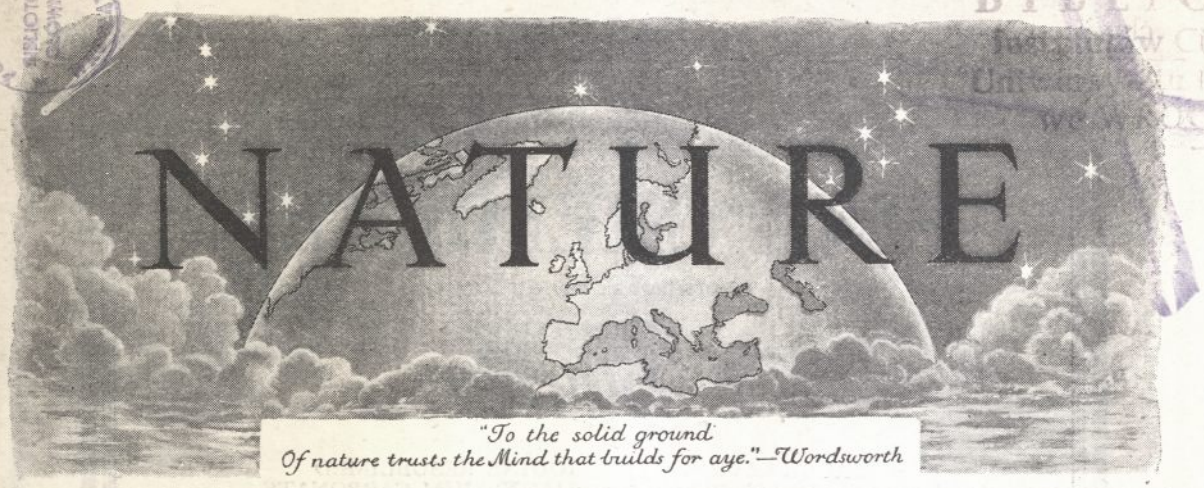

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COLONIAL FORESTRY AND COUNTRYSIDE PROBLEMS

BUT a short while ago this heading would have been written in an inverse order, that is, countryside problems and forestry, the greater stress being laid on the former. In some matters, the British are ultra-conservative ; the more so perhaps where ignorance of a subject leads them to an instinctive opposition and disinclination to move in a, to them, unknown direction. In no department of administration has this national trait become more evident than the forestry departments throughout the Empire. India early broke loose from this official inertia, owing to a fortunate combination of clear-headed, wide-visioned Secretaries of State and competent Governors-General. The extensive, valuable and well-administered Indian forests are witness to this fact.

In the Colonial Forest Services, on the other hand, a very different position had gradually arisen. Forestry was completely misunderstood. It was thought that totally undeveloped areas of existing forests, supervised by small inadequate staffs, should pay their way almost from the start or they were not worth the trouble and expense of administration. The Secretary of State left matters to the individual and constantly changing Governors, who, with no knowledge of forestry principles, were for the most part guided by their financial advisers ; these latter regarded a forestry department merely as a potential source of revenue, the expenditure of which was ruthlessly cut when for various perfectly justifiable, in fact often obvious, reasons, the anticipated revenue was not forthcoming.

Although lip service had been given in expressions of opinion on the value of forests and their protection, etc., until well within the last decade there had been no real attempt at a continuity of management, with one or two notable exceptions, in the forestry services under the Colonial Office. An awakening had commenced and the present War appears to have hastened it.

The annual report of the Uganda Forest Department for the year ending December 31, 1939 (Entebbe, Govt. Printer, 1940) opens with a quotation from the Secretary of State for the Colonies (taken from "The Colonial Empire," Cmd. 6023, 1939) as follows : "Forestry Departments are becoming more and more involved in the study of general rural development and land use and contacts between them and other departments engaged on similar work have been strengthened."

In his introduction, the conservator of forests, Mr. N. V. Brasnett, who had been working closely with the director of the Geological Survey of the Protectorate, enunciates once again the time-honoured principles of a forest policy dealing with forest reservation ; obtaining the best financial return for the forest estate ; encouragement to private forestry, whether by native enterprise or private individuals ; and propaganda towards giving the people a knowledge of the value of forests both to themselves and to their posterity. There appears to be hope that Uganda, in spite of the War, will now be granted the facilities to put in force, practically, these articles of the forestry creed.

In the annual report of the Forestry Department for Nyasaland for the year ending December 31, 1939 (Zomba, Nyasaland, Govt. Printer, 1940) the Conservator, Mr. J. B. Clements, develops the same theme.

It is pointed out that the outbreak of War has enhanced the need for making the Protectorate independent of imported soft woods, and particular attention has been given to means of increasing the outturn of local timbers for building purposes, both hard wood and planted soft wood, in anticipation of increased demands. The village forest area scheme is providing a valuable reserve of poles and firewood near the villages themselves which did not exist a few years ago. This enables the urban natives to obtain these materials at low rates from forest reserves near the townships—a benefit now becoming appreciated by those responsible for the administration of improvident populations in tropical countries.

In the connexion here dealt with, the following depicts the new position as regards the forests, which is acquiring definite recognition. Alluding to a draft revision of forest legislation during the year, the Conservator says that the revision had become necessary for two reasons : (*a*) the change in status of various classes of land (native forest land) brought about by the Order in Council, 1936 ; and (*b*) the need for the gradual devolution of responsibility for forest protection and management to native authorities, and for their participation in a share of forest revenue. The Agronomic Sub-Committee of the Native Welfare Committee simultaneously put forward suggestions to Government for the enaction of legislation to implement soil conservation policy relating to all classes of land.

These proposals, together with those for the revised forest legislation, mark an important stage in efforts towards reform, and bring new emphasis on land conservation both as regards the selection of land for various purposes, and the conservative treatment of lands selected for agriculture and grazing. The land protection involved in forest policy, namely, the constitution of forest reserves in important catchment areas and watersheds, the closure to cultivation of steep hill slopes which in many cases become village forest areas, the enforcement of stream bank regulations, forms a really satisfactory nucleus for complete land planning in very many regions.

This encouraging departure, which in one form or another is making its appearance in other parts of Africa, will need the most careful supervision on the part of Governors, the civil administration and the Conservators, if it is to justify the high hopes which its introduction gives rise to. The education of populations accustomed from time immemorial to treat the forests as a property of no value will not be completed in a day.

CULTURE OF THE NUER

The Nuer
A Description of the Modes of Livelihood and Political Institutions of a Nilotic People. By Dr. E. E. Evans-Pritchard. Pp. xii + 271 + 30 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 17*s.* 6*d.* net.

TO understand Dr. Evans-Pritchard's admirable account of the Nuer, a pastoral group inhabiting the swampy lowlands south of the junction of the Nile with the Sobat and Bahr el Ghazal, one must learn to think in terms of ox or cow (the ambiguity of these words in the English language showing how far we have degenerated in this respect). For it is explained that "their social idiom is a bovine idiom". Thus their difficult cattle terminology of colour, age and sex—the colour scheme is given us in a dozen striking diagrams—affords the chief clue to their marriage arrangements, ritual and law. Even kinship, that basic fact in the sociology of any primitive community, is customarily defined by reference to payments of cows in the form of dowries and other wedding-presents ; so that "movements of cattle from kraal to kraal are equivalent to lines on a genealogical chart".

Thus this study by Dr. Evans-Pritchard, which is singularly successful in harmonizing a descriptive with an analytic interest, moves naturally forward from an examination of the ecology—that is, the economic life as determined by the physical conditions and state of the arts—to a review of the social organization as consisting in three complementary elements, the political system, the lineage system, and a peculiar system of 'age-sets', the sentimental bond uniting fellow initiates. The book, then, is remarkably compact, and the author is much to be commended for achieving so neat a

synthesis ; even if it is only fair to allow some of the credit to the Nuer themselves for conceiving life as so well-rounded a sphere of functions and values.

Though he lays but little stress on the personal side of his experiences, the author could scarcely have enjoyed playing 'parasite of the cow', as every Nuer is only too happy to do, luxuriating not only in its milk, meat and blood, but in its more odoriferous products ; so that animals and humans wallow in the same fetid and insect-haunted byre with that immunity to squeamish humours which precedes the evolution of the sanitary inspector. Nay, our veterinary experts would likewise be out of place here ; for it is argued in some detail that, although the cattle-husbandry of the Nuer is in important respects out of keeping with our conventions of farming, their methods work well enough for them, and could not be altered without involving a fundamental change in their whole method of life. In fact, as so often, civilization in its most benevolent mood might easily make an end of their ancestral habits and of them together.

True, the Nuer are partly dependent on the cultivation of millet—though millet without milk strikes them as highly unpalatable ; and are also handy at spearing fish. But it is not the nutritive so much as the social importance of the cow that ensures its pre-eminence in their vital economy. A man and his favourite beast become one in name, that is, for the primitive intelligence well-nigh one in soul ; and the cow-name received at birth, and by which he was known to the playmates of his youth, will after death be handed down to posterity as if such an identification were a fuller expression of his inward being.

Another way of realizing how the culture of the Nuer is founded on one idea, one passion, is in the light of their saying : "it is cattle that destroy people". Not only among themselves do they indulge, as did our own ancestors, in the honourable sport of cattle-raiding, but this is the main cause of war with their neighbours, the Dinka, as also of trouble with the Government, the earlier methods of which indeed do not seem to have differentiated between cattle-raiding and tax-gathering as clearly as might be desirable. Feuds being composed by fines, blood-wealth, with bride-wealth rising and falling in harmony, provides the standard governing all commercial transactions, which are thus 'pecuniary' in the etymological sense. Indeed, to understand the political system in all its ramifications, it is sound policy to start from a blood feud involving in the first instance small agnatic groups. This thereupon creates an enmity spreading through a network of kinship ties, until the interrelations of whole communities are influenced as they variously seek vengeance or arrange for compensation. All this militant clannishness makes for a spirit of dour independence and pride which the European visitor may easily resent as an ill-mannered truculence until he learns to understand their life and accept their values. It takes an anthropologist of Dr. Evans-Pritchard's insight and breadth of mind to do this ; and therefore, if only because it is so fair to the facts, spiritual and material alike, does this book deserve to rank as a masterpiece of scientific interpretation.

R. R. Marett.

THE SCIENCE OF PLANT PROTECTION

The Scientific Principles of Plant Protection With Special Reference to Chemical Control. By Dr. Hubert Martin. Third edition. Pp. x+385. (London : Edward Arnold and Co., 1940.) 22*s*. 6*d*. net.

THE need for methods of plant protection arises because, when plants are grown close together as a crop under favourable growth conditions, far greater opportunity is provided for the spread of pests. A fungus grown on a single plant has small chance of survival, but when there is a crop of many acres the conditions for the multiplication and spread of the fungus may render it a factor of primary and adverse importance.

Plant protection has become a science involving partnership between the biological sciences of entomology, mycology and plant physiology, and the physical sciences of chemistry and physics. Success involves their closest co-operation, for which an understanding of the scientific principles involved is essential : the book under notice seeks both to survey these as well as to provide a book of reference on insecticides and fungicides.

The methods of plant protection can be classified as preventive and curative. More or totally resistant varieties of the host plant may be selected and propagated ; it may be protected by a chemical or by a combination of climatic and biological factors. The parasite may be destroyed on the seed or in the soil by a variety of methods. It may be attacked by toxic chemicals after its action on the plant has begun.

The greater part of the book is devoted to the

consideration of fungicides and insecticides. The chemical manufacturer is becoming more and more attracted to this field as an outlet for his products on the large scale, and an extension of chemotherapeutic knowledge is enabling a widely extended range of chemicals to be tried, not merely empirically, but as the result of the correlation of structure with toxicity. The physicist is at the same time learning to understand the theory and technique of spraying, dusting and fumigating with liquid, solid and gas. Hence he has been able to lead on to spreaders, stickers and emulsifying agents so as to promote the formation of the liquid/solid interface.

Fungicides are based on sulphur, copper, arsenic and fluorine compounds as well as on such organic substances as nicotine, pyrethrum, rotenone. Other materials are being tried in the laboratories, where a technique of measurement is being elaborated as a preliminary to establishing the connexion between toxic action and chemical constitution. Quite another class of chemicals serve as fumigants.

The magnitude of the subject will be apparent from the foregoing remarks. The author has in this third edition made good use of his earlier experience and produced an up-to-date and at the same time stimulating account of the subject. The research station at Long Ashton, from which the book is dated, can regard it as worthy of the scientific standing of the laboratory.

E. F. ARMSTRONG.

ELEMENTARY BIOLOGY

Intermediate Biology

By W. F. Wheeler. Pp. xiii+530. (London: William Heinemann, Ltd., 1940.) 15*s*.

THE remarkable development of biology in schools during the last decade has been accompanied by the inevitable spate of text-books which follow on the introduction of a new subject. The majority of the writers of these text-books have been stirred to produce works which would include cognate topics relating to the syllabuses of the various examining bodies. From the authors' points of view, it is a little unfortunate that the rapidity of the growth has been accompanied by the constant revision of examination syllabuses in biology, with the result that many of the books produced have quickly become unsuitable. Mr. Wheeler's book has been prepared to meet the demands of present-day students offering biology at higher school certificate, intermediate degree, pre-medical and allied examinations.

In the succinct accounts of the anatomy and embryology of the 'types' set in the plant and animals section of the various syllabuses, the author adheres rigidly to the standard of knowledge that might be expected of Intermediate students, the descriptive technique showing little advance on that in use some ten years ago. A useful innovation is the inclusion, at the end of some of the chapters on animal types, of a short section in which attention is focused upon the more important biological principles that the particular group illustrates. This feature could profitably have been extended to other parts of the book.

In other sections relating to the cellular structure and comparative physiology of organisms, the author has added a valuable contribution to the teaching of biology, as distinct from the daughter sciences of botany and zoology. The main biological principles are considered in terms of living organisms, plant and animal, adequate attention being devoted to the peculiar as well as the conforming types. Apart from the confused description of hormonal reactions in plants, these sections are clearly set out. The chapters on heredity, evolution and the relation of the organism to its environment are stereotyped, except for a concise description of the evolution of the vascular and urinogenital systems. The latter will probably be ineffective for the type of student for whom the book is intended, but, with a curtailment of detail, would perform useful service in any future edition.

The book is profusely illustrated, many of the diagrams having been taken from books already in use; the original figures are good, although, in contrast to some text-books in school biology which have been published recently, add little to established text-book illustration.

A real criticism of this, as of so many school biology books, is that the subject-matter is narrowly concentrated upon existing examination syllabuses. The need for this method of treatment is readily understood, but until writers of school text-books are prepared to include topics of wider interest to their pupils, examination syllabuses are likely to remain circumscribed.

This criticism is not intended in any way to detract from the usefulness of the book; it is eminently suitable for students preparing for the examinations mentioned above.

T. H. HAWKINS.

PROBLEMS OF NEUROHISTOLOGY

Problems of Nervous Anatomy
By Prof. J. Boeke. Pp. vii + 164. (London: Oxford University Press, 1940.) 7*s*. 6*d*. net.

THE disadvantage of divorce between form and function in biological study is nowhere more often seen than in relation to the nervous system. Doubly valuable, therefore, is a review of some current problems by one of the foremost living neurohistologists who, while declaring that "however valuable physiological observations may be, as long as their real histological basis is disproportionately small or entirely missing, even the best physiological theories remain nebulous", is willing to admit that "morphological details everywhere only derive their full value in view of the physiological and functional insight which they are able to furnish".

The book is in four parts, based on as many lectures given in the latter part of 1937 in the Universities of London and Oxford and to the Anatomische Gesellschaft, with a bibliography which unfortunately does not include all names cited in the text. The first part deals with cutaneous innervation, and stresses the lack of a known structural basis for many clinical and experimental observations on cutaneous sensibility. Boeke rejects Head's view that two different kinds of nerve fibres are concerned with protopathic and epicritic sensation. In the light of recent histological, developmental and experimental studies, he suggests that protopathic sensation is the outcome of incompletely regenerated end-organs and as yet unmyelinated nerve fibres. He directs attention to the rich sympathetic plexus in the dermis, but the absence of all 'endings' in this plexus leads him to conclude that it is efferent in function.

