"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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HOURS OF WORK, HEALTH AND EFFICIENCY

HOW many more wars will be necessary before those responsible for working hours learn that man is not a machine, and that the very qualities that enable him to rise above himself for an emergency period prevent him from continuing that process indefinitely ? This question is prompted by a consideration of "Hours of Work and their Influence on Health and Efficiency", by Dr. H. M. Vernon, recently published by the British Association for Labour Legislation*.

In war-time, the question of hours of work becomes of immediate importance owing to the need for maximum production. It is therefore obvious that as many hours must be worked as will make this possible over a prolonged period. This aspect is easily understood, but it should be equally obvious that the health of those doing the work should not be injured by demands that are neither physiologically nor psychologically reasonable. If these demands are enforced, production suffers in two ways ; first, by the lowered production of those present ; and secondly, by the absenteeism of those who break down.

In peace-time, the hours of work for different categories of workers and age-groups are carefully regulated, but in war-time a general relaxation of the regulations is inevitable. The serious situation caused by the evacuation of the British Expeditionary Force from Dunkirk led to an immediate extension of working hours ; the seven-day week and the twelve-hour day applied to thousands of workers, women as well as men, and the almost superhuman efforts made by the munition workers did result at first in an enormously increased production, which however gradually fell, owing to the cumulative effect of fatigue, to the pre-Dunkirk level. This effect of fatigue was known during the War of 1914–18 and the data were published in the Report of the Health of Munition Workers' Committee. It is unfortunate that many factory managers and people in responsible positions are so much impressed by the increase of output resulting immediately from an increase of working hours that they are apt to continue the overtime indefinitely. It is seldom that they ascertain by careful measurement what exactly is happening to production.

Another condition often overlooked is that the proportion of women to able-bodied men increases from week to week during war. Women have usually, in addition to the hours in the factory, home duties which are often heavy enough in peace-time but still heavier under war-time conditions. The result has been a serious reduction in the hours devoted to sleep. It is true that the Minister of Labour recommended in July 1940 that there should be a return to more reasonable hours of work, but the gap between the recommendation and its application still remains in too many factories.

* Hours of Work and their Influence on Health and Efficiency. By Dr. H. M. Vernon. Pp. 38. (London : British Association for Labour Legislation, 27 Clareville Grove, S.W.7, 1943.) 9*d*.

Apart from reduced output, long hours result in an increase of absenteeism, of which sickness represents approximately half the total loss, although the relationship varies from factory to factory. Some of the casual absence is due to the demands of shopping, to the illness of children or to sheer fatigue. The sickness rate of men almost doubled itself after the 70-hour week was imposed, but the 65-hour week was accompanied by quick recovery. The 60-hour week in the case of women led to a considerable increase of illnesses diagnosed as nervous breakdown. Not only adults but also far too many young persons have been working dangerously long hours, with the result that many are physically and mentally exhausted. Such hours were illegal, but that does not lessen the effect on the health of the young people. The Select Committee on National Expenditure has emphasized the importance of abolishing Sunday labour : in one factory the workers lost more than three times as much time when the hours were raised from 56 a week to 69½ by means of a longer working day and work on Sunday.

In 1940 the accident-rate of fatal, non-fatal and minor accidents rose considerably above the pre-war level. The employment of inexperienced and young people is partly responsible, but it is also known that the frequency of accidents is influenced by long working hours.

If the worker finds conditions too onerous, he may absent himself altogether. The result is a high labour turnover. To restrict this tendency, in April 1941 the Government introduced the Essential Work Order, according to which no person could leave his employment or be discharged (except for serious misconduct) without the permission of the National Service officer. This had the immediate effect of reducing the labour wastage, but nevertheless in some factories workers have found ways of evading the order.

It is recommended that in the interests of production as well as of health, the ordinary regulations of the Factories Act should be kept except for special temporary conditions. For men a working week in excess of 60 hours usually leads to no increase in production, and for women the hours should never exceed 54. Young women aged sixteen and seventeen should not work more than a 48-hour week, though youths of the same age can do up to 54 hours. Boys and girls aged fourteen and fifteen should be limited to 44 hours.

The importance of limitation of hours of labour has been recognized by the Government for some time, and one result has been an investigation of the effects of war-time hours of labour on young persons. In December 1941 the Government decided that youths and girls aged sixteen and seventeen were to register, so that the local education authorities could make contact with them and that they might be encouraged to fit themselves for national work. Most of the interviewing panels were much impressed by evidence of the strain upon young people due to long hours of work. The actual working hours were rarely excessive, but to the official hours must be added the hours spent in travelling. Also many of the young people were doing two or more jobs ; for example, colliery boys doing farm work in the evenings, girls doing normal factory hours and, in addition, working in fish-and-chip shops or acting as usherettes in cinemas in the evening. In the case of young girls who were running the home while their parents were at work, the interviewers felt that they were often carrying a burden too heavy for their years, leaving very little time for recreation. The interviewers were most impressed by the calibre of the young people and of their general morale, but point out the lack of attention they have received since leaving school. The most alarming symptom was that of mental lassitude in those who were unable to get adequate time for relaxation and recreative activity.

The report of the investigation, which has been issued as a White Paper by the president of the Board of Education and the Secretary of State for Scotland (Cmd. 6446*) outlines the action which it is proposed to take. Hours of employment are to be reviewed, travelling times reduced by transferring youths where necessary to employment nearer their homes, feeding arrangements are to be examined and interviewing panels are to discourage undue activities outside working hours. These steps are all in the right direction, but speed is necessary to prevent undue strain on those who, while they are contributing to the war effort, are also the foundation on which will fall a heavy burden in the early years of peace.

* Board of Education : Scottish Education Department. Youth Registration in 1942. (Cmd. 6446.) Pp. 28. (London : H.M. Stationery Office, 1943.). 6*d*. net.

FARM AND FOREST IN COLONIAL ADMINISTRATION

ALMOST alone among the former great Powers, the Anglo-Saxon race has ignored the intimate relation existing between agriculture and forestry. This is as true of the United States of America as it is of the great Dominions of the British Empire and the Colonies under the administration of that Empire. The Anglo-Saxon races all had the same cradle, the island of Britain, and they all seem to lack feeling for the relation of agriculture to the forest. In connexion with future planning of the British countryside, reports have been issued in which the forestry side of this question is either totally ignored or receives scant mention. This want of appreciation in the past of the true role of the forest may have been a natural outcome of the absence for so long of substantial forests in Britain ; the large areas of semi-derelict land in the mountainous and more out-of-the-way tracts being practically unknown or, at least, disregarded.

The Anglo-Saxon races have carried with them this lack of appreciation of the value of the forest to agriculture all over the world ; in the New World, the United States and Canada, eastwards to Australia and New Zealand, and many Colonies. But out-

side Great Britain, the position was very different. Enormous stretches of forest, apparently inexhaustible, were in existence. Since the new-comers had no idea of the value of the forest or its relation to other conditions of the countryside—to mention one, water—a relentless war was waged on these great forests. This war varied. It might be pure lumbering to supply ever-growing markets—wasteful lumbering often accompanied or followed by great fires which swept away large tracts of natural forest as yet unexploited. This type was commonest in the New World. In the more tropical forests in the Old World containing a large number of species of trees, only a few of which had any marketable value, the removal of the salable individuals, while reducing the commercial potentiality, still left a forest on the area. The damage here was due to other but equally destructive practices.

The general results of the maltreatment of the forest in various parts of the world by the Anglo-Saxon race (or through their instrumentality) during the past century, to go no farther back, are well known, although the results of such treatment are still disputed by administrators and by considerable sections of the public, few of whom in the past were given that modicum of scientific training which would have enabled them to appreciate some of the more elementary laws of Nature. The British Empire was not the only offender. The citizens of the United States have shown equal misunderstanding of Nature and her decrees. Indiscriminate lumbering of the forests and over-utilization of the great corn lands have led to disasters both in the United States and Canada. Excessive sheep farming has occurred in Australia, and uncontrolled firing of the countryside in New Zealand. Soil sterility and erosion have put out of commission thousands of farms.

The reasons and causes of this treatment of the forest and soil may be different, but the aftermath in no way differs from the growing impoverishment, and in cases sterility, of the soils of many British Colonies. The administration of these latter, in that it has put an end to internecine strife between the tribes or chiefs, introduced education, health measures, sanitation and so forth, is as good as can be found anywhere else in the world—in methods often far superior. The British administrations have, however, been guilty of an error of judgment in the rigid application of the early introduced rule that all interference on the part of the administration with the local practices, habits and customs of the people was deprecated and would not be countenanced. Consequently such common practices as shifting cultivation, firing of the countryside in the hot season and unrestricted grazing by herds of stock, increasing with amazing rapidity under the *Pax Britannica*—all these practices continued unchecked in the form found when the country was taken over. The inevitable results, as in the case of the New World and in the Dominions of the British Empire, were not foreseen or the dangers even appreciated.

In New Zealand, at least, a recognition of one of the causes of erosion, namely, unchecked firing of the countryside, has begun to make its appearance. In the Dominion Forestry Report (March 1942) on the subject of soil erosion one reads:

"Forest clearing and grassing have ceased on all State-owned lands, and attempts to grow one blade of grass where two trees grew before are now recognized as the root cause of the Dominion's erosion problem. Should further forest clearing be allowed on any lands—private or Native—if it contributes to accelerated erosion? In the belief that the public is convinced of the necessity for controlled clearing of all forested land, irrespective of ownership, appropriate recommendations are being drafted for consideration by the Government."

In how many of the Colonies of the British Empire could such a statement be made? A great deal has been heard recently of the attempts to improve agricultural methods there. In the past, every effort was made to improve the commercial and financial position—the so-called development of the Colony—by the introduction and growth of crops of tea, coffee, cocoa, sugar, rubber and so forth, all at the expense of the forest, for the development was made by the large-scale felling of the most valuable, because the richest in commercial timber species, of the forest areas. For a time, all went well. Wealth came to the Colony and the planters, while the natives continued their old practices of shifting cultivation, etc., in the rest of the accessible forests. But the rich forest soil, the product of centuries of conservation under the canopy of the trees, gradually became used up and dissipated when exposed, for little protection was afforded to it by the crops grown. We are now facing the results to be expected, and the British taxpayer will be called upon to foot the bill.

The administrations still appear to regard it as a purely agricultural matter. More research, it is said, will lead to a better because more intensive agriculture. Is this a logical conclusion because, in isolated instances, a Colonial agricultural department can show, on a small scale, the example of a success? In Africa it is beyond question that the soil of the Continent is becoming increasingly impoverished by the very means by which great tracts of that old Continent have become reduced to desert, or practically desert conditions, by man in the past.

It was in justification of this belief that the Royal African Society set up a small Commission of Research for Africa and invited representatives who had been administrators in those Colonies from the Free French, Belgian and Dutch Governments in London to serve on it. The two British representatives were both retired officials, one a former lieutenant-governor. The Commission came to unanimous conclusions on the subject of shifting cultivation, bush fires, grazing, reservation of forests, and erosion, and suggested practical proposals for dealing with those evils—evils which the administration has refrained from touching for so long, as an interference with the habits and customs of the people. It may be hoped that the Secretary of State for the Colonies may yet find time to study this important problem, vital to the future well-being of the large populations under his care.

MODERN BIOMETRY

Statistical Analysis in Biology

By Dr. K. Mather. Pp. iv+248. (London : Methuen and Co., Ltd., 1943.) 16*s*. net.

DR. MATHER'S book begins with the remarkable statement that "Statistics is the mathematics of experiment". In fact, statistics originated in the spheres of demography and economics, where experiment is difficult, dangerous, and rarely scientific ; and among their most successful spheres of application is astronomy, where it is wholly impossible. Perhaps it is for this reason that Dr. Mather completely ignores the construction and interpretation of life-tables, though these are not merely fundamental for human biology, but are assuming an ever-growing importance in animal biology also. Nor is there any suggestion for the treatment of statistics of fertility, such as are given in Salisbury's "The Reproductive Capacity of Plants". Yet any theory of evolution must be based on such data as these.

In his mathematical analysis, "The primary concept of statistics," Dr. Mather tells us, "is that of the infinitely large hypothetical population of which the observed data form a sample". Certainly theoretical statistics can be built up around this concept. But they can also be built up around that of a random variable, or around that of probability in accordance with such axioms as those of Jeffreys. Many writers regard one or both of the latter approaches as logically sounder, if only because they do not necessitate the concept of likelihood, which is not derivable from that of an infinite population.

The ground covered by Dr. Mather is much the same as that covered by Prof. R. A. Fisher in "Statistical Methods for Biologists" and "The Design of Experiments", and his debt to Fisher is obvious and fully acknowledged. As compared with these books, Dr. Mather's gives a fuller account of some arithmetical methods. His discussion of the interrelations of the normal deviate, χ^2, Student's distribution, and that of the variance ratio, is illuminating, as is his detailed account of the individuality of degrees of freedom.

But, as might perhaps be expected from his opening paragraphs, Dr. Mather's treatment is sometimes logically incorrect. Thus, after finding χ^2 for a 2×2 contingency table on p. 193 to be 1·17, he adds that this shows "that there is no interaction between the classifications, i.e., that the type of water does not affect germination". Actually it proves nothing of the kind. It merely shows that if loam water leads to better germination of seeds than rain water, or conversely, a test on a hundred seeds is inadequate to demonstrate the fact. But it is entirely possible that a test on several thousand seeds would have shown 15 per cent more germination with loam water than rain water. Perhaps if the author were accustomed to thinking in terms of probability rather than of infinite populations, he would not have fallen into this elementary fallacy. It is sometimes as important to realize what statistics do not prove as what they do prove.

On the whole, Fisher's approach in the books mentioned is not only more logical than Dr. Mather's, but is also likely to be more intelligible to a beginner. Nevertheless, Mather has cleared up a good many points which Fisher treated rather rapidly, if at all.

The ideal book on statistical methods for biologists has not yet been written, and perhaps never will be. But it is worth speculating on its contents. It would include the mathematical proof of the validity of all methods used. It is perfectly true that the majority of biological students are willing to take statistical methods for granted, as they take microscopes. But those who possess the scientific spirit in any large measure will certainly insist on understanding chromatic aberration, on one hand, and skew frequency distributions, on the other. Actually the necessary mathematics could be compressed into a smaller space than might be thought.

Secondly, it would deal with the history of biometry, which has some bearing on its present situation. Forty years ago, a spectator of the controversy between Bateson and Pearson might well have said, "I don't know which is right, but it is certain that both of them can't be". As a matter of fact, both of them were so to a very large extent. To-day the views of certain statisticians appear to be quite irreconcilable. Yet a historical retrospect suggests that all may be of value. Thus Neymann and Pearson, Fisher, and Jeffreys, use different criteria of significance, each defending his own point of view with considerable force. They have been mainly concerned with industrial products, living organisms, and earthquakes respectively, and each may have chosen the best method in his own field ; but these methods may be of some value outside that field.

Thirdly, it would deal with all the important applications of statistics to biology. A very brief survey would show how unevenly statistics have been applied. Thus, for obvious economic reasons, the preparation of life-tables now rests on a very complex and meticulous technique, while that of growth curves is in an embryonic condition.

The book before us fulfils none of these conditions, nor of course does it claim to. The formulæ of the main theoretical distributions are given, none the more intelligibly for containing factorials of fractions, the meaning of which is nowhere explained ; and the statement on p. 35 that "moments of order higher than the second are not often used", if true, merely suggests that biometry is in a somewhat decadent condition. The assumption that any distribution may be treated as normal has led to serious errors in recent years, notably in the comparison of mutation-rates and the detection of linkage.

Dr. Mather is nothing if not up to date. "The correlation coefficient," he tells us, "has occupied a very important place in statistics, but its use is gradually dying, as the method of regression will always offer as good a solution to a problem, and frequently better." No doubt in individual cases regression coefficients tell us a little more than correlation coefficients. But they do not enable us to compare the relations of different variates ; for example, to answer the question whether we can predict brain-weight better from body-weight or head circumference. Also they are essential in the study of heredity, not only according to the methods of Pearson, but also to those of Sewall Wright, which are fully applicable to Mendelian cases. The broader the generalization reached, the more does correlation prove superior to regression.

These opinions can be explained by the limited field from which Dr. Mather's examples are drawn. Grossly skew variation is found, for example, in the distribution of weights, of drug tolerance, of life expectations, and of fertilities, but these are not considered.

When all these criticisms have been made, the book

will be of value to a great number of biologists. The tables at the end are very succinct, and sufficient for many purposes. The treatment is often more detailed than in any other similar book. There is at least a fair probability that a research worker will find here, and nowhere else, a detailed description of a method suited to his or her particular problem. But just because "Statistical Analysis in Biology" will fill a gap, it is essential to point out its very real limitations.

J. B. S. HALDANE.

HIGH FREQUENCY THERMIONIC TUBES

High Frequency Thermionic Tubes

By Dr. A. F. Harvey. Pp. viii+235. (London: Chapman and Hall, Ltd., 1943.) 18*s*. net.

DURING the past quarter of a century the technique of the application of electric waves to communication and other problems has been steadily progressing to shorter and shorter wave-lengths. Naturally, research on more fundamental problems was in advance of these applications, but it is likely that time will disclose in due course how much this gap has been shortened during the past few years and to what extent the previous trend has been accelerated under the stimulus and incentive of war-time conditions. The crux of the problem in all this work is the development and adaptation of the thermionic valve in one of its many forms to the generation of the very high frequency oscillations required at the correspondingly short wave-lengths.

In Dr. Harvey's book we have a very thorough survey of the published literature on the special types of thermionic tubes which have been developed for the above purpose; and this survey is supplemented by a more detailed account of the author's own work on the performance and operation of the magnetron in one of its several modes of oscillation.

The book opens with an introductory chapter on the general properties of valves, which might, with advantage, have been omitted or abbreviated. The author then proceeds to a description of the effects of electron inertia in limiting the performance of the normal type of thermionic valve, and of certain commercial types of valves designed to minimize these effects. Later portions of this chapter deal with measurements of valve characteristics and parameters at very high frequencies. Chapter 3 deals with the retarding field type of generator, in which the electron inertia effect in valves is utilized to advantage for the production of very high frequency, although somewhat weak, oscillations. An account is given of various experiments made with positive ions in the valves with the object of increasing the transit time and so enabling the oscillations to be studied at a frequency of the order of one five-hundredth that obtained with electronic oscillations in ordinary valves.

The next two chapters, occupying nearly one half of the whole book, deal with the characteristics and properties of the magnetron valve, and with the results obtained when it is used to generate oscillations in one of the several possible forms. Much of the material in this portion of the book is derived from the author's original work, although adequate reference is made to the results of other investigators.

In one form of oscillation generator, the negative-resistance property of the magnetron is utilized to produce 'dynatron' oscillations at a frequency determined by that of the external circuit attached to the valve. Two other types of oscillation, termed resonance and electronic respectively, are possible with a magnetron; and each of these shows the characteristic that, whenever the frequency is changed, both the operating conditions of the valve and the component valves of the external circuit have to be changed. This is one of the factors that largely limits the applications of the magnetron to single-frequency operation. The characteristics of these resonance and electronic oscillations are described at length, and it is pointed out that they are fundamentally the same. In this work, the author has clarified some of the confusion that has arisen from time to time between these and the dynatron type of oscillation referred to earlier. This portion of the book is, in many ways, the most important, because short wave oscillations in magnetrons are usually of the resonance type.

