determined readily by using an ordinary ten-digit computing machine.

W. H. FURRY.

Harvard University,
Cambridge, Mass.

HENRY HURWITZ.

Ithaca, New York.
Aug. 30.

Nature, **154**, 803 (1944).

Hissing Sounds Heard During the Flight of Fireballs

MANY responsible eye-witnesses, in their descriptions of fireballs, have emphatically stated that they have occasionally heard a peculiar hissing sound *simultaneously* with the flight of a meteor. From personal observation, I can also testify to the validity of these statements. Fireball literature is full of such accounts. Three recent cases (connected with fireballs seen by a number of competent observers at Hyderabad, on October 13, 1936, on March 25, 1944, and on August 6, 1944, respectively) have placed the matter beyond any doubt whatever.

The obvious difficulty is about the simultaneity of the light and sound phenomena noticed by observers fifty to a hundred miles distant from the meteor. But it must be remembered that the fireball rushes through the upper atmosphere with parabolic speed (about 26 miles per second); its duration of visible flight is generally 6–8 seconds. Assuming its height to be roughly 75 miles, *matter* from a *friable aerolite* can issue in a regular stream along its entire path, into the lower atmosphere, with velocity large enough to bring it in the vicinity of an observer while the meteor is still in sight. For the height assumed, four or five seconds may suffice (even allowing for air resistance) for the *matter* from the meteor to reach the air in the neighbourhood of the observer, and thus give rise to sounds variously described as like the swish of a whip, the hissing noticed while a cutler sharpens a knife on a grindstone, or a hot iron being plunged into cold water.

A shower of fine sand beating against the leaves of trees was noticed immediately after the apparition of the fireball of October 13, 1936, described in detail in *Science and Culture*, Calcutta, 2, No. 5, 273 (1936).

MOHD. A. R. KHÁN.

Hyderabad Academy,
Begumpet, Hyderabad.

RESEARCH ITEMS

Peruvian Pottery

THE gap between the Early Chimú (or Mochica) and Late Chimú pottery has long troubled students of Peruvian archæology, though Kroeber in particular has made great efforts to indicate the probable characteristics of a Middle Chimú style. Jorge C. Muelle (*Univ. California Pub. Amer. Arch. and Ethnol.*, 39, No. 3. 35 cents) despairs of finding pottery which may bridge the gap, and suggests instead that the Late Chimú pottery developed from metal prototypes, most of which have, for obvious enough reasons, disappeared. He points out many metallic features in the Late Chimú bucchero ware, and illustrates some interesting parallels between pottery and metal forms. The theory is ingenious, but it is difficult to regard it as altogether satisfactory. There are many points of similarity between Early and Late Chimú, and it seems improbable that lost metal forms can be the only link between two cultures so rich in pottery. Until the northern part of the Peruvian coast is more thoroughly explored, the possibility of finding an intermediate pottery style cannot be excluded. In support of his theory, the author makes a suggestion that the heavy stirrup-spouted "coastal Chavin" vessels were derived from metal forms, which were in their turn copied from Early Chimú stirrup spouts. In so doing he disregards the general belief that the coastal Chavin, or Cupisnique, style is earlier than Early Chimú, a belief which recent excavations by Rafael Larco Hoyle have done much to uphold.

Blood Urea Clearance of Indians

THE 'blood urea clearance' is widely used in clinical medicine as a measure of kidney function. The normal standards usually adopted are those of van Slyke for healthy Americans calculated to a standard body area of 1·7 m.². The figures are 54 c.c. for the standard clearance and 75 c.c. for the maximum clearance. C. Srikantia and D. Shamanna (*Proc. Ind. Acad. Sci.*, 19, 121; 1944) have found that the corresponding average figures for healthy Indians from the Province of Mysore are 36 c.c. for the standard clearance and 47 c.c. for the maximum clearance. Grokhale (*Ind. J. Med. Res.*, 3, 627; 1941) found very similar figures for Bombay Indians. The figures suggest that the Indian kidney has only about two thirds the efficiency of its American counterpart; but whether this is true or not, it is obvious that a new and lower 'normal' standard will have to be adopted for clinical work on Indians. The first authors suggest that the lower clearance of Indians is related to the lower protein content of their diet.

Utilization of Metabolic Water in Insects

IT has often been suggested that insects developing on substances with low water-content such as flour, grain, wool, etc., obtain their necessary water from the products of food combustion. Growth in insects normally living on such dried foods is faster and higher than at low humidities. Experiments were carried out by G. Fraenkel and M. Blewett (*Bull. Entom. Research*, 35; July 1944) with the flour moth *Ephestia kuehniella* and two beetles, namely, *Tribolium confusum* and *Dermestes vulpinus*. It was found that at lower humidities more food is eaten to produce a given unit of body weight, because part of the food is utilized as water. As a consequence of this, the larva grows more slowly and its final size is smaller. It is shown for *Dermestes* at 30 per cent R.H. and *Ephestia* at 1 per cent R.H. that less than 32·9 and 7·6 per cent of the water in the pupæ can be derived from water ingested with the food. The authors consider that they have established beyond doubt that the insects in question, which normally live on very dry food, acquire a substantial, or, at extremely low humidities, the greater part of the water ultimately found in the body, from oxidation of food.

Heritable Wildness in Turkeys

IN a field study conducted in the Ozark region of Missouri, A. Starker Leopold has endeavoured to assess the ingredients which make up the adaptive condition of wildness in turkeys (*Condor*, 46, 133; 1944). His method was to compare various characteristics of the native wild turkey (*Meleagris gallopovo sylvestris*), of which free populations are notably successful in the Ozarks, with characteristics of hybrid and domesticated turkeys (derived from the Mexican race, *M. g. gallopovo*) the populations of which are partially or entirely unsuccessful there. Differences which appear to be directly or indirectly connected with relative wildness and domesticity are described under these heads: (1) wariness and tolerance of disturbance; (2) age of attaining sexual maturity, and the related development of secondary sex characters in males; (3) timing of the breeding cycle; (4) behaviour of hens and chicks in response to threatened danger, and the differential behaviour of chicks in the laboratory; (5) extent of moult in young birds; and (6) the relative size of the brain and endocrine glands. The original domestication of *M. g. gallopovo* was probably a gradual selective process by which the genetic constitution of the wild bird was modified to bring about a physiological adaptation to existence with man; while the wild condition of native turkeys is effectively maintained by a different set of selective factors in a natural environment.

Are Genes Related to Antigenes?