In the next two parts the author develops a consideration of this "sympathetic ground plexus" in many parts of the body, and identifies the cellular elements in the plexus with the interstitial cells of Cajal. Boeke's review of the vexed question of the interstitial cells is one of the most useful things in his book. He thinks them to be of great phylogenetic significance in attempting to relate the vertebrate nervous system, with its highly organized cell patterns, to the simple nerve net of the lower invertebrates. This section was written before Prof. Woollard's last paper, in disproof of the invertebrate nerve net (Woollard and Harpman, *J. Anat.*, **73**; 1939). But Woollard's work, so sadly cut short, cannot be taken as conclusive, though it does imply that re-examination of the invertebrate nervous system is needed before further theoretical correlations are established. What neither the protagonists nor the antagonists of the nerve net seem to have considered is the relation between the "ground plexus" and the vascular system, which is undoubtedly retiform in its development and remains so in its periphery. Some of Boeke's own figures of the ground plexus strongly suggest a capillary relationship. How far is the one the trellis along which the other grows?

Several threads in the earlier sections are taken up in the last part, which is a review of the present state of the neurone doctrine in the light of modern physiological conceptions of the inter-neuronal synapse. It is a wise and thought-provoking chapter, which demands that out-worn concepts and conflicts be discarded so that fresh attacks can be made upon basic problems of neurology in the unhindered light of newer knowledge. Here, as elsewhere in the book, is evidence of the mature judgment, open mind, and breadth of vision of the man who has succeeded Cajal as the doyen of neurohistologists.

D. M. Blair.

NUTRITION IN WAR-TIME

Nutrition and the War
By Dr. Geoffrey Bourne. Pp. xii + 126. (Cambridge: At the University Press, 1940.) 3*s*. 6*d*. net.

IN Great Britain there has been, in the last few years, a great improvement in the national dietary which has been accompanied by a corresponding improvement in national health. The limit of improvement has not yet been reached. The increase in physical fitness of recruits drawn from the poorer class after a few months in the Army and of slum children evacuated to the country is an indication of the extent to which national health and physical fitness can be still further increased. All we have learned of nutrition in the last twenty-five years suggests that food is probably the most important factor in this improvement in physical fitness. The author of this little book gives some striking illustrations of the connexion between diet and physical fitness.

In the present struggle for our existence it is of the utmost importance to have the whole population in the highest possible state of physical fitness, upon which morale and fighting- and working-efficiency so largely depend. An important part of our war effort should be making the national diet fully adequate for health. At first sight, there would appear to be great difficulty in improving the national diet under present conditions when we are threatened with a shortage of some foods. Fortunately, however, it is possible to provide all the health factors from a few foods which we can produce in sufficient amounts at home.

The two most important 'protective' foods are milk, including dairy products, and vegetables, including potatoes. If consumption of these among the poor be brought up to the level among the well-to-do, we need have no fear of deterioration of the national diet in war. These foods should, therefore, receive priority in home-production. As the author of this little book points out, a reduction in the milk supply is likely to cause widespread ill-health, especially among children, whereas a reduction in the beef supply by even as much as 50 per cent would not necessarily be serious. There may be a great reduction in imported fruits, but this also need not be serious because all the nutrients of special value for health contained in fruit can be obtained from vegetables and potatoes. Fortunately, vegetables and potatoes are two of the crops which give the highest yield of food per acre, and the milk cow provides four or five times as much food for the feeding-stuffs consumed as the bullock. If our agricultural policy be based on nutritional needs, there is likely to be an increase in the production of these, even at the expense of less essential foods.

The Government may provide the food, but its efficient use depends on the housewife. The Ministry of Food is carrying out an extensive propaganda to bring the knowledge of nutrition to every household. This publication is designed to serve the same purpose. It deals mainly with the nature and composition of various foodstuffs. It gives the calorific value and an indication of the protein, vitamin and mineral content of a long list of foods. This will be of interest to the scientifically minded housewife. But, however much the experts may theorize about the perfect diet in terms of calories and vitamins, the well-to-do will continue to eat what they like and the poor to eat what they can get. The well-to-do are well fed. It is the poor who are ill-nourished. The problem of malnutrition is mainly an economic problem. Measures, such as the new milk scheme, which enables the poor to get milk for women and children at a reduced price, the allotment scheme, which provides cheap vegetables for families, and the placing of wholemeal bread on the market at the same price as white bread, are likely to do more to improve nutrition among the poor than technical instructions on food values.

AIR SURVEY

Air Photography Applied to Surveying
By Dr. C. A. Hart. Pp. xx + 366 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 25*s*. net.

NO one could be better qualified than Dr. Hart to write this book, on the use of air photographs in the making of maps. Unfortunately for the advocates of this new method of surveying, they have had not only to amplify and perfect the instruments, the cameras and aeroplanes as well as the ground instruments, but they have also had to persuade the future users of the maps and surveyors that the resultant maps in many cases will be better in quality, quicker and cheaper in execution, and more accurate than maps made by older methods. Now when we consider the reasons for this rather curious state of affairs, we must attribute the blame fairly between the conservatism of surveyors and the over-statement of the merits of these air survey methods by some of the original advocates. There is, moreover, one other reason, and that is that this new method was left to commercial companies to develop, while heretofore it had always been Governments which had supplied maps. It was therefore often difficult for a man to realize that the sheet he could buy for 2*s*. 6*d*. had cost thousands of pounds to survey, and that the advocate was not only trying to sell him something, but also to sell something really good.

These points, and the original history and gradual introduction of air survey methods into the making of modern maps, are very clearly brought out in this book. Dr. Hart is not only a surveyor and therefore a maker of maps, but also, as an engineer, one of the users of maps. We therefore have both sides of the question fairly represented.

To the makers of maps we commend the technical chapters, which are full, accurate and clear; to the future users of maps who still may have a lurking

doubt as to the value of air photography as a sound method, we recommend the earlier chapters ; and to the field surveyor we would add that ground survey will still remain as valuable and as necessary as ever.

The introduction of air photography, either vertical or oblique, is a somewhat similar epoch in the history of surveying as was the introduction of the plane table ; only the older of us can remember the introduction of this instrument from India, and its rejection by many in England who preferred the chain and compass method.

Of late years the methods of air surveying have been greatly improved, and thanks are due to those like Cochrane-Patrick and others, who laid down their lives in the execution of air surveys, and to Kemp, Hemming and others who not only carried out surveys but also advocated and advertised their utility to a too often incredulous client. Air photography applied to surveying has come to stay.

Dr. Hart's book is a very good one, and Sir Alexander Gibb's foreword most appropriate.

C. H. D. R.

COKE AND ITS PROPERTIES

The Quality of Coke

Being the Second Report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council. By Dr. R. A. Mott and Prof. R. V. Wheeler. Pp. xxxv + 464. (London : Chapman and Hall, Ltd., 1939.) 36*s*. net.

THE literature on cokes until about twenty years ago concerned itself mainly with analytical information. Knowledge of their properties in use was mainly empirical, and to many important questions no answers could be given. In the meantime, a very large amount of experimental study has been devoted to the subject by research workers, and in Great Britain by committees established by producers and users of cokes. The Midland Coke Research Committee has issued two reports—the first in 1930—of work done under the direction of the late Prof. R. V. Wheeler and Dr. R. A. Mott. The second and present report was ready for issue just before Prof. Wheeler's death last year, and was his last publication.

Among common commercial products cokes are distinguished by a peculiar combination of qualities, the united effect of which determines their usefulness. These properties are both chemical and physical. Some are inherited from the parent coal and even when disguised by processes of manufacture are nevertheless detectable in the finished product. Thus raw coals are not homogeneous but possess a banded structure, evidence of which can be found in cokes. The properties of a coke can be influenced by conditions of carbonization and by treatment after manufacture. Again, even the densest coke contains 75 per cent of free space consisting of pores varying widely in size. All these properties combine to determine the behaviour of the product, which is normally consumed in lump form. Laboratory work, when, as is usual, made on samples in the form of fine particles, cannot take account of the differences due to size and structure of lump coke. This omission reduces the weight of the conclusions of many workers. Large-scale work is laborious and costly, but necessary to reveal the incidence of certain factors. It is the merit of the work in this report under notice that it is mainly about material in commercial form.

In the combustion of cokes, two chemical reactions are of primary importance : (*a*) the union of carbon with oxygen to form carbon dioxide and liberate the heat of combustion ; and (*b*) the reaction of carbon with carbon dioxide in the fuel bed. Although at low temperatures cokes differ in their reactivities to oxygen, above a red heat the rate of reaction is so great that no differences can be measured. Rate of combustion is determined by rate of air supply, and differences in 'reactivity to oxygen' have no significance. At lower temperatures, differences can be measured and are significant in all those processes where a coke must attain or maintain combustion at temperatures up to a moderate red heat. This is generally the case in domestic grates, boilers and stoves burning at a low rate of combustion and usually in a small fuel bed. Under these conditions, the differences in chemical reactivity to oxygen between cokes of different origin and process are significant.

On the other hand, in industrial processes at high temperatures and in large fuel beds, the dominant factor is usually mechanical strength—resistance to 'shatter' and 'abrasion' in handling and movement during combustion. Anything that interferes with the free passage of gases through the fuel bed reduces the serviceability of the fuel. Indeed, chemical reactivity may accentuate this diminution by promoting the reaction of the carbon

with the carbon dioxide present in the fuel bed. By this reaction carbon is consumed with absorption of heat already liberated by the combustion of carbon with oxygen, and temperature rise is hindered. The manner in which these various factors are interwoven in different fuel processes forms the subject of the experimental work recorded in the report.

It should be mentioned that the Research Committee is interested primarily in the products of the large coke oven. Gas works coke, made to-day predominantly in continuous vertical retorts, has qualities which receive little prominence in the report. Nevertheless, it is the most comprehensive account of work on the qualities of cokes available in Great Britain, and is indispensable to all interested in this branch of technology.

H. J. HODSMAN.

BUSINESS MANAGEMENT

(1) The Science of Production Organization
By Prof. E. H. Anderson and Prof. G. T. Schwenning. Pp. x + 282. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1938.) 17*s*. 6*d*. net.

(2) The Economics of Business Enterprise
By Prof. Walter Rautenstrauch. Pp. xiv + 446. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 20*s*. net.

BOTH these books are further contributions to the already extensive American literature on business management.

(1) The first, dealing with production organization, seeks to gather up and correlate recent writings on the subject, to smooth out and reconcile apparent contradictions, and to point the true path to further progress. There are doubtless still many who regard the extreme analysis of business methods and the more advanced tenets of scientific management with some distaste, not to say great aversion ; but whilst industry and trade remain largely on a competitive basis—and possibly still more so if they were on some other basis—it appears to be a primary need to seek out the best and most effective methods of running a business. This necessarily involves a close study of the science of organization, and the book before us gives, lucidly and concisely, within the comparatively short compass of some 250 pages, much of the best of recent American thought in this field.

After a preliminary clearing up of definitions, the authors deal with the growth of organization ideas from the time of Adam Smith ; the organization of work ; organization structure ; types of organization-line, line-staff, functional, and committee ; comparison of these ; principles and laws ; and broader aspects. The analytical mind at least will probably study with some interest the discussion of Gilbreth's 'therblig', the unit of human effort which F. W. Taylor had sought for in vain. There are at present eighteen of these, with promise of more to come, and the authors think the 'therblig' is destined to become a standard unit of manual productivity and possibly of labour cost. A fairly extensive and carefully selected bibliography is appended.

(2) The second work is rather more formidable —more than four hundred pages and a longer bibliography—and yet its modest aim is merely to serve as an introductory text on *some* economic problems of business enterprise. It is also much more concrete in that its chief pre-occupation is with practical methods for dealing with such things as cost estimating, interest and depreciation, evaluation of machines, materials and supplies, interpretation of financial statements, together with an interesting discussion of business enterprise in general illustrated with valuable examples of actual American businesses taken from a wide range of industry. Another admirable feature which gives a welcome realistic touch and a satisfying method of grasping the subject-matter is the addition of problems at the end of each chapter. There are numerous tables and a certain amount of fairly easy mathematics.

Costing and accounts executives who wish to add to the basic knowledge underlying their particular fields of action will find much of interest and value. Prof. Rautenstrauch certainly seems to have done a good piece of work, something more than an introductory study, and has adequately fulfilled his purpose of "stating what is generally considered to be good practice in dealing with the economic problems of specific business enterprise, inquiring into theories on which these practices rest, and developing methods of analysis" for dealing intelligently with the economic problems of a given business. But although he goes very thoroughly into the questions of costing, he does not seem to worry much about the 'therblig'.

ECONOMIC RESOURCES AND THEIR EMPLOYMENT*

By Dr. Wesley C. Mitchell,

Director, National Bureau of Economics Research, New York

THE most important resource available to man is knowledge, for the materials and forces in his environment become useful to him only as he learns about them, and through science and technology converts them to his needs. In view of this fact, any denial of the right to follow the truth wherever it leads will assuredly hamper the future growth of science and so dim humanity's prospects. To-day, the widespread recognition of the fundamental importance of study and research to society is indicated by the huge sums and vast amount of energy invested in schooling and development of new techniques.

Essential, then, is the task of conserving for future generations these resources, lately become precious because of autocratic pressure in various quarters of the globe. Knowledge is power; it holds the key to all other resources and the better way of life which all men are seeking. Those democracies still existing must examine to what extent they are prepared to defend their right to gain knowledge. Scientific research, more than any other type of activity, requires freedom. The man who makes discoveries must be free to ask sceptical questions. Dogmas have ever been the foe of science, and science the destroyer of dogmas.

The modern classification of resources made by economic theorists is essentially that devised by Ricardo more than a century ago, with a few modifications. Whereas Ricardo thought of the annual produce of society as being divided into rent, wages and profits, to-day we think of interest as distinguished from profits and capital as distinguished from business administration. In our day most people get their living by making and spending money incomes, making it obvious that the processes of producing and distributing wealth have become interdependent.

The development of man's most important resources has enabled him to command innumerable natural forces and convert to domestic use many things which at one time in history were dangerous. The process, of course, started ages before records were kept, and the triumphs of science since the days of Galileo and Dalton have covered so wide a range, and have yielded so many practical applications, that we have acquired an almost mystical faith in its ability ultimately to solve the problems that still baffle us—provided we do not stop the process of discovery by using the present powers of science to destroy ourselves and our culture.

Study of the development and utilization of the economic resources in our culture, however, gives no reason for believing that the form of economic organization influences the occurrence of scientific genius. Certainly some of the great early discoveries came from economically backward countries—for example, Copernicus from Poland, Galileo from Italy, Descartes from the *ancien régime* in France, Leibniz from cameralistic Germany. But I do think that capitalism provides conditions far more favourable to the practical application of scientific discoveries and the work of the world than the economic forms it has gradually displaced. While capitalism nurtured the Industrial Revolution, it is true also that the Industrial Revolution has in turn fostered science. An excellent example of this is to be seen in the great assistance given to biologists, anthropologists, geophysicists, meteorologists, and by rapidly expanding world trade. Slowly but surely, business men are learning the value of research for their particular needs.

But this alliance between research and business developed latent incompatibilities between the temperaments of the two. Business enterprises have uses for science in so far as it promotes their pecuniary aims. They maintain research staffs to study their problems, but do so chiefly with the expectation of keeping newly discovered ideas in reserve until business conditions make their use expedient. In many an American corporation tension has developed between the engineering staff interested in technological perfection and the financial executives interested in profits. This gives evidence that our economic organization, in spite of its prodigious efficiency in comparison with the forms it has superseded, still fails to make full use of the resources at its command. This is true even at times of greatest expansion. A great increase in the output of useful goods—no one can say how great—might be effected if we employed our basic resources of knowledge to the full.