The sixth and last chapter of the book is devoted to a brief description of the klystron type of oscillation generator, in which velocity modulation of the electron stream is used with associated electromagnetic resonators. The later portion of this chapter deals very briefly with wave guides and horn radiators for use at very short wave-lengths.

To each chapter of the book is appended a very comprehensive bibliography of references to the literature on the subject; these are mostly confined to publications up to about 1939, although some later references have been included. The extensive nature of the literature on this subject prior to the outbreak of war is indicated by the fact that more than five hundred references are contained in the book, which will clearly fulfil a most useful function as a first comprehensive survey of this field of thermionic valve technique.

FISHERIES OF LAKE NYASA

Report on the Fish and Fisheries of Lake Nyasa

By C. K. Ricardo Bertram, H. J. H. Borley and Ethelwynn Trewavas. (Published on behalf of the Government of Nyasaland.) Pp. 181+12 plates. (London: The Crown Agents for the Colonies, 1942.) 12*s*. 6*d*.

MRS. RICARDO BERTRAM is a naturalist (fisheries), Miss Trewavas is a systematist (ichthyology), and Mr. John Borley is an administrator with a background of natural history, and between them they studied the fisheries in Lake Nyasa, and, in spite of many difficulties, they have followed up their eight months in the field by producing this handsome report. The report is well set out, clearly written, and illustrated with beautiful and instructive photographs. With its generous appendixes, it will be the standard work on the subject for many years to come. It has no index.

The study of an African lake makes a wide subject. This report, very properly, deals with geography, anthropology, nutrition and economics. Lake Nyasa is 350 miles long and not more than 50 miles wide anywhere; it has a deep area, 300–400 fathoms, but the ends are shallower, especially the southern. The

water is rather alkaline, clear in the middle of the Lake, devoid of oxygen in the depths. The level of the Lake varies considerably. There are many kinds of fish. Counting the many species of certain fruitful genera as one, there are about thirty important kinds of fish in the Lake, mostly cichlids, cyprinids and silurids, with a few mormyrids and others, but, curiously, no lung-fishes. In all, 223 species are recognized so far : about 250 native names are listed, many, of course, being duplicates.

As in the Victoria Nyanza, two nearly related species of Tilapia provide most of the catch of edible fish. This is a case of parallel evolution, of which the Cichlidæ endemic to various African lakes provide several examples. The differences both in habit and in anatomical structure between the two Tilapias of Lake Nyasa are closely similar to the differences between the two species in Lake Victoria.

Fishing by Europeans has only recently been introduced to Lake Nyasa. The methods include seine nets, which were already established in the native fisheries, along with gill-nets, baskets and lines. The Fisheries Survey carried out experimental fisheries, as well as fish-marking, but the work did not pass the experimental stage. The Survey also tried to improve on the crude methods of curing employed by the natives, but this, too, requires further experiment.

Indeed the outstanding feature of surveys of the fisheries of African lakes, of which the Lake Nyasa survey is the sixth—no less—is the need for following up (see also Worthington, E. B., NATURE, **151**, 353; 1943). The surveys have all shown that the fish trade needs development for the sake of the diet of the natives, but so long as there is no determined policy, and neither a plan nor people to implement the investigators' conclusions, nothing much can follow. The present report shows the scale of the economic and administrative problems involved, and they are worth mentioning here.

First, as matters are at present, the level of Lake Nyasa is always changing. In 1931 the mean annual level was 5 ft. above that of 1902. Consequently rice fields that were productive in 1902 are useless in 1931 ; sand-spits that gave shelter to parts of the shoreline are submerged ; and beaches are studded with stumps of trees, so that a seine net cannot be worked. Rivers running into the lake have become sluggish and clog with vegetation, making them unsuitable for the sandy nests of the valuable Tilapia. What is wanted is stabilization of the level of the Lake, which would also reduce erosion by rivers changing their courses, and allow of afforestation in the Lake area. Stabilization would certainly allow further development of the fisheries, because beaches could be cleared for seining with some prospect of the site remaining useful.

The fisheries also need further action to encourage trade. The Nutrition Survey—with which the Fisheries Survey was associated—showed that many of the natives of Nyasaland depend on fish for proteins, minerals and certain vitamins. "With rare exceptions, however, fresh fish is not available to natives living more than about three miles away from the lake shore, though a crudely cured product is eagerly bought whenever possible by people living away from the lake", whose main diet consists of a single cereal, such as maize or kassava. But you cannot get the fish to the hill people unless the hill people have some trade article that the lake people need, such as a surplus of flour. Clearly, there are technical problems to solve, such as transport and preservation of the fish ; but there are also social habits to consider, and the building up of a regular and voluminous trade can only be done by directed fostering over a considerable period. Among the many details that need attention, a supply of salt bulks large : at present it is rare and precious everywhere in central Africa.

Now that no country in the world knows how much or how little it is going to direct trade and production, it may be easier, psychologically, to direct matters like native trade, when the health of the natives demands it. Naturally, in considering the fishery of Lake Nyasa, it is of importance first to have these investigators' informed opinion that the stock of fish would stand up to carefully controlled expansion of the fishery. (Unfortunately, I disagree with their definition of over-fishing ; but they refer to papers of mine, which brings the blame to my door, for not making the theory more clear.) Whether the administration will be able to follow up these investigators' work or not, this report shows that the Survey, without which there could be no following up, was well accomplished.

MICHAEL GRAHAM.

A SWEDISH VIEW OF BRITAIN

Sweden Speaks

Edited by Gustaf Witting. Translated by Edith M. Nielsen. Pp. 212. (London : George Allen and Unwin, Ltd., 1942.) 8*s*. 6*d*. net.

THIS book on the British contribution to civilization, written by a group of distinguished Swedes in 1940, when the outlook for Britain and the whole movement of humanist development since the Renaissance was exceedingly dark, will strike many British readers as superior to most of the British works of the same sort. The Swedish writers are noticeably better informed than British authors on this subject. Perhaps this is because few British writers of the first rank have addressed themselves to it.

The essays in this volume include reviews of scientific research in England by Ansgar Roth, and medical research in England by Prof. Göran Liljestrand. On the first page of Dr. Roth's essay there is an account of Prof. P. A. M. Dirac's forecast of the existence of the positive electron, and a new form of hydrogen. On the second page of Prof. Liljestrand's essay we already learn of the triumphs of Sir Thomas Lewis in the investigation of the heart and the capillaries. These are examples of the admirably modern tone of the book.

The world wishes to know what Great Britain is contributing in the present and what she promises for the future. The British critical historical expositions of Newton, Darwin, and the other masters of the past are meagre, yet even so they smother the negligible corresponding studies of the masters of the present. This has had two ill-effects. The merits of the present British scientific contribution have not been rightly assessed by people overseas, nor its defects by people at home ; with the result that our friends believed we were weaker than we are, and we have been too ignorant of our own condition to make the best use of our abilities.

J. G. CROWTHER.

A Course of Instruction in the Qualitative Chemical Analysis of Inorganic Substances

By Prof. Arthur A. Noyes. Tenth edition, revised and rewritten by Prof. Ernest H. Swift. Pp. xv+418. (New York: The Macmillan Company, 1942.) 14*s*. net.

THE new edition of this well-known text-book brings several important and useful features into the text. The general plan of the work is to provide a really practical laboratory guide to qualitative analysis in a framework of theory and general chemical knowledge which should lead to intelligent work and to the acquisition of a grasp of fundamental principles which can, as the authors fully realize, be made to result from a good course in qualitative analysis. Many of the experiments are semi-quantitative, and throughout emphasis is laid on the possibility of working with small quantities of material, a procedure which not only teaches manipulative skill but also lays the foundations of later work on quantitative analysis. Several literature references are given, and difficult points are explained clearly and fully. A good feature is the use made of the modern theory of strong electrolytes, and such matters as the theory of solubility product are dealt with in a modern way. The book is arranged so that the work of the teacher will be simplified and lightened, and throughout the student is encouraged to think for himself, a large selection of questions, including numerical examples, being provided.

There is no doubt that this is one of the best text-books on qualitative analysis, and even those who are familiar with the subject and have taught it for a long period should find something new and interesting in many of the sections. All teachers are recommended to have the book even if they do not adopt it in their classes, since the discussions of many parts of the theory, and the numerous alternative methods given in it, must prove of the greatest value. It should be emphasized that, although the book covers the theory in an admirable way, it is thoroughly practical, and abounds in manipulative hints which make it a sound laboratory guide.

Radio Receiver Design

By Dr. K. R. Sturley. Part 1: Radio Frequency Amplification and Detection. Pp. xii+435. (London: Chapman and Hall, Ltd., 1943.) 28*s*. net.

THE principles upon which radio receivers of various types are designed at the present time have been developed by various technical workers, who have in many cases specialized on particular applications or even on integral portions of the receiver itself. As a result there is a widespread and varied literature on the subject of receiver design, which has for some time needed digesting and classification. In the book under review, Dr. Sturley has met this situation by bringing together the fundamentals of receiver design for the benefit of those engaged in this class of work. After two introductory chapters dealing with general considerations and valves, the order of treatment is to follow the received signal from the aerial through the radio-frequency amplifiers, the frequency changer with its local oscillator and then through the intermediate-frequency amplifier to the second detector giving an audio-frequency output. The present volume ends at this stage, leaving audio-frequency amplifiers and power supplies to be dealt with in Part 2.

The treatment throughout is of a practical analytical nature, with care taken to insert typical numerical values as frequently as possible. Each chapter is accompanied by a bibliography, which is intended not to be exhaustive but to be helpful in the further study of the subject. The book will be welcomed by all those engaged in radio receiver design and development, whether for experimental or commercial purposes.

Atlas of the Scale Insects of North America

By G. F. Ferris. Fourth Series: Family Diaspididæ, Subfamily Diaspidinæ, Tribes Diaspidini and Aspidiotini; Family Diaspididæ, Subfamily Phœnicococcinæ. Pp. 314. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1942.) 46*s*. 6*d*. net.

IT was pointed out in the introduction to the first series of this work that the group commonly referred to as the family Coccidæ or scale insects is elevated to the rank of a super family—the Coccoidea. The present contribution deals with the remainder of the family Diaspididæ, which is divided by the author into the two subfamilies Diaspidinæ and Phœnicococcinæ—the last group including only a small number of species. As its name implies, Mr. Ferris's work is an illustrated atlas which figures the more important diagnostic characters of the North American species together with relevant descriptive letterpress.

Owing to the great economic importance of the scale insects this work is likely to be indispensable to all future investigators on account of the clarity of its illustrations and its terse but adequate descriptions, which are invaluable qualities in a work of reference. Unfortunately, the disturbed condition of the world makes the continued publication of this atlas impossible unless financial help becomes available. The author states that he is willing to complete the treatise if the requisite monetary aid is forthcoming.

Science and Ethics

An Essay by Dr. C. H. Waddington. Together with a Discussion between the author and the Rt. Rev. E. W. Barnes, the Very Rev. W. R. Mathews, Prof. W. G. de Burgh, Prof. C. E. M. Joad, Prof. Susan Stebbing, Prof. A. D. Ritchie, Prof. H. J. Fleure, Prof. J. S. Huxley, Prof. J. B. S. Haldane, Dr. C. D. Darlington, Dr. J. Needham, Prof. H. Dingle, Dr. G. Burniston Brown, Dr. Karin Stephen, Miss Melanie Klein, Miss Miriam Rothschild, Prof. J. D. Bernal, Prof. Chauncey D. Leake. Pp. 144. (London: George Allen and Unwin, Ltd., 1942.) 7*s*. 6*d*. net.

ON September 6, 1941, NATURE printed an essay by Dr. C. H. Waddington on "Science and Ethics" (p. 270). This essay had previously been submitted to various men of science, philosophers and churchmen whose comments were published in the same number of NATURE (pp. 274–280). The discussion that had been opened in this way led to further communications between Waddington and authorities on the particular subjects to which he had referred, including psychology, anthropology, Marxism and logical positivism. The entire material has now been put together and published collectively in this book. Among the contributors are the Bishop of Birmingham, the Dean of St. Paul's, Profs. Huxley, Haldane, Dingle and Bernal with Drs. Needham, Darlington, Stephen and Joad, and Mrs. Melanie Klein. The book is a notable contribution to the contemporary philosophy of science.

FOUR YEARS OF PLANNED FEEDING IN GREAT BRITAIN

By DR. MAGNUS PYKE
Ministry of Food

TWO fundamental difficulties beset the scientific distribution of nutrients among the population of a warring nation of forty-seven million people. Leaving aside for the moment the immense practical administrative problems involved, there is first the lack of precise scientific information on a number of nutritional matters, and secondly, when the best scientific judgment available has been adopted, there is the difficulty of finding out whether the distribution of nutrients has, in fact, been effective ; and if it has, whether the health of the people is being maintained on a nutrient provision which is itself based on incomplete scientific data.

During the last thirty years or so, the science of nutrition has concerned itself almost exclusively with the study of substances present in the diet in minute amounts. A dozen or more vitamins have been discovered, their chemical nature investigated, their physiological significance studied, their distribution in foodstuffs surveyed and the amounts of them needed assessed. The blockade of Great Britain, which put in jeopardy the supply of food itself, at once threw back the emphasis on to the weightier constituents of food.

The fundamental principles governing calorie requirements were worked out in detail by Rubner and Atwater and their colleagues between 1850 and 1907. During the War of 1914–18 and between that and the present War, Cathcart and Orr, Moss and a few others carried on the work. They were, however, only a rearguard of the classical nutritionists : the big battalions studied vitamins and minerals. In first attempts in this War to solve the problem of what was the daily calorific requirement per head of the population, it was only possible to say that 'sedentary' men needed 2,500 calories, 'active' men 3,000 and so on. This, of course, merely changed one question to another : what was a 'sedentary', an 'active' or a 'very active' man ? Any competent student, even with information mostly forty years old, could make an estimate of the national needs, but whereas in the university a margin of a hundred calories each way is unimportant, a hundred calories a day for forty-seven million people for a year represents half a million tons of wheat.

Knowledge with regard to protein requirements is even less complete than that of calorie requirements. The figure usually accepted of 70 gm. includes an elastic safety margin. Perhaps 50 gm. would suffice, and of this perhaps 25 gm. of animal protein would be enough for adults. Fortunately, the assessment of total protein requirement is only of academic interest, since the acquisition of calories in such foods as bread from high-extraction flour, and also potatoes, brings with it an intake of protein substantially higher than the minimum requirement.

The Ministry of Food has made the best assessment that scientific knowledge could suggest of the physiological requirement of each nutrient by every class of the population. Judgment was happily reinforced by almost complete agreement with similar estimates made by the National Research Council of America and published in 1941. Simultaneously with this work, at the request of the Ministry of Food, the Medical Research Council was preparing a table of food compositions to be used as a standard for calculating the composition of the national diet.

Here then was the scientific basis upon which a logical food policy could be built. Nutrients could be translated into those foods which were available and, conversely, crops and shiploads could be assessed in calories, proteins or vitamins. This scientific attitude has in the main been successful and unquestionably must be followed in the future. Freedom from want implies the distribution of food according to physiological need.

The problem, however, is not only one of distributing nutrients systematically. In the spring of 1941, after a winter of bombardment and privation, the national diet of Great Britain, although physiologically sufficient, had reached its lowest ebb, and although bread and potatoes were unrationed there was evidence to suggest that calorific needs were not being filled. Nevertheless, the foodstuff in greatest demand, for which people were prepared to queue, was onions, which are of negligible nutritive value. Furthermore, it was found necessary to transfer acreage intended for vitamin C crops of greenstuff to the production of mustard for pickles. It is a matter of great difficulty and importance to judge at what stage a commodity not of itself of any value becomes of nutritive significance by rendering palatable nutritious food which otherwise would not be eaten.

The Ministry of Food took over the nation's feeding as a going concern. In order to plan improvements and to assess the results of its own actions, it was necessary to know and to be informed continuously about the state of the national nutrition. Two distinct methods are used to estimate the nutrients available per head. On one hand, the amounts of food imported, plus the amounts grown within the country, are known with some degree of precision. Allowances for waste during the various stages of distribution can be made, and thus the nutrients theoretically available per head can be calculated. The degree of reliability of the results of this method of assessment depends on the precision of the Ministry's knowledge of the amounts of food in the country at any time, which, with a commodity like potatoes, for example, can never be perfect, and upon the efficient functioning of rationing and other machinery of distribution.

The second means of gauging continuously the national nutrition is the method of the domestic budgetary survey of the type which has become well known through the work of Sir John Orr. Each week of the year, about 5,000 people from twenty towns throughout the country are under investigation. This war-time food survey is probably the most important single scientific work carried out by the Ministry of Food.

Neither method of investigating the national nutrition is, of course, complete. The figures for total supplies give an estimate of the food available per head of the nation. The budgetary assessment provides a measure of the food bought per head of the family. In neither case can we reach the individual. Both methods, however, are of cardinal value. Figures based on total supply estimates arr available over a number of years and render it possible for comparison to be drawn between pre-wae and war years, and for estimates to be made for contingencies after the War. The figures from the budgetary surveys show broadly the effectiveness of food distribution and any nutritional changes from month to month. In the surveys, however, a child

is merely a vulgar fraction of a man and we put together without distinction the heads of the coal-miner, the adolescent and the sedentary legislator.

A child's requirements for protein and calcium are proportionally higher than those of an adult. Its digestive machinery is less rugged and smaller and, since his body is growing, errors of diet in childhood may leave permanent effects. The child, then, has first call on milk. It is given supplies of vitamin D in cod-liver oil and vitamin C in concentrated fruit juice. This simple application of nutritional knowledge has not been carried out without administrative and technical difficulty. A reduction of income tax is accepted as some recompense for the expense of a child, but the provision of low-priced or free milk and orange juice to meet the special needs of the child was a new step in enlightened public administration. To provide fruit juice as a source of vitamin C it was necessary to enlist the help of analysts to insure that the stated concentration of vitamin was present in the preparation issued. This called for a certain change in outlook. The agricultural chemist is accustomed to analyse feed for its nutritive value. The analyst of human food, however, is usually engaged in a search for adulterants or preservatives.

Although the nutritive policy of the Ministry of Food is based on the distribution of equal shares to every individual, there is, in addition to the special individual provision of extra rations to children and expectant or nursing mothers and to certain invalids and other special categories, a group distribution to special classes. These classes are school children and industrial workers.

Hitherto it has been possible to obtain sufficient food to provide a nutritionally adequate diet for the population of Great Britain. First-class protein, fats and some other foods are rationed. By good fortune perhaps rather than by good management, of all nations in Europe only in Great Britain has it not yet been necessary to ration bread and potatoes. Nor are ration coupons demanded for communal meals. If bread, potatoes and communal meals were rationed in such a way as to make a material saving in food, it would probably be necessary to impose some measure of underfeeding.