A. H. Sturtevant (*Proc. U.S. Nat. Acad. Sci.*, 30. 176; 1944) and Sterling Emerson (*Proc. U.S. Nat. Acad. Sci.*, 30, 179; 1944) have published a most important hypothesis of a relationship between genes and antibodies. It was suggested by Haldane in 1935 that there might be a similar molecular configuration of the antigene to that of the gene which produced it. Hence the antibodies produced in reaction to the antigene might react also with the gene. The classic experiment of Guyer and Smith with the lens of the rabbit would be explained on the new hypothesis as follows: The antibodies to lens protein are free in the circulation of injected rabbits, and some combine with the genes in the germ track which are responsible for the specific lens-antigenes. By so combining, the antibodies inactivate these genes, leading to the observed lens deficiency of the progeny. Thus a mutation is produced, but not in a manner analogous to a Lamarckian induction. S. Emerson treated *Neurospora crassa* with antisera from rabbits treated with mycelial filtrates of this fungus. Of 270 controls from untreated cultures crossed with a standard line *N. crassa* cultures none produced a detectable mutation; among 695 cultures from treated cultures crossed with the standard line there were 25 mutations. The author suggests that the mutations were direct results of reaction between the gene and its specific antibody. The far-reaching

effects of the hypothesis necessitate further experimentation on a large scale. Might it not be valuable to irradiate antibodies and to test their reactions with the originating genes ?

Virus Disease of Lupins

D. O. NORRIS (*Aust. Coun. Sci. and Indus. Research Bull.* No. 170) describes the symptoms of a virus disease upon several species of lupin. The reactions of *L. varius* are peculiar in that the first stage of infection affects the leaves, which become distorted and lighter in colour and develop necrotic areas. In the second stage, which occurs after a resting period of a fortnight or more, a large number of spindly shoots arise to give a 'bunch-top' closed appearance. The main vector is *Myzus Persicæ*, and infection may be carried over the hot dry season on *Cassia corymbosa*, peas, broad beans, and sweet peas. The degree of attack on five species of lupin is inversely correlated with the alkaloid content. This may be due to the unpalatability of high alkaloid plants, but *L. luteus* is low in alkaloid and is less susceptible to this mosaic disease.

Equation of State for Solids

BRADBURN'S equation of state for a solid cubic crystal of identical atoms uses the postulate that the mutual potential energy of a pair of atoms follows a law of the form $\varphi = -ar^{-m} + br^{-n}$. R. Fürth (*Proc. Roy. Soc.*, A, **183**, 87 ; 1944) has developed a method for determining the exponents m and n in the force law for a given element from measurements of the sublimation energy, the compressibility, the thermal expansion coefficient, and the dependence of these quantities on pressure and temperature. For many elements the predicted values of compression and thermal expansion are in satisfactory agreement with measurements up to very high pressures and to temperatures near the melting-point. The relation between melting and mechanical instability of the lattice is discussed, and a rule connecting the two phenomena is found to be closely related to Lindemann's law.

A 700-kV. D.C. Electrostatic Generator

A PAPER by J. F. Smee (*J. Inst. Elec. Eng.*, **91**, Pt. 1, No. 47, November 1944) covers in some detail the construction, development and operation of a Van de Graaff type of electrostatic generator, which was originally designed to give an output of 1 mA. at 700 kV., operating at atmospheric pressure. Under certain conditions, however, this current and voltage may be considerably exceeded. Assuming that a machine can be designed *ab initio* for a given output, an allowance must be made for certain factors which cannot be precisely predicted. It appears that in all probability each generator of the Van de Graaff type which differs from others in the details of its design and construction will have its own set of special problems, which must be solved empirically for that particular machine. As the generator was originally intended for research on nuclear physics in a restricted space, the overall dimensions were reduced to a minimum. The main advantages of this type of machine in connexion with acceleration-tube apparatus of any kind are its relative cheapness of construction and maintenance, the ease with which the polarity can be reversed, and its constant current characteristic, the latter being especially valuable in its avoidance of damage to the tube or associated apparatus in the event of accidental short-circuit, failure of vacuum, etc.

Wave Mechanics in Chemistry

IN his presidential address to the Chemical Society (*J. Chem. Soc.*, 340 ; 1944), Dr. W. H. Mills pointed out some of the simpler aspects of wave mechanics as they may most usefully be applied to chemical problems. The implications of the exchange integral and the broad theory of resonance are very clearly stated, and a detailed consideration of many actual examples shows that the ground-states of aromatic compounds may be represented as resonance hybrids in which the conventional structure is stabilized by contributions from electromeric modifications. Such matters as aromatic substitution, and the relation of five-membered heterocyclic compounds to the aromatic series, are dealt with in an interesting manner.

Titan's Atmosphere

THE March issue of *Sky and Telescope* has a brief note on Gerald P. Kuiper's discovery in January of the composition of Titan's atmosphere. The same subject is dealt with at greater length by Charles A. Federer, jun., in Science Service. It was known several decades ago that Titan had an atmosphere, but the difficulty of obtaining satisfactory spectra prevented any statement regarding its composition. Dr. Kuiper, of the McDonald Observatory of the Universities of Chicago and Texas, has photographed its spectra and has shown that it contains methane and ammonia, like Saturn. Although the gravitational pull of this satellite is only about one seventh that of the earth, and hence we should not expect it to retain an atmosphere, yet, owing to its great distance from the sun, it receives only about one per cent of the solar radiation which our moon receives. As a consequence, its temperature is very low, probably about $-160°$ C., and everything except methane must be frozen to the surface of the satellite. It is believed that clouds or droplets of ammonia are suspended in the methane atmosphere of Saturn, and probably the same is true of the atmosphere of Titan. A common origin for the satellite and its primary is indicated by the similarity of their atmospheres, in spite of the fact that the density of Titan is about five times that of Saturn. The low density of Saturn is easily explained, however, by assuming that a great portion of what we see is its atmosphere.

Orbit of Melb. 4 *AB*

W. P. HIRST has given revised elements for the two brighter components of this triple star (*Mon. Not. Roy. Astro. Soc.*, **103**, 6 ; 1943). These are compared with Voûte's elements, and it is shown that Voûte's eccentricity is too small, 0·551, as contrasted with 0·574 obtained by Hirst. Some of his other elements are also capable of improvement to a small extent. The corrections to all the elements, except the semi-axis major, were based on the angles only. Distances were not used because the earlier ones, especially those used by northern observers, occasionally show large residuals which appear, among certain observers, to be systematic. On the whole, the angle residuals are fairly satisfactory, though, as the table shows, between 1934·21 and 1934·62, there is a run of residuals of the same sign, and these (all by Voûte) have a systematic appearance. There is a long run of distance residuals from 1917·58 to 1928·53, and it is suggested that this is due mainly to low altitude or small aperture.