Even though we do not make full use of our economic resources, we are nevertheless using

* Substance of an address given on September 17 at the Bicentennial Conference of the University of Pennsylvania.

up certain of them at a rate that rouses grave apprehension as to the future. Forests are disappearing, valuable soils are being eroded, animal species are being exterminated, and coal, petroleum, natural gas, and mineral ores are being used in prodigious quantities. If these inroads upon Nature's cupboard continue to grow for a few generations, the cupboard will be bare of many treasures that have become almost indispensable to our culture.

Books have been written on the problems created by large-scale industry, recurrent business-cycles, giant monopolies, waste of natural resources, etc.; but underlying all these problems our economic difficulties are a result, primarily, of an uneven growth in different parts of man's knowledge.

One group of sciences which, compared to the natural sciences, has not yet reached adolescence, is the social sciences. Many more benefits might have accrued to society from its rapidly increasing mastery of Nature had not the progress of discoveries and applications of the social sciences lagged behind those of the natural sciences. The explanation of this lag is apparent. The social scientist deals with man—a far more complex being than the materials with which the natural scientists deal. He is variable to responses to given situations and is far less susceptible to control by an investigator. Social inventors likewise have an excuse for their paucity of gifts to mankind. The social inventor does not have a large body of precise tested knowledge to draw from; seldom does he have the opportunity for extended and methodical experiment. Unless money is to be made, society is indifferent. Quite often governmental action is necessary before a trial can be made. In this connexion, the necessity for a changed social point of view to expedite the lagging progress of the social sciences has been employed.

The hesitant progress of the social scientists and social inventors does not indicate that all hope of progress has gone. Undoubtedly advances in knowledge of human behaviour have been many since the time of Adam Smith. Many data concerning individual social behaviour have been assembled and classified. Social inventions have been made also, for example, the limited liability of stockholders, cartels, chain stores, birth control, social insurance and the parole system.

If our inability to make full use of our other resources is due in large measure to maladjustments among economic processes, and if economics has developed methods that promise to make it more applicable to actual conditions, then enlightened citizens should do all they can to promote social research in general and economic research in particular.

Of course, no certain returns can be guaranteed upon research of any type, but a success here and there may repay many times over not only the direct costs of the successes themselves but also the cost of numerous failures. For example, the many millions of dollars per business-cycle that society would gain from a mitigation of cyclical contractions would justify investing some millions in trying to find out how the flows of products, incomes and purchases can be kept better balanced. To gain a billion it is mathematically worth while risking a million, if the chances of success are more than one in a thousand. A nation whose current annual income is estimated at seventy thousand millions would be wise to accept the odds.

Since the day of the French physiocrats and Adam Smith, economics has breathed the breath of freedom. The autocracies' way of using resources to aggrandize the State is a serious threat. Admitting certain immediate benefits to be derived from the totalitarian form of government, it is still difficult to believe that this demonstrates that autocracy is more efficient than democracy in satisfying the wants of its citizens. Of course, if these citizens have been brought to the point of preferring their individual shares in military triumphs to "life, liberty and the pursuit of happiness", they must be satisfied for the time being. For this military gratification, they are paying a heavy price in the severe sacrifices which are imposed upon them in their daily lives.

All of us realize that democracy is far from perfect, but we prefer it infinitely to a system under which compulsion rules. Our economic organization works out results that satisfy no one; but with all its faults it produces a higher standard of living at the cost of less effort than any autocracy has shown.

The present world conflict does not demonstrate conclusively that autocracy confers great military power upon a nation in the long run. All that is clear is that a heavily armed nation governed by a single will is for a while more than a match for nations that have neglected their defences materially and morally. But since war depletes irreplaceable natural resources with utter recklessness, there is more than ever a need to cultivate the one great resource that can be increased and through its increase made to open other resources, namely, scientific research; and since scientific research requires freedom, in defending freedom we are also protecting the future of mankind from a deadly menace.

The real strength or weakness of democratic institutions in meeting autocratic aggression will be shown by the intelligence and the wholeheartedness with which the peoples who cherish individual liberty behave in the next year or two.

MEDICINE IN WAR-TIME

By Prof. J. R. Marrack,
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SOME twenty years have passed since the Medical Research Council published a Medical Supplement to the War Office *Daily Review of the Foreign Press*. In those twenty years the foundations of medicine have been widely extended, the methods of medicine have continued to shift from treatment towards prevention and, particularly in the last few years, the general outlook of men of science has changed from a detached aloofness towards active participation in the solution of social problems. Supposing that a medical man of 1918 had slept from then to now and woke up to read the first number of the new *Bulletin of War Medicine*, issued by the Medical Research Council (see p. 585 of this issue), what evidence would he find of the progress of medical knowledge and of a wider outlook ?

He would find that the treatment of wounds is still considered the most important task of medicine in war and that, as in 1918, great interest is taken in the chemotherapy of infections. Sulphanilamide, the compound recommended, is new—that he would expect ; but he would not realize, from the articles abstracted, how much more effective sulphanilamide and allied compounds are than previous chemotherapeutic agents. If he were a research worker he would be humbled when he learned the history of the discovery of sulphanilamide. For years now, patient research has been made into the nature of the specific protection given by antisera. We have learned much about the relation of such specific reactions to chemical structure. It might reasonably have been hoped that this type of research might lead to the discovery of specific therapeutic agents—the converse of Goebel's preparation of specific protecting sera by the use of synthetic antigens. Actually, the sulphanilamide compounds, which have revolutionized the treatment of septic infections, were discovered by the method of trial and error.

'Dr. 1918' might console himself by another advance in the treatment of wounds. He would find abstracts of three papers which deal with the source of infection of wounds. These are the fruit of straightforward research, particularly on streptococcal infection after childbirth. Some women carry hæmolytic streptococci in the vagina ; but it was generally agreed that these women were not particularly liable to puerperal sepsis. It was necessary to look for some source of infection outside, but it was difficult to incriminate the real source of infection, for streptococci are as widely distributed as pound notes. It is not possible to find whence a person got a pound note unless it is marked.

It has, of course, long been realized that there were many types of streptococci ; but the methods of identification presented peculiar difficulties. Now that these difficulties have been overcome and more than twenty-four distinct types of streptococci are recognized, the streptococci are 'marked'. If a streptococcus of the same type as that causing puerperal sepsis is found in the nose or throat of a person in contact with the patient, it is highly probable that this person is the source of her infection. In one series studied about six years ago the infection in 57 per cent of the cases was traced to the throat or nose of persons in contact with the patient.

This method has been applied to other infections, and the writers quoted in the *Bulletin* conclude that infection with pyogenic cocci does not usually occur when a man is wounded, but is derived from the nose or throat of an attendant or the dust of septic wards. 'Dr. 1918' might remember that, when he was admitted to a base hospital in 1917 with streptococcal tonsillitis, the man in the next bed to his had had his leg amputated at the knee ; and that the ward sister took a special pride in herself stirring up the dust of the ward with a duster, collecting at the same time a small fraction of the dust on the duster. We might conceal from him, for a time, that there are still civilian hospitals that do not use vacuum cleaners.

In the work on the treatment of shock, 'Dr. 1918' would find a direct continuation of the research and advances made during the War of 1914–18. It was then realized that some of the symptoms of shock were due to loss of fluid from the blood to the tissues and that any effective treatment must restore the blood volume. If salt solution was injected, to replace lost fluid, it also quickly escaped from the vessels. What was needed was a solution of some substance of high molecular weight, which, like the proteins of plasma, would not diffuse readily from the blood vessels and might even, owing to its osmotic pressure, suck fluid back from the tissues. Foreign proteins could not be used

and human plasma proteins could not then be obtained. The obvious fluid to be used, then, was blood, although the concentration of corpuscles in a shocked patient's blood was high already (and adding more corpuscles might make matters worse, if more fluid from the injected blood was lost). Besides, blood for transfusion could not always be obtained. Solutions of gum acacia, with an osmotic pressure equal to that of plasma protein, were tried, but were not satisfactory. Attempts were made to preserve blood, but these were not successful. So for years transfusion of blood from a donor, fetched for the occasion, was used ; the only advances were in details of technique and in the organization of donors.

When the rebellion started in Spain in 1936 the Catalan authorities, partly inspired by the use of cadaver blood in the U.S.S.R., organized a service of stored blood. It was found that blood could be used two weeks after it was collected. Transfusion with fresh or stored blood came to be used much more freely than before. When stories of the use of stored blood first reached Great Britain they were received with scepticism ; but, as medical men who had been attached to the Government medical service returned and gave detailed accounts, the value of the method, particularly in war, was recognized. When the War broke out large amounts of blood were collected in readiness for a heavy demand ; as these stores became unfit for use, they were thrown away and fresh supplies obtained. Blood was wasted and donors became reluctant to give their blood merely in order that it might be poured down the drain.

However, only the red corpuscles of the blood deteriorated in a few weeks ; the plasma proteins remained as good as ever. Early this year it was realized that even when the whole blood was unfit for transfusion, the plasma could be drawn off and used. A few years ago American physicians had started to treat the œdema of certain forms of kidney disease with concentrated human serum, which had been made by evaporating serum and redissolving in a small volume. The dropsy is due to the low concentration of protein in the plasma of these patients, and by this means the concentration of protein was raised and the œdema cured. This suggested a much better way of keeping and using the surplus plasma. When dried it was convenient to store, it could be redissolved in a small volume and be used to raise the concentration of large molecules in a patient's plasma, not with a foreign substance, but with the natural protein.

It is now found to be simpler to collect blood solely for the purpose of making dried protein, to let it clot and use the serum instead of plasma. Dried serum and plasma are now being prepared on a large scale. The product is a waxy-looking solid that dissolves readily ; it can be kept indefinitely at room temperature ; when required for use, sufficient water is added to make up the concentration required. It seems possible that dried serum will replace blood in the treatment of shock.

All this appears obvious, but behind it lies research work that may be said to begin with the preparation of dried proteins in a soluble form by Hardy and Gardner, and includes the studies of the relation of plasma proteins to dropsy. It has had the support of the great increase of knowledge of the physical chemistry of proteins, particularly that obtained by the ultracentrifuge methods of Svedberg.

There is little, however, in these achievements that the medical man of 1918 might not have anticipated. But the recommendation in several of the papers of corticosterone or desoxy corticosterone for the treatment of shock is something that is entirely new ; here, and in the paper by Mottram on "Diet in Wartime", we get hints of the great gap that lies between 1918 and 1940, of the great advance in knowledge of the working of the body.

The sterones of the adrenal cortex recall the work on endocrines—the discovery of insulin, the unravelling of the sex hormones, the separation of the various hormones of the anterior pituitary, the explanation of the action of the parathyroids, all of which have come since 1918. In 1918 adrenalin was the only hormone the structure of which was known ; thyroxin had been isolated in crystalline form, but its true structure was not settled until about ten years later. Cholesterol was then an alcohol of high molecular weight ; fragments only of its structure were known. The question of this structure was not settled until 1932 ; and new methods of investigation, X-ray analysis and the measurement of surface films helped in the solution of the problem. Now a whole series of sex hormones, the hormones of the adrenal cortex, the precursors of the D vitamins and the aglucone fraction of the cardiac glucosides, are known to have the same skeleton as cholesterol. Their structures have been established and some have been synthesized.

'Dr. 1918' knew of three vitamins, fat-soluble A, water-soluble B and the antiscorbutic vitamin. The amounts in various foods were represented by one or more plus signs. Now the amounts in food and the requirements of human beings can be given quantitatively. As with hormones, the chemist seems suddenly to have mastered the difficulties of isolating vitamins in a pure form and of analysing their structure. The structures of nine have been discovered within the last ten years ; seven have

been made artificially; three and a substitute for a fourth are made on a commercial scale.

The practical importance of this fourth, vitamin K, is a story of the last three years. It has been known since 1934 that the blood of chicks, the food of which did not contain this vitamin, clotted very slowly. The reason for this delay is deficiency of prothrombin—one of the normal constituents of blood plasma which is a factor in causing clotting. The amount of this factor in plasma is reduced in liver disease also; partly because bile, secreted by the liver, is necessary for the absorption of vitamin K, without which men, like chicks, cannot make prothrombin, partly because the diseased liver may not be able to make prothrombin even when sufficient vitamin K is absorbed. Because the blood did not clot, bleeding was one of the dangers of operations on patients with diseases of the liver. It is now possible to increase the prothrombin in plasma, so that the blood clots normally, by giving vitamin K and bile; provided, that is, that the liver is not so badly damaged that it cannot manufacture prothrombin. The natural vitamin, the structure of which was discovered in 1939, has a naphthoquinone nucleus with a long phytyl tail. Fortunately, synthetic compounds, without the tail, are equally effective. They are now used in treatment of patients with liver diseases, and of new-born babies with a tendency to bleed, due, also, to deficiency of prothrombin.

It is now generally accepted that vitamin B_1 forms a coenzyme that is required in the intermediate metabolism of carbohydrates in the brain; and it has recently been realized that the two vitamins, nicotinic acid and riboflavin, are embodied into compounds that act as carriers of oxygen for the oxidation of glucose. The part that these three vitamins play in the economy of the body is now settled. Here is the great difference between 1918 and 1940; in place of vague principles in some way necessary to health, we have substances of known chemical constitution which we can measure, the function of which in the working of the body we are beginning to understand.

Half the *Bulletin* is devoted to the treatment of wounds. But if the methods recommended reduced the morbidity of wounds by three quarters, they would make little difference to the issue of the War. The matters that concern medical men and that may have a decisive influence on the course of the War are preventive, namely, proper protection against air attack and the maintenance of nutrition. There is little in the *Bulletin* about either; this is due in part, of course, to the selection of papers for abstraction.

We know how much lack of food was responsible for the collapse of Germany in 1918. Both to keep our health and to sustain the maximum effort for victory we must plan our limited resources to the best advantage, and people must know how to make the best use of the food that they can get. Yet only one paper on food in war is included in the *Bulletin*. Several other valuable papers have appeared during the last year which might have been included. Yet there has been pitifully little discussion and criticism of the Government's food policy. Food is a matter of which we all know something; general practitioners, in particular, are in a good position to know about people's mistakes and wishes. Why have they not written more?

If proper protection from air attack is not soon provided, it will be difficult to maintain the production of munitions (which is not a medical matter) and the will to continue the War (which is). We have already signs of the epidemics which will attack us if the overcrowding in shelters and sanitation is not improved. It may already be too late.

One paper only in the *Bulletin* can be said to deal in any way with the protection of civilians. The abstractor is able to point out that this matter is treated excellently in the A.R.P. handbook. But what about the subjects that are not treated well in official publications? Have there been no suitable papers at least on the organization of the collection and treatment of air-raid casualties?

But the editors can take only a fraction of the blame. All people with any trace of scientific training must have realized the futility of the so-called gas-proof room, which, for years, was the form of protection recommended by the A.R.P. authorities. Yet how many individuals or organizations of men of science made any protest against this bluff; and when the A.R.P. authorities did start on real protection, how many demanded that shelters should be sufficient, sanitary—and in time?

Think how freely and vigorously the Food (War) Committee of the Royal Society criticized the Government in the War of 1914–18 and how big a part it played in shaping a sound food policy. How different our situation might be to-day if the Royal Society had appointed an A.R.P. Committee some years ago. Only an independent body can make the necessary criticism; Government advisers are too tied by loyalty and caution.

Perhaps we might find it difficult to convince 'Dr. 1918' that men of science are turning towards a more active participation in the solution of social problems.

"Curse ye Meroz, curse ye bitterly the inhabitants thereof, because they came not to the help of the Lord, to the help of the Lord against the mighty."