To-day almost a quarter of the school-children in Great Britain receive their main meal of the day 'off the ration', and so do about an equal proportion of the industrial workers. The study of the nutritive value of these meals is an interesting matter. It has been investigated in a way similar in principle to the twofold scrutiny of the total national diet. First, the nutritive values of the catering allowances have been examined. An ordinary restaurant is allowed rations based on one pennyworth of meat per main meal. Industrial canteens receive a penny-halfpennyworth of meat and other additions. Canteens serving certain specified heavy industries are allowed two pennyworth of meat. School meals get the biggest allowances of all and two pennyworth of meat. The meat provided for the children is based on their high physiological needs of animal protein.

Rationed foods supply only a part of the total meal. Its full composition is based on custom, catering facilities and scientific advice. Those responsible for communal catering are eager for nutritional advice which is difficult to give. Daily requirements of nutrients are known with some degree of precision, but little well-grounded information is available about the desirable value for a single meal. In order to find out the nutritional value of meals known to be satisfactory; to be able to suggest improvements; and to investigate the effects on food values of large-scale catering, the Ministry of Food enlisted the voluntary co-operation of biochemists in more than a dozen towns. These public-spirited workers have analysed the meals and investigated nutritional problems which arise in providing them. This work is continuing.

A number of important technical advances have been made in fulfilling the Ministry's policy of providing a diet which people will eat and which will supply their physiological requirements. Of foremost importance is the national loaf. Eighty-five per cent of the wheat grain is used. The part which is discarded is the least digestible fraction. The discovery that a minute morphological structure, the scutellum, which divides the germ from the endosperm, is by far the richest in vitamin B_1 of all parts of the grain, has enabled a flour to be prepared which is high in vitamin content and low in fibre. A chronic deficiency of vitamin B_1 in the national diet widespread in peace-time has thus been overcome. Other important advances have been the successful production of dried milk and dried egg. Dried meat, fish and vegetables are available for the Forces. The concentrated fruit juices as sources of vitamin C and perhaps other vitamins have already been mentioned.

The application of scientific planning to the nation's food calls for a better understanding by the public of the elementary principles of nutrition. The Ministry has in the past three years conducted an educational campaign stressing such points as the proper choice of foods for a balanced diet and the careful cooking of vegetables to preserve their vitamin C. How far the effects of this campaign are permanent cannot be judged until the relaxation of war-time restrictions once again gives the housewife some freedom of choice. The success of the predominantly scientific policy of the Ministry of Food can only be measured by the economies in shipping which it has rendered possible, and, most important of all, by the health of the nation. The national health has, so far, been well maintained. Clinical surveys for the assessment of nutritional well-being, which are carried out by the Ministry of Health and others, confirm what is suggested by the Ministry of Food's own surveys of food intake, that the rational distribution of the nation's food resources has caused, in general, an improvement rather than a deterioration in nutrition in Great Britain during these four years of war.

BIOGEOCHEMICAL RESEARCH IN THE U.S.S.R.

By A. P. VINOGRADOV

GEOLOGISTS have always taken an interest in the problem of the influence of life on the chemical processes going on within the earth's crust. In the early days of the Revolution, V. Vernadsky, first in the Ukrainian Academy of Sciences at Kiev and later in the Academy of Sciences of the U.S.S.R. in Leningrad, organized, on a very modest scale, experimental work in the study of the chemical composition of organisms. His friend and pupil, Prof. Y. Samoilov, of the University of Moscow, working independently, conducted research on the part played by organisms in the formation of soils. F. W. Clarke in his "Data of Geo-chemistry"

(5th ed. 1924), the appearance of which opened up a new era, treats the same subjects mainly on the basis of American work.

It was, however, only after university courses delivered by Vernadsky in Prague, Paris and Leningrad, and the appearance of the fourth edition of his "Outline of Geochemistry" in 1930, that wide acceptance was given the postulate that the distribution, combination and migration of chemical elements in the earth's crust and in the biosphere could not be understood without taking into consideration the influence of the sum total of all organisms.

Twenty years ago, when geochemical ideas were being crystallized and the young science was being formed, together with the laws of the distribution and combination of chemical elements, the migration of chemical elements, their dissemination and concentration, and the theory of the energy-levels of crystallized natural bodies, the lack of knowledge of the chemical composition of organisms and also of soils and organogenic rocks was very keenly felt.

In 1929 V. I. Vernadsky founded the Biogeochemical Laboratory of the Academy of Sciences of the U.S.S.R. to study the laws of the distribution and migration of chemical elements in the biosphere, employing for the solution of these problems the whole arsenal of modern perfected analytical methods—spectroscopy, X-ray spectroscopy, mass spectroscopy and other chemical and physico-chemical methods. Similar research was begun later in the Chemico-Radiological Institute in Odessa, where the work was directed by Prof. E. Burkser, in the Geological Institute and the Institute of Soil Study of the Academy of Sciences of the U.S.S.R. and in other institutes. Research carried on in the Biogeochemical Laboratory and the researches of another Soviet geochemist, A. Fersman, published in his comprehensive work "Geochemistry" (1933–39) laid the foundation of geochemistry, of its zone of hypergenesis. In 1937 another of the founders of geochemistry, V. M. Goldschmidt, of Oslo, pointed out the significance of the work done by Vernadsky's school on the geochemistry of alluvial soils, and included them in his plan of experimental work.

Soviet men of science working in this field were mainly interested in the study of the laws of distribution between living matter, soil, surface waters and rare and disseminated chemical elements. On one hand, this research touched on the biochemistry of these elements, established as the result mainly of the work of G. Bertrand in Paris, and in the U.S.S.R. under the influence of the geochemical work of V. Vernadsky, in the Biochemical Institute of the Ukrainian Academy of Sciences, Prof. A. Pelladin, in the Pavlov Physiological Institute, by Prof. V. Sadikov and others; and on the other hand, it developed into the biochemistry of alluvial deposits. With regard to the former, stress must be laid on the present state of the question of the chemical composition of organisms in the light of geochemical conceptions.

During the past hundred years, the idea has developed that organisms consist of a limited number of certain chemical elements known as the biogenic elements. Completely new data on the systematic presence in organisms, in addition to others in soils and alluvial deposits, of bromine, iodine, fluorine, rubidium, lithium, nickel, cobalt, vanadium, titanium, molybdenum, lead, copper, strontium, barium, boron, radium and other strongly radioactive elements, the discovery of the rare elements germanium, gallium, niobium, selenium, chromium, zirconium and many others, found by and published in the papers from Vernadsky's school (A. Vinogradov, S. Borovik, V. Baranov, L. Selivanov, D. Maliuga, S. Sinyakova and others), enable us to put the question differently nowadays, and no longer to speak of which elements go to make up a living organism but rather of which elements have not yet been discovered in organisms; among these are indium, hafnium, niobium, tantalum, tungsten, radium and tellurium elements of the platinum group, although they have not yet been systematically sought. From a geochemical point of view, therefore, the organism and its environment are connected by the common history of all chemical elements. The question of the quantitative chemical composition of living matter and of various types of organism is therefore one of great interest. Here we will confine ourselves to the presentation of the geochemical curve of the distribution of chemical elements in organisms, which to some extent sums up our knowledge of this subject. The regularities observed in the average quantitative chemical composition stand out clearly when we compare the character of the curve with the character of analogous geochemical curves for soils and the earth's crust.

In general, the average chemical composition of organisms is reminiscent of the composition of soils forming the earth's crust. Chemical elements of low atomic number predominate. The position of certain chemical elements on that curve, lower or higher in comparison with the curve for soils and the earth's crust, may be explained by geochemistry. At the maxima of the curve we find those chemical elements which under biosphere conditions form easily moving compounds, gases, soluble salts, etc.; while chemical elements at the minima of the curve do not form such compounds, as, for example, scandium, tin, titanium, hafnium, zirconium, thorium and many others. In spite of the frequently high content of the latter elements in soils and rocks, their content in organisms is one thousand to one ten-thousand times smaller. So far as the former are concerned, the concentrators are known; organisms in certain districts are greatly influenced by the insufficiency or abundance of these chemical elements in their environment.

That very brief and general outline of the geochemical data of organisms with average chemical composition, the collection of which required a tremendous amount of labour and knowledge, must now serve as the basis for a theory of the comparative elemental composition of various species and the evolution of their chemical composition. These data show that the chemical composition of organisms is one of the distinguishing features of species.

The attention of Soviet investigators has been directed towards endemic diseases of plant life, animal life and man. Thanks to the expeditions of the People's Commissariat of Health of the U.S.S.R., the Biogeochemical Laboratory of the Academy of Sciences has at its disposal a considerable amount of material concerning the distribution of iodine in organisms, waters and soils from places with endemic goitre (the following were investigated: Kabardino-Balkaria, Azerbaijan S.S.R., Mari A.S.S.R., Karelian A.S.S.R., Eastern Siberia and other districts of the Soviet Union). The data on iodine served as a basis for the systematic iodine treatment of the population which was carried out by the People's Commissariat of Health. These data enabled us to investigate the

causes of an insufficiency of iodine in these districts. Similar geochemical research was carried out by the Biogeochemical Laboratory in the Urov region in eastern Siberia, which shows an insufficiency of calcium; soils of the Belorussian S.S.R. were investigated for copper content, insufficiency of which leads to a stunting of grain crops; investigation of soils of the U.S.S.R. in connexion with an insufficiency of boron leading to plant diseases, and a study of the flora in regions with excessive selenium content in the soil, etc. Investigations of this nature have enabled us to establish that at least twenty or thirty similar endemic diseases are connected with insufficiency or superfluity of certain chemical elements in the environment and have laid a scientific foundation for measures to be taken (A. Vinogradov).

Flora and fauna passing through such biogeochemical provinces are subjected to the specific influence of this insufficiency or superfluity of certain chemical elements. Some species acquire, as might have been expected, a certain physiological tolerance, as for example, tolerance to superfluous quantities of copper, nickel, lithium, etc., and form, apparently, races with a high content of these elements, whereas others die out. The question which has now arisen is whether certain species, concentrators of various chemical elements (for example, plants with high lithium content described by Vernadsky's school, plants rich in boron, plants concentrating molybdenum, etc.), came originally from similar biogeochemical provinces, and whether they show by their chemical composition signs of their origin.

As we have already said, the other side of the work of Soviet biogeochemists concerns problems connected with the geochemistry of alluvial deposits and rocks. It is, therefore, natural that sea deposits and the present geochemical processes going on in the depths of the sea should attract them. These researches have been developed side by side with oceanographical work in our seas, work which has been carried on at the State Oceanographical Institute.

A. Arkhangelsky has carried out extensive research on the presence of, and changes in, organic matter in Black Sea alluvial muds in connexion with the formation of oil deposits, the Oceanographic Institute has worked on the problem of obtaining a clear picture of the distribution of organic matter in the Barents and other Soviet seas; finally, a balance has been drawn up of organic matter, nitrogen and phosphorus in the Caspian Sea (S. Bruyevich). These and other similar investigations are all component parts of one and the same old, but nevertheless perpetually new, practical and very important problem of the fate of organic matter in the sea.

Sea organisms take part in a number of exceptionally many-sided geochemical processes, as was shown in A. Vinogradov's paper "The Chemical Elemental Composition of the Sea". Here I can only mention a few new and more important facts and conclusions in this respect. It has been proved that the concentration of iodine by seaweeds and still more by plankton diatoms creates the necessary condition for an accumulation of iodine in sea muds. During the process of the metamorphosis of muds, the iodine enters into solution with the water, forming strata of mineral iodine-bromide waters, which have considerable regional distribution and are a source of commercial iodine.

It has been further shown, for example, that exceptional concentrations of vanadium are deposited on the sea bed by Ascidians and are accumulated in the sea muds when the organisms perish. Radium and many other widely disseminated chemical elements are extracted from sea water by organisms. Research into the influence of organisms on the natural radioactive balance has shown in particular that various radioactive elements in the environment may be transformed into equivalent radioactive quantities (with equal number of disintegrating atoms), the absolute concentration of radioactive elements being changed a million times (V. Baranov).

The study of the migratory routes in the sea of boron, lithium and rubidium, which in general repeat the history of potassium, the picture of their dissemination given in the works of L. O. Solivanov, shows that although these elements are concentrated by organisms, in the final analysis they saturate and are accumulated in alluvial soils through water solutions in the form of chemical deposits. This is also to a considerable degree true of the formation of deposits of strontium and thorium salts occurring, for example, in the form of facies with celestite and rathite in the depths of the Permian Sea.

The formation of phosphate facies (and the formation of phosphorites) has been explained by A. Kazakov, also on the basis of research into the equilibrium of dilute solutions containing calcium and phosphate, as the appearance in water at certain depths in the zone of regeneration of organic phosphorus, deposits of calcium phosphate and apatite.

A few words about organogenic rocks. Thanks to the systematic study of the ashes of oils and solid bitumens, we have been able to discover the existence of oil-bearing regions where all the bitumens contain vanadium. The oils and hard bitumens of Baku, Grozny and other Caucasian oil-fields are practically free from vanadium. Nor, apparently, do the bitumens of Emba concentrate vanadium. The oils and asphalts of the Volga-Ural provinces, on the other hand, are extremely rich in vanadium, their vanadium content in some cases, for example in the ashes of Sadkin asphalt, being as much as 75 per cent V_2O_5. Priperchorsky district has oils with similar vanadium content.

On the basis of these geochemical data we may formulate the hypothesis that vanadium was selected from alluvial deposits in the sea by the primary matter of oil. The presence of vanadium, on account of its marked catalytic character, determines the later character of the oil, which as a rule has an asphalt base with a high sulphur content (A. Vinogradov).

At the same time, coal has been found with a large germanium content. All this has given us reasons for investigating the processes of the accumulation of rare elements in coal with the object of searching for industrially useful concentrations (Biogeochemical Laboratory: S. Borovik, V. Ratynsky and others).

As a result of the accumulation of considerable data on the distribution of rare and widespread chemical elements in soils and strata, and the geochemical explanation of the history of these chemical elements, a method of correlation or indication of separate geological provinces in accordance with the distribution of microelements in them has been established. This opens up extensive prospects in the problem of drawing up a geochemical map of ancient processes in the earth's crust. Publications which have appeared during recent years on researches into the geochemistry of isotopes of the light elements have the same object (V. Vernadsky, P. Teis, A. Brodsky).

AN ATTEMPT AT A NATURAL CLASSIFICATION OF THE STEROIDS

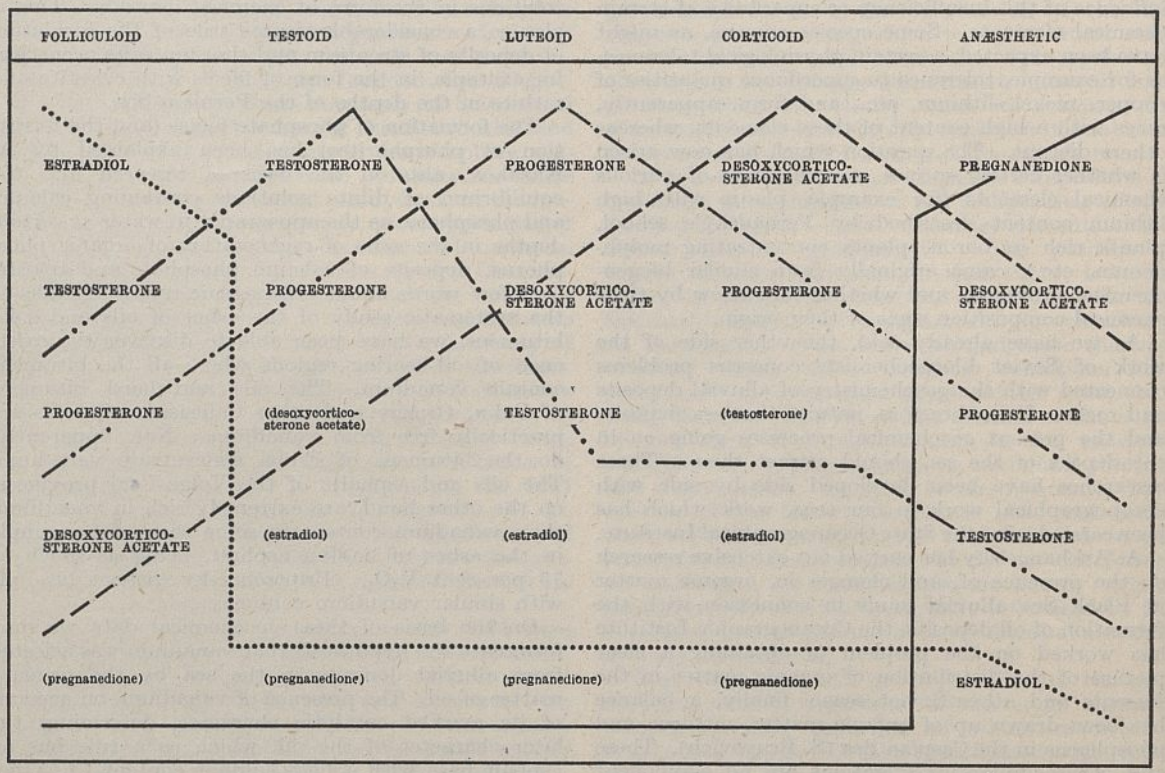
By PROF. HANS SELYE
McGill University

THE manifold and overlapping activities of hormonal steroids tend to give the impression that there is no orderly pharmacological correlation among them. It is known that testoid or 'male' compounds may have folliculoid or 'female' hormone-like activities, that adrenal steroids may imitate the hormone of the corpus luteum, and so forth. An additional complication has recently been introduced by the observation that under suitable experimental conditions all steroid hormones exhibit anæsthetic properties.

However, certain regularities are detectable. Thus it has been shown that some steroid hormone actions are independent of each other, while others are strictly interdependent. The folliculoid, testoid, luteoid, corticoid, anæsthetic, renotropic and spermatogenic activities all have proved to be independent of each other inasmuch as there is no parallelism in the ability of compounds to exhibit these various effects. On the other hand, such responses as vaginal cornification, uterine enlargement, testis atrophy and the cure of castration changes in the hypophysis are all subordinate to the folliculoid action. Hence the degree to which a compound is able to exhibit any one of these effects is proportionate to its other folliculoid activities. Similarly the comb-growth effect, as well as the stimulation of the seminal vesicles and prostate, are subordinate to the testoid action, and so forth. There is no such parallelism in the degree to which a compound exhibits any two of the so-called independent actions. However, even among these, only the folliculoid and anæsthetic potencies are ever demonstrable in a steroid in the complete absence of all other hormonal effects. Furthermore, with the exception of the purely anæsthetic compounds, all hormonal steroids exert some degree of folliculoid activity, and conversely, all hormones are active as anæsthetics.