SIXTH-FORM PHYSICS AND CHEMISTRY

IT is generally agreed that the present standard of the higher school certificate examinations, which serve as a means of selection for State and county major scholarships in addition to their function as tests of a two-year sixth-form course, strains the average candidate. It is also said that they cause even the gifted boy to be cramped by a too early specialization, which reacts unfavourably on his university career and later life, a charge which is made against the open scholarship examinations at Oxford and Cambridge themselves. Some of these effects are noticeable in physics and chemistry; parts of the normal course are too exacting for the boy of moderate ability, while the boy who proceeds to the university is likely to be disappointed and unsettled by the recapitulation during his first year of work already done at school.

The report of the Institute of Physics on the Education and Training of Physicists remarked in 1943 on the economy of time and effort that could be achieved by rationalization of the whole scheme of scholarship and higher school certificate examinations. A first step towards general agreement along these lines has been made by the Cambridge Joint Advisory Committees, which have issued syllabuses* indicating the course of school work on which the Cambridge Higher School Certificate Examination, the Oxford and Cambridge Joint Board Higher Certificate Examination, and the College Scholarship examinations will be based. The Science Masters' Association and the Association of Women Science Teachers were represented on the Committees, which comprised school and university teachers, and representatives were appointed as observers by the Joint Matriculation Board of the Northern Universities and the University of London Matriculation and School Examinations Council.

The syllabuses have been adjusted to the capacity of the average candidate, and designed to avoid overlapping with first-year university work. Scholarship and distinction candidates would offer an optional theoretical paper on each of the syllabuses in addition to the practical examination and two theoretical papers compulsory for all candidates, the practice which has for some years been followed by, for example, the Northern Universities Joint Matriculation Board. It is hoped that this would serve to select scholars without subjecting them to the pressure of unduly advanced work.

The Physics Committee has faced the chief problem of the sixth-form physics class—the 'weak mathematicians' and those whose interests are not primarily mathematical. It is undoubtedly possible for such boys to make good progress in physics up to a certain standard, without being able to do themselves justice in examinations with the present kind of question. They can follow a quite rigorous argument with intelligent resignation, and understand and apply the physical principles concerned, but cannot do mathematical problems of the conventional type. Most teachers will therefore approve of the list of topics, mainly mathematical, and some of acknowledged difficulty to all students (such as the force between the plates of a condenser), on which questions will not be asked.

The usual ground has been extended by including simple radio theory, and appliances such as the cinematograph, gramophone, sound film projector, loud speaker, and cathode ray oscillograph. It should thus no longer be theoretically possible (as it was some years ago) for a boy to leave school, after two years of specializing in science, completely uninstructed in the principles of most of the electrical appliances to be met in the outside world.

Experiments of the 'pure practical' type, involving problems on topics not necessarily covered by the theory syllabus, may be set in the practical examination. The boy of outstanding promise should more readily reveal it in this kind of exercise than in the usual routine type of experiment, and a practical course containing a good proportion of these problems has a surprisingly stimulating effect on a class.

In drawing up the chemistry syllabus, the Committee concerned has borne in mind that the study of this subject should be based on experimental work, and that a clear understanding of chemical and physical principles, founded on first-hand knowledge, is of paramount importance.

In general and inorganic chemistry, importance is attached to the gradation in properties of the elements and their compounds, such as hydrides, oxides and halides; this study to be closely linked with the Periodic Table. The Committee stresses that every effort should be made to provide the student with a mental picture of the molecular processes involved in the fusion of solids, evaporation of liquids, diffusion, gaseous reactions and chemical equilibria, and that the mathematical treatment of these topics should not be expected.

Most teachers will welcome the decision to delete from the syllabus, limiting densities, the phase rule, ionic mobilities, transport numbers and quantitative problems on solubility products, since experience has shown that these are rather beyond the grasp of the average sixth-form pupil.

In organic chemistry the usual sixth-form syllabus has been pruned considerably. Emphasis is placed on a knowledge of the arrangement of the atoms (excluding stereoisomerism) in the molecules of compounds, and of the typical reactions of characteristic groups, rather than on the preparation of a large number of compounds. The economic aspects of the subject have not been overlooked, and teachers will be glad to see that the cracking of oils, polymerization of olefines, and syntheses from acetylene and carbon monoxide have been included in the syllabus.

In the practical work the Committee recommends that a knowledge of the standard qualitative analysis tables should not be required, but that analysis should be closely linked with the teaching of inorganic chemistry, and that the fundamental principles involved should be clearly understood. The identification of mixtures of salts is limited to three radicals, of which no two metals will be in the same group, and the phosphate elimination will not be required. The volumetric work is confined to acid, alkali, permanganate, thiosulphate and silver nitrate (in neutral solution) titrations, and if problems are set involving other reagents, sufficient working details will be given.

The syllabuses do not seem too long for the time allowance of seven or eight forty-minute periods, which is proposed for each of the subjects, physics and chemistry; these allowances are more generous than those on which the present arduous courses are covered in some schools.

* Cambridge Joint Advisory Committees. Syllabuses for Examinations taken by Sixth Form Pupils in Physics and Chemistry. Pp. 16. (London: Camb. Univ. Press, 1944.) 6d.

The Committees invite criticism and comment, which will be considered before further editions are issued. No doubt individual teachers will have constructive suggestions to make, and probably the very detailed list of topics for study and omission will be revised from time to time; but the syllabuses as a whole will be widely welcomed, representing as they do a standard which the majority of sixth-form boys should be able to reach.

Teachers and examiners, who have for many years accepted with patience the hitherto untested hypothesis that many of the defects of their students are due to their own excessive zeal, will have another reason for welcoming the new syllabuses. One factor responsible for literary incapacity, narrowness of outlook, and other personal shortcomings, has now been much reduced in magnitude; should these failings still persist appreciably, attention may in future be turned to other factors in the curriculum. Mere absence of intensive specialization is not enough; a sound general course for the sixth-form science student calls for the best that the humaner studies can provide, and they now have their chance.

The shifting of emphasis from the needs of the gifted few to the needs of the majority still leaves a problem to be faced. The good scholarship boy at present enters the sixth form at the age of fifteen, takes a higher school certificate examination for the first time at sixteen or seventeen, and then (in peace-time) has a year and a term at least in which to compete for awards, proceeding to the university at eighteen or nineteen. With the proposed scheme, it seems likely that boys of scholarship calibre may gain awards at seventeen, which is generally considered too young for entering a university. It would appear undesirable for these boys to spend a further year at school simply marking time with the rest of the class, and anticipation of university work is one of the disadvantages of the present system. It would be valuable indeed if the Committees, in later issues of the syllabuses, could round off an already excellent job by suggesting general syllabuses covering a year's post-higher school certificate work for those who are preparing either to enter a university or start directly on their careers after a final year at school.