THE SCIENCE OF RHEOLOGY

BY V. G. W. HARRISON,

PRINTING AND ALLIED TRADES RESEARCH ASSOCIATION

THE word 'rheology' was coined in the United States in 1929 to denote the science of the deformation and flow of matter. Though the name is new, the science itself is old, and man has had a practical knowledge of some of the main facts of rheology since very early times. The phrase "rheological phenomena" may sound learned and forbidding; yet we study these "phenomena" every time we spread butter over bread with a knife, grease a motor-car, paint a garden shed or 'help' children make sand castles. If it be of any advantage to man to improve bread, butter, cheese, jam, chocolate, inks, paints, varnishes, textiles, building materials and a host of other everyday commodities—without which civilization as we know it could not exist—then the study of rheology needs no further justification.

It would be impossible to say who was the first rheologist. The discovery of facts so intimately connected with our daily life and associated with the very foundation of civilization was probably made gradually and by many people at about the same period. Some of the earliest handwork of man has been pottery. Pottery is made from material which is sufficiently plastic to be moulded in the hands, but retains its shape when left untouched; it must also dry out to form a rigid, hard substance. One can well imagine the early potters making experiments with various natural clays which they found; they were conducting a piece of rheological research of the first importance.

Coming to more recent times, we find Lucretius wondering why olive oil flows less readily than wine, and making theories to explain this fact not essentially different from those we hold to-day. To Heraclitus came the idea that "everything flows". Despite this good beginning, however, it must be admitted that to-day rheology, as a science, is still in its infancy, and it has received far less attention from scientific men than it deserves. Rheological research is, however, now making rapid progress, since it has been found indispensable in many industries, and it is my purpose here to describe some of the facts which have come to light, and to show how they can be used for the solution of practical problems.

THE THREE STATES OF MATTER

Nature is immeasurably complex, and in the early stages of learning it is a great help to classify and simplify the various facts with which we are faced. Such classifications and simplifications serve, so to speak, as pegs on which to hang our knowledge where we can see it conveniently, but, while undoubtedly useful, it must be remembered that they are man's creation and Nature herself pays scant attention to them. Thus, sooner or later, our knowledge reaches a stage when we become aware of facts which do not fit in with our artificial scheme—the classification breaks down, and we either have no "peg" on which to "hang" our fact, or, worse still, the fact looks as if it ought to be "hung" on two or three "pegs" at once and yet fits properly on none of them.

In our early days we recognize three well-defined states of matter: solids, liquids and gases. By applying heat, solids melt and become liquids, and liquids boil and become vapours or gases. Similarly, by cooling, gases can be condensed to form liquids and finally frozen into solids. The melting and boiling points are sharp and well-defined temperatures. Water is a perfect example: it freezes into ice at 32° F. and boils to form steam at 212° F.; at 32° F. you can have ice crystals and water mixed, but you cannot have an intermediate pasty substance neither ice nor water.

It is not possible to give here scientific definitions of solids, liquids and gases, but their general properties are well known. Solids are characterized by a definite shape, and other solids cannot pass through them—they can only break them. The shape of solids can be altered to some extent by the application of forces, but as soon as these forces are removed, the solid tends to return to its original shape. This characteristic behaviour is known as *elasticity*. Liquids, on the other hand, have no elasticity in this sense. They have no definite shape and solids can pass through them, though solids meet with some resistance when in motion through fluids—this is called *viscosity*. Thus glycerine is more viscous (that is, less fluid) than water. Elasticity is a property characteristic of solids, and viscosity one characteristic of liquids.

So far so good. But on further examination one finds that the distinction between solids and

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liquids is in some cases not so clear. For example, some materials, such as glass, have no definite melting point, but become pasty over a fairly wide range of temperature before they finally melt ; in other words, the transition from solid to liquid seems to be not sharp but gradual. When they are in the pasty state, are they to be regarded as solids or liquids ? There is a certain kind of marble which, when examined over a period of a few hours, appears to be a typical solid ; nevertheless, over a number of years it is found to flow like a liquid. Is it solid or liquid ? The older chemist used to evade such awkward questions by saying that such materials were "not pure" ; however, be they pure or not, many of them are of the greatest importance in daily life, and it is the duty of the rheologist to examine their properties. One meets with surprisingly few chemically pure substances outside the laboratory.

Some of the most characteristically solid materials we possess are the metals, yet even these can, in certain circumstances, show some of the properties of liquids. An example will make this clearer. A steel wire suspended at one end from a beam in the ceiling can be overloaded so that increase in length is no longer proportional to increase in load and the wire no longer regains its original length when the load is removed : in this state engineers say that it has received a 'permanent set'. If the wire is greatly overloaded, it will be found to stretch visibly over a period of time before it breaks, and in this state it is really flowing like a liquid. The extension due to flow is many times greater than that due to true elasticity and it does not take place instantaneously. These quasi-liquid properties are of great importance from the engineer's point of view, since without them the forging and cold working of metals would be impossible. They are a mixed blessing, however, since some materials can show slight flow over a long period of time even when they are not overloaded, and such 'creep' can prove troublesome.

There is yet another effect of overloading which deserves mention. An overloaded wire is harder than the original metal was. This 'strain hardening' is familiar to the engineer ; but it may be surprising to find that it occurs also with butter and cheese. Another form of overloading occurs also when metals are polished. Very high stresses are set up at the surface during the polishing operation, and the surface layers of the metal flow like a liquid ; consequently the polished surface has a different structure from that of the body metal.

In certain circumstances liquids can behave in ways characteristic of solids. This is especially true of liquids of very high viscosity. For example, some bitumens are true liquids, but under ordinary conditions they flow so slowly that the movement is noticeable only after a long period, probably many days. Consequently, they can be cut like a solid. Pieces so cut will not retain their shape indefinitely, but for short periods of time they can be treated almost as solids. They even show a form of elasticity. If they are deformed by the application of a force and the force is removed after a short time, many of them will slowly recover their original shape ; if, however, the force remains applied over a long period, the deformation is permanent. Certain other liquids show a form of 'flow elasticity'. If they are flowing through a narrow tube and the supply of liquid is suddenly cut off, not only does the flow from the end of the tube cease abruptly, but also the liquid actually recedes into the tube a little way.

Plastic Materials

The materials so far examined have all been predominantly solid or liquid in character. There are, however, many materials in which solid and liquid characteristics are about evenly balanced, so that it is impossible to decide whether they are to be regarded as solids or liquids. These are said to be 'plastic', and are to be distinguished from the 'plastics', such as bakelite, which are now widely used as constructional materials in industry. True plastics have the appearance of solids and if left undisturbed they will retain their shape indefinitely. If they are subjected to a small force, they deform elastically like a solid and recover their shape (though not necessarily instantaneously) when the force is removed. Should the force, however, be increased past a certain critical value, often called the 'yield value', they flow continuously like a liquid. Consequently, plastics can easily be moulded to any desired shape and will retain that shape as long as they are left undisturbed. Potters' clay is a typical plastic. It is only because clay has these rheological properties that the making of pottery is possible.

Another familiar material which has both solid and liquid properties is flour dough. This behaves in many ways like a viscous liquid, yet it shows partial elastic recovery if a force is applied to it and removed after a short time. The recovery is not complete and it takes place gradually, so that the dough has a definite 'recovery time'. The rheological properties of dough are particularly important, since if these are unsuitable, it is impossible to make a good loaf. The properties of doughs have, therefore, been studied extensively by rheologists, and it has already been found that the addition of small quantities of certain substances, such as cystine, to the dough improve its working qualities.

'Non-Newtonian' Liquids

There is another property of certain materials which deserves mention. With true liquids, such as water, the viscosity is not altered by stirring; these are known as 'Newtonian liquids'. There are, however, many 'non-Newtonian' liquids, the viscosity of which is affected by stirring, and these are of considerable practical importance. This behaviour is known as 'thixotropy', and is well shown by the clay bentonite when mixed with water. When mixed in the right proportions, this sets to a firm jelly which is easily liquefied by stirring or shaking. When left undisturbed, the liquefied jelly soon re-sets. Similar behaviour is shown by many apparently viscous liquids which lose their 'body' on stirring, only to regain it as soon as they are left to settle down. For example, printing inks appear, in the tin, to be either thick liquids or solids—some have actually to be cut out of the tin with a knife. They rapidly become quite fluid on the machine, however, on account of the stirring and shaking they receive, and they can thus be distributed over the rollers to the printing block without any difficulty. Once the ink is transferred to paper, it re-sets. This behaviour is important, since inks normally take several hours to dry hard, and the initial 'thixotropic setting' helps to reduce the tendency of the wet print to smudge.

Similar to printing inks in many respects are artists' oil colours. These can be spread easily by a brush, but the colour sets rapidly as soon as the brush has left it, so that most of the brush marks are retained, giving the characteristic appearance of an oil painting. Paints are thixotropic, and they have to be so prepared that the mixture sets sufficiently slowly to allow the brush marks to flow out, but sufficiently quickly to prevent the paint from running down sloping surfaces. Heather honey, unlike honey from all other European floral sources, is also thixotropic. At rest, its viscosity is high, so that air bubbles within it are entrapped and prevented from rising to the surface; the viscosity drops on stirring, so that the honey can be spread easily by a knife. Much the same is true of butter and cheese, toothpaste and shaving soap lather.

There is another class of non-Newtonian liquid, in which the viscosity *rises* on stirring. An excellent example is a suspension of rice starch in water. This can be prepared so as to appear of the consistency of cream, when tested by gently tilting the containing vessel. The mixture can be stirred slowly without trouble. The more rapidly one attempts to stir it, however, the stiffer it becomes, and it appears to be impossible to stir it at more than a certain rate, no matter how much force is applied to the stirrer. Still more remarkable: a small quantity can be poured into the palm of the hand and will flow quite freely when the hand is tilted—nevertheless, the whole drop can easily be picked up between finger and thumb. When rubbed between the hands, the drop turns to an apparently dry powder, but it liquefies again on standing.

Other Properties of Matter

The list of curious properties of matter which the rheologist is called upon to investigate has by no means been exhausted. For example, there is 'fibrosity', or the property by which certain liquids can be drawn out into long stable threads. The formation of threads of silk and of artificial textiles is dependent upon fibrosity. Another property is 'dilatancy', by which a material increases in volume when it is stirred. Thus in walking over wet sands, the gloss disappears and the sand appears to dry out wherever the foot is placed; incidentally, quicksands are not dilatant and one should beware of wet glossy sands which do not 'dry out' when one is treading on them.

Yet another important rheological property is 'stickiness', which enters into the preparation and use of adhesives of all kinds and many other materials. There is 'oiliness', which is of vital importance in the study of lubrication. The rheological properties of rubber are so extraordinary that in text-books on rheology rubber usually has to have a chapter to itself. The properties of muscle (human or otherwise) are in many respects closely parallel to those of rubber.

Rheology thus covers a wide field indeed, and there are few engaged in science or industry who can afford to ignore it. It concerns physicists, chemists, biologists, engineers, medical men, manufacturers—in detail the list can be extended almost indefinitely. Hitherto, there has been no recognized society in Great Britain at which rheologists could meet to discuss the results of their work; consequently, there has been duplication, and, through ignorance of the work of others, the most efficient means are not always used in the investigation of practical problems. Without such a common meeting ground, no science or art can hope to make satisfactory progress. This is now realized by many rheologists, and steps have been taken to establish a British Rheologists' Club (see Nature, October 19, p. 518) which, it is hoped, will serve these needs in an informal way during the present emergency; and in the industrial reconstruction which will follow the War, we may expect rheology to play an important part.

OBITUARY

Sir Henry Head, F.R.S.

THE announcement of the death on October 8 of Sir Henry Head at his home near Reading at the age of seventy-nine closes the career of a great neurologist. He came of an old Quaker family, was educated at Charterhouse, and in 1880 was elected to a scholarship at Trinity College, Cambridge. In due course he graduated B.A. with a first class in physiology in the Natural Sciences Tripos. He then spent a period of two years at the German University of Prague and the University of Halle. His first paper was a contribution to *Pflügers Archiv* in 1887 on the action current of nerve, and from Hering's laboratory in Halle he published in 1889 a masterly paper on the whole question of the respiratory effects of the vagus nerve. He had himself devised a method of registration of respiration which was afterwards to become a standard method.

Head now proceeded to qualify in medicine, following study at University College Hospital, London. His M.D. thesis in 1892 was "On disturbance of sensation with especial reference to the pain of visceral disease" and was of outstanding merit. It led to the long series of investigations of disorders of sensation resulting from damage to, or disease of, the nervous system, with which his work is chiefly identified. His original study of pains referred from deep structures was followed by the elucidation of the pathology of herpes zoster (shingles), and from the pattern of the eruptions of that disease he was led to the delineation of the areas supplied by the various sensory nerve roots in man. This latter investigation, partly in collaboration with A. W. Campbell, was of great practical importance in the localization of nervous disease in medical practice, and secured him world-wide recognition. The proof of the astonishing accuracy of detail which he obtained was demonstrated by Foerster's mapping in 1933 by an entirely different method. In 1898 he was elected assistant physician to the London Hospital, and was occupied in hospital and private practice to the time of his retirement.

Head's attention was next turned to the disorders of sensation resulting from interruption of nerves to the skin. With Sherren and Rivers, in 1905 and 1908, he demonstrated the curious features of sensation at the border of an area deprived of supply by a cutaneous nerve. Here he established the existence of a zone, hitherto undescribed, where the threshold of sensation to touch, pain and temperature was profoundly altered, and discriminations of localization and intensity no longer possible. He established the existence and nature of sensations perceived through the deep nerves under skin which was completely deprived of sensation. He and Rivers described in detail and with great accuracy these changes in an experimental section of a nerve in Head's own arm.

These studies opened a whole chapter in neurology and were of great practical importance. The hypothesis by which Head accounted for these phenomena led to much discussion for many years and stimulated a great deal of investigation by others. The facts brought to light by the original investigation have been amply confirmed and little more has been added. Essentially, Head's hypothesis was that the zone of intermediate sensation represented a primitive 'protopathic' variety of sensation which he supposed to be evolutionally earlier than 'epicritic', highly discriminative qualities of sensation. His imaginative mind enlarged the conception in masterly fashion, adducing careful studies of many different aspects of sensation in man in support. The chief defect of this conception was the lack of any biological evidence of such evolution, and the failure of any subsequent confirmation that two entirely different systems of nerves existed. It is to-day more widely held that the differences are not so sharp and clear-cut as Head's methods of testing led him to believe, that more quantitative methods reveal a gradual transition, and that the qualities of the intermediate zone are the effect of the quantitative reduction of data conveyed by the nerves to the discriminative mechanism in the brain. However that may be, it is to be deplored that the discredit of Head's hypothesis should have detracted, as it certainly did, from the magnificence of his contribution to knowledge of sensation in the skin.

In 1906 Head published with Thompson studies on the conduction of sensation in the spinal cord, and again clearly defined principles which are an essential part of the practice of everyday neurological medicine. They plainly demonstrated the functions of the dorsal columns.

With Gordon Holmes in 1911 Head extended his investigations to the disorders of sensation resulting from damage to the cerebral cortex and other parts of the brain, and illuminated a whole field hitherto completely obscure. During the War of 1914–18 he gave up his private practice and lived at hospital, not only giving the benefit of all his invaluable experience, but also making new investigations, notably on the disturbances of speech resulting from localized damage to the brain, and, with Riddoch, on some of the effects of damage to the spinal cord.

Head's extensive painstaking study of disorders of speech was finally completed by the publication of two volumes on "Aphasia and Kindred Disorders of Speech" in 1926. His contribution in this field had less immediate practical importance than his earlier works, but was highly original and brought new emphasis on the complex interrelation between disorders of language and intellect. He freed the terminology of the subject from its implication of minutely localized sensory and motor components, and demonstrated the similarity in type of disturbance of both comprehension and expression from any particular damage.