It has now been observed that the above rules, as well as other regularities among the steroids, can readily be visualized by their classification into the systematic table shown below. The most active representatives of five independent actions have been selected and arranged from left to right according to decreasing order of folliculoid potency. (Since the most potent representatives of the renotropic and spermatogenic series have not been definitely identified as yet, these actions are not considered here. However, according to the folliculoid effect of the known prominent representatives of these groups, they should both be inserted next to testosterone.) It will be noted that the folliculoid activity of all these compounds, except estradiol, is 'masked' and detectable only under certain experimental conditions. Furthermore, for the purpose of this discussion prostatic enlargement is considered sufficient for the demonstration of testoid activity. The potency ratings for folliculoid[1,2], testoid[3], luteoid[4], corticoid[5,6,7,8] and anæsthetic[9] activities have all been taken from publications based on assays performed before this system was devised. Desoxycorticosterone acetate has been chosen as the most active representative of the corticoid series as it is the only highly active

SYSTEMATIC TABLE OF THE STEROIDS.



member of this group which has been adequately studied for all five independent actions. In each column representing a certain type of activity the inert compounds are inserted in brackets below the active compounds of the group. When the steroids are so arranged according to decreasing folliculoid activity in the first line of the table, the most active representatives of the folliculoid, testoid, luteoid, corticoid and anæsthetic compounds appear in the order stated. The second most active representatives of each of these five activities were placed in the second line, third place being given to the next most active compounds, and so forth.

Perusal of the table indicates that, if the steroids are arranged in the first column according to decreasing order of folliculoid activity, they are automatically in increasing order of anæsthetic potency. The position of each steroid was traced by a line through the five columns. This revealed that estradiol and pregnanedione are at the bottom of the graph, except in the column in which they are placed on top as the most active folliculoid and anæsthetic compound respectively. The three remaining compounds slowly lose height in both directions with approximately the same slope. Thus the curve described by the position of any steroid in the table exhibits a single maximum.

Prof. D. L. Thomson kindly analysed these data in order to determine whether the apparent 'orderliness' is statistically significant. Disregarding all possible *a priori* arguments from chemical relationships he found that the regularities observed in the whole scheme—allowing for the selection of the top entry in each column and giving no 'credit' for possible orderliness in the compounds found inactive in each type of test—would occur by chance only in 1 out of 2,304 trials. Hence it may be said that this particular arrangement is not due to chance, but is apparently dependent upon certain inherent natural relationships between the steroids.

The table also expresses the empirical fact that only folliculoid or anæsthetic potencies may be exhibited to the exclusion of all other independent actions, since these two are on the outer limits of the system and hence do not have to overlap with other effects. Compounds not included in this table also obey the same rules although, of course, depending upon the degree of their potency they range above or below the curves given here. Thus ethinyl-estradiol, which is somewhat more folliculoid than estradiol, describes a line parallel with that of estradiol although somewhat higher than the latter, while pregnenolone, a compound having an activity which is qualitatively similar but quantitatively inferior to that of progesterone, parallels the curve of the latter at a somewhat lower level. Acetoxy-pregnenolone, a comparatively inactive corticoid[6], parallels the desoxycorticosterone acetate curve in a similar manner, and so forth. Among all steroids studied no exception could be found to the rule that all compounds describe curves with a single maximum when inserted in this system. The main weakness of the classification so far detected is that the activity curve of a certain compound may skip one or more points on the curve, perhaps because this particular action is so 'masked' that it is not detectable with our bio-assay methods.

The biological significance of these correlations among the steroids is not easy to interpret. It may be that the molecular structure necessary for any one activity necessarily carries within itself other pharmacological properties and that the intensity of these decreases in direct proportion to their distance from the primary activity in the table. It is also possible that the compound placed at the peak of any one curve is partly transformed in the body into compounds with neighbouring actions which in turn yield smaller amounts of steroids in the columns next to them. Thus the degree of activity would gradually diminish in proportion to the distance in the table from the position of the original compound injected. In this sense the pure folliculoids and anæsthetics might be considered as metabolic end-products incapable of re-transformation into compounds occupying more central positions in the table. This is graphically expressed by their marginal position and the steep curve which separates them from neighbouring activities. In connexion with the observation that a compound may skip a point on the curve, we must consider the possibility that certain steroids may go through a pharmacologically inactive stage during their metabolism.

Considering the limited data available at this time, it would scarcely be justified to base any far-reaching speculations on the regularities observed. The only purpose of this communication is to direct attention to the fact that if the steroids are arranged according to the degree of their folliculoid activity, they fall into a system which permits—within limits—a prediction of their other activities.

[1] Selye, Hans, and Albert, S., *Amer. J. Med. Sci.*, **204**, 876 (1942).
[2] Clarke, Eleanor, Albert, Samuel, and Selye, Hans, *Anat. Rec.*, **83**, 449 (1942).
[3] Selye, Hans, and Albert, S., *J. Pharm. and Exp. Therap.*, **76**, 137 (1942).
[4] Selye, Hans, and Masson, Georges, *J. Pharm. and Exp. Therap.* (in the press).
[5] Segaloff, Albert, and Nelson, Warren O., *Endocrinol.*, **31**, 592 (1942).
[6] Selye, Hans, *Science*, **94**, 94 (1941).
[7] Steiger, M., and Reichstein, T., *Helvet. chim. Acta*, **20**, 1164 (1937).
[8] Schwabe, E. L., and Emery, F. E., *Proc. Soc. Exp. Biol. and Med.*, **40**, 383 (1939).
[9] Selye, Hans, *Endocrinol.*, **30**, 437 (1942).

ORIGIN OF COSMIC RAYS

By DR. R. A. MILLIKAN, DR. H. V. NEHER and DR. W. H. PICKERING

Californian Institute of Technology

THE hypothesis here adopted as to the mode of origin of the cosmic rays makes possible the prediction of five definite vertically incoming cosmic-ray bands. As the observer moves north from the magnetic equator, each of these five bands should begin to reach the earth at a particular latitude and continue reaching it at all more northerly latitudes. Between each latitude of first entrance of a band of particular energy and the latitude of first entrance of the band of next lower energy, there should be found a plateau of constant vertically incoming cosmic-ray energy. Four such plateaux should be experimentally observable.

The hypothesis rendering possible these predictions rests upon five major discoveries[1]:

(1) The proof by Millikan and Neher that more than 60 per cent of all incoming cosmic-ray energy is of the nature of incoming charged-particle bullets, each of energy between 2 billion electron volts and 15 billion electron volts.

(2) Neddermeyer and Anderson's discovery of the production by nuclear impacts within the atmosphere

of mesotrons which serve as the chief carriers of the cosmic-ray energy down to the lower levels of the atmosphere.

(3) Bowen's remarkable discovery that atoms, when out in interstellar space, are able to undergo atomic transformations forbidden to them within the stars.

(4) Bowen and Wise's discovery that in ring-nebulæ, trillions of miles away from the exciting star and therefore presumably reflecting conditions in interstellar space, there are five of the atoms, namely, helium, carbon, nitrogen, oxygen and silicon, each of which is more than ten times more abundant than any other atom save hydrogen (which must be excluded from measurable cosmic-ray effects because of the smallness of its rest-mass energy).

(5) Lauritsen and Fowler's discovery in the Kellogg Radiation Laboratory that a part, at least, of the rest-mass energy of an atom has the power under suitable conditions of transforming itself *directly* into the creation of a positive-negative charged-particle pair.

The hypothesis made in view of these five discoveries is that, while the evolution of energy by the stars is maintained, as Bethe has recently shown, by the *partial* transformation within the stars of the rest-mass energy of hydrogen into radiant energy through the building of helium, carbon and other atoms out of hydrogen, and the release through this process of the so-called 'packing-fraction' energy, the energy of cosmic rays, on the other hand, is maintained by the occasional *complete* transformation in interstellar space of the rest-mass energy of the atoms of helium, carbon, nitrogen, oxygen and silicon (and presumably in small amounts of heavier aggregates) into cosmic rays; each such event presumably creating an electron pair, though an occasional photon pair, or even heavier-particle-pair, need not *necessarily* be excluded.

The foregoing hypothesis requires that the cosmic rays of measurable energy reveal a spectral distribution of five distinct, definitely measurable bands as follows: (1) a band of rays each having an energy of 1·9 billion electron volts produced by the annihilation, or complete transformation, in interstellar space of the rest-mass energy of the helium atom; (2) a carbon-atom-annihilation band of energy 5·6 billion electron volts (b.e.v.); (3) a nitrogen-atom band of energy 6·6 b.e.v.; (4) an oxygen atom band of energy 7·5 b.e.v., and (5) a silicon atom band of energy 13·2 b.e.v.

The hypothesis requires, further, that there should be in India for vertically incoming rays between the magnetic equator and magnetic latitude about 20° N. a plateau of unchanging cosmic-ray intensity with latitude. This plateau our experiments in India in 1939–40 brought to light, also the appearance between Agra (17·3° N. Mag.) and Peshawar (25° N. Mag.) of a new cosmic-ray band which we identified with the silicon band of energy 13·2 b.e.v. These results have already been reported[2], and in that report we promised further tests of the hypothesis in Mexico and the United States. In spite of our absorption in war-work we succeeded in December 1941 and March 1942 in making these tests with the following results, which are reported in full in the *Physical Review* of April 1–15, 1943.

(1) *Tests in Mexico.* We had predicted that since the hypothetical silicon-annihilation rays should have enough energy (13·2 b.e.v.) to get vertically through the earth's magnetic field at the equator in Peru, though not in India, there should be found, both at sea-level and at all altitudes in the Americas, when vertically incoming rays alone are under test, a very long plateau of uniform cosmic-ray intensities extending north from Mollendo, Peru, to about the latitude of Victoria, Mexico (mag. lat. 32·8°). There the strong band due to oxygen-annihilation rays (7·5 b.e.v.) should first appear, to be followed in going still farther north when the latitude of 40° N. magnetic had been reached, by the full entrance of the nitrogen-annihilation band (6·5 b.e.v.). *The experimental findings were in accord with these predictions.*

(2) *Tests in the United States.* In going from Pasadena (mag. lat. 40·7°) to St. George, Utah, but 4·1° (280 miles) nearer to the north magnetic pole than Pasadena, the carbon-annihilation band (5·6 b.e.v.) was expected to appear, to be followed by a flat plateau clear up to latitude 54° N. magnetic, when helium-annihilation rays (1·88 b.e.v.) were expected to appear. A balloon flight at St. George (mag. lat. 44·8°) and another at Pocatello, Idaho (mag. lat. 51°) yielded preliminary results in harmony with these predictions.

(3) *Evidence that the act of atom-annihilation actually transforms the rest-mass energy of an atom into an electron pair.* The flat plateau between St. George and Pocatello (mag. lat. 51°) corresponding to the absence of abundant atoms of atomic weight between that of carbon and that of helium, and the definite appearance of a new band between Omaha (mag. lat. 51·3°) and Bismarck (mag. lat. 56°), constitute new and strong evidence for the transformability of the complete rest-mass energy of an atom into an electron pair.

[1] *Phys. Rev.*, **53**, 217 (1938) and **61**, 397 (1942).
[2] *Phys. Rev.*, **61**, 397 (1942).

SIR DAVID GILL, K.C.B., F.R.S., 1843–1907

By ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

JUNE 12 is the centenary of the birth of Sir David Gill, who has been called "the greatest Scottish astronomer of his generation". Born in Aberdeen and educated at the University there, where he came under the influence of Maxwell, he early abandoned a lucrative business career for the life of an astronomer, and eventually gained a world-wide reputation among his fellows.

Gill made his first observations in the small observatory at King's College, Aberdeen; afterwards he erected a reflector in the garden of his father's house, and then in 1872, at the age of twenty-nine, became the first director of the Dunecht Observatory erected by Lord Lindsay, afterwards the Earl of Crawford. In 1874 he organized and accompanied Lord Lindsay's expedition to Mauritius to observe the Transit of Venus. His next expedition was to Ascension, which he visited in 1877 with the object of determining the solar parallax from measures of the parallax of Mars at its nearest to the earth.

His work during these expeditions was so notable that in 1879 Gill was appointed to succeed E. J. Stone as "Her Majesty's Astronomer" at the Cape of Good Hope. This position he held until 1906, raising the reputation of the Observatory and playing a part in many important undertakings. A successful photograph of the great comet of 1882 suggested to him the practicability of mapping the whole sky, resulting ultimately in the inauguration of the great

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.

INDIAN INSTITUTE OF SCIENCE BANGALORE, INDIA

The Council of the Indian Institute of Science, Bangalore, India, invite applications for the appointment of (1) Professor and Head of the Department of Electrical Technology from candidates who are specialists either in Heavy Electrical Engineering or Communication Engineering, and (2) of Professor and Head of the Department of Applied Mechanics and Automobile Engineering from candidates of high academic qualifications who (a) have conducted research and (b) have practical experience in an automobile works in design and construction. Salary Rs. 1,000—50—1,250 per mensem, with an overseas allowance of Rs. 250s. per mensem in the case of selected candidates who are of non-Asiatic domicile. The selected candidates will be on probation for two years, after which the appointments, if confirmed, shall continue till June 30 following the date of their attaining the age of 55, but the Council may grant extension of appointment beyond that age provided the candidates remain efficient and the extension is considered to be in the interests of the Institute. In case a house in the grounds of the Institute is provided, rent therefore in accordance with the by-laws of the Institute will be charged. The selected candidates will have the benefit of Provident Fund, the rate of subscription being 8¼ per cent of the salary, the Institute contributing an equivalent amount. Leave and other privileges will be determined by the Regulations and by-laws of the Institute. The selected candidates will be required to sign an agreement specifying the conditions of appointment. Six copies of the application and of the testimonials and two sets of the published papers of the candidate, which will not be returned, should reach the Registrar, Indian Institute of Science, Bangalore, India, not later than September 15, 1943. Candidates from abroad should submit their applications by airgraph to reach India in time and the published papers by air mail.

KENT EDUCATION COMMITTEE

MEDWAY TECHNICAL COLLEGE

SENIOR DEPARTMENTS, GILLINGHAM

A Senior Laboratory Assistant and Storekeeper (man or woman) is required immediately in the Chemistry and Physics Departments.

The qualifications looked for are previous experience of this type of work and some knowledge of chemistry and glassblowing.

The senior assistant will be required to take charge of three junior assistants.

Salary £3 10s. to £5 weekly, according to experience and qualifications. A temporary war addition is payable.

Applications, in the candidate's own handwriting, giving details of experience and qualifications, together with two recent testimonials, should be sent to the Principal, Senior Departments, Medway Technical College, Gillingham, Kent, not later than June 15.

HUDDERSFIELD TECHNICAL COLLEGE

Principal: Dr. J. W. Whitaker

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the position of lecturer in the above department. Candidates should have University Degree qualifications or equivalent, and industrial experience. Salary: Burnham Scale plus bonus. Forms of application may be obtained from the Principal. They should be returned by June 16.

H. KAY,
Director of Education.

DERBY TECHNICAL COLLEGE

NORMANTON ROAD, DERBY

The Governors invite applications for TWO Lectureships in MATHEMATICS. Applicants for:

(1) Should possess a special degree and will be required to teach Mathematics to the standard of the Final Degree in Engineering and Science.

(2) Should possess a General Degree in either Science or Engineering and will be required to teach Mathematics up to Advanced National Certificate standard.

Salary according to Burnham Scale, plus war bonus. Application forms and further particulars may be obtained from the undersigned and should be returned by June 21, 1943.

W. ALFRED RICHARDSON,
Principal.

ESSEX EDUCATION COMMITTEE

SOUTH EAST ESSEX TECHNICAL COLLEGE AND SCHOOL OF ART

Longbridge Road, Dagenham, Essex.
Principal: P. J. Haler, M.B.E., M.Sc., M.I.Mech.E.
Science Department
Head: E. Tyler, D.Sc., F.Inst.P., A.M.I.E.E., A.F.R.Ae.S.

Applications are invited for the following permanent full time posts:

1. Senior Lecturer in Chemistry.
2. Senior Lecturer in Physics.

Duties to commence on September 1, 1943.

Candidates must possess high academic qualifications in Physics or Chemistry, in addition to having specialized in the teaching of one of these subjects to B.Sc. Honours standard. In the case of Chemistry an F.I.C. qualification is essential. Research or industrial experience is also desirable.

Salary in accordance with the Burnham Provincial Technical Scale plus £40 p.a. for post of special responsibility.

For further particulars and forms of application apply to the Clerk to the Governors at the College, enclosing stamped addressed envelope.

Applications should be received by the Clerk to the Governors not later than June 16, 1943.

B. E. LAWRENCE,
Chief Education Officer.

DURHAM COUNTY MENTAL HOSPITAL

PSYCHIATRIC SOCIAL WORKER (FEMALE)

NON-RESIDENT

Applications are invited for the above post. Candidates should not be over 35 years of age, and preference will be given to those in possession of a Social Science Certificate or a Mental Health Course Certificate as granted by the London School of Economics.

Salary £200 per annum rising by two annual increments of £25 each to a maximum of £250 per annum plus war bonus, at present £39 2s. 2d. plus travelling expenses. Officer required to co-operate with medical staff in investigating history and social welfare of mental cases.

Appointment subject to provisions of Asylums Officers' Superannuation Act, 1909, after 6 months satisfactory service. Applications stating age and experience, to be accompanied by copies of 3 recent testimonials and to be addressed to the Medical Superintendent, Winterton, Sedgefield, Stockton-on-Tees, must be received by June 19, 1943, and all envelopes to be endorsed "Social Worker."

UNIVERSITY OF ABERDEEN

APPOINTMENT OF UNIVERSITY ASSISTANT IN PHYSIOLOGY

Applications are invited for the post of Assistant in the Department of Physiology. Salary £250 to £300 according to qualifications. The Assistant will take up duty on October 1, 1943.

H. J. BUTCHART,
Secretary to the University.

UNIVERSITY OF LEEDS

DEPARTMENT OF AGRICULTURE

NATIONAL MILK TESTING AND ADVISORY SCHEME

Laboratory Assistant to the Advisory Dairy Bacteriologist. Applications are invited from suitably qualified candidates for this post. Initial salary £3 per week. Further particulars may be had from The Secretary, Department of Agriculture, Leeds University, to whom application should be sent on or before June 18, 1943.

NATIONAL MILK TESTING AND ADVISORY SCHEME

Applications are invited for post of Assistant Bacteriologist, male or female, in S.E. Province. Salary according to experience, but not less than £275 p.a. plus bonus for male and £220 p.a. plus bonus for female.—Apply stating age, sex, qualifications, experience and position in regard to National Service to H. Barkworth, Provincial Advisory Bacteriologist, 50 Woodland Drive, Hove 4, Sussex.

NATIONAL MILK TESTING AND ADVISORY SCHEME

Applications are invited for the appointment of Laboratory Stewards at Croydon and Ashford, Kent. Laboratory experience essential. Salary from 60s. per week, plus bonus. Applications, stating age, experience and position re Military Service to H. Barkworth, Provincial Advisory Bacteriologist, 50 Woodland Drive, Hove 4, Sussex.