AGRICULTURAL EDUCATION ASSOCIATION

JUBILEE MEETING

THE Agricultural Education Association celebrated its fiftieth birthday at a luncheon at the Holborn Restaurant, which took place during the annual conference held during December 12 and 13 in London. The principal guest was the Minister of Agriculture, who had with him Sir George Courthorpe, president of the Royal Agricultural Society, Mr. Nevill, representing the National Farmers' Union, the United States agricultural attaché, and the chairman of the Horticultural Education Association.

In his address, Mr. Hudson said that the Agricultural Education Association has important functions to perform; not the least is the opportunity it affords workers of meeting and getting to know each other. He referred to the legislation which has recently been passed providing for the establishment of a unified National Agricultural Advisory Service, and defended the decision to separate responsibility for farm institutes from the main scheme. "We want and intend to make this Service one which by its conditions, its opportunities of advancement and its scope will attract to it the most highly qualified men in all its branches", the Minister continued.

Mr. Hudson stressed the importance which he attaches to the twin jobs of education and advice for the future of agriculture. The future of the industry will depend upon the ability of the farmer to produce food at prices which will bear a reasonable comparison with the prices at which we can buy food from overseas; to do this, the industry must make use of all the latest scientific discoveries, all the most up-to-date methods that exist in the world and are suitable for British conditions. The farmer is not a person who is able to travel about freely and see and learn things for himself; it must be through the eyes and ears of technical advisers that he will be able to keep abreast of modern developments. Mr. Hudson said he is anxious about the great scarcity which exists to-day of good technical men. Men must be found for the Advisory Service; men to teach the older students at the universities and colleges; men to teach the younger students at the farm institutes; men to instruct the large numbers of ex-Servicemen; men to staff the research stations, and so on. Men with an expert agricultural training will also be wanted by commercial firms, by the Colonial Agricultural Service and in other fields. Therefore it might be difficult for a time to push on as rapidly as he would like.

Dr. Charles Crowther had previously given an account of the early days of the Association. It was founded in 1894 at the instance of Mr. Brooke-Hunt, then the one education inspector of the Board of Agriculture. At first the membership was small, consisting of a handful of heads of agricultural educational institutions and departments. Soon, membership was thrown open to members of staffs, and in 1912 the Association numbered 130. After the War of 1914–18, a great expansion took place, and the present membership is between four and five hundred. After referring to the contributions which the Association has made to experimental work, Dr. Crowther said that it has never failed to formulate its views and present them to every commission or Government committee that has reviewed the field of agricultural education during the past fifty years, and the recommendations and subsequent administrative action have shown clearly the potency of the Association's intervention. Dr. Crowther concluded with the comment that the more highly specialized agricultural education becomes the greater will be the need for the Agricultural Education Association.

A feature of the programme at this jubilee meeting were the surveys of progress during the past half-century in grassland, livestock and dairying. Very aptly, Sir George Stapledon contributed the review of grassland work. He claimed that permanent grass dominated the outlook at first. Even the pioneer investigations of Somerville, Gilchrist and Elliot were mainly directed towards permanent turf. To Gilchrist, Sir George gave the credit for bringing together the important factors of phosphates, wild white clover, sensible seeds mixtures and the greater needs of the farmer. He paid tribute to the valuable work on the nutritive value of grass carried out by Prof. T. W. Fagan and Dr. H. E. Woodman, saying that if we do not have a clear understanding of the factors influencing the nutritive value of grass we

can have no scientific basis for the proper management of grassland as feed for animals. He praised very highly the pioneer work of Hosier with his milking bails, and went on to say that a two-compartment system of agriculture, based on huge areas in permanent grass and rough grazings, and lesser areas in arable land, affords the minimum of insurance against weathering catastrophe, and makes impossible a virile and adventuring agriculture throughout the country.

Mr. James Mackintosh said that the chief change in dairying has been the increase in the demand for milk for liquid consumption. In 1875, Morton estimated that only one third of the milk produced in England and Wales was used for liquid consumption. Rew, in 1892, raised the proportion to two thirds. In 1938, of the total milk production, some 68 per cent was consumed as liquid milk, and in 1943 no less than 90 per cent was directed to the liquid milk market, and only 10 per cent was made into produce. Mr. Hudson has now said that another 350 million gallons a year will be needed before rationing of milk can be discontinued. Mr. Mackintosh discussed in turn such influences on milk production as the introduction of imported foods, of improved methods of feeding, of modern methods of housing milking cows, of milk recording, and of regulations made by Government and other bodies. This was a comprehensive and very much appreciated review of progress and development.

Prof. R. G. White, dealing with British livestock during the last fifty years, believes that the most obvious advance has been in the control of disease, particularly with regard to sheep. He referred to the influence exerted by the importation of cheap phosphatic fertilizers for grassland, and of cheap feeding stuffs, on livestock, and also on the effect of changed standards of living. He commented on the fact that although Great Britain is a relatively small country, there are a large number of local breeds of sheep and cattle ; while he does not see any great need for starting new breeds, he would be sorry if any of the old local breeds disappeared before we obtained much fuller information than we have at present about them and their suitability for their special environments and functions. He, too, spoke of the striking development of milk production, saying that fifty years ago about 20 per cent of our cattle were of the purely beef type, and less than 10 per cent of the purely dairy type. Now, he estimates, the figures are 25 per cent purely dairy and 15 per cent purely beef. On the subject of breeding, Prof. White said that as regards the immediate major problems of breeding policy we can still do nothing better than follow on the lines of Bakewell, nearly two hundred years ago—ruthless selection, inbreeding, followed by more ruthless selection and progeny testing. We have, however, a great advantage over Bakewell in that we understand to a great extent the effect of inbreeding. We know its value, and we realize the dangers and obstacles which are to be avoided.

A paper by Mr. E. L. Crossley described the way in which spray-dried milk powder, the demand for which in war-time has enormously increased, has been packed so as to stand up to tropical conditions for a much longer period. Specially made tins are exhausted of air after being filled with milk powder, and then supplied with nitrogen gas at a pressure of 2 lb. per sq. in. The process is simple in theory, but in practice many difficulties have to be overcome, for the vacuum employed is a low one, and the nitrogen itself must be of at least 99·7 per cent purity. This gas-packing process has extended the keeping quality of full-cream spray-dried milk to seven years in temperate climates and to at least three years in the tropics.