In his interpretation of the late changes of spinal reflexes from spinal injury, Head invoked reversion to a hypothetical primitive state in explanation of the final disintegrated state, the 'mass reflex', again eliciting the criticism levelled against his views of 'primitive' sensation in the skin. Nevertheless, as with all his other investigations, he brought new light and abundant stimulus to the problem, and at a bound advanced the whole subject from the previous confusion of ideas and crudity of method of exploration then still prevailing in most fields of investigation of disordered physiology at the bedside.

These form Head's chief contributions, a truly noble series which placed him for all time among the small band of British neurologists—Gowers, Hughlings Jackson, Ferrier, and Sherrington, who adorn that period of remarkable advance in all medicine, 1890–1920. His other writings include a volume of verse published in 1919. He received many honours, was elected a fellow of the Royal Society in 1899, and was knighted in 1927. A man of great patience, humility and profound learning, he was fated to endure great physical discomfort and incapacity from a slowly progressive nervous disease for the last twenty years, made heavier in the last eighteen months by the loss of his gifted and devoted wife.

D. DENNY-BROWN.

WE regret to announce the following deaths :

Mr. M. B. Buxton, president of the Institution of Structural Engineers, on October 14.

Dr. Myron Mathisson, formerly of the University of Warsaw, who during the past year has been doing mathematical research work at Cambridge, aged forty-three.

Dr. C. H. Merz, a well-known consulting electrical engineer, aged sixty-six.

Mr. E. L. Rhead, formerly lecturer in metallurgy in the College of Technology, Manchester, on October 19, aged seventy-six years.

NEWS AND VIEWS

Greece

WITH the open attack on Greece by Italy, a new phase of the War, centring on the eastern end of the Mediterranean, would seem to have opened. The long threatened invasion of Great Britain having been postponed—or found still-born—the Axis partners have turned to the Mediterranean, towards which the dominant member has already made an approach by taking over Rumania, in their search for a quick and resounding victory. However deeply we may regret that still another country is to be exposed to all the horror and destruction of modern war, it has become increasingly clear in the course of the events of recent months that the whole world is becoming more and more closely involved in the struggle on one side or the other, while for those people who aspire to maintain their freedom and preserve the liberty of the individual, there is no hope save in fighting on the side of those who champion the ideals of democracy.

The attack on Greece has long been foreshadowed in Italy's attitude in respect of 'incidents' on the Albanian frontier, and it is evident that steps had been taken to deal with the situation when occasion arose. Already the Greek people have experienced something of the nature of attack from the air. The proclamation of Athens as an 'open city' should serve, if respected, to preserve a city rich in archæological and classical associations. It would plumb the depths of irony if, in the struggle to preserve what is best and noblest in modern civilization, the relics of the source from which so much of it has sprung should be irretrievably destroyed.

Camouflage

THE many absurdities in methods adopted for camouflage and the lack of co-ordination of research on this all-important subject formed the basis of an article in NATURE of June 22, p. 949. However, some progress, though somewhat tardy, has been made, and indications of this were given by "J. S. H." in NATURE of October 12, p. 482, after a visit to the headquarters of the Civil Defence Camouflage Organization. But such progress has been made by technicians in practical research ; there has been little indication of improvements in co-ordination of such research, and collaboration with the military and other authorities in its application. We are therefore pleased to note that such is on the way, as shown in the fourteenth report of the Select Committee on National Expenditure (H.M. Stationery Office, price 2*d*.) The committee received a report from its sub-committee on home defence services and adopted it with an amendment as its report.

Among the recommendations made are the following : The four existing camouflage departments should be united in a single organization with its own research staff and administered by the Ministry of Home Security. Greater use should be made of the experience and knowledge of the non-departmental members of the Camouflage Committee than has been made in the past. Departments and industrial undertakings of the kind which are required to be camouflaged should, when considering plans for buildings, be under an obligation to consult the central camouflage organization proposed.

Camouflage officers required for the fighting services should be supplied by the proposed

camouflage organization. Serving officers required for camouflage duties should be seconded to it for training. The sub-committee states that the Ministry of Supply and the Admiralty have no research staff of their own and rely largely on the Ministry of Home Security's establishment. The sub-committee does not regard this as satisfactory. Recalling that two members who have great practical knowledge resigned from the Advisory Committee on Camouflage, the sub-committee is unable to acquit the camouflage departments of a certain degree of neglect of the knowledge and research placed at its disposal by members of the committee (see NATURE of June 22, p. 949). A new committee was formed afterwards.

The testimony of departmental witnesses with the longest experience of camouflage of all kinds was emphatic that specimens of camouflage of fortified posts throughout the country are absurd and cannot be regarded as camouflage at all. The responsibility for these works rests with the Home Forces and the staff of camouflage officers attached to corps and divisions. The sub-committee attributes such errors to the hitherto insufficient number of these officers. It learns, however, that the number has recently been increased. Cases have been brought to the notice of the sub-committee where private practitioners have undertaken the camouflage of industrial premises. Some of these attempts have been futile and might be dangerous. The sub-committee learns with satisfaction that most of these private firms have gone out of existence since the beginning of the War. An Admiralty witness informed the sub-committee that camouflage of ships at sea has been abandoned. In its conclusion, the sub-committee says that the defence of this country so far as camouflage is concerned is a single problem. All schemes of camouflage should be considered as part of a general picture.

Medicine in War-time

OWING to the War, many medical men are cut off from access to journals dealing with their special subjects and from all foreign periodicals. Changed conditions of war may give rise to new problems. The Medical Research Council has therefore undertaken to issue a *Bulletin of War Medicine*, containing abstracts of papers from both British and foreign sources. This *Bulletin* is to supply information, not only to specialists, but also to practising medical officers. It is intended to cover all branches of medicine that can apply to war conditions, but not those concerned more intimately with tropical diseases, or matters of purely public health interest, abstracts of which are already available in the *Bulletin of Tropical Diseases* and *Bulletin of Hygiene*. The work of searching literature and abstracting suitable papers has been entrusted to the staff of the Bureau of Hygiene and Tropical Diseases.

The first number of the new *Bulletin*, which is dated September, contains sixty-three papers. Twelve deal with surgery of special regions, nine with general diseases and eight with aviation medicine. Among the subjects dealt with are blood transfusion (eleven abstracts), shock (five abstracts), the use of sulphanilamide and similar preparations (six abstracts) and civil evacuation (five abstracts). Two abstracts only deal with food in war-time. The abstracts are thorough ; in many cases it would be unnecessary for the reader to refer to the original article for further details. It is proposed to issue the *Bulletin* every two months ; besides being distributed to medical officers of the fighting services and the emergency medical service, the *Bulletin* is being placed on sale (London : H.M. Stationery Office 2*s*. 6*d*. net.).

Mr. J. B. Priestley's "Postcripts"

IT is given to few to provide such a complete interpretation of the spirit of Great Britain as Mr. J. B. Priestley has achieved in the 'postscripts' which he has broadcast regularly during recent months. His has been the authentic voice of the country, whether in expressing the courage, resolution and good humour with which the people are meeting the challenge and dangers that confront us, or in voicing the passionate desire and determination to be found in all sections of the population that the sacrifices now being made shall issue in a new order, to be shared by men of good will everywhere, from which the grosser injustices and inequalities of the past have been eliminated. Scientific workers will share to the full the general regret at Mr. Priestley's announcement of the termination of these broadcasts, much as they will respect the reasons which have led him to that decision. All who have enjoyed these broadcasts can best show their appreciation by the wholeheartedness with which they address themselves to the tasks of reconstruction already to hand, the extent and urgency of which has been the theme of many recent articles in NATURE.

Fitness in Industry

FITNESS in industry is of primary importance to the nation, and nothing that will contribute to the good health and high morale of industrial workers should be neglected. Not the least important of its applications is the provision of the tonic effects of natural sunshine by artificial means (welfare solaria). A letter recently communicated to the Press by Mr. F. J. Pascoe, director of British Timken Ltd., describes some of the activities of his company in this direction. The Company's welfare ideas are based on years of experiment, and are not a product of present emergency conditions. The blackout, the seven-day week and night shifts deprive workers of sunlight. The Timken works produce artificial sunlight treatment. These works are large, and elaborate arrangements are justified. Suitable equipment is attainable comparatively cheaply for smaller works, but treatment must be regular and carried out under qualified supervision and in accordance with carefully prepared plans. The Timken Co. has a medical man in frequent attendance, and treatment is administered by a qualified nurse. This treatment has been found to be definitely beneficial to the workers. Short-wave

therapy apparatus is used for treating septic wounds and skin troubles met with in the industry. For a small works this apparatus is somewhat costly, but the results obtained in a relatively short time are astonishing. Treatment should be given under medical supervision.

Eyesight is of vital importance in quick and accurate production. Free eyesight tests by the visiting doctor costs the Company little and is a help to the workers. Footwear is a problem. A girl worker standing most of the day on concrete floors in thin high-heeled shoes will take very serious toll of her staying power. This is a most neglected point; workers' footwear should be stout and in good repair. Rubber soles, except in certain types of factories, should be prohibited. The Timken Co. purchases wooden shoes (sabots) which the girls buy at half their cost to the Company. Smoking is allowed. Some works cannot do this, but where it is allowable it does help. One very strict rule, rigidly enforced, is that there must be no smoking in the half hour before people knock off; the reason for this is that fires caused by cigarette ends nearly always show within that time. Music in working hours is beneficial. The Company has had long experience of this, and broadcasts records in two sessions each day to quiet shops where work is of a monotonous nature. One class of music is given in each session—waltzes or marches; mixing the different classes of music upsets rhythm. Vocal records are never broadcast; light classical music is broadcast at meal times. For A.R.P. shelters stirring choruses are used. Works canteens are sometimes dingy. There is no reason for this. Paint is cheap and pleasing and decorative ideas are even cheaper. A woman's ideas will soon brighten the canteen. Preparation and choice of food for the workers should be as carefully planned as the production in the factory.

Control of Wild Life

FOR various reasons in the national interest, a number of official decisions have recently been made to limit the numbers of certain species of British fauna, which in some cases will check the results of protective legislature and private efforts at conservation in the past decade. The Air Ministry has authorized the taking or the destruction of peregrine falcons or their eggs in certain areas including Ayrshire and Dumfriesshire in Scotland and a ten-mile deep area along the Kent and Sussex coasts in England, because of the risk of these falcons attacking carrier pigeons. A deer controller has been appointed to reduce the numbers of wild red deer in Lakeland and north Lancashire, where in recent years these animals have spread from the forest of Martindale and as a result of crossbreds with escaped hinds carted for hunting. A deer controller was appointed for a similar purpose with the Scottish deer forests last year. An Order prohibiting the use of any land for the artificial hatching and rearing of pheasants except under licence—which is chiefly granted to certain game farms where the birds are to be reared for food—does not include partridge and wild duck, but a recent inquiry by the Gamekeepers' Association to the Ministry of Agriculture elicited the information that an Order is contemplated prohibiting the rearing of all game for sporting purposes, and another prohibiting the use of feeding stuffs to game birds, except under licence. For the time being, this means the end of artificial encouragement of game birds and the complicated upsetting of the balance of Nature which it entails in the countryside.

Dr. Christian Fenger

DR. CHRISTIAN FENGER, the first teacher of pathology in the Middle West and an eminent Chicago surgeon, was born on November 2, 1840, at Copenhagen, where he qualified in 1876. He then went to Egypt, where he became a member of the Sanitary Council and surgeon to the Khalifa in the Cairo district. In the following year he settled in Chicago, where he was appointed consulting surgeon to the Cook County Hospital and lecturer on surgery to the College of Physicians and Surgeons. His post-mortem examinations and surgical clinics henceforward became the centre of postgraduate instruction in Chicago. During the thirty years of his professional life he contributed more than eighty articles to surgical literature, his chief work being connected with cancer of the stomach, hernia of the brain, the ball-valve action of floating gall-stones, the operative treatment of cerebral abscesses and the surgery of the ureters and bile-ducts. He died on March 7, 1902. After his death the Christian Fenger Memorial Association was founded under the auspices of the Chicago Medical Society and published his collected works in two large volumes.

All-Electric Laundry

ST GABRIEL'S LAUNDRY, of which an illustrated account is given in the *Electrical Review* of October 11, is the first all-electric establishment of its kind in Eire. It serves Athlone and the surrounding region and belongs to Sisters of Mercy, one of whose main activities is the domestic training of girls. Originally all the work was done by hand, water being carried from the River Shannon. In 1907, a steam engine and washing machines were installed. Recently, the laundry has been completely electrified, resulting in greater cleanliness and better working conditions. Belt-drive and shafting have been eliminated, and there has been a consequent all-round improvement. In the new wash-house there are three large washing machines supplied directly with water at 180–200° F., as required, from two 700-gallon storage electric water-heaters which feed the washing machine, rinsing troughs, soap boilers, starch emulsifier, etc. The water is heated at night so as to get the advantage of the cheap rate.

The utilization of electricity has greatly simplified the blueing and starching process. In the case of most of the work coming to the laundry, washing, blueing and starching processes are carried out without the clothes leaving the washing machine. Four methods of drying are available, three of them

electrical. The drying apparatus is divided into three groups and consists of two large hydro-extractors, a drying tumbler and a drying room. The ironing room is airy, spacious, and lighted by large windows. The electric lighting is specially designed to give perfect illumination on the work and prevent glare in the eyes of the workers. Electric hand-operated irons are installed on both sides of two long tables adequately lighted from both natural and electrical sources. There are also a collar-finishing table, two large press ironers for coats, suits, etc., and one small press ironer. A calendering machine for flat work is notable by the absence of steam. The bed of the machine is electrically heated and the roller hollow and perforated. The steam which would otherwise rise when the damp articles are heated enters the roller and is drawn off by a fan through an exhaust pipe to the outside of the building.

The Dionne Quintuplets

An editorial in the May issue of the *Statistical Bulletin* written on the occasion of the sixth birthday of the Dionne quintuplets on May 28 points out that never before has a similar event been recorded, as no other quintuplets have ever survived more than a few hours after birth. The five sisters, who were premature and tiny at birth, by living to the age of six have also surpassed the record of many normal full-born infants. Although about 94 per cent of all newborn baby girls live to the age of six, the chance of any group of five baby girls surviving to that age is appreciably smaller, namely, 75 per cent. At their present age each of the Dionne children has an even chance of living sixty-three years more. The editorial also points out that the Dionne quintuplets are fortunate not only in being born at a time when the knowledge of how to control sickness and death is being constantly extended, but even more so in having been attended by Dr. Dafoe, who used all the expedients of modern medical science on their behalf. As regards the special hazards to life and health facing the Dionne children in their coming year of life, the records of the Metropolitan Life Insurance Company show that accidents at the age of six are by far the greatest danger to both boys and girls. Next, but causing considerably less than half as many deaths, come influenza and pneumonia, closely followed by appendicitis, heart disease and tuberculosis.

A New Museum at Leicester

The opening on July 23, 1940, of the Chantry House and Newarke Houses, the former dating from 1512 and the latter a century later, as a regional museum, illustrates one successful method of preserving and using characteristic examples of local architecture (*Museums Journal*, **40**, 173; 1940). More than a quarter of a century ago these houses were threatened with destruction with a view to the erection of factories in their place; but the intervention of a few public-spirited citizens and the interest of Leicester Corporation saved the site and buildings. The new museum, to be known as the Leicester and County Museum, is planned, according to the trust deed, "for the purpose of telling the story of the City and County of Leicester in ages past and illustrating its condition for the time being and exhibiting suggestions for its reform and improvement and the promotion and extension of artistic culture and scientific knowledge". The War has delayed the fulfilment of these projects, but a beginning has been made, and the exhibits of civic ceremonial relics, early pieces of Corporation plate, wearing apparel of the eighteenth and nineteenth centuries, military uniforms, and agricultural and domestic implements, indicate the lines on which development will proceed. At present only the ground floor is being used, but the hope is expressed that soon other parts of the buildings will contain their own special collections.

