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SOCIAL EDUCATION IN THE SERVICES

A GOOD deal has been said and written in recent weeks about education in the Forces, or the lack of it. It is generally agreed that something needs to be done, although there may be considerable difference of opinion as regards steps which might be taken.

Among the often conflicting evidence, particular weight must be attached to that of the men most concerned, namely those actually in the Forces. Among officers the complaint has been heard that army education is virtually non-existent, and men in the ranks have been heard to tell the same story. There are graduates in the ranks who will vouch that repeated inquiries after lectures have had no effect, and cases are even known of names having actually been collected for lectures which never materialized. Much of the complaint must, of course, be discounted as unavoidable. In addition to the static units, there are mobile units which are liable to very frequent removal about the country-side, and even the so-called static units must of necessity be moved on occasion. Removals such as these will naturally render more difficult the organization of army education, but they are scarcely an excuse for the conditions obtaining in some units.

There have been suggestions that the whole educational work of the armed forces should be organized on a compulsory basis, and recently there have been moves in this direction as regards one particular range of subjects. But in general the military authorities insist that the attendance of the men must be voluntary. Here a distinction must be made between the different types of instruction available. There are the purely training lectures, which, of course, must necessarily be compulsory. Then there are what may for convenience be termed vocational lectures, in subjects not directly connected with immediate military necessity, but likely to be of pecuniary advantage to the men on their return to civil life. Here, however, we are concerned much more with 'interest' lectures of no immediate military concern and of no likely financial advantage. Many people will be found to say that to take men away from their civil life and conscript them for military service, and then to hesitate to take an occasional hour of their free time for a lecture, is to swallow a whale and strain at a gnat. But there will be general agreement with the official view that men should not be forced to attend non-military lectures.

There is, however, among the men a considerable demand for voluntary lectures of this nature. Organizations, whose function it is to arrange lectures in different parts of the country for the civil population, report that men in uniform attend their lectures in considerable numbers,

although there is clearly not a trace of compulsion to do so. In fact, in some areas it has been known that the uniformed members of the audience have outnumbered the civilians. A major distinction exists in this respect between the three services. In general, shore naval establishments are so busy with purely instructional work that the men have neither time nor inclination for further lectures, and to a lesser degree the same is true of the Royal Air Force. But this is by no means true of the army. Vast numbers of men do not know what to do with their spare time. Granted that a certain amount of leisure is wisely spent on amusement, there still remains too much time on hand during which men would gladly be occupied. This state of affairs must inevitably lead to boredom, and one would expect it to be of major concern to the military authorities.

The main difficulty seems to be that although there is this desire among the men for lectures, the official machinery for translating the desire into the lecture does not in many cases function. Its efficiency, of course, varies much from unit to unit. Where the education officer is a man with his heart in his educational work, the possibility of organizing interest lectures will not merely be brought cursorily to the men's notice by occasional announcement or poster, but will be impressed continuously and actively upon them, and it will be emphasized that any request for a lecture will be listened to sympathetically and, where at all possible, granted. The crux of the matter is this need for the initiative to come from the ranks.

There is no doubt that a really determined seeker after enlightenment, who is prepared to persuade a few comrades to support him, can make it rather difficult for an education officer of a unit to refrain from arranging lectures. But is it fair to expect men to take such steps? And can we not readily understand if men feel that it may not react to their advantage to act in this way? Surely it should not be necessary for the provision of cultural lectures to depend upon the presence in a unit of men of rather exceptional initiative. It might be possible, for example, while retaining to the full the voluntary nature of the men's attendance, for education officers themselves to arrange attractive lectures for the men as an experiment. If as a result of experience it were found that men would not attend, other methods would have to be adopted. But all the evidence suggests that many would be glad of the opportunity of spending some of their spare time in this way.

There must be many bodies, national as well as local, which are able and willing to undertake interest lectures to the forces. On the biological side, such topics may be suggested as the human applications of biology, some of which are capable of presentation in a way directly concerned with the ideological struggle in which the men are engaged. The Nazi myth of an Aryan race of supermen, for example, could be used as a basis for anthropological lectures. Then there are all the problems of the history and development of the family, the entrancing subjects of evolution and heredity, in which there is widespread interest. On the physical and chemical side, the possibilities of dealing with applications are equally numerous, though care would of course have to be exercised to avoid making such lectures appear to be supplementary to instructional lectures at which attendance is compulsory; nevertheless, we believe that many soldiers would be quick to perceive the value of knowledge acquired by this means in their military duties. Geology should also provide good topics. A moment's consideration will show that outside the sciences also there are numerous opportunities of engaging interest. There is a far too common tendency to underestimate the intellectual level of the men in the Forces. It seems often to be assumed that so soon as a man dons khaki, he puts away all his normal mental interests and becomes a mere number. The army to-day is a fair cross-section of the younger civil population, and will have the same interests and intellectual level.

If, as is to be hoped, lectures become more easily available to the men, there will be a demand for lecturers which cannot be met from normal resources, and that will present to scientific men and others an opportunity to perform a most valuable piece of service to their fellows. There must be many who, under competent organizations, could give useful lectures; this applies with particular force to teachers, who have the vitally necessary training in presenting subjects in a simple and intelligible form. Moreover, there must be at present, in the armed forces themselves, large numbers of men who are excellently qualified to carry on this work.