A qualified Pharmacist, preferably with some scientific training, is required in the manufacturing department of a well-known firm of wholesale manufacturing chemists, N.W. district.—Apply Box E 2899, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Metallurgists required for light alloy research in industrial laboratories in Manchester district. Must be able to carry through research programmes without detailed direction. A sound knowledge of modern developments in physical metallurgy is necessary. Applicants' experience should be such as to enable them to apply principles of physical metallurgy to practical problems of alloy development. Age 35 to 40 preferred, but younger applicants exempt from Military Service will be considered. Knowledge of German an advantage. Salary range £450 to £700 per annum for suitable applicants.—Apply stating age, experience and salary required to Box 960, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Lady required for analytical work in metallurgical laboratory Wolverhampton District, to take charge of small staff of females under direction of Chief Chemist. Candidates should possess organizing ability. Previous experience is not essential as training can be provided. Applicants state age, with details of experience to Box 961, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Ido, the History of our Language, by Otto Jespersen, 4d. post free from The International Language (Ido) Society of Great Britain, 3 Spareleaze Hill, Loughton, Essex.

Colorimeter, Photo-electric or Optical— Klett, Hellige, Duboscq or other good make, urgently required.—Details and price to E.C.D. Limited, Priory Works, Tonbridge, Kent.

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

Polyglot Translation Service Ltd., Terminal House, 52 Grosvenor Gardens, S.W.1. Sloane 7059. Translations in all languages. English and Foreign Secretarial work.

THE fact that goods made of raw materials in short supply owing to war conditions are advertised in this publication should not be taken as an indication that they are necessarily available for export.

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International Astrographic Chart and Catalogue at the Paris Congress of 1887. Of this work Gill said in 1907: "A century hence this great work will have to be repeated, and then, if we of the present day have done our duty thoroughly, our successors will have the *data* for an infinitely more complete and thorough discussion of the motions of the sidereal system than any that can be attempted to-day".

Another scheme of Gill's was the measurement of the Great African arc on the 30th meridian. So early as 1874, after his visit to Mauritius, at the invitation of General Stone, chief of the military staff of the Khedive, he had measured a base-line for a proposed survey of Egypt, and once settled at the Cape he took up the question of a geodetic survey of South Africa. It became the dream of his life to see the completion of the measurement of an arc from Cape Agulhas to Cairo, whence the measurement would be carried by the eastern shore of the Mediterranean and Greece to meet Struve's great arc which extends to North Cape.

But while it was these and other labours of a kindred nature which occupied Gill's time and raised him to a leading position in the astronomical world, his success was to a large extent due to his simple, direct and energetic character. As his biographer in the Report of the Council of the Royal Astronomical Society for 1915 said: "Those who came in contact with him felt the charm of his personality. In some indefinable way he could inspire others with his enthusiasm and determination. Enjoying a life crowded with activity, surrounded by an unusually wide circle of friends, he was ever ready and eager to encourage the humblest beginner." Settling in London after his retirement from the Cape, he did valuable service for various scientific societies, and in 1913 he published his "History and Description of the Cape Observatory".

Gill was elected a fellow of the Royal Society in 1883 and made K.C.B. in 1900. He fell ill with pneumonia in December 1913, and died on January 24, 1914; he was buried at Aberdeen.

OBITUARIES

Mr. Lionel R. Crawshay

MR. L. R. CRAWSHAY, who died suddenly at Plymouth on April 24, was born at Honiton on July 9, 1868. He was educated at Harrow and Brasenose College, Oxford; he graduated in arts, but later took up natural science, studying under Prof. Minchin at University College during 1903–5. He was then appointed assistant naturalist to the Marine Biological Association under Dr. E. J. Allen, a post which he held until 1914. During the War of 1914–18 he served as a trooper in the First King Edward's Horse and as instructor in computation, Field Survey Co., R.E. In 1919 he was awarded a Ray Lankester investigatorship at the Plymouth Laboratory, but shortly afterwards he was selected for a Colonial Office appointment as research officer, Sponge Fishery Investigations. The post was a temporary one, at Nassau in the Bahamas, and was originally for one year only; but Crawshay quickly proved his capacity and the appointment was repeatedly extended until his service had reached a total of fifteen years. He worked for some time in British Honduras, living in primitive conditions on a reef adjacent to the sponge fisheries, and in 1930 he was deputed to report on the sponge industry in Cyprus. He retired in 1934, and during the remainder of his life he worked regularly at the Plymouth Laboratory, continuing his researches on the Porifera with unabated enthusiasm.

It is greatly to be regretted that so little of Crawshay's unrivalled knowledge of sponges and sponge culture has been published. The results of his long years of work in the West Indies and British Honduras were sent as official reports to the Colonial Office and none of them has been printed. His report on the Cyprus industry has, however, been published, and one paper, intended as the first of a series, which he wrote after his retirement. Throughout his life he was interested in entomology, in which his brother, the Rev. G. R. Crawshay, did most useful work; in 1903 he published a detailed account of the development of Drilus (Coleoptera) and he made valuable observations (not published because he regarded them as incomplete) on certain Dartmoor Coleoptera. He wrote on the arterial system of the Anura, contributed short papers on a variety of subjects to the *Journal of the Marine Biological Association*, and reported on the microplankton obtained by the *Scotia* in a voyage which he himself accompanied in 1913.

Crawshay was a keen lover of Nature at its wildest. He delighted in solitary tramps across the remotest parts of Dartmoor, and spoke with such enthusiasm of his work abroad that it may be doubted whether he ever felt the extreme loneliness of his life on the sponge lagoons. As a scientific worker he had outstanding qualities, observing and recording with scrupulous accuracy and exercising the greatest caution in his deductions. He devoted himself to his work to the exclusion of every other thought, and had no regard whatever for his own material comforts. To all at the Plymouth Laboratory he endeared himself by his modesty and charm of manner and by his constant thoughtfulness for others.

S. KEMP.

Dr. H. Gordon Rule

DR. H. GORDON RULE, reader in the Department of Chemistry at the University of Edinburgh, died on March 15, at the age of fifty-five. After graduating with honours in chemistry at Birkbeck College, London, he carried out research with Prof. Alex McKenzie and then worked for two years under Otto Dimroth in von Baeyer's laboratory in Munich, where he gained his Ph.D. in 1912. Returning to Great Britain, Rule spent a year at Birkbeck College and in 1913 went as an assistant to the University of Edinburgh. In 1921 he was appointed senior lecturer in organic chemistry, a position he held until his death. He was made reader in 1939.

Much of Rule's time was devoted to research, but he never neglected his teaching duties. He was an excellent teacher and his lectures were models of clearness and conciseness, while his quiet humour added to his popularity with the students. It was the same at the Chemistry Colloquium: a 'full house' was assured if Rule was the speaker.

Rule's main research work extended over a period of twenty years and dealt with the factors governing the magnitude of optical rotatory power, a problem which had earlier attracted the attention of another Edinburgh chemist, Crum Brown. Rule published more than thirty papers on this subject and estab-

lished the important part played by the polar groups in the asymmetric molecules and in the solvent employed. Later he turned to quite a different line of research and made some notable contributions in the rather ungrateful field of benzanthrone chemistry. Before the end, however, he returned to his first love, stereochemistry, and with G. M. Henderson published an account of the resolution of an organic racemic compound by chromatographic adsorption.

No record of Rule's work would be complete without reference to his admirable translation of the well-known German text-book, Julius Schmidt's "Kurzes Lehrbuch der Organischen Chemie", the fourth edition of which was in the printer's hands when Rule was overtaken by the illness to which he succumbed. His extensive alterations and improvements of the original text undoubtedly contributed much to the success of the volume in Great Britain.

All Rule's work was characterized by orderliness and neatness and his motto might well have been the dictum of Hofmann, "Ordnung ist die halbe Chemie". The value of his researches was widely recognized and his death will be keenly felt.

NEIL CAMPBELL.

NEWS and VIEWS

Royal Botanic Gardens, Kew: New Director
Prof. E. J. Salisbury, C.B.E., F.R.S.

THE appointment of Prof. E. J. Salisbury as director of the Royal Botanic Gardens at Kew will give general satisfaction. Like one of the most successful of its directors, Sir William Thiselton Dyer, Prof. Salisbury began his career as a teacher of botany, having held with distinction the Quain professorship of botany in University College, London, for many years. His earlier interests in botany were in the field of plant ecology, to which he made a number of first-rate contributions. His study of the vegetation of Blakeney Point, Norfolk, led him to take a special interest in the distribution of plants in the neighbouring parts of the country and resulted in an excellent account of the East Anglian flora published in the *Transactions of the Norfolk and Norwich Naturalist Society*. His work on the distribution of plants directed his attention to the gradual disappearance from some of our counties of many interesting plants, and his account of the "Waning Flora of Britain" expresses his concern in the matter, and has caused him to take an active part in the preservation of the flora of Britain.

Always a keen and successful gardener, Prof. Salisbury's "Living Garden" embodies the why and wherefore of his success and gained for him the recognition of the Royal Horticultural Society. During the War, he was elected to the Agricultural Research Council and his scientific knowledge joined to his horticultural experience has enabled him to play an important part in the solution of many horticultural problems. By Prof. Salisbury's appointment to Kew, the Gardens will not only gain a director with a wide outlook, who will ensure the continuance of the good work of the Herbarium and the advisory work to the Colonial gardens, but his horticultural experience will enable him to carry on successfully the cultivation of the collection of living plants and will lead, it is to be presumed, to some experimental work both in the cultivation of plants and in plant genetics.

King's Birthday Honours for Canadian Services

A SEPARATE list of honours conferred by the King "on the occasion of the celebration of His Majesty's birthday and on the advice of Canadian Ministers", includes the following names: *C.M.G.*: Prof. C. J. Mackenzie, acting president of the National Research Council of Canada; Prof. W. G. Penfield, head of the Neurological Institute, Montreal. *C.B.E.*: Dr. A. E. Archer, president of the Canadian Medical Association; Prof. J. B. Collip, president of the Royal Society of Canada; W. E. Phillips, president of Research Enterprises, Ltd.

Association of Scientific Workers: Council Meeting

THE twenty-sixth council meeting of the Association of Scientific Workers was held in London during May 8 and 9. A rapid growth in membership was recorded, the present total being more than 11,000. The most important organizational development during the past year was the decentralization of much of the work of the Association to area committees, nine of which have been formed to co-ordinate the work of the 148 branches. As a result of this, area offices have been opened in London and Manchester. It was decided that in future half the executive committees would be elected as representatives of the areas. After debating internal matters, the Council instructed the executive committee to "carry out a nation-wide campaign to draw the attention of all citizens to the contributions to human welfare which science can make if properly planned, adequately financed, and applied solely for the good of society". It approved the principle of a State Medical Service, and urged the rapid extension of the use of mass radiography. Many aspects of science education were debated, and changes in university curricula to enable students better to meet present industrial requirements were recommended. The need for employees to have opportunities for part-time study was stressed, and the executive committee was asked to "obtain from the Board of Education a definite undertaking (on the lines of that given by the Canadian Government) that students trained under special war-time schemes in Universities and Training Colleges will be accorded adequate post-war facilities for the completion of their education". Support was given to the broad principles embodied in the T.U.C. Memorandum on Education. The council reaffirmed its views that a central planning board was necessary to obtain the maximum utilization of scientific and technical resources, and urged that scientific knowledge should be used on joint production committees by allowing the technical staff to be represented. The Beveridge Report was discussed by the delegates, who welcomed "the adoption in the Scheme of scientifically determined

standards of human needs". The president, Sir Robert Watson-Watt, the hon. general secretary, Dr. W. A. Wooster, and the treasurer, Dr. S. Masterman, were re-elected to hold office for the coming year. The Association has just published the full proceedings of the Conference on "Planning of Science" held during January 30–31.

Aims of the Association

FOR his presidential address to the Association, Sir Robert Watson-Watt took as his theme the topic of contentment. The Association, he pointed out, is now strong, but still not fully representative of scientific and technical workers as a whole. Nevertheless, it is strong enough to be able to admit misunderstanding of its objects. One charge brought against the Association is that it is more concerned with politics than science; this suggests that some people do not realize how fundamental politics is. Scientific workers are citizens, and as such they should be profoundly concerned with the application of science to the good of the State and of the world. Politics means publicity, and so the Association must of necessity undertake to influence public opinion. The social relations of science is a primary object of study for the Association, but propaganda and economic and engineering efficiency play equal parts in its trade union activities. It has been said the Association fosters enmity between juniors and seniors. Sir Robert takes the view that the enmity already exists, though to a diminishing extent, and he is all for bringing it out into the open and treating it by free discussion. Seniors who make this charge are suffering from the dread disease of contentment. The last charge he discussed was that the Association consists of idealists. To the extent that we all believe in the possibility of making a better world, we are idealists. But Sir Robert was scathing in his comments on dangerous idealists of industrial research laboratories, who declare that the methods of the Association have brought discord between laboratory staff and management; they indeed are suffering from contentment, or even complacency, which may easily come to mean smugness.

Anglo-Czechoslovak Chemical Collaboration

THE need for closer collaboration between British and Czechoslovak chemists was stressed at a meeting under the auspices of the Association of Czechoslovak Scientists and Technicians Abroad held at the Czechoslovak Institute, Grosvenor Place, London, on May 14. It was attended by Czechoslovak chemists serving or working in Great Britain and by members of the five British chemical societies, and was addressed by Dr. G. Druce and by Dr. George Lewi, chairman of the chemical group of the Czechoslovak association. Dr. Druce briefly described some of the contributions of Czechoslovak chemists to the advancement of science, particularly during the two decades between 1918 and 1938. Reference was also made to the importance attached by Czechoslovak educational authorities to science and scientific research, especially in chemistry. There is a relatively extensive scientific and technical literature, and Czechoslovakia possessed many public and corporate research institutes in connexion with the country's sugar, glass, brewing, mining and metallurgical industries and with agriculture and forestry. The German occupation of Czechoslovakia and the closing of the universities, etc., has interrupted the investigations in progress under Czechoslovak men of science, but with such a tradition as they possess, the nation's chemists and technologists will doubtless resume and extend their peaceful activities as soon as the country regains its independence. In this work British chemists will watch with interest the efforts to reconstruct the chemical and other scientific institutions and the industries they serve.

Dr. Lewi gave an impressive account of his country's chemical industry, the extent of which has not been realized abroad. The output was very great and included a long list of varied types of products. Nevertheless, Czechoslovakia imported considerable quantities of chemicals and similar products. Hitherto these had come mainly from Germany. Again, although Czechoslovakia's natural resources are great and include most metal ores as well as coal, lignite, graphite and pitchblende and also timber, they were insufficient for local needs and more had to be imported. In particular, the chemical and allied industries would need financial and technical assistance for the reconstruction that would take place in the post-war years. This help could best come from British sources, to which Czechoslovak chemists look for guidance in the difficult times ahead. Many industries would be left in ruins by the Germans, who had already pillaged both private industrial undertakings and public scientific institutions. Dr. Lewi took the opportunity to agree with Sir Robert Robinson's contention that the German chemical industry must not be allowed to menace mankind in the future. In the meanwhile, the Czechoslovak chemical community in Britain places its knowledge and experience at the disposal of the common cause, and at the same time attempts to assist its members and student nationals to prepare for the tasks that lie before them when they return to their liberated homeland.

Reconstruction in the Birmingham Area

SPEAKING to the Birmingham General Branch of the Association of Scientific Workers on June 1 on "Reconstruction in Birmingham and the West Midlands", Councillor Paul Cadbury outlined the original research work which is being done by a group of paid and voluntary workers connected with the University of Birmingham under the chairmanship of Dr. R. E. Priestley and the technical direction of C. B. Parkes of the Bournville Village Trust. Surveying the five counties forming the Midland Civil Defence Region, by excluding land of various categories (for example, inaccessible, marshy, highly fertile, and of great natural beauty) there remains only a very restricted number of areas suitable for future industrial and urban development. In some cases these happen to adjoin existing market towns (for example, Bridgnorth) which have facilities and services particularly suitable for an increased population. Before the publication of the Uthwatt Report, Mr. Cadbury said that State ownership of all land was recommended as ideal, with the vesting in the State of the development rights of all land as an immediate necessity. In rebuilding, existing towns should be broken down where possible into 'neighbourhood units', each with its own community centre and group of industries. Large dormitory suburbs and dependence on only one industry would thus be avoided. The whole talk provided an excellent example of realistic application of the scientific method of planning to a social problem.

An Army Nature Observation Scheme

THE new Army Nature Observation Scheme has as its first object co-operation in the national wood pigeon investigation of the Edward Grey Institute at Oxford. Under this scheme, states the fifth *Wood Pigeon Bulletin*, recently issued, standard cards are being supplied to one of the Army Commands stationed in Britain through the unit education officers, who will periodically distribute, collect and return them. If the scheme shows promise of being a success in this Command it will be extended to others, and the printed cards have already been dispatched to the War Office. However, a naturalist in the Forces points out that, while the idea is most welcome, the difficulties are that everything depends upon the interest shown by commanding officers, whose power over the activities of their regiments is immense: many units, especially training ones, have little experience of the Army Educational Unit, and organized natural history work depends upon freedom from evening and week-end fatigues, while the largest number of results would be obtained if permission were gained to fill the cards during parade hours. For the bulk of the modern army there is little time or facility for much apart from soldiering, so technical is modern war.

The *Bulletin* contains interesting examinations of the sexual organs of Scottish and English wood pigeons which suggest that Scottish males develop their gonads earlier than English ones: there is the same trend among the female birds, but English birds take longer to 'catch up'. In southern England, the winter field counts suggested a low and stable population in the western portion, but quite different conditions in the middle portion with a high population, reaching its peak in January, while the eastern section, on a migration route from the Continent, had its peak figures in November, falling to a low figure in February. Counts from Scotland suggested a peak in December, whereas from England they suggested January as the peak. In Scotland the fall after the December peak was rapid, so heavy as to imply an outward movement, leaving what may be a bare resident population. In England, the January numbers suggest a sudden influx of birds.

War and Medicine

THE February issue of the *Journal of Laboratory and Clinical Medicine* contains an interesting article on war and medicine by Dr. Henry E. Sigerist, professor of the history of medicine at Johns Hopkins University. He remarks at the outset that the contribution of war to medicine is first of all negative. Not only are many of the *élite* of a nation killed or crippled, but also the civilian population are liable to be affected by famine and pestilence. On the other hand, war is a stimulus to medicine both technically and socially, as it provides opportunities for experimenting on a tremendous scale such as would never be available in time of peace. This applies particularly to surgery, as was first illustrated in ancient Greece when Greek surgeons travelled with the mercenaries in the army of the Egyptian pharaoh Psammetich. War was also responsible for the erection in ancient Rome of hospitals, which were unknown in ancient Greece. War surgery was revolutionized by Ambroise Paré, who, in his work on the treatment of gunshot wounds published in 1545, showed that these wounds heal much better without the brutal treatment of pouring on them boiling oil which destroyed so much of the tissues. The part played by John Hunter in the expedition to Belle Isle in 1761 was notable, in that the British Navy had the services not only of a surgeon but also of a man of science. Hunter gained invaluable experience on gunshot wounds, which he discussed in his great work on "Blood, Inflammation and Gunshot Wounds" published in 1794.