Comets

Harvard College Observatory Card 531 announces the discovery of Comet Whipple, 1933 *f*, by Mr. L. E. Cunningham on September 1, at Oak Ridge. Photographs made through passing clouds with the 12-inch Metcalf refractor gave the following positions:

1940 U.T.	R.A. 1950·0 h m s	Dec.	Mag.	Diam.
Sept. 1·1486	22 34 08·1	−0° 15·9′	15·5	10″
1·1895	22 34 06·5	−0° 16·2′	15·1	

Perihelion passage would appear to be Jan. 22·464, 1941, which is about 0·23 day earlier than was predicted. The following ephemeris uses the corrected values of T, and gives small residuals for the above positions:

1940 U.T.	R.A. h m s	Dec.	r	Δ
Nov. 3	22 24 30	6° 50·0′	2·538	1·955
19	22 36 01	−6° 59·0′	2·519	2·129
Dec. 5	22 52 18	6° 26·2′	2·504	2·316
21	23 12 18	−5° 18·8′	2·494	2·505

Card 533 announces that Mr. Cunningham has found a comet on a photographic plate taken on September 5 with the 8-inch Ross telescope at Oak Ridge. The comet appears also on eleven patrol plates taken between August 25 and September 15 at Oak Ridge or Cambridge. The estimated magnitude on August 29 was 12·9, but plates taken on September 9 show that the comet is slightly brighter and had a strong nucleus and a tail 2′ long extending southward. Orbits have been computed by Cunningham and also by Maxwell and Bendler; the elements of the latter, which differ very little from those of Cunningham, are:

T 1941 January 18·952
ω 197° 29′
Ω 299 02 } 1940·0
i 51 24
q 0·3754

Ephemeris 1940·0

		R.A. h m	Dec.	r	ϱ	Mag.
1940	Nov. 19	19 16	+35° 18′	1·44	1·32	8·1
,,	Dec. 21	19 18	20° 42′	0·76	0·85	3·1
1941	Jan. 22	19 59	−29° 06′	0·38	0·63	−2·1
,,	Feb. 23	20 52	46° 30′	0·93	1·40	5·4

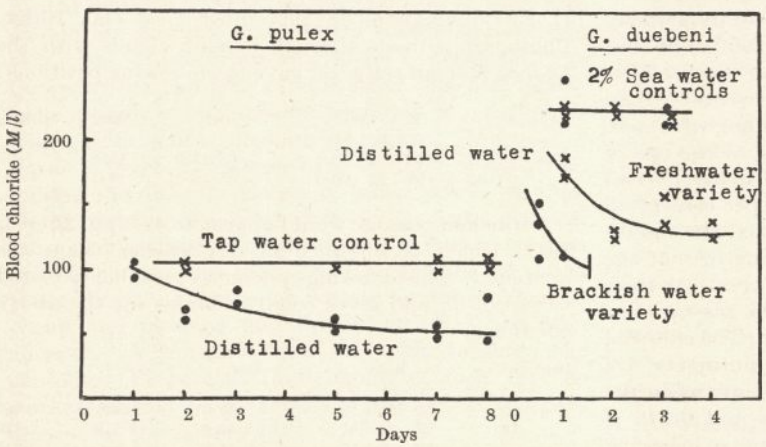
LETTERS TO THE EDITORS

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

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Osmotic Regulation in Freshwater Animals

IT has recently been shown that both brackish- and fresh-water animals can actively absorb ions from the external medium against a considerable concentration gradient. Most fresh-water animals can do so from solutions as dilute as normal fresh-waters[1]. Krogh has suggested that in some cases, during periods of enforced starvation when salts are therefore not available from food, this mechanism is of survival value in maintaining the normal ionic and osmotic concentration of the blood[1]. In a recent paper[2] on the euryhaline crab *Carcinus mœnas*, Webb has gone further than this in assuming that "the active absorption of salts forms the basis of the osmoregulatory mechanism, not only in freshwater forms, but also in brackish water forms, including the euryhaline Crustacea". Without criticizing his conclusions as applied to Carcinus, we wish to point out that some experiments which we have carried out on brackish and freshwater species of Gammarus suggest that active absorption of ions from the medium is not of such universal importance as is implied in the above sentence.



The freshwater *Gammarus pulex* survived in a healthy condition when individuals were isolated and starved for at least eight days in glass-distilled water (changed twice daily). During the first two or three days there was a reduction in the blood chloride level, which thereafter remained relatively constant (see accompanying graph). Under these conditions, the possibility of absorption from the medium being excluded, *retention* of salts must be the predominant factor, for, as Webb points out, the possibility of the tissues possessing a store of chloride is extremely remote. Experiments with *Gammarus duebeni* lead to the same conclusion. This species is found in brackish water in most parts of Britain, but in some western districts it has invaded fresh-waters and it is the principal freshwater species of Ireland. Animals from brackish water rapidly lost chloride and died in distilled water, but the freshwater variety was resistant for at least four days (extent of experiment) and, after an initial loss, maintained a fairly constant blood chloride (see graph).

It is evident that an increase in the efficiency of a retention mechanism is mainly responsible for the adaptation of *G. duebeni* to fresh-water. The brackish water variety will live indefinitely, not only in 2 per cent sea water, but also in the same concentration of pure sodium chloride. Thus the power to retain ions other than Na^+ and Cl^- is well developed. Finally, we would quote experiments on the freshwater crustacean *Asellus aquaticus* (unpublished), which was unaffected by treatment for eight days with distilled water, and on the mosquito larva *Aëdes detritus*, which can live for long periods in distilled water, pure sodium chloride and glycerol solutions[3].

We have also found that *Gammarus pulex* and *G. duebeni* can actively absorb chloride from the external medium, but our experiments with distilled water show that this is not an essential part of the osmoregulatory mechanism. There is, in fact, no direct evidence that any freshwater animal is dependent upon salt absorption from the medium for the maintenance of an adequate concentration and composition of its blood.

We hope to publish these experiments in detail when we have the opportunity to extend and complete them.

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[1] Krogh, A., "Osmotic Regulation in Aquatic Animals" (Cambridge 1939).

[2] Webb, D. A., *Proc. Roy. Soc.*, B, **129**, 107 (1940).

[3] Beadle, L. C., *J. Exp. Biol.*, **16**, 346 (1939).

Golgi Apparatus as an Indicator of Secretory Activity in Pancreatic Islet Cells

Anselmino, Herold and Hoffmann[1,2] claimed in 1933 to have demonstrated a "pancreotropic" activity of pituitary extracts. Their claims rested on experiments in which a crude extract of the pituitary body was injected into young rats; in a few days an increase in the number of the islets of Langerhans was observed. The increase in islet tissue was ascribed to the action of a substance normally present in the pituitary gland. These observations were confirmed by several authors[3,4,5], and denied by others[6,7,8]. The majority of the investigators based their conclusions on anatomical and morphological variations of the pancreas islets, a somewhat subjective method of appreciating quantitative changes. The individual variations in the disposition and volume of the islets in the animals usually employed are unexpectedly large, and opinions based on inspection of microscopic sections, even serial sections, are unreliable. Richard-

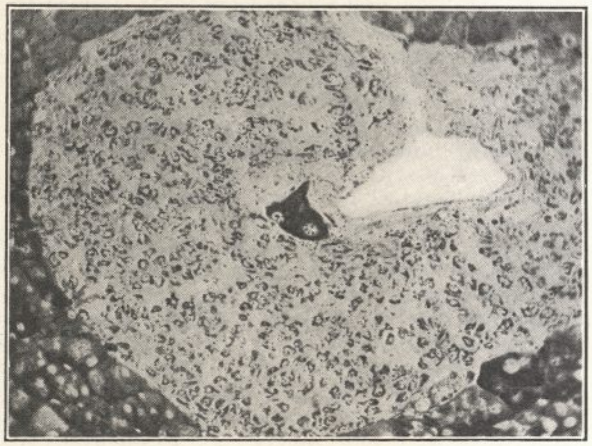

Fig. 1.

son and Young[9] have applied a quantitative method of estimating the ratio of islet-acinar tissue for Wistar rats, and have found that the mean value of this ratio in animals treated with a saline extract of fresh pituitary gland is double that of normal rats, a difference which is statistically significant. Extracts prepared by the methods used by Anselmino had no such effect.

Pituitary hyperplasia accompanied by enlargement of the islets of Langerhans can be brought about by the prolonged action of œstrogenic substances[10]. Material suitable for the study of fine changes in the islet cells, changes which may be an index of endocrine activity, can thus be easily obtained. I am indebted to Dr. Gye for providing tissues of many mice of diverse age, of several strains and of both sexes, which had been treated with œstrogenic substances during variable periods of time, but always at least several months. Many of the animals examined presented pituitary enlargement with hæmorrhages; in others the hyperplasia was not so pronounced, but cytological modifications were always the same and suggested the existence of states of hyperfunction. Some of the animals bore malignant tumours, mainly mammary carcinoma.

The cytological alteration found in these animals to which I wish to direct attention is the presence,

Fig. 2.

in *every* cell of *all* the islets of Langerhans that have been examined, of a hypertrophic Golgi apparatus of a size never observed in the normal mouse. The normal Golgi apparatus consists of a number of threads in the vicinity of the nucleus, sometimes forming a tightly threaded network; in mice treated with œstrin it appears as dense thick regular threads in the form of a loose net with clearly visible spaces, spread all through the cytoplasm of the cell (Fig. 1). Whilst the normal structure resists our methods of impregnation, the altered structure is easily rendered visible. We employ the Cajal formol-uranium method and with this technique failure to demonstrate hypertrophy of the Golgi apparatus in every cell of an islet is exceptional.

The cells of islets are generally notably increased in size, and sometimes cells with two or more nuclei are found. In such cells the Golgi apparatus reaches its maximum size, enveloping the nuclei and presenting excellent conditions for detailed study (Fig. 2).

It is interesting to note that Ludford and Cramer[11] found that in pregnancy the Golgi apparatus of the cells of the islets is frequently enlarged and conspicuous.

The presence of giant islets with or without acinar residues and the apparent formation of new minute islets cannot be accepted as proof of absolute increase of the endocrine portion of the pancreas; but we have found with relative frequency a type of architectural alteration which seems to be the result of proliferation of the insular cells. Instead of a structure of chains of cubic or prismatic cells, more or less regularly disposed around the capillaries, there are islets, especially the larger ones, in which the cells

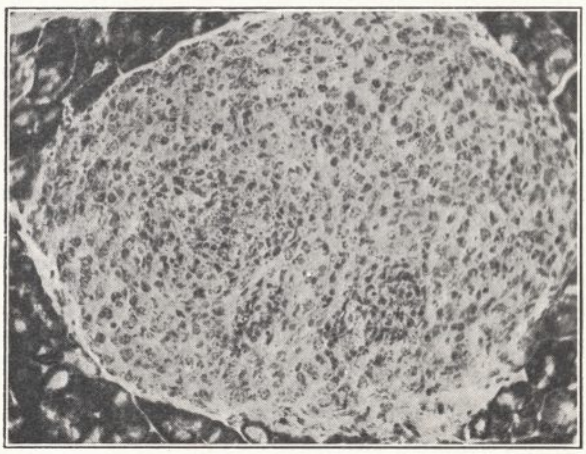

Fig. 3.

appear compressed and elongated by pressure of neighbouring cells, with nuclei ovoid in shape, homogeneous and intensely stainable. The disposition *en tourbillon* of the cells can be clearly appreciated when the section corresponds to a zone in which only a part of an islet seems to be affected, the nodules being especially shown up by their nuclear density from the tissue that is normal (Fig. 3).

Griffiths and Young[12] have demonstrated an increase in the insulin content of the pancreas of rats treated with œstrogenic substances. We think that the modifications briefly described above represent the histological basis of functional hyperactivity dependent upon excessive pituitary stimulation.

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[1] Anselmino, K. J., Herold, L., and Hoffmann, F., *Klin. Wschr.*, **12**, 1245-1247 (1933).

[2] Anselmino, K. J., Herold, L., and Hoffmann, F., *Z. deutsch. ges. exp. Med.*, **97**, 329-335 (1935).

[3] Bierring, K., *Bull. Hist. Tech. micr.*, **11**, 297-301 (1934).

[4] Chrzanwski, B., and Grzycks, S. J., *Klin. Wschr.*, **16**, 488-490 (1937).

[5] Fichera, G., *Pathologica*, **30**, 286-290 (1938).

[6] Elmer, A. W., Giedosz, B., and Scheps, M., *C.R. Soc. Biol.*, **124**, 823-826 (1937).

[7] Santo, E., *Z. deutsch. ges. exp. Med.*, **102**, 390-406 (1938).

[8] Wolf, R., *C.R. Soc. Biol.*, **131**, 315-317 (1939).

[9] Richardson, R. C., and Young, F. G., *J. Physiol.*, **91**, 352-364 (1937).

[10] Cramer, W., and Horning, E. S., *Lancet*, **1**, 247-249 (1936).

[11] Ludford, R. J., and Cramer, W., *Proc. Roy. Soc.*, B, **101**, 16-24 (1927).

[12] Griffiths, M., and Young, F. G., NATURE, **146**, 266-267 (1940).

Biological Effects of High-frequency and Magnetic Fields

SINCE diathermy first became a generally recognized method of treatment and especially after short-wave therapy was universally accepted, the controversy as to whether the heat effects alone account for the biological effects has not ceased. No other physical effect but heat has, however, up to the present been proved to exist while high-frequency currents are applied.

In the course of more than a year's work with an 'Inductotherm' short-wave diathermy apparatus it has become, by clinical observation, obvious to me that the magnetic field produced as well as the electric field was of some effect. An investigation of the effect of magnetic fields of different kind showed that small differences of potential and actual electric currents were produced inside biological objects very much after the principle of a dynamo, the biological object acting as the rotor.

The application of a concentrated magnetic field between the narrowly tapered poles of a D.C. magnet produces in a glass tube of 0·5 cm. diameter electrical potential differences if a salt solution or blood is pumped through it. With a D.C. magnet of 5,000 gauss and a velocity of flow of a salt solution of 60 cm. per second, potential differences of about 2 millivolt could be produced. This is well within the range of biological currents of the heart or the brain.

In the case of a D.C. magnet the production of electric currents within the tissues depends on the blood flow with the pulse. With A.C. magnets the changing of the direction of the field adds to the production of these currents. With high-frequency currents the magnetic field alternates so quickly, that the movement of a stream of liquid is no longer needed, and electric currents are produced also in capillary and lymphatic areas, even in non-vascularized tissues.

While with D.C. magnets electric currents of a certain direction can be produced, electric currents produced by A.C. and high-frequency magnetic fields cannot be directed, but originate more or less in the form of eddy currents. But the possibility of localizing diathermy and ultradiathermy makes it possible to concentrate the production of these electric currents in circumscribed areas or organs.

It seems certain that these magnetically produced electric currents play a part in the effects of diathermy treatments. They probably account for the immediate relief of pain in some cases, long before any measurable rise of temperature in the tissue occurs. The production of electric currents inside the tissue differs from the ordinary external application of electricity exactly in the same way as the production of heat in the tissue by diathermy differs from externally applied heat.

Biological and clinical investigations along these lines have been started.

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The Existing Coelacanth Fish, Latimeria

IN my review of Prof. J. L. B. Smith's account of the existing Coelacanth fish, Latimeria (NATURE, July 13, 1940, p. 53), I remarked that the fins appeared to agree with those of the fossil Coelacanths in all respects except the considerable extension backwards of the membrane of the anterior dorsal fin.

According to the annual report of the South African Museum for 1939, the dried fish has been prepared anew with great skill by the Museum's taxidermist, Mr. James Drury, and it is now evident that such an extension of the anterior dorsal was deceptive. All the fins of Latimeria, therefore, are of the normal Coelacanth type. As shown by the photograph published in the report, Mr. Drury has made an excellent restored cast of the fish, of which it will be possible to distribute copies. There seems to be only one small feature open to criticism—the bifurcation of the rays in the hinder portion of the pectoral fin. All the fin rays hitherto observed in Coelacanths are simple rods, and those preserved in the specimen of Latimeria are likewise without any distal sub-division.