Mr. V. C. Fishwick submitted data from experiments with pigs to show that nutrition during the early life of the piglet has a considerable influence upon the breeding capacity and milk production of the gilt. If she is badly fed during the first twelve weeks of her life, she is liable to develop a short frame and a heavy fore end, and her capacity to produce pigs and milk is liable to be reduced. These conclusions can probably be applied to other farm stock ; he suggested that the high price of milk encourages calf rearers to use little milk and unsuitable calf-rearing substitutes, so that the calves are raised on too low a plane of nutrition, with detrimental results on the animal's capacity to produce milk.

An unusual case of crop failure due to the presence of excess amounts of zinc in the soil was described by Mr. F. Knowles. A field in Essex had apparently been used as a dump for the disposal of dross from a munitions factory operating during the War of 1914–18, and when ploughed up for cropping during the present War, cereals and other crops would not grow. The trouble was traced to large amounts of zinc and copper in the soil, and experiments made in pots and in the field showed that the trouble could be overcome by liming the ground. Prof. T. Wallace contributed a paper summarizing our present knowledge of mineral deficiencies in soils and crops.

Other papers were read by Mr. F. H. Garner and Dr. Dillon Weston on the growing of field beans and on the fungus diseases to which the crop is subject. There was also a useful discussion in the Biology Section on modern methods of pasture evaluation, the principal speakers being Mr. William Davies and Mr. J. Lambert, of the Grassland Improvement Station, Stratford-on-Avon. A small committee was set up to go thoroughly into the question of technique.

THE BRITISH COUNCIL

ANNUAL REPORT

THE annual report of the British Council for the year ended March 31, 1944, covers the tenth year of the Council's work and indicates not only the part the Council has played in the war effort but also its value as an instrument for the no less difficult days of peace to come. Cultural relations are not competitive but reciprocal, and no Government can look with equanimity on the prospect after the War of international competition in this field.

The British Council, with the President of the Board of Trade, initiated a Conference of Allied Ministers of Education in London, and with the Board has borne the burden of its administration, and will continue to do so until it can hand over such responsibilities to a United Nations organization. Plans for providing schools and universities with the necessary books, stationery, laboratory apparatus, radio sets and film projectors were among the subjects discussed by the Conference. Four lines of development are picked out for special mention in the report : the start of effective work in China, the increasing importance of medicine, the growing interest in British music and the services rendered to the Armed Forces

of the United States of America in Britain. In connexion with the first, the report pays a well-deserved tribute to Dr. Joseph Needham, who has been working in China for the past eighteen months. Of these developments, those in regard to medicine, more particularly in contacts in this field with Turkey and the U.S.S.R. and the work in China, are the features of primary interest to scientific workers. The report notes that the Americans in Great Britain are making considerable use of the Council's facilities for professional contacts.

With regard to activities in the British Commonwealth and Empire, the appointment of Sir Harry Luke to the West Indies and of Prof. William Macmillan to West Africa has meant the beginning of serious work. Mr. Malcolm Guthrie has completed the preliminary survey of East Africa. At Malta a new institute was opened in the island of Gozo by Lord Gort. In the British West Indies, the circulation of *Monthly Science News* was largely increased, and the *British Medical Bulletin* was distributed to leading medical men in the area. An extensive library scheme is being sponsored for the islands with Trinidad as the centre.

A visit of British surgeons to the Soviet Union was sponsored by the British Council together with the Medical Research Council, and arrangements were made by the Medical Department of the former. American and Canadian authorities were represented. The visit gave many opportunities for the exchange of information on Soviet and British surgical methods and medical research, and the Mission was particularly impressed with the Soviet hospital organization and methods, and with the practice of early specialization in dealing with war casualties and the extremely efficient arrangements for blood transfusion. Books on many subjects have been dispatched for presentation to Soviet institutions, and further supplies of scientific material were sent to the scientific, agricultural and medical sections of the V.O.K.S. More than a thousand reprints and papers published by British scientific men during the past four years have been forwarded, and steps have been taken to centralize in the Science Museum Library, at South Kensington, London, any Russian scientific material received in Great Britain*.

By the summer of 1943, the Council was able to commence work in North Africa, and the supply and dispatch of more than 65,000 volumes of British books to libraries in Algeria, Morocco and Tunisia has been arranged. Events have made the Council almost the only means of cultural contact between Britain and Sweden, and difficulties of transport from September onwards did not prevent its work from rapidly increasing. The exchange of periodicals, mostly scientific, between Britain and Sweden is considerable, and would be much larger if transport allowed; transport also limits the contact between Britain and Sweden in the field of research. Sir Lawrence Bragg, the only lecturer from the Council to visit Sweden during the year, proved a most popular visiting lecturer and spoke on electron microscopy at four university centres and to five Anglophil societies. Dr. Dudley Cheesman gave a series of lectures on scientific development in Britain at the Wenner-Gren Institute.

The Council's work in Turkey continues to expand proportionally. The number of British professors holding chairs at the University of Istanbul, on the recommendation of the Council, is now ten, and there are three at the University of Ankara (see *Nature*, October 21, p. 509). The expansion in teaching was accompanied by an extended programme of special lectures, and the Council had four distinguished visiting lecturers in Turkey during the year—Dr. B. Ifor Evans, Dr. H. R. Hamley, Dr. S. J. Davies and Mr. J. Steegman. A Turkish version, translated locally, of the *British Medical Bulletin* was published for the first time during the year, as well as a locally compiled and translated *British Engineering Bulletin*. *British Agricultural Bulletin* and *British Law Bulletin*.

In pursuance of the valuable but difficult project of translating British Standard Specifications into Turkish, B.S.S. No. 132 (Steam Turbines) has been published in England during the present year. Six further specifications have been approved for translation and are completed and awaiting publication, and the translation of fourteen other specifications is being technically checked. Three distinguished Turkish medical men, Prof. B. Tugan, Dr. Avni Aksel and Dr. B. N. Taskiran, visited Britain as the Council's guests and inspected various aspects of medical organization and research.

The Anglo-Egyptian Union is so successful that membership has had to be restricted owing to the lack of accommodation. Membership of the Council's Centre in Brazil increased by fifty per cent during the year, and the distribution of *Monthly Science News* has now risen to 4,000 copies, with large numbers of new requests.