The introduction of general anæsthesia in 1846 and of antisepsis in 1867 helped to save many thousands of lives. The work of Florence Nightingale during the Crimean War of 1853–56 was the beginning of modern nursing, just as the battle of Solferino in 1859 was the starting point of the Red Cross, due to the work of the Swiss banker Henri Dunant. The value of vaccination was conclusively shown in the Franco-Prussian War of 1870–71; in the German army, where most of the soldiers were vaccinated or re-vaccinated, there were 4,800 cases of small-pox with 278 deaths, whereas among unvaccinated French people there were 14,000 cases with 2,000 deaths. The War of 1914–18 demonstrated the importance of protecting the workers' health, and industrial medicine led to the establishment of ministries of health in various countries. In conclusion, Dr. Sigerist states that though the present War will undoubtedly stimulate medical science, its social effects will be much more strongly felt.

Cancer Control in the United States

IN a recent paper (*Public Health Rep.*, **57**, 1613; 1942), Dr. A. Scheele describes the present cancer control activities conducted by thirty-nine health departments and three cancer commissions in the forty-eight States and the Territory of Hawaii. The known expenditure for programmes amounted to about 1,280,000 dollars during the fiscal year ending June 30, 1941. The activities consisted of lay and professional education, provision of diagnostic and treatment facilities, and research, primarily statistical. Interest in cancer control in the United States has rapidly increased during the last few years, and most of the new programmes have developed since 1930. It seems probable that real gains in the campaign against cancer will come through improvement and extension of current programmes. Later it is hoped that the campaign will become primarily preventive rather than curative.

Public Health in Chile

THE January issue of the *Boletín de la Oficina Sanitaria Panamericana* contains an account of the state of public health in Chile by Dr. Juan Antonio Rios, president of the Republic. With the exception of an outbreak of cerebro-spinal fever in Santiago and Valparaiso which has been successfully combated, there has been no recent epidemic. Typhus is no longer a menace, and cases of typhoid fever have been decreased by mass inoculation and other measures. An efficient control of drinking water is being carried out. The various mother and child welfare services have been grouped under a Technical Advisory Division, the functions of which have been co-ordinated with those of social security and private institutions. An eye clinic and one for skin and venereal diseases have been completed. Five institutions deal with industrial accidents.

Identification of Indian Timbers

Two leaflets have been issued by the Forest Research Institute (Pub. Forest Research Inst., Dehra Dun), on "How to Identify Timbers", Nos. 21 and 25 (Utilisation). The present War, as was the case with the War of 1914–18, has made a great demand on the timber resources of India. As the demand increases, many new or little-known timbers are being placed on the market. Considerable confusion in identity has supervened, causing perfectly good timbers for the purpose in view to fall into disrepute owing to the substitution of inferior ones. This fact has become well understood by the Defence and Supply Departments which handle timbers, and many inquiries on the subject have been put to the Institute. Leaflet (Part 1) No. 21 gives some general information on the subject of identification of timbers, well known to students of the subject. Leaflet (Part 2) No. 25 is more specialized, dealing with the identification of timbers for "Helves and Tool Handles". The leaflet gives a key for the field identification of certain timbers for tools, the demand for which in ever-increasing numbers, as is well known, has become world-wide. Short anatomical descriptions of the timbers mentioned as suitable for the purpose are included.

The High-pressure Gas-filled Cable

In a recent paper on this subject read by C. J. Beaver and E. L. Davey before the Institution of Electrical Engineers in London, the present position of existing types of high-voltage cables is briefly reviewed and the reasons underlying the development of the gas-filled cable are given. Following a brief description of the cable, the design is dealt with in detail. The construction and manufacture of the cable are then described and the physical behaviour of the cable in service is considered. Details of the accessories associated with the cable system are given, and the routine type and research testing of both cable and accessories are discussed. After dealing with gas-pressure considerations of the cable system in service and installations carried out, a brief survey of the economic aspect of the cable is given.

It is concluded that the high-pressure gas-filled cable system has certain special advantages, and that since its technical and economic positions are sound it should, in the future, be a factor to be taken into consideration when schemes involving power transmission at voltages of 33 kV. and upwards are envisaged. The design of the gas-filled cable is based upon a quantitative appreciation of the electrical and physical requirements of the dielectric of a cable to withstand service conditions without deterioration, and definite margins of safety are provided and maintained. The manufacture of the cable does not involve the use of any novel or special plant or manufacturing processes other than those which have already been in use for many years past in the manufacture of the solid-type cable. The cable system is free from external accessories, and no special arrangement is necessary if the cable is run vertically for any height or distance. The economic aspect of the cable for the voltage range of 33–132 kV. is good. The permittivity of the dielectric is a good deal lower than that of any other impregnated-paper dielectric. This is of importance in relation to the future use of higher voltage and more highly stressed cables, and the necessity of keeping the cable capacitance load on systems to a minimum value.

Earthquakes Registered at Kew

During April 1943, seven strong earthquakes were registered by the seismographs at Kew Observatory. The first of these, on April 1, was registered at 14h. 41m. 40s. U.T., and a tentative analysis puts the epicentre 15,000 km. distant. The maximum ground amplitude at Kew due to this shock was 115 μ. The second shock was on April 5. This earthquake, from an epicentre some 5,450 km. distant, recorded *ePz* at Kew at 02h. 05m. 09s. U.T. and attained a maximum ground amplitude at Kew of 67 μ at 02h. 25m. 18s. U.T. The third shock was on April 6, recording impulsively on the vertical component at 16h. 21m. 10s. U.T. It attained a maximum ground amplitude at Kew of 470 μ on the east-west component at 17h. 05m. 35s. U.T. It came from an epicentre some 11,450 km. distant, the epicentre possibly being in the neighbourhood of lat. 30° S., long. 70° W., which is in Chile. On this day a message from Santiago de Chile said that a very severe earthquake with epicentre in the Illapel zone had partly destroyed buildings in Illapel, La Serena, Combarbala and Ovalle. Further details were not given as communications with the area were severed. The fourth shock, on April 7, recorded *eP* on all three components at 09h. 03m. 40s. U.T. and a tentative analysis puts the epicentral distance at some 11,500 km. The fifth earthquake, on April 11, recorded *iP* on all three components at 14h. 58m. 43s. U.T. from an epicentre some 9,100 km. distant. Maximum ground amplitude at Kew was 170 μ on the vertical component at 15h. 41m. 17s. U.T. The sixth earthquake came from 1,800 km. away and therefore may be considered a near shock. On April 16 it recorded *iPz* at 11h. 76m. 56s. U.T. and finished recording near 12h. 25m. The seventh and last strong shock of the month was recorded on April 29. It began recording with *iP* on the vertical and north-south components at 15h. 37m. 05s. U.T. and came from an epicentre some 8,800 km. distant.

Earthquake in Colombia

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has received instrumental reports concerning an earthquake on December 26 from the observatories at St. Louis, Georgetown, San Juan, Tucson, Fordham, Philadelphia, Des Moines and Huancayo. From this data it appears that the earthquake originated at approximately 12h. 31·8m. U.T. from an epicentre near latitude 9·0° N., longitude 75·0° W. This is in Colombia, South America, near the confluence of the Cauca and Magdalena Rivers. Earthquakes are not uncommon in this region.

Supply of Organic Compounds

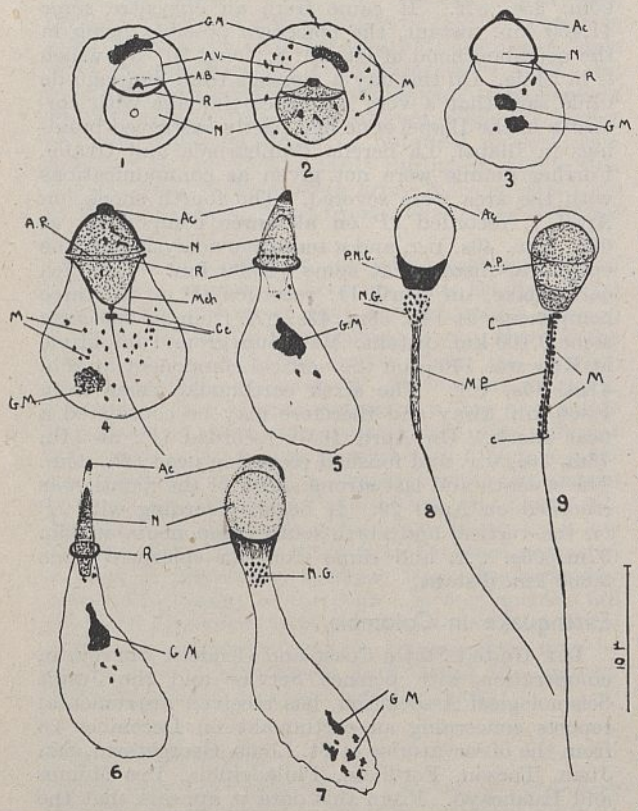
We have received from L. Light and Co., Ltd., Old Bowry Laboratories, Wraysbury, Bucks, a price list of more than four hundred organic compounds not usually available commercially. This includes a large number of compounds used in synthetic work, such as ethyl acetoacetate, ethyl malonate, and ethyl iodide, many alcohols, esters and ketones, and also inorganic reagents such as magnesium turnings, hydrazine, selenium, and selenium dioxide. It is very interesting to find that such a wide range of materials is available, and research workers should be materially assisted by having them at their disposal. A copy of the list can be obtained on application to the firm.

LETTERS TO THE EDITORS

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

A Nuclear Ring in the Developing Male Germ Cells of Dog and Cat

IN the course of recent work on the spermatogenesis of the dog and the cat, I noticed a peculiar ring-shaped structure on the nucleus of the spermatid and on the head of the young sperm. Observations were afterwards carried out on the origin and fate of this ring, here called the nuclear ring. Similar



Ac., acrosome; *A.P.*, posterior limit of acrosome; *A.B.*, acrosome bead; *A.V.*, acrosome vacuole; *C.*, *c.*, centrosomes; *G.M.*, Golgi material; *M.*, mitochondria; *M.P.*, middle piece; *Mch.*, manchette; *N.*, nucleus; *N.G.*, neck granules; *P.N.C.*, post-nuclear cap; *R.*, nuclear ring.

structures have been observed (but not so far described) in the spermatid and in the young sperm of the bull, by Dr. R. A. R. Gresson of this Department, who has shown me his preparations. As the nuclear ring has not previously been described, a short note on its appearance and development is given here. Later, I hope to publish a full account of the spermatogenesis of the dog and cat.

Very small pieces of the testes of the dog and cat were placed immediately after death in fixing fluids and afterwards sections were cut, 5 μ and 8 μ in thickness. Smears were also made. The methods used for both sections and smears were those of Champy-Kull, Flemming, Kolatchev, Aoyama, and Regaud. The smears treated with Aoyama's method were not very satisfactory, but the sections were very clear and beautiful.

The structure and history of the nuclear ring was investigated chiefly in the dog, and the following account is of observations on that animal, although similar stages were seen in the preparations of the cat testis. The nuclear ring was first noticed as a conspicuous structure in the late spermatid, in the form of a black ring (Figs. 5, 6). The forerunner of the nuclear ring first appears in the spermatid at the stage when the acrosomic vacuole pushes up the Golgi apparatus and causes a depression on the surface of the nucleus (Figs. 1, 2). The edge of this depression, in the form of a circular line, stains more deeply than the nucleus. In the middle of the nuclear depression a small bead can be seen, the acrosome bead. At a later stage when the Golgi apparatus starts to drift down along the semilunar vacuole, the acrosome bead swells, and with the decrease in size of the vacuole the nucleus tends to regain its original shape, thus causing the disappearance of the depression. The circular line which marked the edge of the depression remains, and appears to be the forerunner of the ring-shaped structure round the nucleus of the late spermatid (Figs. 3, 5).

After the Golgi apparatus has moved away from the vacuole, the acrosome bead spreads out over the anterior part of the nucleus and forms the acrosome, the posterior edge of which rests on the nuclear ring (Figs. 3, 5, 6).

During the metamorphosis of the head of the sperm, the nucleus elongates in an anterior direction from the nuclear ring. In the unstained Aoyama's preparations the anterior part, about two thirds, of the nucleus is covered with the acrosome, which terminates posteriorly in contact with the nuclear ring.

The part covered by the acrosome is of a light golden colour; the remainder of the nucleus is left unstained (Fig. 5). The detachment of the acrosome from the nuclear ring was observed in Champy-Kull preparations. Two rings are present, one consisting of the posterior limit of the acrosome, the other deeper in colour, being the nuclear ring (Figs. 4, 9).

With the metamorphosis of the spermatid, the nuclear ring becomes progressively deeper in colour in the silver preparations and in side view is very conspicuous (Fig. 5). In later stages granules are deposited along the ring, and this causes a widening of the ring in a posterior direction and a gradual blackening of the whole posterior part of the head of the nearly ripe sperm (Fig. 7). Finally, a complete cap is formed, the "post nuclear cap" of Gatenby (Fig. 8).

The presence of the post-nuclear cap in mammals was recorded by Gatenby and Wigoder[1] in the guinea pig, and in the human sperm by Gatenby and Beams[2], but no reference was made to any ring round the nucleus of the late spermatid. According to Gatenby, in the human spermatozoon the post-nuclear cap is formed by a creeping up and growth in an anterior direction of argentophil material. According to my observations on the sperm of the dog and cat, the post-nuclear cap seems to be formed by growth in a posterior direction from a fixed circular structure.

This work was carried out in the Department of Zoology, University of Edinburgh, under the supervision of Prof. James Ritchie and direction of Dr. R. A. R. Gresson.

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[1] Gatenby, J. B., and Wigoder, S. B., *Proc. Roy. Soc.*, B, **104**, 471 1929)).

[2] Gatenby, J. B., and Beams, H. W., *Quart. J. Micro. Sci.*, **78**, 1 (1935).

Histochemistry of the Gram-staining Reaction for Micro-organisms

IN 1884 a Dane, Christian Gram, while working in Berlin, discovered a method of staining micro-organisms which has gone under his name ever since that date[1]. Although the method is in daily use by bacteriologists of various nationalities all over the world, and has by reason of its importance in ordinary routine diagnosis been the subject of extensive research, it may be fairly said that it has never been adequately explained.

The method consists in staining heat-fixed smears with an aqueous solution of a dye of the pararosaniline series, mordanting with aqueous iodine, washing with alcohol until no more of the blue dye can be extracted and then counterstaining with a red dye of the acid fuchsin series.

Organisms which after extraction retain the blue dye are described as being Gram-positive, while those which are decolorized by the alcoholic extraction and take up the red dye are said to be Gram-negative. Obviously there must be some marked chemical or physical differences in the two groups of micro-organisms in order to account for such diverse staining reactions. Special interest is attached to the underlying mechanisms since it has been shown[2] that dramatic differences exist in the selective bacteriostatic and bactericidal action of some of the newer anti-bacterial agents. Thus, for example, basic dyes, cationic detergents[3], penicillin, gramicidin, etc., are much more active against Gram-positive species, anionic detergents inhibit the metabolism of Gram-positive organisms only, while tellurites, azides, etc., appear to be selective against Gram-negative species.

As a result of investigations carried out conjointly, we have observed that Gram-positive organisms can be rendered Gram-negative by a variety of methods, for example, by the action of certain carbohydrate-splitting enzymes and by extraction processes. We have devised a method whereby organisms, for example, *Cl. welchii*, can be 'stripped' of an essential part of their Gram-positive material and separated into Gram-negative cytoskeletons and a Gram-negative extract. Furthermore, we have developed a simple technique whereby a fraction from the extract can be 'plated' back on to the cytoskeletons to reconstitute Gram-positive bacilli. We have been able to show that the essential constituent in Gram-positive organisms which differentiates them from those which are Gram-negative lies in their having as part of their surface structure the magnesium salt of ribonucleic acid.

The method of extracting this material utilizes the action on washed cells at 60° of a 2 per cent aqueous solution of a bile salt in presence of oxygen. Material in the extract could be precipitated by alcohol, and fractionation methods showed that it consisted essentially of magnesium ribonucleate together with inert polysaccharides and traces of proteins.

The fundamental requisite for the successful recombination of magnesium ribonucleate with the Gram-negative cytoskeleton material is that the latter must be in a *reduced* condition. A number of reducing agents have proved suitable for this preliminary reduction, but all our recent experiments have been carried out with 1 per cent formalin in 0·8 per cent sodium chloride, in which the cytoskeletons can be kept in satisfactorily receptive condition for several days. With exposure to air the cytoskeletons become irreversibly oxidized and recombination does not occur. Of particular interest is our observation that it has not yet been found possible to combine Gram-negative organisms with salts of ribonucleic acid.

In further experiments, brewer's yeast, *Saccharomyces cerevisiæ*, was subjected to the same extraction method and it was found that the extraction was essentially complete in 2–3 hours. The normal yeast cell was coated with a layer of Gram-positive material which stained a deep blue-black, and it was only when this was removed that the cytoplasm and the large nucleus it contained could be demonstrated by the Gram-staining method. The stripping of the yeast cell by the bile salt occurred in stages; as the blue-black surface material disappeared there was left a nucleated cell with a stippled surface. On further extraction the surface stippling and the nucleus were progressively bereft of their Gram-positive material so that eventually the whole cell became Gram-negative. The extract contained polysaccharides and magnesium and sodium salts of ribonucleic acid.

Magnesium ribonucleate from the extract, or from extracts of other organisms, could successively be plated back on to the reduced yeast cytoskeletons so that their nuclei became once more Gram-positive and the surface stippling also was restored. If one replaced the magnesium ribonucleate by the sodium salt this did not readily combine with the surface of yeast cytoskeletons, the results with the sodium salt being irregular and chiefly confined to plating the nuclei after prolonged contact. In no case could plating be achieved with salts of desoxyribonucleic acid or with nucleosides or nucleotides.

In the course of our experiments it has been shown that certain Gram-positive organisms, for example, *Streptococcus salivarius*, may become Gram-negative when grown in media in which the magnesium content is reduced to a minimum or in media where the production of acid is sufficient to prevent the formation of magnesium ribonucleate. In some cases these Gram-negative individuals display striking evidence of nucleation, and on sub-culture give rise on an agar surface to colonies which are *rough*, whereas their Gram-positive relatives produce colonies which are *smooth*.

The bearing of these facts on antigenic structure and relationships is under investigation, as also is the structure of the various cytoskeletons. Those from *Cl. welchii* and from *Saccharomyces cerevisiæ* give a vivid Sakaguchi reaction and appear to contain a high proportion of basic protein material. We have, therefore, some evidence for the tentative suggestion that the Gram-positive (that is, dye-retaining) material is a high-molecular complex formed by the combination of a reduced basic protein substrate with magnesium ribonucleate.

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May 12.

[1] Gram, *Fortschr. Med.* (I), **2**, S. 185 (1884).
[2] Dubos, *J. Bact.*, **41**, 269 (1941); *Biochem. Rev.*, 659 (1942).
[3] Baker, Harrison and Miller, *J. Exp. Med.*, **74**, 611 (1941).

The Nature of Entropy

THE statement of Sir James Swinburne[1] that the engineer understands entropy is correct so far as heat engine cycles are concerned, because there are diagrams which give a very convenient representation of such cycles. There are, however, other energy conversion processes in engineering in which the Second Law of Thermodynamics is of equal importance and for which no comparable diagrams exist, heat transfer and combustion reactions being typical examples.