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RESEARCH ITEMS

Pueblo Indian Irrigation Systems

An attempt to reconstruct the methods of irrigation developed by the Pueblo Indians, the earliest agriculturists among the indigenous inhabitants of the United States, in cultivating the arid lands of the south-west in the period preceding the Spanish conquest, has been made by Guy E. Stewart (*Scientific Monthly*, **51**; 1940) on the evidence mainly of an examination of ancient sites of cultivation, more especially the famous Mesa Verde, where early abandonment places Old World influence out of the question. Here the Far View group of ruins is near the upper end of an unusually complete unit of flood water irrigation which begins from a circular reservoir for flood water now known as Mummy Lake. This supplied cornfields and check dam areas along the Mesa top by a primitive ditch. Deposits of silt 10 ft. deep in the Lake indicate use over a long period. Evidence along the ditch indicated where water might have been turned off to the cornfields and where additional water might have been picked up. The cross-section of the ditch is broad and flat, and the ditch has a remarkably uniform grade. Two areas of garden check dams were located adjacent to the flood water ditch. The check dam type of village gardens is a characteristic of agriculture at Mesa Verde. They vary widely in size, ranging from 6 ft. × 9 ft. to 35–40 ft. wide with a cultivable breadth of 10–15 ft. All have a definite type of construction with the corner of the dam well toed in to the bank to give stability. Most of these were built on rock ledges. The entire length of the flood water supply ditch from Mummy Lake to the lower check dam area measures approximately four miles. The purpose of the system was evidently water conservation. Evidence of similar or analogous systems has been examined on the Rio Grande and Gila Rivers.

Infra-Red Transmission of the Human Body

C. Hawley Cartwright, John Daniel and Alex Petrauskas, of the Massachusetts Institute of Technology, described experimental research on this subject in a paper at the annual meeting of the U.S. National Academy of Sciences during April 22–23. The percentage reflection and transmission of a human cheek was measured as a function of wave-length in the visible and infra-red spectra. Absolute values were obtained to 12,000 A. by using a special photocell and an integrating sphere, for collecting all the light. The reflection of the cheek reaches a maximum of about 50 per cent in the visible red and gradually decreases for longer wave-lengths. The cheek (10 mm. thick) is opaque below 6050 A. and increases its transmission linearly to about 2 per cent of that entering the skin at 7000 A. Between 7000 A. and the water absorption band at 10,000 A., the transmission is rather uniform. Beyond 10,000 A., the transmission rises, reaches a maximum value of about 3 per cent at 11,000 A. and decreases to zero beyond 13,500 A., due to the water absorption. Using as a control a bearable discomfort on the outside of the cheek, measurements of the temperature rise inside the mouth were made using various sources of radiation. The best of these was a tungsten lamp with a water filter. An increase in temperature of 3° F. was obtained inside the cheek without external discomfort.

Indian Copepods

Dr. F. Kiefer, in a handsome monograph, has described the copepods collected by the Yale North India Expedition, which made a speciality of the study of the lakes, tanks, ponds and pools in the area investigated (Freilebende Ruderfusskrebse (Crustacea, Copepoda) aus Nordwest und Südindien (Pandschab, Kaschmir, Ladak, Nilgirigebirge), by Friedrich Kiefer, Karlsruhe (Baden). Scientific Results of the Yale North India Expedition. Biological Report No. 19. *Mem. Indian Mus.*, **13**, Part 2; 1939). The bulk of the work is confined to systematics and descriptions of the species with careful drawings, but there is included a detailed account of their ecology and geography and a list of the free-swimming freshwater copepods of India. A key is given of the males and females of the species of the genus Neodiaptomus Kiefer (six in all). 27 species of copepods were collected, 10 of which are new. Most of them are from altitudes ranging from 1,000 to 5,000 metres. Eucyclops (a separate genus according to Kiefer, but regarded as a sub-genus by Gurney and others) has a world-wide distribution. In the present work three species are recorded. A recent contribution to the study of these forms is by K. Lindberg (Cyclopides (Crustacés, Copépodes) de l'Inde. III. Une Revision des représentante indiens du sous-genre *Eucyclops* s.str. (Groups *serrulatus*.) *Rec. Indian Mus.*, **41**, Part 4; 1939).

Peculiar Water Relations of a Diatom

In a recent publication D. Bhatia (*Proc. Roy. Soc. Edin.*, **60**, 245; 1940) has continued the study initiated by Gross of the remarkable water relationships of the diatom *Ditylum Brightwelli* (West). This diatom plasmolyses rapidly in isotonic and hypotonic sodium chloride and sugar solutions and also, more slowly, in sea water in the dark. Weak concentrations of urethrane produce effects similar to those produced in the absence of light, namely, delayed plasmolysis and immediate recovery on return to normal conditions. Inhibition of oxidative processes by treatment either with cyanides or sulphides causes immediate plasmolysis, and the subsequent recovery on return to normal is delayed if the oxygen inhibition is prolonged beyond 8–10 hours. Similar effects are obtained in 'reduced' sea water. Absence of light is without effect in this relation of oxygen deficiency to plasmolysis. The effects of alcohols do not resemble those of light or oxygen deficiency, for plasmolysis is incomplete or else the effects are destructive. Their effectiveness follows the series methyl < ethyl < butyl < amyl < octyl. Rapidly formed 'artificial' resisting spores (plasmolysed cells) recover partially in the absence of light before beginning to shrink again, as also do spores under anaerobic conditions. 'Exhausted' resting spores (plasmolysed in the dark) never recover. Resting spores formed under oxygen deficiency recover partly if oxidation is restored but assimilation prevented. It is suggested that under normal conditions turgor is maintained by secretion

of cell sap at the expense of energy released by respiration. An energy-precursor, produced during assimilation, is also necessary. With the inhibition of assimilation (darkness or urethrane) this energy-precursor is reduced, and after using up its store in 15–20 hours the cell begins to plasmolyse. Inhibition of oxidation, on the other hand, causes immediate plasmolysis owing to the withdrawal of the necessary energy. Recovery consists of two stages : an initial anaerobic process dependent on the presence of energy-precursor and connected with change in state rather than volume, and the subsequent complete recovery which depends on the presence of oxidative processes.

Unequal Breaks in Sister Chromatids

M. Demerec and E. Sutton (*Proc. Nat. Acad. Sci.*, **26**, 532–536 ; 1940) show that, as a result of X-rays, one of the two sister chromatids may be broken at one point, while both chromatids are broken at a second point in the same chromosome. Females of a strain of *Drosophila melanogaster* which were heterozygous for *dm* had diminutive bristles, and some showed mosaic spots covered with wild type wing bristles. Cytological observation confirmed the supposition that a chromosome rearrangement involving *dm* and heterochromatin had taken place. Further investigation showed that one chromatid of the *X*-chromosome has a deficiency involving changes of several known gene loci, while a slightly shorter segment has been translocated from the sister chromatid to the fourth chromosome. It is believed that one electron hit produced all the changes noticed.

Aleutian Islands Earthquake

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of August 22 at 3h. 27m. 18s. G.M.T. from reports received from twenty seismographic observatories. The epicentre appears to have been at lat. 51·9° N., long. 164·9° W., which is in the Pacific Ocean to the south of Unimak Island in the Aleutian Islands group. This is a continuation of the seismic activity previously reported in the Aleutian Islands, though it is somewhat to the east of other recent earthquakes in this neighbourhood. An earthquake was recorded at Kew Observatory on August 22 at 3h. 39m. 3s. G.M.T., attaining a ground amplitude of 84 μ at Kew, and provisionally estimated at Kew to have taken place 8640 km. away.

Reaction between Chlorine and Nitric Oxide

The combination of nitric oxide with chlorine : $2NO + Cl_2 = 2NOCl$, has always been considered a homogeneous termolecular reaction, but E. M. Stoddart (*J. Chem. Soc.*, 823 ; 1940) finds that it can be considerably influenced by surface conditions and hence concludes that it is really heterogeneous in character. The nitrosyl chloride, by adsorption on the walls of the vessel, can inhibit the reaction so that it ceases altogether. The kinetic experiments can be interpreted by assuming that the nitric oxide associates to $(NO)_2$ on the surface, and the complex may or may not undergo homogeneous reaction with chlorine according to whether the complex molecule has or has not been stabilized by the surface of the reaction vessel, the latter being assumed to be composed of active and inactive portions. The unusual assumption that the surface and gas phase are not in equilibrium, is also necessary to explain the results.

Scale Formation in Electric Water-Heaters

In an article on electric water-heaters by J. F. E. Edgell, consumer's engineer to the City of Gloucester, in the *Electrical Times* of October 3, it is stated that the storage capacity of a 1½ gallon cylinder can be reduced by scale to a ¾ gallon capacity in a period of service of only one year. Illustrations are given of severe practical examples of scaling. Last July, J. I. Bernard read a paper to the Institution of Electrical Engineers on this subject, in the discussion of which Mr. Edgell took part ; the paper and discussion are published in the October issue of the *Journal* of the Institution. Mr. Bernard referred to the usual classification of water as hard and soft, the former being distinguished by a small content of lime which is deposited in the form of 'scale' on heating. Soft water, on the other hand, frequently contains traces of carbonic acid, and when heat is applied it is liable to corrode base metals, such as iron and lead. Hence the prevalent use of copper for hot-water storage vessels in soft-water districts, in contrast to the use of iron tanks where hard water is encountered. Analyses of scale deposits show a variety of salts, principally calcium carbonate and also calcium sulphate, magnesium hydrate, etc., most of which are not precipitated until a temperature of 180° F. is reached. Mr. Edgell stated that while this is most probably correct for most salts, a lot of precipitation occurs at a much lower temperature. He submitted also that the temperature at which liberation of the carbon dioxide gas occurs is governed to a large extent by the turbulence of the liquid. The liberation of carbon dioxide is, of course, the root cause of scale formation.

Theory of Nuclear Resonances

G. Breit, of the University of Wisconsin, discussed this subject in a paper at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. He pointed out that pronounced resonances are observed in a number of nuclear reactions, and it is customary to interpret these as due to the formation of temporarily stable states of the compound nucleus. While this qualitative picture is applicable in many cases, its quantitative validity is doubtful. Some limitations of the 'dispersion' treatment which become apparent when the wave equation is treated accurately are as follows : (*a*) Coupling through the field changes the position of the levels in addition to the Dirac frequency shift. (*b*) The same energy level should not show peaks at the same energy in different reactions. Shifts of the order of the level width are expected. Sufficient conditions for the absence of shifts are known. (*c*) The combined effect of several levels shows itself in interference in both the numerator and denominator of a fraction. (*d*) Neither the regular nor the irregular (F, G) solutions of the radial wave equation are universally applicable to the computation of mean lives of compound states. Green's function for two and more dimensional separable problems is used for an estimate of competitive effects of nuclear excitation. Additional justification is given to the form of dispersion theory worked out by Wigner and Breit.

EVACUATION OF THE VERY YOUNG

THE further report on evacuation (Evacuation: the Under Fives. August 1940) by the Evacuation Committee of the Association of Architects, Surveyors and Technical Assistants deserves wider attention than it appears to have yet received, particularly in view of the determined policy of evacuation urged by Lord Horder and the statement of Mr. Malcolm MacDonald, Minister of Health, to the House of Commons on October 17. Mothers and children, he said, are leaving London at the rate of several thousands a day. Already about 489,000 school children or some 56 per cent of the school children in the London evacuation areas had left, and 300,000 out of 500,000 in the L.C.C. area had gone to reception areas.

This movement, which gains part of its present importance by the indirect consequence of reducing the demand for deep shelter and the risk of overcrowding, removes to safer areas some of those most liable to dangers to health which attend nights in deep shelters, apart from the special risks of overcrowding. From every point of view their removal out of London is to the good, but as was shown in the report to the Fabian Society edited by Richard Padley and Margaret Cole entitled "Evacuation Survey" (see NATURE, October 5, p. 439) the evacuation of very young children presents special difficulties and problems. The present report makes a very definite contribution to an acute problem, and adoption of its recommendations should prevent a number of the mistakes made in the earlier evacuation being repeated as well as offer safeguards for the health of those going to the reception areas.

The report points out that in August some 750,000 babies, belonging to about 500,000 mothers, were in dangerous areas, as well as more than a million children between two and five. Any evacuation scheme to the relatively safe areas must be based on a thorough re-zoning of the British Isles by competent military and civil authorities taking into account both types of dangerous area. The failure of the first scheme is attributed to lack of consideration for the psychology of family life, coupled with a lax definition of safety areas, the absence of satisfactory arrangements to accommodate mothers with young children, and the placing of the responsibility for carrying out the scheme on local authorities who were not sufficiently interested or qualified. The principle of evacuation was not at fault. Failure of the general scheme as a whole was due to insufficient understanding of the problems which are involved and refusal to deal with the many deficiencies that appeared by financing a workable scheme.

The scheme put forward in this report is founded on the belief that no baby under two years old should be sent away from its mother unless in special circumstances a close and suitable friend can be found to act continuously as a foster-mother. Most two- to five-year olds can be successfully separated from their parents if a mother substitute looks after them in small groups. Groups of four or five children may be joined together in school units of not more than twenty children.

An evacuation allowance should be available for mothers of babies under two or of several children under five, so that they have a free choice of whether to evacuate or not. Evacuated mothers must have independence in managing their own families and must be fully used in caring for other unaccompanied children. Visits by husbands must be possible, and for this purpose reduced fares and overnight accommodation must be provided. Temporary day nurseries must be set up for all children under five in the dangerous areas as part of the organization for evacuation and to establish confidence in it. Welfare centres and young people's hostels will also be required for members of the family who are left behind. Local authorities in the dangerous areas should be empowered to act equally with those of the reception areas in initiating evacuation arrangements.

The second essential is proper accommodation in the reception areas. The only way of evacuating mothers and young children immediately is into group billets, and accordingly it is proposed that the large country houses in safe areas should be immediately requisitioned for the reception of three quarters of a million mothers and children under five. A building programme is also essential. This should be carried out in stages; first, making all suitable existing buildings usable; second, providing sleeping and feeding accommodation; and third, the provision of day crèches, playrooms and staff accommodation. The report suggests that less alteration than is often supposed will be required for the large houses. The extra sleeping and feeding accommodation to be constructed includes family cottages and hostels for mothers and babies, and sleeping and feeding sections of residential nursery schools for children of two to five years.

This building programme avoids, to a great extent, using materials which are imported or urgently wanted for war purposes, and skilled site labour. An adequate quota of materials and labour must, however, be made available by the Government. The whole cost of the scheme is estimated at £100–£140 millions, and this expenditure would have important results in morale and organization during the War as well as provide permanent assets to the community.

The second part of the report gives details of the recommended planning standards for the new buildings proposed with detailed suggestions for economy of available materials in construction and sketches of typical designs for the alteration of existing country houses and the erection of family cottages for two mothers and children, a hostel for twelve mothers and children, a day crèche for twenty children under two years old and a residential nursery school for forty children in two separate groups with a matron, two assistant teachers, eight foster mothers and a cook.

The report appears to represent exactly that type of positive criticism for which Mr. Bevin recently appealed and indicates the opportunity which still remains for retrieving past mistakes and profiting by them to build better.

TRANSFORMER INSULATING OILS

A USEFUL paper on transformer insulating oils was read by B. Calvert before the Sheffield Section of the Graduates and Students of the Institution of Electrical Engineers last year and is now printed in their *Quarterly Journal*.

Mr. Calvert points out that Faraday appears to have been the first to examine oily liquids for their insulating properties. The first commercial use made of his discoveries was in connexion with telegraph cables, for which rosin oil was employed. With alternating current transformers, the high temperatures used in practice made rosin oils unsuitable because of the formation of sludge and rapid evaporation of the oil. Thus modern transformers are usually immersed in mineral oil, which is freer from these disadvantages.