The report includes the full results of Dr. Joseph Needham's valuable scientific work in China; Mrs. Needham later joined her husband. The activities of the Council's cultural scientific position in China commenced on February 24, 1943, when Dr. Needham reached Kunming (Yunnam). Within a fortnight of his arrival, it was reported that co-operation with scientific organizations and individuals had begun and that he had visited more than a dozen universities and research institutes and factories in the vicinity, lecturing on his own field and on topics of general scientific and social interest. Three weeks later he reached Chungking, and on April 3 submitted to the British Ambassador a detailed memorandum on Sino-British scientific relations and cultural co-operation, setting forth the services which might be rendered by a science co-operation officer in China, outlining the possible future developments of such an office and raising the question of technological, as distinct from cultural scientific, aid from Britain to China. Academia Sinica has now agreed to second a scientific worker to assist in matters relating to the Cultural Scientific Office, and the Ministries of Health, National Resources, Agriculture and Education are willing to co-operate. Dr. Needham left Chungking on August 7 on a round trip of 4,000 miles and has now visited more than a hundred scientific institutions in China. Since returning to Chungking he has continued the work of organizing and developing the Cultural Scientific Office. Dr. Needham's valuable and interesting articles published in *Nature* during the summer of 1943 are evidence of his activities.

Of great importance to the Chinese war effort and for the development of all branches of science in China is the supply of information and constructive ideas on the problems arising in pure and applied science. The Council's Office constitutes the link between the Chinese Ministry of Health and the

* Russian periodicals received at *Nature* office also are eventually sent to the Science Library.

Medical Research Council in Great Britain, between the Chinese Ministry of Economics and Natural Resources and the Department of Scientific and Industrial Research, etc.

A fund has been set up in India for the maintenance of a Scientific Supply Service, so that the essential needs of Chinese research institutions, etc., many of which are engaged on war work, may be met. Six copies of current issues of some seventy-five British scientific journals are regularly sent to China for distribution by the Cultural Scientific Office, and it is hoped to arrange for a Chinese edition of *Monthly Science News* to be published in Chungking. *Monthly Science Abstracts and Reviews* and copies of *Endeavour* are distributed through Academia Sinica. Six positive micro-film copies of each of these seventy-five scientific journals are being sent regularly to China for distribution by the International Committee for the Supply of Scientific and Cultural Reference Materials, and this organization also handles all American supplies of micro-films. British scientific films are being supplied to the Department of Educational Cinematography of Nanking University, and a number of offprints of scientific papers from British journals have been transmitted to China at the author's wish or on request from Chinese workers. The number of text-books and monographs on scientific subjects which have reached China in response to requests passed on by the Council's Office runs into hundreds. Thirty manuscript papers in English by Chinese workers have been submitted for publication through the Chungking Office to editors of British scientific journals, and a panel of translators from Chinese to English has been assembled so that scientific papers of special interest can be translated or abstracted. A grant has been made for the preparation of abstracts in English of Chinese publications on chemical matters, and at least four hundred current Chinese scientific publications have been distributed through the Council to British scientific workers and science libraries. A science news letter, *Acta Brevia Sinensia*, giving an account of current Chinese scientific activities, is duplicated and distributed by the British Council in Great Britain. Prof. E. R. Dodds returned from China in the summer of 1943 after a successful tour of the university centres, Mr. E. Hughes has been in China since May 1942 and was remaining until the end of September 1944. Prof. W. L. Renwick, who reached China more recently, has already submitted a report on the fine arts in China.

WORK OF THE ROYAL ARMY VETERINARY CORPS

MAJOR A. V. FRANKLIN, writing in the *Veterinary Record* (447, Nov. 18, 1944), tells one of the most interesting and humane stories of this war. As a result of the progressive mechanization of our armed forces before the War, the Royal Army Veterinary Corps was very considerably reduced, and some prophets decided that it would never be revived. How wrong they were they will learn from Major Franklin's article. When a cavalry division was formed for service in Palestine, veterinary units of the Royal Army Veterinary Corps were organized to attend to its animals. Mobile units were also serving, at the outbreak of the War, the two cavalry regiments stationed in Palestine. Other veterinary units were attached to Indian and Cypriot mule pack transport companies operating in France. This was the extent of the British Army veterinary services until the end of 1940.

In 1941, however, a striking change occurred. The duties of the Army Remount Service were transferred to the Royal Army Veterinary Corps, which thus undertook the purchase, training and maintenance of animal reinforcements, as well as the care of the animal sick and injured. In the difficult country of Eritrea and Greece, where pack animals played such an important part, the Royal Army Veterinary Corps had ample opportunity to prove its efficiency. In Greece many veterinarians were taken prisoner and some heavy casualties were incurred. One of the saddest tasks was the rescue, by the mobile section stationed at Alexandria, in veterinary charge of the Polish Carpathian Brigade, of hundreds of mules in the North African desert. The Italians fleeing before Lord Wavell had left them there without food, water or attendance and their condition was deplorable; but they were soon restored by proper veterinary care. In Syria, several regiments of yeomanry operated with their own veterinary officers and also two mobile veterinary sections. It was here that the Royal Army Veterinary Corps showed the efficiency of its remount organization. Horses of all kinds were taken over from the Vichy French, classified, examined for disease, branded, shoed and generally conditioned before they were re-issued for service with the Allies. Here also many horses and mules were found deserted by their attendants without food or water and often in a pitiable condition. While this task was being completed, yeomanry and cavalry regiments were being mechanized and their horses were taken over and trained for transport work.

In 1942, the Royal Army Veterinary Corps was given the task of meat inspection and administration of the livestock depots from which the Army's meat supply was derived. The stock were inspected both before and after slaughtering, and this service was so beneficial that it was extended throughout the Middle East. The existing slaughter-houses were often so insanitary that the Royal Army Veterinary Corps designed and built new ones with adequate rail and road facilities. The serious danger of transmission to man of certain animal parasites which are very prevalent in bovines was removed. Later, the Corps undertook the actual selection of the beasts provided by local contractors, who soon learnt that inferior stock would not be accepted. Often, indeed, they could not supply beasts of sufficiently high quality, and the Royal Army Veterinary Corps established its own livestock depots, first in Syria and later throughout the Middle East, in which cattle, sheep, goats and pigs were reared and supplied to the Forces. Patients in the hospitals received white meat in the form of rabbits from the Corps' rabbitries. One of these depots, carrying a stock of 1,500, was able to produce 150 animals a week. The commanding officer of this depot has reported that, in Syria, parasitic disease in sheep and goats caused the deaths of one million animals in one winter alone, a loss which amounted to three million pounds sterling, or one quarter of the annual budget of the country.

In Italy, the Royal Army Veterinary Corps had perhaps its most difficult task. Many of us have heard about the mules used in this extraordinary campaign; but we have not all realized how much our men

owe to the R.A.V.C., which bought, conditioned, trained and issued these invaluable animals. This work called for high administrative and business skill. Mules had to be sought out in many countries, and the right types had to be selected and transported across land and sea. Many veterinarians were required for the pack transport companies and more for the remount depots, animal hospitals, mobile sections and laboratory services. Evacuation of animal casualties from the line and the supply of reinforcements was one of the most eagerly sought jobs in the veterinary service. The Corps is now considering the extensive use of dogs.