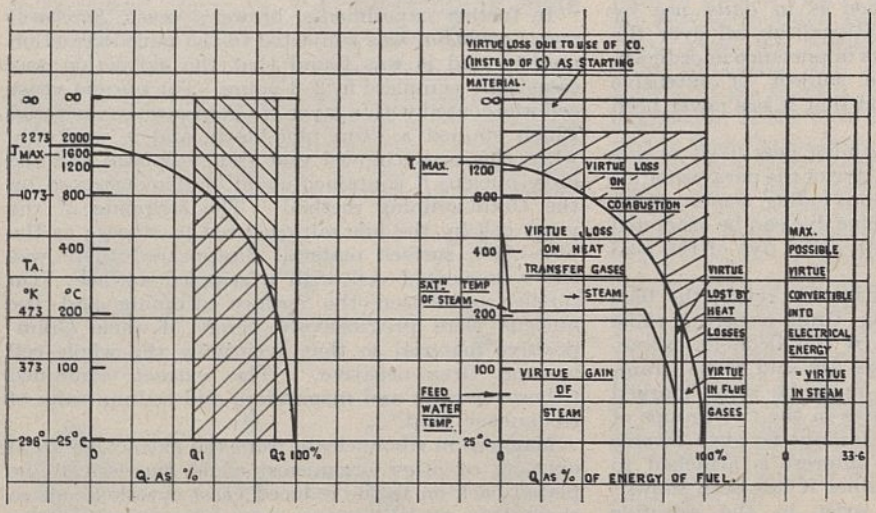

Fig. 1.

Fig. 2. VIRTUE DIAGRAM FOR INDUSTRIAL BOILER AND IDEAL HEAT ENGINE.

It is possible to construct simple diagrams relating to these processes which bring out very clearly the practical significance of entropy and of its negative, for which the term 'virtue' is suggested. The abscissa is Q, the 'available' heat of the working substance at a given temperature T_A (°K.) expressed in any convenient units. The ordinate is $1/T_A$. This is conveniently plotted downwards so that the line $T_A = \infty$ is at the top of the diagram and the line $T_A = 298$°K. at the bottom. Suppose now that we have a body (for example, of combustion gas) of constant specific heat at temperature $T_{max.}$. The graph of the available heat is then a rectangular hyperbola crossing the lowest abscissa at the point representing its total heat content above room temperature and crossing the line $Q = 0$ at the point corresponding to $T_{max.}$ (see Fig. 1). The area between the curve, the lines $Q = Q_1$ and $Q = Q_2$ and the line $T_A = \infty$ is the entropy change of the body on losing heat $Q_2 - Q_1$. It is, however, much easier to regard the area between the curve, the line $T_A = 298$°K. and $Q = Q_1$ $Q = Q_2$ as the 'virtue' of this amount of heat, since we can then express the Second Law of Thermodynamics by the statement that the virtue of a certain quantity of heat must always decrease in any physical process.

It is at once possible to represent heat transfer by drawing the curves for the body losing and the body receiving heat with corresponding values of Q. The area between the curves is then the irreversibility of the process or the loss of virtue of the heat.

Heat engine processes may also be conveniently represented, since the condition for the perfect engine that entropy does not increase is represented by an equal area under the curve for the working fluid, and that for the mechanical or electrical energy, which are lines coinciding with $T_A = \infty$.

When considering a chemical reaction such as combustion, it is necessary to take into account the fact that there is an entropy change between the initial and final compounds when both are at room temperature. If this is done by representing the initial virtue of various fuels by lines differing slightly from $T_A = \infty$ (the correction is of importance only in the case of carbon monoxide and hydrogen) then the irreversibility of adiabatic combustion is the area between this initial virtue and the curve for the 'theoretical' hot products of combustion.

It thus becomes possible to represent on one diagram the irreversibility of the successive stages of (1) combustion of a fuel, (2) heat transfer from the hot gases to steam, and (3) conversion of the steam energy into mechanical work. An industrial example is shown in Fig. 2.

These ideas have considerable practical importance in these times when energy conservation is so vital to the war effort.

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[1] NATURE, 151, 335 (1943).

A Diatom New to Britain

IN a previous communication[1] one of us described the insect fauna of a brine-pit[2] situated on the border of Cheshire and Flintshire about two miles south of Malpas. The diatom flora of this same pit has recently been the subject of an investigation by us. Preliminary observations indicate that the majority of the diatoms occurring in the pit are exceedingly minute and that their frustules are poorly silicified. Generally speaking, the assemblage of forms is of the type to be expected in a brackish habitat. A complete account of the diatoms found must await later publication. One diatom, however, which we have identified as *Navicula incerta* Grun. (see accompanying illustration), is of special interest and deserves notice now because it is a purely marine form and so far as can be ascertained from the sources of information at our disposal[3,4,5,6] has not previously been recorded from British waters.

(× 1450).

Navicula incerta was found in a gathering collected from the brine-pit on June 21, 1942. An analysis of the pit water at that time showed the following composition: 9,500 parts of sodium chloride per 100,000; 10,400 parts of dissolved solids per 100,000, and a *p*H value of 7·5 (Lovibond comparator).

Navicula incerta was by no means a common diatom in the gathering; in the six strewn slides examined only seven specimens were observed. These varied somewhat in length from 0·014 mm. to 0·019 mm., but they were all 0·006 mm. in breadth. In each of the forms examined the number of striæ was uniform at 16 in 0·010 mm., and the lineolations 15–17 in 0·010 mm.

P. T. Cleve[7] describes this diatom as follows: "Navicula incerta (Grun 1880) linear with slightly convex margins and obtuse ends. Length ·016 mm., breadth ·006 mm., striæ 15 in ·010 mm. not radiate; axial and central areas indistinct. NOTE. A small form with coarse striæ unknown to the author—Marine".

We are appreciative of the kindness of the Director of the Royal Botanic Gardens, Kew, for supplying a number of the references quoted.

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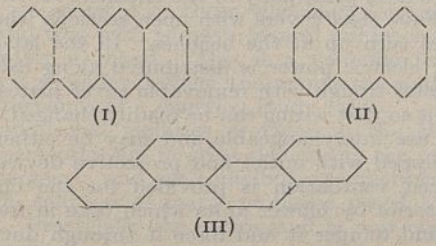
[1] Burke, F., NATURE, **150**, 610 (1942).
[2] Sherlock, *Mem. Geol. Survey*, "Mineral Resources of Great Britain, Rocksalt and Brine", **18**, 54 (1921).
[3] Kew. No Herbarium record.
[4] *Biological Abstracts* back to 1927.
[5] Tilden's "Index Algarum Universalis".
[6] Index to the articles on, and the references to, Diatomaceæ in the *Transactions* and *Journal of the Roy. Micro. Soc.*, Lond. (1853–1915).
[7] Cleve, P. T., "Synopsis of the Naviculoid Diatoms", Part 2, p. 26.

Fluorescence of Anthracene in Presence of Naphthacene

IT is known that pure naphthacene crystal (I) fluoresces very feebly, but in dilute solid solution of anthracene (II), the crystal fluoresces with its characteristic yellow-green light; and the blue fluorescence of anthracene is quenched.



(I) (II)

(III)

This phenomenon is represented as follows: in dilute solid solution the anthracene molecules easily absorb light energy and release an 'exciton' which causes naphthacene to fluoresce. We find that solid naphthacene fluoresces not only in anthracene, but also in chrysene (III); there is a little shifting of the fluorescence bands, depending on the substance with which it is mixed.

In view of this fact, the study of fluorescence spectra in alcoholic solution of anthracene, naphthacene and the mixture of the above two is interesting. In alcoholic solution, anthracene has four fluorescence bands (excited by 3,650, 4,046 of the mercury arc), and naphthacene has three fluorescence bands on the red side of the fluorescence bands of anthracene; the mixture has both the fluorescence of anthracene and of naphthacene. Three solutions were prepared, one of pure anthracene, the other of pure naphthacene, and the third a mixture of the two. The number of gram molecules per c.c. of anthracene and of naphthacene in the mixture were identical with those of the pure substances taken separately. Exposures were given for the same time and under identical conditions.

It was found that there is no appreciable change of intensity of the fluorescence bands of anthracene due to the presence of naphthacene; or of that of the fluorescence bands of naphthacene due to the presence of anthracene. Absorption spectra of the above three solutions confirm the result.

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Indian Association for the
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210 Bowbazar Street,
Calcutta.
March 26.

Post-War Agricultural Education

IN the last paragraph of the second column on p. 540 of the article on post-war agricultural education published in NATURE of May 15, quotations from the Report of the Luxmoore Committee dealing with courses in agriculture and horticulture are summarized as follows: "It is difficult to understand that what is right for horticultural graduates is wrong for agriculture". It is not clear from the text of the article on what grounds this charge of inconsistency is made. Two constructions are possible, both of which rest on a misunderstanding of the Committee's intentions.

If the objection is to the establishment in universities of graduate courses leading to diplomas in horticulture, it is without foundation because there is a similar recommendation in the case of agriculture. Further, the proposed diploma courses in both subjects would be of an advanced nature for those already possessing a degree, and would be given in a university.

On the other hand, it may be that the objection refers to the statement that instruction in horticulture should be given in a "separate department". The fact that some agricultural colleges are now departments of a university may have given rise to the assumption of a difference in treatment of the two subjects. The idea of a separate department for horticulture reflects the Committee's view that horticultural education requires separate and different treatment and should not be considered as subservient to agriculture. The departments proposed were intended to be an integral part of the university concerned, and not physically isolated as in the case of the agricultural colleges. It was envisaged by the Committee that the teaching of agriculture and horticulture in a university should be on the same lines, namely, in separately constituted university departments. Thus the statement quoted that for agriculture "the whole of any course leading to a degree should be taken in the University itself so that the benefit of contact with teachers and students engaged in other subjects should not be lost" applies with equal force to the teaching for degrees in horticulture.

RONALD EDE
(Secretary of the
Luxmoore Committee).

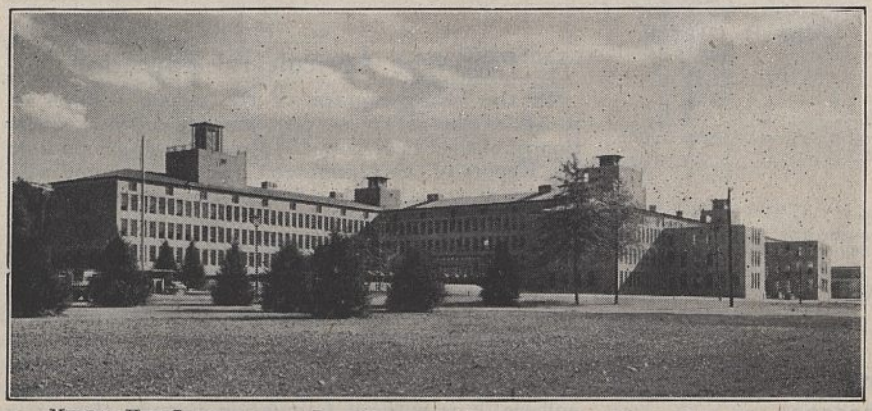
School of Agriculture,
Cambridge.

MURRAY HILL LABORATORY OF BELL TELEPHONE LABORATORIES

By FRANKLIN L. HUNT
Bell Telephone Laboratories

A RURAL location for part of the research and development work of Bell Telephone Laboratories has long been contemplated, and after extensive preparations it has taken form at Murray Hill, New Jersey, about twenty-five miles from New York City. In a group of new buildings there, on a 200-acre site bordering a park reservation, are now accommodated about eight hundred of the Laboratories' employees, which now number more than six thousand.

The buildings form an H-shaped structure of buff-coloured brick which provides approximately 215,000 sq. ft. of laboratory area. There is also a separate acoustics building, a boiler house and a garage. The main building is in two parallel sections, 675 ft. and 340 ft. long. These are connected by a 144-ft. transverse building in which the entrance is located. There are also five 50-ft. projecting wings on the two parallel buildings to provide additional space for the offices. Each section of the building has three laboratory and office floors, a cellar and an attic. The latter are used exclusively for piping, pumps, ventilating systems and storage.



MURRAY HILL LABORATORY OF BELL TELEPHONE LABORATORIES. *Photograph by Eric Baker.*

Restaurant, cafeteria and luncheon room facilities, with a combined seating capacity of more than four hundred persons, and a kitchen completely furnished with the most up-to-date equipment have been provided. These are essential to the operation of the plant because other eating places are not available in the immediate vicinity.

In designing the Murray Hill building, plans were made not only to provide laboratory and office space of any size needed, but also to make quick changes and re-arrangements possible. There are no permanent partitions in the buildings except those around the stair wells, toilets and elevator shafts. All other partitions are built up of standard metal panels 10 ft. 8 in. high and, with a few exceptions, 4 ft. wide.

The outside surfaces of these units are sheet steel, which is stiffened by transverse members welded to it inside on 9-in. centres. The steel sides are separated by a 3-in. space which is packed with rock wool to prevent the transmission of sound and heat. The inside surface of the steel is also coated with a deadening material. Doors and transoms are made in one unit which is 4 ft. wide so that it can be interchanged with a partition in any part of the buildings.

Along the outside wall of the buildings there is sheet steel wainscoting under the windows and up the piers between them. This is the same in appearance as the partition panels and it is also stiffened like them with transverse members and coated on the back side with mastic. This wainscoting is removable without special tools to give access to service pipes and wiring behind it. Similar wainscoting is applied around interior columns.

A research laboratory requires many special facilities such as compressed air, vacuum, hydrogen, oxygen, nitrogen and illuminating gas, steam at several pressures, hot, cold, chilled and distilled water, chemical drains, and electric power at different voltages. Fifteen such services are regularly supplied and distributed to individual laboratories at Murray Hill, and there are also special services. The service mains are installed either in the basement or the attic. Risers are grouped at the outside walls and pass up through vertical chases located there at 6-ft. intervals throughout the buildings. Horizontal run-outs below the window-sills pass behind the metal wainscoting and extend all the services into individual laboratories. To get these services from the risers at the side walls to laboratory benches, special supports were devised for quick attachment to the partitions.

Another method of bringing service pipes into the laboratories is through ducts in the floor fill which extend 8 ft. into the room from the outer wall. These ducts are installed only when required for 'island' benches located in the centre of the room and are used principally in the chemical laboratories. They have steel covers with open sections where the services turn up at the benches. In the laboratory rooms, electric power is distributed along each wall in a metal trough with removable cover plates which face out so that wiring can be readily changed. These plates are interchangeable and may be either plain or equipped with outlet and protective devices.

Forced ventilation is provided for the chemical laboratories by blower units which take in fresh air, filter and temper it and force it through ducts into each laboratory room. The air is exhausted through the fume hoods by another set of fans. All the ventilating equipment is located in the attic of the chemistry section of the buildings.

An unusual feature at Murray Hill is the distribution of hydrogen, oxygen and nitrogen as well as illuminating gas to individual laboratories by pipes from a central supply. The hydrogen is stored in pressure tanks in one room and the oxygen and nitrogen in another to avoid fire hazard. There is a rate of flow gauge in the hydrogen lines to keep the amount used in any room below that which could form an explosive mixture. All these gases are distributed from the attic to individual laboratories by mains which run the length of the building under the roof.

The acoustic laboratories are housed in a separate

building to avoid noise and vibration from other activities. Besides regular laboratory space, this includes a large 'dead' room for response measurements of microphones and loud speakers, two 'live' rooms or reverberation chambers for transmission and absorption measurements and a small auditorium.

The auditorium was built primarily for experiments in auditorium acoustics and its construction follows the latest practice in acoustic treatment. To break up reflections, the side walls are splayed and the rear wall is sloped away from the seats for the same purpose. Panelling at the rear of the room, and that on the adjacent side walls and ceiling, is perforated and backed by absorbing material to reduce reflected sound from these areas. There are 363 seats. Each is upholstered to absorb about as much sound when not occupied as would a person, thus maintaining the same reverberation characteristics in the room whether it is empty or filled to capacity. For the convenience of the audience, the seats are widely separated in accord with European practice. Although made quite reverberant for musical reproduction, the excellent acoustic characteristics of the listening room make it exceptionally satisfactory for speaking. There are no windows. Decorative lights are mounted on the side walls. Recessed lamps are distributed uniformly over the ceiling and spotlights illuminate the platform and speaker. These groups of lights can be used separately or in combination and most of them can also be dimmed.

A technical library is an indispensable adjunct to a research laboratory, and provision has been made at Murray Hill for this need by transferring about eight thousand volumes from the main library at New York City. Reference books and technical periodicals make up most of the collection, since other books are always available on request from New York. The stacks are made of sheet steel with adjustable metal shelves, slotted to prevent the accumulation of dust, and the front edge of the lowest two shelves is tilted upward to aid in reading titles. Along two sides of the room there is a row of small study carrells with chair, writing-table and shelves for the convenience of those who have long assignments and who wish to have several reference books immediately at hand. This is a valuable feature, because it provides privacy and avoids the confusion and disturbance of a common study table.

The additional facilities provided at the Murray Hill Laboratories are in great demand in the present war emergency, and are contributing effectively toward the solution of many problems posed by the conflict. Practically the entire staff is now engaged in war work.

A MYRMECOPHILOUS WOODLOUSE

IN the spring of 1938 Prof. G. E. Hutchinson found a small white blind myrmecophilous sowbug in North Branford, Connecticut. The species was afterwards found in ants' nests in a small tract of country several miles in area round about the original locality, and within the Mt. Carmel region of Hamden, Conn., some nine miles from North Branford.

Prof. J. L. Brooks, in a recent paper (*Ecology*, **23**, No. 4, 427–37 ; 1942), points out that in 1921 there were five valid species of Platyarthrus, four of these being restricted to the Mediterranean region, and only one, *P. hoffmanseggi* Brdt., being found throughout Europe. In 1931 Archangeli described a new species from the Canary Islands, and in 1934 Demianowicz reported two more from Bessarabia. The Connecticut species was identified as *Platyarthrus hoffmanseggi* Brdt. Its distribution is given as Upper Italy, Spain, France, Switzerland, Holland, Germany, Denmark, Austria, Hungary, Russia and the British Isles.

North Branford, Conn., is the first place in the New World where a Platyarthrus has been found. In all probability it was accidentally introduced from Europe.

All the species of this genus are myrmecophilous, but most of the observations concerning them are confined to the species in question. Although Wasmann considered *P. hoffmanseggi* to be pan-myrmecophilous, Prof. Brooks says that it has not been recorded with other ants than those he lists. He points out that the records from the Continent are from Archangeli ; and for England from Donisthorpe, and Webb and Sillem. He is indebted to Prof. Neal A. Weber for the names of the ants with which it has been found in America.

Prof. Brooks considers that the data indicate the existence of some factor or factors governing the presence of this sowbug only in the nests of certain species in any region. This is possibly the case ; but I am inclined to think that if collectors had always recorded the presence of the crustacean when they had seen it, or had specially looked for it, the number both of localities and species of ants would be considerably greater.