Quite recently a synthetic oil patented under the name of 'Pyranol' has been found excellent for insulating purposes and is extensively used in America. The crude oils from which insulating oils are derived can be divided into three types: first, those having a composition of more than 66 per cent of paraffins, that is, saturated open-chain fatty hydrocarbons, such as Pennsylvanian oils; secondly, those consisting of more than 66 per cent of naphthenes, such as Russian oils; and thirdly, those having not more than two-thirds of either paraffins or naphthenes in their composition, such as Rumanian and Texas oils.

The insulating oils obtained from these crude oils are separated by fractional distillation and then purified with sulphuric acid; the tarry deposit resulting from this treatment is removed. The oil is then washed with caustic potash and water to remove any trace of acid. In order to remove the last impurities, such as fibres and dust, from the oil it is finally centrifuged and filtered before dispatch.

The cooling of a transformer depends principally upon the viscosity of the oil used, on which depends the convection currents; the transference of heat being more rapid with low viscosity. Unfortunately, as the viscosity decreases, flashpoint decreases and volatility increases. Thus a compromise has to be made since loss by evaporation is objectionable and fire risk should be as small as possible. Besides these properties, the oil must remain fluid at the lowest temperatures likely to be met with when the transformer is off load. The temperatures at which oils cease to be fluid vary considerably, some congealing at about the freezing point of water, others requiring a temperature lower than $-40°$ C. Two further important attributes of a transformer oil are maximum resistance to the formation of sludge and acid when in service. In Great Britain the principal requirements have been defined and standardized by the British Standards Institution in specification No. 148/1933 entitled "Insulating Oils for Electrical Purposes other than Cables". It also describes the methods of test and the apparatus required.

The oil deteriorates under working conditions, and it is the manner and results of this deterioration that are of moment to the engineer using the transformers. From this point of view the most important characteristic is the variation of the electric strength. The presence of water and particles of solid matter in the oils have the effect of lowering the breakdown value. For example, a mixture of 4 c.c. of water with 3·74 mgm. of fibre in 10,000 c.c. of oil is sufficient to lower the electric strength of a clear dry oil from 100 kilovolts to 37 kilovolts, although both water and fibre are in a pure state. It should be noted that oil absorbs moisture from the atmosphere and therefore, if possible, the filling of transformers or other apparatus with oil should not be done on wet days.

Pyranol is widely used in the United States, especially for indoor and traction work, because of its non-explosive and non-inflammable characteristics. Owing to the removal of the restrictions as to the use of fire-proof vaults, etc., the cost of the Pyranol-filled transformer is generally cheaper than the oil-filled installation. Owing to the high cost of pyranol, it is not thought that it will be widely used in Great Britain, at least for the present. Mr. Calvert thinks that there are cases where its use may be justified. In boiler houses air-cooled transformers have been installed owing to fire risks. In many cases pyranol transformers would be a better substitute, and on economic grounds alone would probably be justified.

ELECTRIC STRENGTH OF SOME SOLID DIELECTRICS

IN connexion with the theory of the breakdown of solid dielectrics, the British Electrical and Allied Industries Research Association has made a helpful technical report* discussing important theories which have recently been advanced, and describing methods by which the 'intrinsic' electric strength of solid dielectrics may be defined and evaluated. It is shown that the magnitudes of, and the effect of temperature and thickness upon, the electric strength of certain crystals agrees with Fröhlich's theory of electronic breakdown. The effect of disordered structure and microstructure also agrees with it in similar instances. On the other hand, departures from theory occur with complex organic dielectrics, and also with crystals when certain limits, for example, of the temperature of the material, are exceeded. Some observations are also made on the effect of temperature and electric stress upon the conductivity of the material.

The object of the present report is to amplify a previous note by A. E. W. Austen and W. Hackett (NATURE, April 15, 1939; p. 637). Experimental values of the electric strength of certain solid dielectrics are compared with the values predicted theoretically from the known structure of the materials. The electrical breakdown is often influenced by the thermal and special electrical conditions

* Tech. Report, Ref. L/T 114: The Electric Strength of Solid Dielectrics in relation to the Theory of Electronic Breakdown. Pp. 18+9 plates. (London: British Electrical and Allied Industries Research Association.) 3*s*.

under which the test is made; for example, the breakdown due to discharges in a surrounding medium or due to thermal instability. For the present purpose, the electric strength measured must be independent of such conditions. It appears that a type of breakdown which is a property only of the physical nature of the dielectric and its temperature exists, and may be defined. It has been called intrinsic breakdown, and the corresponding field strength is termed the intrinsic electric strength.

Intrinsic breakdown should possess the following properties: (*a*) it should be independent of thickness over a fairly wide range; (*b*) it should be independent of the nature or duration of the electric stress, provided no appreciable change of temperature occurs as a result of the application of the electric stress, and provided the duration is sufficiently long; (*c*) the actual discharge should occur wholly within the dielectric and in the region where the field is most intense. In the experiments it was found convenient to satisfy certain further conditions.

Attempts have been made to identify intrinsic breakdown with various mechanisms. Fröhlich has examined mathematically the equilibrium of an electron in a solid. His theory shows that beyond a certain critical field-strength an electron may gain energy from the field, and will eventually ionize the lattice. The following deductions can be made from Fröhlich's theory: (*a*) breakdown should increase with temperature for materials having a low Debye temperature, and be practically independent of temperature for substances with a high Debye temperature; (*b*) the electric strength should be independent of thickness until the thickness approaches the order of the electronic mean free path, when the electric strength should increase with decrease of thickness.

Many interesting experimental results on mica and on glass, both plain and coloured, are given. The report concludes that it has been shown that the electric strength of certain solid dielectrics may be defined in such a way that it is independent of the immersion medium, if any, of the shape of the specimen, of the nature of the electrodes, of the nature of the electric stress provided the maximum value persists for a period of a few micro-seconds, and of the thickness, within certain limits. Excellent diagrams are given showing comparisons between experimental and calculated values, the agreement of the variation of conductance with temperature, and the electric strength of clear ruby muscovite-mica.

Based on this report, a paper by A. E. W. Austen and S. Whitehead on the same subject has been communicated to the Royal Society, and is published in the *Proceedings* (A) of August 28, 1940. It describes some recent measurements of the intrinsic electric strength of certain solid dielectrics. This property of homogeneous solid dielectrics is defined, and methods of measurement suitable for a wide range of materials and conditions are described. A comparison of experimental results with Fröhlich's theory yields the following conclusions: (*a*) the electric strengths of mica, quartz, potassium bromide, and other alkali halides agree with the theory; (*b*) the effect of temperature on the electric strengths of mica and potassium bromide agree qualitatively with the theory, while for mica the agreement is also satisfactory quantitatively; (*c*) the electric strength of mica increases when the thickness is reduced to the order of a few mean free paths, and the agreement is quantitative to the accuracy with which calculation is possible; (*d*) fused quartz has a relatively higher electric strength than crystalline quartz, corresponding to the prediction of the theory that disorder increases the electric strength.

YELLOW FEVER AND ITS CONTROL*

In research on yellow fever to-day, the tiny chick embryo, both as minced tissue culture and as the whole embryo in the shell, is one of the most important of the experimental animals used; but man himself was the only useful experimental animal in the study of this disease until as recently as 1927. Research was thus impeded until that time by the reluctance to expose human volunteers to so dangerous an experimental infection.

The extensive history of attempts to learn how the disease was transmitted reveals, nevertheless, that numerous medical men, without thought to their own comfort or safety, performed the most unpleasant experiments upon themselves. A medical student of the University of Pennsylvania during 1802–1803 placed black vomit and blood serum from yellow fever patients in wounds made in his arms and legs and injected black vomit into animals. Other early experimenters exposed their skins to the soiled clothing, bedding, sweat, black vomit, tissues or blood of yellow fever patients.

In none of these experiments did the yellow fever 'take', and the evidence therefore seemed strong that the disease was not contagious. However, there was so much interest in the disease that a total of 556 articles on it are referred to by a writer of 1827, reviewing the literature since 1797.

Although generally accepted proof that a mosquito was the carrier of the disease was not established until the work of Dr. Walter Reed and his associates of the U.S. Army Yellow Fever Commission in 1900 and 1901, Dr. Carlos J. Finlay, of Havana, declared as early as 1881 that he was convinced a mosquito was responsible; and he pointed to the right species, namely, *Aedes ægypti*. Finlay used 102 human volunteers, who permitted themselves to be bitten by mosquitoes which had sucked the blood of yellow fever patients. That the few illnesses observed among his volunteers could not be accepted as yellow fever is due, Dr. Sawyer suggests, to the fact that Finlay did not let the virus incubate long enough in the mosquitoes before they bit the volunteers.

After Reed's brilliant work showed the way to successful control of yellow fever by eliminating the mosquito, no important new discoveries about the disease were made for another quarter century. This was partly because of the deaths of several human volunteers and the reluctance to use more.

Interest in the possibility of immunization was aroused when, in 1927, Drs. A. Stokes, J. H. Bauer and N. P. Hudson, while making investigations in West Africa, discovered that Asiatic monkeys,

* From a paper by Dr. Wilbur A. Sawyer read on September 17 at the Bicentennial Conference of the University of Pennsylvania.

including the common rhesus monkey, were susceptible to yellow fever. Monkeys were immediately used in the research laboratories to study the disease, but during the first few years of this work many scientific workers became infected and several died. Since the development by Drs. Sawyer, W. Lloyd and W. A. Kitchen in 1931 of a vaccine with which all members of the Rockefeller Foundation yellow fever staff are inoculated, there have been no accidental infections among this group. The vaccine consisted of virus cultivated in mice and when injected was accompanied by a protective quantity of blood serum from people who were immune to the disease.

A curious characteristic of the yellow fever virus which has proved of value in developing vaccines is its manifestation of two types of virulence, namely, 'viscerotropism', meaning that it attacks such viscera as the liver, kidneys and heart, and 'neurotropism', meaning that it damages the nervous system. As the virus occurs in Nature it is capable of inflicting both kinds of damage and is therefore said to be 'pantropic'. But man ordinarily suffers only the viscerotropic attack—in his liver, kidneys and heart. The mouse, on the other hand, is susceptible only to the attack on the nerves, and after long passage through a series of mice the yellow fever virus becomes almost purely neurotropic, that is, capable of attacking only nerve tissue and having little power to damage viscera. It was such a modified virus strain that was thought safest to use on man as a vaccine, since man was thought to be relatively resistant to the neurotropic attack. Nevertheless, immune serum was given with the vaccine to prevent the possible occurrence of a yellow fever encephalitis (brain inflammation).

The next step was so to modify the virus strains that they lost their affinity for the nervous tissue also, and this was attempted by growing the virus in culture media consisting of chick embryos from which the brain and spinal cord had been removed, so that the virus had no nerve tissue on which to grow. The strain thus produced actually has a low virulence for nerve tissue as well as for viscera, and it seems to have undergone a permanent 'evolution' in this direction, for it can now be grown on chick embryos containing the nerve and spinal cord without increasing its virulence for nerves. It is not known, however, whether the fortunate radical change in the virus was due to the absence of brain and cord tissues from the tissue cultures or to an unknown factor. At any rate, this vaccine, produced by workers in the Rockefeller Foundation, and known as 17 *D*, has been used to vaccinate more than a million people in Brazil with results pronounced 'on the whole very satisfactory'.

Another new angle of the yellow fever control campaign is the discovery that not all yellow fever is carried, as had been thought for many years, by the *Aedes ægypti* mosquito, which usually frequents the environs of towns and cities. Yellow fever has also been found in the wild areas of central Africa and South America. It is known as jungle yellow fever, and is probably carried by several species of mosquitoes and possibly harboured also by monkeys and other animals. If jungle fever reaches cities infested with the *Aedes ægypti* it can get into these mosquitoes and start an epidemic of the familiar urban yellow fever. Therefore mosquito control is still an effective weapon. In Brazil, this control includes putting fish in the cistern and water jars to consume the mosquito larvæ.

FORTHCOMING EVENTS

Tuesday, November 5

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, S.W.1), at 1.30 p.m.—Sir Leopold H. Savile: Presidential Address.

Wednesday, November 6

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (STUDENT SECTION) (at Bolbec Hall, Newcastle-upon-Tyne), at 6.45 p.m.—Mr. A. Lawson: "Marine Steering Gears".

APPOINTMENTS VACANT

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

ASSISTANT MASTER FOR PHYSICS AND BIOLOGY at the Queen's Royal College, Trinidad—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

ASSISTANT MASTER FOR CHEMISTRY AND PHYSICS at the Queen's College, British Guiana—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

ASSISTANT MISTRESS FOR MATHEMATICS IN MALAYA—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

LECTURER IN GEOGRAPHY, and a LECTURER IN PHYSICS—The Registrar, Portsmouth Municipal College, Portsmouth.

PERMANENT TECHNICAL ASSISTANT and a TECHNICAL ASSISTANT IN THE DEPARTMENT OF ECONOMICS—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

LECTURER IN ENGINEERING SUBJECTS in the Department of Mechanical and Civil Engineering and Building, College of Technology and Art, Rotherham—The Director of Education, Education Offices, Rotherham.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 21: The Swimming and Burrowing Habits of the Amphipod *Urothoë marina* (Bate). By Dr. E. Emrys Watkin. Pp. 271–280. 1*s*. Vol. 60, Part 3, No. 22: Random Paths in Two and Three Dimensions. By Prof. W. H. McCrea and Dr. F. J. W. Whipple. Pp. 281–298. 1*s*. 6*d*. Vol. 60, Part 3, No. 23: An Analysis of the Influence of Weather upon a Migratory Movement of Birds. By Prof. James Ritchie. Pp. 299–321. 2*s*. Vol. 60, Part 3, No. 24: Early Glacial Remains of Reindeer from the Glasgow District. By Dr. M. Macgregor and Prof. James Ritchie. Pp. 322–332. 1*s*. 3*d*. Vol. 60, Part 3, No. 25: The Effect of Increased Daily Illumination and of Reversed Day and Night on the Œstrous Cycle of the Mouse (*Mus musculus*). By Dr. R. A. R. Gresson. Pp. 333–343. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1410

Other Countries

U.S. Treasury Department: Coast Guard. Bulletin No. 28: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1938. By Floyd M. Soule and G. Van A. Graves. Pp. v+173. (Washington, D.C.: Government Printing Office.) [1410

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1939. Pp. 81. (Calcutta: Government of India Press.) [1410

Records of the Indian Museum. Vol. 42, Part 2: On the Systematic Position, Structural Modifications, Bionomics and Development of a Remarkable New Family of Cyprinodont Fishes from the Province of Bombay. By C. V. Kulkarni. Pp. 379–423. (Calcutta: Indian Museum.) [1410

Preliminary Annual Report of the Public Health Commissioner with the Government of India for 1939. Pp. iii+75. (Delhi: Manager of Publications.) 8 annas; 9*d*. [1410

Catalogues, etc.

The Wild-Barfield Heat-Treatment Journal. Vol. 4, No. 26. Pp. 10–22+iii. (Watford: Wild-Barfield Electric Furnaces, Ltd.)

Multipoint Temperature Indicator. (E. 15.) Pp. 4. Pyrometer Controller. (E. 17.) Pp. 6. Recording Pyrometer. (E. 19.) Pp. 6. (London: Negretti and Zambra.)

A Catalogue of Books and Periodicals on General Natural History, including a Selection on Hawking, Hunting, Shooting. (No. 580.) Pp. 40. (London: Bernard Quaritch, Ltd.)

OFFICIAL ANNOUNCEMENTS

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J. A. MAIR,
Director of Education.

Education Offices,
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THE INSTITUTION OF CHEMICAL ENGINEERS

EXAMINATION, 1941

Application forms (returnable December 16, 1940) and particulars of the Associate-Membership Examination for 1941, together with the Memorandum on "The Training of a Chemical Engineer" may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56 Victoria Street, Westminster, London, S.W.1.

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