It is certainly true that, as Major Franklin says, the story of all this work, when it can be told in full, will bring great honour to the veterinary profession. Much of the veterinarian's work, in peace-time as well as in war, is unspectacular and done with a quiet efficiency which does not get into the news. It deserves the admiration and gratitude of all who care for animals. G. LAPAGE.

RELATIVITY OF TEMPERATURE RADIATION

IN his Halley Lecture[1], Prof. H. Dingle gave an outline of an entirely new application of relativity principles to thermal radiation. He has now published a more detailed account[2] which shows how far the theory has been worked out. The fundamental idea is that "our theories should not imply the possibility of observing what is, in fact, unobservable". Thus in Einstein's theory of two bodies moving with uniform relative velocity, it is only this relative velocity and its limiting value which are of importance. Moreover, the equality of the inertial and gravitational mass is regarded not as a remarkable coincidence, but as establishing that these two masses are two aspects of the same property.

Guided by this analogy, Prof. Dingle deals with the radiation of a black body, of constant temperature, in terms of its effect upon a second black body. He regards the equality of the emissive and absorptive powers as establishing that these are two aspects of the same property. It should have been pointed out that this equality exists only when the powers are defined in a general way[3]. The conventional definitions[4], which give absorptive power as a pure number, but emissive power as a quantity with dimensions, obscure this equality.

The most important part of Prof. Dingle's theory seems to be the analogy between the three kinematical variables, displacement, time and velocity, and three thermal variables, entropy received by a certain instrument, 'thermal time', and what I will venture to call 'radiocity', though he calls it 'radiation temperature', or simply 'temperature'. It is certainly not the usual absolute temperature, as it is approximately proportional to its fourth power. The 'thermal time' is measured by a 'thermal clock', which records what in ordinary terms would be called the total amount of radiant energy received from a black body radiating at a constant rate. In terms of these variables, Stefan's law of radiation takes the form 'radiocity is rate of change of entropy', exactly analogous to 'velocity is rate of change of displacement'. Moreover, if the zero of 'radiocity' is changed, the three thermal variables are transformed by formulæ that correspond roughly (but not in detail) with the Lorentz transformation formulæ of Einstein's theory. Finally, there is an invariant thermal interval; but this involves an expression of the fourth degree in the differentials, whereas the kinematical interval of space-time involves only one of the second order.

Two applications of the theory are to the maximum efficiency of a heat engine working between fixed temperatures, and to the general equations of the thermo-electric circuit. It is difficult to find other applications, as there are few phenomena which depend only on temperature differences, do not appreciably alter the temperature, and are independent of the properties of particular substances. It is emphasized that the theory, at any rate in its present form, deals only with radiation; no claim is made that all thermal phenomena are independent of the zero of temperature.

Prof. Dingle concludes by indicating how the limitation of constant temperature might be removed. As in the extension of the special theory of relativity to the general theory, it would be necessary to deal with tensors, but in the thermal case the work would be much more difficult. Perhaps some enterprising young mathematician may care to tackle this. If Prof. Dingle's arguments are sound, they open up a new line of approach to the theoretical study of radiation and a new opportunity for the use of the tensor calculus. H. T. H. PIAGGIO.

[1] *Nature*, **153**, 731 (1944).
[2] *Phil. Mag.*, **35**, 499 (1944).
[3] Preston, "Theory of Heat" (4th ed.), 494.
[4] Preston, "Theory of Heat" (4th ed.), 541–42.

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

THE annual report of the Indian Association for the Cultivation of Science for the year 1943 includes the presidential address, the report of the committee of management, including lists of papers published in the *Indian Journal of Physics*, vols. 16 and 17 and in the *Proceedings* of the Association, and appendixes on the scientific work of the Association. The membership increased from 157 to 213 during the year, and of the latter figure 133 are life-members.

The report on the scientific work of the Association refers to a study of primary extra reflexions in Laue photographs, in which the exact location of the absolute maximum of each extra spot at different orientations of a crystal, the spread of the intensities of the spots along different directions, the change of maximum intensity with variation in the angle of incidence, and the deviation of the direction of maximum intensity from the planes of incidence are being studied. A closer study of the extra reflexions in Laue photographs of phloroglucinol crystals indicated that these reflexions are also of the secondary type and originate from the lattice degradations along the trigonal and the diagonal axes, and further investigations of this effect in benzil are in progress. Attempts are also being made to obtain accurate values of the atomic parameters in benzil crystals by a two-dimensional Fourier analysis.

Investigation of the magnetic behaviour of rare earth ions in crystals at low temperatures led to the conclusion that the paramagnetic units do not change with temperature, but the angle between the various paramagnetic units and the unit cells in these crystals

changes with the temperature. Magnetic studies have confirmed the predictions as to the fine structure of potassium permanganate single crystals drawn from X-ray studies. The Hall effect of molybdenite has also been investigated, and in a study of the fluorescence of anthracene crystals containing naphthacene, excited by monochromatic radiation, it has been shown that the position and number of fluorescent bands of naphthacene are independent of the wave-length of the radiation, and that the intensity of fluorescence rapidly falls to zero as the wave-length of the inciting radiation increases beyond the central part of the longest absorption band.

Research work carried out by Dr. S. C. Sirkar covers the Raman spectra of ethyl, methyl, propyl and butyl sulphide in the solid state at the temperature of liquid oxygen. The investigation has been extended to aromatic compounds of high boiling point, such as benzyl alcohol, benzylamine and benzoyl chloride. An X-ray analysis of jute fibre has led to the grouping of the fibres into four broad classes, and the result may lead to the development of a method of classification of jute fibre similar to that adopted by the U.S. Government for cotton fibres. Mr. B. C. Guha has studied the temperature variation of anisotropy of many paramagnetic ions in crystals of salts of the iron group of metals over the temperature range 300°–80° K.

FORTHCOMING EVENTS

Monday, January 15

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 8 p.m.—Brigadier R. A. Bagnold: "The Early Work of the Long Range Desert Group".

Tuesday, January 16

BRITISH PSYCHOLOGICAL SOCIETY (INDUSTRIAL SECTION) (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 1.15 p.m.—Dr. A. H. Seymour: "Psychological Problems of the Personnel Function in Industry".

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. B. Gresford: "Scientific Aspects of Australia's Industrial Development".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. Cecil Binney: "Eugenics and Criminal Law".