As Mr. Brooks is not a myrmecologist himself, he can be excused for some errors in his list of ants. There are no species called *Myrmica rufa*, or *Formica flava*. Also the genus *Atta* F. only occurs in Texas, Mexico, Central and South America, and has certainly never been recorded from Europe. *Atta cephalotes* L., not *cephalotis*, is recorded from the basin of the Amazon, Columbia, Central America, and Mexico. Furthermore, as Prof. Brooks says himself, he has used the generic nomenclature adopted by the Committee of the Royal Entomological Society of London, and thus has been 'let down' about *Acanthomyops*. For example, *A. fuliginosus* Latr. belongs to the subgenus *Dendrolasius* Ruzsky. It could be called, according to whether one accepts Lasius or Acanthomyops as the genus, either *Lasius* (*Dendrolasius*) *fuliginosus* Latr., or *Acanthomyops* (*Dendrolasius*) *fuliginosus* Latr., but never *Lasius* (*Acanthomyops*) (see Donisthorpe, *Ent. Record*, **49**, 143 ; 1937). Also *flavus* F., and *umbratus* Nyl., belong to the subgenus *Chtonolasius* Ruzsky. The variety of *Formica fusca* L. is *glebaria* Nyl., not *gleboris*.

We now come to Prof. Brooks' experimental work to endeavour to discover the factors involved in the relationship between the woodlouse and its hosts. These are of a delicate, ingenious, and painstaking nature. They are intended to test the response to light (phototaxis), unoriented response (photoklinokinesis), response to atmospheric humidity gradient, and the reaction to a gradient of formic acid vapour, and are illustrated by diagrams, graphs, histograms, etc. The results are briefly as follows. *Platyarthrus hoffmanseggi* showed no direct response to light under the conditions used in the experiments. It showed a lower klinokinesis in the light than in the dark, and the klinokinesis of this species was found

to be much greater than that of the non-myrmecophilous woodlouse *Oniscus asellus*. It moved towards the humidity end of a humidity gradient, as does also *Oniscus asellus*. It is attracted towards formic acid vapour, whereas *Oniscus asellus* avoided it. It was indifferent to acetic acid vapour, but that of propionic acid repulsed it.

In my observation nests I found that *Platyarthrus hoffmanseggi* always sought the dark chambers of the nest, but this is probably because they are the dampest, and also they are those usually inhabited by the ants themselves.

Prof. Brooks considers that the evidence strongly supports the supposition that Platyarthrus is chiefly found in the nests of those ants which possess an appreciable amount of formic acid. He says that the question of the food of this species has never been adequately answered. He quotes what I wrote on this subject: "Lord Avebury suggested that it fed on spores of the lower plants, such as would be found in ants' nests. These, however, would not be present in plaster nests, and I believe that the food of this species also, in part at least, consists of the 'boulettes de nettoyage' from the ant's infrabuccal cavity"*; but he points out that Platyarthus has been kept in the laboratory for months away from ants, and has even reproduced itself. He thinks it is obvious that these creatures are not directly dependent on ants, but that the nests of the latter provide an environment in which they have a better chance of surviving.

A useful list of references is given at the end of the paper, which is a very able contribution towards the life-history of the animal in question. The discovery that it is attracted by the vapour of formic acid is of considerable value.

HORACE DONISTHORPE.

* "Guests of British Ants", 215–17 (1927).

ELECTROMETALLURGICAL INDUSTRY

DR. J. W. CUTHBERTSON, of the University of Manchester, gave a lecture on May 19 before the London and South Eastern Counties Section of the Royal Institute of Chemistry on "Recent Advances in Electrometallurgical Industry". He pointed out that during recent years, and especially since the outbreak of war, development in this field has been very rapid, particularly in the United States, where raw materials are plentiful and there are ample facilities for the production of cheap electrical energy. The possibilities of further expansion both in Great Britain and elsewhere, however, are now being exploited, and the development of the home industry will doubtless be stimulated by the growing realization that, in certain circumstances, electrical energy can be produced by the modern steam generation station on a basis which compares favourably with the cost of production by a hydro-electric plant.

Electrometallurgy can be subdivided into two main sections covering electrolytic processes and electrothermal processes respectively. The former include extraction, refining, electrodeposition, surface protection and so on. In the extraction field, mention may be made of the enormous expansion in the production of aluminium and magnesium, and of the pioneer work now yielding results in the United States on the electrolytic production of manganese from low-grade ores.

Turning to the sphere of electrodeposition, bright plating, which was first introduced some years ago, has since made great strides. This is particularly noticeable in the case of nickel and latterly also of zinc. Electrogalvanizing has now to a large extent superseded the old hot-dip process, while considerable progress is being made in the corresponding electro-tinning industry. Hard chromium plate is in wide demand throughout the engineering industry as a means of obtaining improved resistance to surface wear and abrasion of metals and alloys. Efforts which continue to be made to find a non-toxic substitute for plating baths of the cyanide type appear to be meeting with some success, more especially as regards the deposition of copper. Recent work on the deposition of aluminium from non-aqueous electrolytes has led to the development of a process which is now being exploited on a semi-industrial scale. Considerable advances have also been recorded in the deposition of alloys—a field which for certain engineering and other applications would appear to offer possibilities.

Until only a very few years ago, electrolytic polishing was almost unknown outside the laboratory, but rapid progress has been made recently in the industrial development of this method of surface finishing.

In the electrothermal field the most noteworthy achievement of recent years has probably been the perfecting of the coreless induction furnace; originally these furnaces were used mainly for melting and alloying, but promising results have also been obtained by using them in refining practice. The use of the coreless furnace as a means of raising the temperature of metals and alloys for purposes of heat treatment is increasing; the versatility of the method is well illustrated by its application to the internal hardening of hollow parts. In the resistance furnace field, developments have largely been confined to improvements in the design and control of units of the closed type intended to be used with special gas atmospheres. Arc furnaces have undergone marked changes in design, but apart from the growing demand for electric steel and consequent expansion of plant, there has not been a great deal of change in arc furnace practice during recent years.

THE JOHN INNES HORTICULTURAL INSTITUTION

A USEFUL review of some recent work in horticultural science is provided by the annual report for 1942 of the John Innes Horticultural Institution (from the Institution, Mostyn Road, Merton Park, S.W.19, March 1943). Mr. M. B. Crane and his colleagues in the Department of Pomology have investigated various factors which affect the production of fruit and seed crops. Dr. D. Lewis finds, for example, that the English cucumber produces seedless fruits when grown at a high temperature, even after the flower has been adequately pollinated. At low temperatures the fruits may be seeded or seedless, according to whether the flowers have been pollinated or not. Mr. A. G. Brown has related the phenology of apple and pear trees to the

suitability of varieties for cross pollination. Some varieties of pear which did not overlap their blossoming times in 'long flowering period years' (1939 and 1941) did so in years with short flowering periods (1940 and 1942). The approximate flowering times of 320 varieties of apple and 138 varieties of pear have been listed.

Alpha-naphthalene acetamide has been used by Dr. Lewis to prevent 'June-drop' in cherries, plums and pears. This substance is applied in aqueous solution or in lanolin to the styles and flower stalks. It delays abscission of the style for two days, thereby giving greater possibility of pollination, and therefore increased fertility.

Dr. K. Mather and his staff in the Department of Genetics have studied the question of polygenes, which are now found to form balanced combinations within the chromosomes under the action of natural selection. Several new lines of approach are thereby opened to problems raised by the behaviour of wild and cultivated plants.

An interesting result from the Department of Cytology is the production of tetraploids by the use of colchicine in species of Nicotiana and related genera.

The Garden Department, under Mr. W. J. C. Lawrence, maintains an extensive advisory service, and has carried out experimental work on the war-time use of fertilizers.

The report of the director, Dr. C. D. Darlington, announces the help of the Agricultural Research Council in the prosecution of new work on the conditions of breeding and maintenance of cultivated varieties of plants. Many other results of the Institution's work are recorded briefly in the report.

PROBLEMS OF AMERICAN UNITY

TWO remarkable pamphlets, bearing the titles "National Unity through Intercultural Education" and "What Democracy Means in the Elementary School", have been published by the U.S. Office of Education at Washington. They belong to a projected series* of about twenty, some of the other titles being "Our Country's Call to Service", "What the Schools Can Do" and "Hemisphere Solidarity". The whole series bears the title "Education and National Defense". Everyone agrees, says the U.S. Commissioner of Education, that "the schools must become increasingly vital centres for the education of youth and adults facing a war-torn world. But how?" That is the question which this series is meant to answer.

The answer cannot be so easy for the United States as it is for Great Britain. We all know well enough for practical purposes what is meant by being an Englishman, but here we have a representative American seriously raising the question—"What is an American? Who is he? Is he of Anglo-Saxon background, which group makes up half the American population? Or does he represent the 15–20 millions of German background, the 5 millions of Italian, the 4 millions of Scandinavian, the 2 millions of French, or the 8–10 millions of various Slavic backgrounds?" We are all familiar with the metaphor of the melting-pot, but it is hard for the untravelled Englishman to realize the immensity of this melting process, and to grasp at once the inner significance of this series of broadcast pamphlets. It is the latest manifestation of the fact that an essential part of the melting process is the system of education. America's lavish support of her schools and universities is due not only to her democratic desire to banish ignorance, but also to her desire to take the quickest and surest road towards national unity.

The pamphlets, which are beautifully produced and abundantly illustrated, contain specific suggestions for the adaptation of the established curriculum to new needs, and they present materials suitable for various educational levels from the primary school upwards. Every care is being taken to secure help and sympathy from teachers and officials in all parts of the United States, to ensure the success of the enterprise.

One reflexion should ever be in the mind of the Englishman as he contemplates the great American war effort. American history, of which he is not quite so ignorant as he used to be, is the history of a gradual union of what were originally a number of independent States, and she can no more get away from the strong tradition of "States rights" than a man can walk away from his own shadow. In many respects the strength of the States, and the corresponding weakness of the central government, has been, and remains, a great advantage. But it is beginning to be realized that America must face her enemies, not as forty-eight States, but as a united nation. This series of pamphlets, issued by the U.S. Office of Education at Washington, and appealing to the whole of America, is perhaps something more than a straw indicating the direction of the wind.

T. RAYMONT.

* Education and National Defense Series (Federal Security Agency, U.S. Office of Education, each 15 cents).

POST-WAR PLANNING OF PSYCHOLOGY IN THE UNITED STATES

THE National Research Council of the United States, the Government-endowed body which promotes research in America, has a division devoted to research in anthropology and psychology. Soon after the outbreak of the present War this division established an Emergency Committee in Psychology on which representatives of the American Psychological Association and other psychological societies were asked to serve. In May 1942, the American Emergency Committee formally recognized long-range planning for the advancement of the profession of psychology as one of its fundamental problems. A group of six psychologists was appointed to prepare a report for the Committee on the immediate and post-war measures that appeared desirable for the promotion of psychology as a profession.

This Committee has considered how the psychological profession might be unified and urges the formation of a single national centre to be known as the American Institute of Psychology*. This central national institute would serve as a 'professional union' of psychologists corresponding to the British Medical Association, which unifies the medical profession. Secondly, this institute should aim at inte-

* Post-War Planning for Psychology, *Occupational Psychology*, 17, No. 2 (April 1943).

grating the desirable educational facilities of the graduate organizations and of clinic experience whether in school, hospital or factory, and whether as 'pure' or as 'applied' psychologists, should work in co-operation with their fellows in other branches of inquiry and practice. Finally, it is suggested that psychological practice should be organized as public service.

In Great Britain there is no single body representing America's National Research Council with its various divisions. Instead, there is the Medical Research Council, the Department of Scientific and Industrial Research, and the Agricultural Research Council. The British Psychological Society corresponds to the American Psychological Association. We think, however, that there should be less difficulty in organizing the professional interests of national psychological societies in Great Britain because there are fewer. Like the Royal Society of Medicine, the British Psychological Society unites all branches of the subject. The creation of a central institute, offering a single service for the promotion of psychology as a profession, is worthy of serious consideration. The societies should be left to continue their scientific work, but they cannot promote and protect psychology as a recognized profession as effectively as a common 'union'.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Tuesday, June 15

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Prof. V. Gordon Childe: "Directional Changes in Funerary Practices during 50,000 Years".

Thursday, June 17

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—The Rt. Hon. Lord Hailey: "Capital and Colonies".

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. E. H. Neville: "Jacobian Elliptic Functions".

CHADWICK PUBLIC LECTURE (at the Chelsea Physic Garden, Swan Walk, Chelsea, London, S.W.3), at 4 p.m.—Mr. F. J. Chittenden: "Plants Causing Irritation".*

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. R. V. Southwell, F.R.S.: "Relaxation Methods—A Mathematics for Engineering Sciences" (Bakerian Lecture).

Friday, June 18

INSTITUTION OF MECHANICAL ENGINEERS (APPLIED MECHANICS GROUP MEETING) (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. Hugh O'Neill: "The Significance of Tensile and other Mechanical Test Properties of Metals".

Saturday, June 19

INSTITUTE OF PHYSICS (JOINT MEETING OF THE ELECTRONICS GROUP AND THE MANCHESTER AND DISTRICT BRANCH) (in the Physics Department, The University, Oxford Road, Manchester), at 2.30 p.m.—"The Electrical Discharge in Gases" (Dr. T. E. Allibone will speak on "Discharge Phenomena" and Dr. J. M. Meek on "Modern Theories of the Discharge").

APPOINTMENTS VACANT

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

LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governors, Mid-Essex Technical College and School of Art, Chelmsford (June 17).

LECTURERS (2) IN MECHANICAL ENGINEERING, AND A LECTURER IN BUILDING SUBJECTS in the Constantine Technical College and Technical School for Boys—The Director of Education, Education Offices, Middlesbrough (June 18).

LABORATORY ASSISTANT TO THE ADVISORY DAIRY BACTERIOLOGIST—The Secretary, Department of Agriculture, The University, Leeds (June 18).

ASSISTANT SPEECH THERAPIST—The Director of Education, Education Offices, Nelson Square, Bolton, Lancs. (June 19).

ASSISTANT LECTURER IN BUILDING—The Registrar, College of Technology, Manchester 1 (June 21).

SPEECH THERAPIST—The Medical Officer of Health, Town Hall, Shipley, Yorks. (June 21).

LECTURERS (2) IN MATHEMATICS—The Principal, Derby Technical College, Normanton Road, Derby (June 21).

PSYCHIATRIC SOCIAL WORKER to work with the Psychiatrist and Educational Psychologist in the Child Guidance Clinic—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea (June 21).

LECTURER IN EDUCATION, PREFERABLY A WOMAN WELL QUALIFIED IN PSYCHOLOGY—The Warden, Goldsmiths' College, at University College, Nottingham (June 26).

HEAD OF THE MINING DEPARTMENT, and an ASSISTANT LECTURER IN MINING—The Principal, Cumberland Technical College, Workington (June 26).

CITY BACTERIOLOGIST—The Town Clerk, Municipal Buildings, Dale Street, Liverpool 2 (June 30).

PROFESSOR AND HEAD OF THE DEPARTMENT OF ELECTRICAL TECHNOLOGY, and a PROFESSOR AND HEAD OF THE DEPARTMENT OF APPLIED MECHANICS AND AUTOMOBILE ENGINEERING—The Registrar, Indian Institute of Science, Bangalore, India (September 15).

ASSISTANT IN THE DEPARTMENT OF PHYSIOLOGY—The Secretary, The University, Aberdeen.

INSPECTOR OF MINES IN THE GOLD COAST UNDER THE GOVERNMENT OF THAT TERRITORY—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Ref. C.1717), Alexandra House, Kingsway, London, W.C.2.

PSYCHIATRIC SOCIAL WORKER—The Medical Superintendent, Springfield Mental Hospital, Tooting, London, S.W.17.

LECTURER IN MECHANICAL ENGINEERING, and a LECTURER IN ELECTRICAL ENGINEERING—The Clerk to the Governors, Technical College, Chesterfield.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Substitute Materials in War and Peace. By Cecil H. Desch. Pp. 28. (London: Royal Institute of International Affairs.) 9*d*. net. [115

Report of the British Commonwealth Science Committee. Pp. 12. (London: Royal Society.) [115

Some Notes on Water Treatment. By Russell G. Pelly. (Twenty-fifth Streatfeild Memorial Lecture.) Pp. 24+2 plates. (London: Institute of Chemistry.) [115

Education and the United Nations. Report of a Joint Commission of the London International Assembly and Council for Education in World Citizenship. Pp. 54. (London: Council for Education in World Citizenship.) 1*s*. net. [115

Health—What needs to be Done. Report of the London Conference of Health held at the Conway Hall, 21st February 1943. Pp. 20. (London: Mrs. N. C. Wolfe, 30 Sinclair Mansions, W.12.) 6*d*. [115

Proceedings of the Royal Society of Edinburgh. Section B (Biology). Vol. 61, Part 4, No. 29: The Effects of Radiation on Pollen Grain Development, Differentiation and Germination. By Dr. P. C. Koller. Pp. 398–429+1 plate. (Edinburgh and London: Oliver and Boyd.) 3*s*. [115

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 61, Part 3, No. 23: On Problems connected with Item Selection and Test Construction. By D. N. Lawley. Pp. 273–287. 1*s*. 3*d*. Vol. 61, Part 3, No. 24: On the Equation of Motion of a Free Particle in the Expanding Universe of Kinematical Relativity. By E. A. Milne. Pp. 288–297. 1*s*. Vol. 61, Part 3, No. 25: Axiomatic Treatment of Kinematical Relativity; a Reply to Dr. G. C. McVittie. By Dr. G. J. Whitrow. Pp. 298–299. 6*d*. Vol. 61, Part 3, No. 26: The Monomial Expansion of Determinantal Symmetric Functions. By Dr. A. C. Aitken. Pp. 300–310. 1*s*. (Edinburgh and London: Oliver and Boyd.) [115

Other Countries

Proceedings of the United States National Museum. Vol. 93, No. 3157: The Nearctic Species of Parasitic Flies belonging to Zenillia and Allied Genera. By Wendell F. Sellers. Pp. 108. (Washington, D.C.: Government Printing Office.) [214

Fifty-ninth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1941–1942. Pp. 12. (Washington, D.C.: Government Printing Office.) [115

U.S. Department of Agriculture. Miscellaneous Publication No. 500: The Fleas of North America; Classification, Identification and Geographic Distribution of these Injurious and Disease-Spreading Insects. By H. E. Ewing and Irving Fox. Pp. 143. (Washington, D.C.: Government Printing Office.) 20 cents. [115

U.S. Office of Education: Federal Security Agency. Bulletin 1942, No. 5; Our Neighbor Republics; a Selected List of Readable Books for Young People. Prepared by Nora E. Beust, assisted by Eimile Sandsten Lassalle and Jean Gardiner Smith. Pp. vi+50. (Washington, D.C.: Government Printing Office.) 15 cents. [115

Transactions of the American Philosophical Society. New Series, Vol. 33, Part 1: Diary of a Journey through the Carolinas, Georgia and Florida, from July 1, 1765, to April 10, 1766. By John Bartram. Annotated by Francis Harper. Pp. iv+120+22 plates. (Philadelphia: American Philosophical Society.) 2 dollars. [115

Publications of the Observatory of the University of Michigan. Vol. 8, No. 12: On the Spectra of Novae. By Dean B. McLaughlin. Pp. 149–194. (Ann Arbor, Mich.: University of Michigan Press.) [115

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