INSTITUTION OF CIVIL ENGINEERS (RAILWAY ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. F. H. D. Page: "Railway Signalling for the Civil Engineer".

INSTITUTION OF ELECTRICAL ENGINEERS (RADIO SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Frequency Allocation for Long Distance Communication Channels (over 1000 Miles)" (to be opened by Dr. R. L. Smith-Rose).

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6.15 p.m.—Mr. P. S. Milne: "Photography and Bee-Keeping Research".

Wednesday, January 17

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Christian Barman: "Design in Modern Transport".

INSTITUTE OF FUEL (MIDLAND SECTION) (at the James Watt Memorial Institute, Birmingham), at 2.30 p.m.—Mr. A. T. Green: "The Properties of Refractory Materials and their Significance to Fuel Economy".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Mr. Fred Wolverson Cope: "Intraformational Contorted Rocks in the Upper Carboniferous of the Southern Pennines".

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON (at 41 Queen's Gate, South Kensington, London, S.W.7), at 3.30 p.m.—Annual Meeting. Dr. E. A. Cockayne: "Some Contributions of Entomology to Genetics" (Presidential Address).

ROYAL STATISTICAL SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.15 p.m.—Mr. M. G. Kendall: "The Analysis of Oscillatory Time Series".

WOMEN'S ENGINEERING SOCIETY (MANCHESTER BRANCH) (at the Engineers' Club, Albert Square, Manchester 2), at 6.30 p.m.—Mr. G. E. Windeler: "Mechanical Mishaps and Industrial Accidents".

Thursday, January 18

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Prof. J. Monteath Robertson: "Diffraction Methods in Modern Structural Chemistry" (Tilden Lecture).

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (at the Royal Institution, 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. L. A. Jordan: "Paint—The Art and the Science" (Jubilee Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on the Second Report on Education and Training for Engineers dealing with "Part-time Further Education at Technical Colleges, including Courses for those returning from the Services".

IRON AND STEEL INSTITUTE (joint meeting with the STAFFORDSHIRE IRON AND STEEL INSTITUTE) (at the Dudley and Staffordshire Technical College, The Broadway, Dudley), at 7 p.m.—Prof. F. C. Thompson and Dr. L. R. Stanton: "Some Observations on the Austempering and Isothermal Transformation of Steels with special reference to the Production of Martensite".

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall, 32 Welbeck Street, London, W.1), at 8 p.m.—Symposium on "Clinical Photography".

Friday, January 19

INSTITUTION OF ELECTRICAL ENGINEERS (MEASUREMENTS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. H. J. Josephs: "The Fixing of Confidence Limits to Measurements".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. Antony R. Vickers: "The Engineer and the Nation's Money".

INSTITUTE OF FUEL (SCOTTISH SECTION) (joint meeting with the SOCIETY OF CHEMICAL INDUSTRY) (at the Royal Technical College, Glasgow), at 5.45 p.m.—Prof. D. T. A. Townend: "The New Era in Combustion".

APPOINTMENTS VACANT

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

CIVIL ENGINEER by the Government of Ceylon, for appointment as IRRIGATION ENGINEER—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. E.1030.A) (January 19).

MATHEMATICAL PHYSICIST to join a small research team working on problems connected with welding—The Secretary, The University, Edmund Street, Birmingham 3 (January 20).

PRINCIPAL OF THE BARNSTAPLE SCIENCE, ART AND TECHNICAL SCHOOL—The Secretary for Education, County Education Offices, Castle Street, Exeter (January 20).

ADVISER IN AGRICULTURAL ZOOLOGY—The Acting Registrar, School of Agriculture, University College of North Wales, Bangor (January 20).

LECTURER (full-time) IN ELECTRICAL ENGINEERING—The Principal, Royal Technical College, Peel Park, Salford 5, Lancs. (January 22).

LECTURER IN METALLURGY—The Secretary, The University, Edmund Street, Birmingham 3 (January 30).

EDUCATIONAL PSYCHOLOGIST—The County Medical Officer, Public Health Department, Shire Hall, Nottingham (January 31).

COMMISSIONER OF PUBLIC HEALTH, Perth—The Agent-General for Western Australia, 115 Strand, London, W.C.2 (February 1).

ASSISTANT HYDROGRAPHIC SURVEYORS by the Kenya Government Public Works Department—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. E.904.A) (February 12).

SUPERINTENDENT OF THE HAROLD COHEN LIBRARY, and three SUB-LIBRARIANS (two in the Faculty of Arts, and one in the Faculty of Science)—The Registrar, The University, Liverpool (April 26).

ASSISTANT CHEMISTS (two) for Laboratory investigating Colonial raw materials—The Establishment Officer, Imperial Institute, South Kensington, London, S.W.7.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 62, Part 2, No. 14: On Substitutional Equations. By D. E. Rutherford. Pp. 117–126. 1*s.* 9*d.* Vol. 62, Part 2, No. 15: Quantum Mechanics of Fields, 2: Electromagnetic Field and Electron Field in Interaction. By Prof. Max Born and Dr. H. W. Peng. Pp. 127–137. 2*s.* Section B (Biology). Vol. 62, Part 1, No. 10: Mitosis and Cell Differentiation in the Blood. By L. F. La Cour. Pp. 73–85+3 plates. 3*s.* 3*d.* Vol. 62, Part 1, No. 11: Some Recent Advances in the Study of the Brain as the Implement of Mind. By Dr. Richard J. A. Berry. Pp. 86–95. 1*s.* 6*d.* Vol. 62, Part 1, No. 12: The Histochemical Demonstration of Ribonucleic Acid in Mammalian Liver. By Dr. J. N. Davidson and Dr. C. Waymouth. Pp. 96–98+1 plate. 1*s.* Vol. 62, Part 1, No. 13: The Appearance in Cross-section of the Hairs of some Carnivores and Rodents. By Dr. J. L. Stoves. Pp. 99–104+3 plates. 2*s.* 3*d.* (Edinburgh and London: Gurney and Jackson.) [2812

Re-educating Adults: an Essay on Adult Religious Education. By Canon R. E. Parsons. Pp. 32. (London: Churches' Committee for Supplementing Religious Education among Men in H.M. Forces.) 1*s.* 6*d.* [51

Ministry of Health. Local Government in England and Wales during the Period of Reconstruction. (Cmd. 6579.) Pp. 20. (London: H.M. Stationery Office.) 4*d.* net. [51

Institution of Electrical Engineers. Education and Training for Engineers (Second Report). A Report to the Council from the Post-War Planning Committee on Part-Time Further Education at Technical Colleges including Courses for those returning from the Services. Pp. 40. (London: Institution of Electrical Engineers.) [51