It seems to be overlooked by those in authority that the present army is a body of citizens who are being trained for the purpose of defeating a specific enemy. It is not, and indeed cannot be, an army of professional soldiers. This is not meant in any disparaging sense, but solely to emphasize that the great majority of the men now serving are temporary soldiers, each of whom is looking forward to the time when, having defeated Nazism by force of arms, he can return to civilian life. He is entitled to expect that he shall be afforded opportunities of fitting himself to take his part as an earnest citizen in building up a new and better world order, and are only waiting for an opportunity to do so.

RECRUITMENT AND FOREST POLICY

AFTER seventy years of forest administration in India and Burma, and nearly forty years in some of the British Colonies, it is disturbing to realize how little the importance of the forest wealth of some of the countries in question is understood in Great Britain or by the responsible administration. The general attitude of administrators is apparently that forest property, especially great areas of tropical and semi-tropical forests, can be left to look after themselves when any period of stress, financial or otherwise, eventuates. These ideas are strongly entrenched in Government circles, particularly in London.

The present position with regard to the training of foresters is causing considerable concern. Whereas men taking certain technical degrees at universities are to complete their studies before being called up for military (or other) service, those taking a pass degree in forestry are not to be retained. This action has been taken apparently after referring solely to the Forestry Commission, which, being at present chiefly a spending department, has of necessity ceased recruiting. In reply to a recent inquiry the Ministry of Labour and National Service stated that the experience of the Central Register is that the demand for pass degree forestry men is almost non-existent. The Central Register has apparently been notified of only two vacancies for such men over the last six months, and both these were offered by the Sudan Government. The position with regard to the demand for agricultural students is of course very different.

The information thus conveyed is not even accurate. At about the time of, or slightly before, the offer of the Sudan appointments, the Punjab Government was offering two appointments for men possessing forestry degrees and was unable to obtain them. Further, the Colonial Office, though much slowed down, had not ceased recruiting. The recollection there was only too vivid, as it should be in India also, of the crucial difficulties in connexion with filling the ranks of forestry services after the War of 1914–18; and of the troubles which inevitably resulted from recruiting excessively large annual batches often inefficiently, because hurriedly, trained.

It may be asked, it being incontrovertible that the millions of the peasant agricultural populations are in one way or another dependent upon these great forest regions in the British Empire, whether ministers and their deputies responsible for the administration of these several countries really understand the position. The forest departments have been cut down, by allowing junior officers to join the Fighting Services and reducing annual recruitment. At the same time, it is well known that enhanced fellings are taking place to provide for military requirements. No forest, whatsoever its type, can stand this kind of treatment without serious deterioration. Moreover, such fellings are often, in the absence of the supervision of trained and responsible forest officers, put into the hands of uncontrolled timber contractors who have no other interest than to complete their contracts at whatever the cost in destruction to the forests.

Under the British system of Colonial administration, it is constantly reiterated that we are governing the countries in the interests of the people, and that when they are ready the government will be entrusted to them. But how are the forests being treated? What will be their condition when we make over this charge? The old Colonial policy was to give a long lease of a block or blocks of forests to a big timber company which paid a royalty, usually so much per tree felled; and it was considered that such arrangements were in the interest of the development of the Colony. Many fine forests have disappeared under this treatment—but their marketable value, that is, the money resulting, mostly left the country. Take, for example, Nigeria at the present time, and the valuable mahogany timber. Under present conditions, Government, that is, the people, obtain about £4 in royalty for a tree selling at present prices for more than £100—and much of this difference goes out of the country. Further, the forests so worked are not under the supervision of trained forest officers.

War does not stop the working of these tropical forests; it tends to enhance it. The staff requires additions, not cuts—as should be evident, if the case were rightly understood, to a wide-visioned administrator. It is not a question of planning ahead. Rather it is that of fulfilling a sacred obligation to the people we govern by handing down to their successors a better heritage; and that the present profits should be spent on the people themselves.

The Secretary of State for the Colonies recently said in the House of Lords: "Not only colonial trade but also colonial development in the widest sense will inevitably have to be regulated and controlled by Government much more than was necessary before the War." The position of forestry in the British Colonies may be commended to the personal attention of the Secretary of State.

DYNAMIC DEMOCRACY

Faith for Living

By Lewis Mumford. Pp. viii+248. (London : Martin Secker and Warburg, Ltd., 1941.) 7*s.* 6*d.* net.

WHEN President Roosevelt on September 3, 1940, in a broadcast to the United States, announced the outbreak of war, although two days later he proclaimed the neutrality of the United States, unlike President Wilson in 1914 he said that he could not enjoin neutrality of thought. The contrast is significant. Anglo-American co-operation has two aspects. There is first the community of ideals, of tradition and of thought. This is itself the firm basis for the second aspect—the practical measures of co-operation, the evolution of technical methods and of common policy in the face of a challenge to these common ideals and traditions, hammered out in part, at least, on the anvil of war.

The pace at which co-operation has advanced in this practical sphere from the establishment of the joint Canadian-American Defence Board in August 1940, the lease to the United States of British bases in the Caribbean and the Atlantic, the assumption by the United States in April 1941 of the responsibility for the defence of Greenland, the passage of the Lease-and-Lend Act, the Atlantic patrol, to the proclamation of an Unlimited National Emergency has tended to overshadow the first and fundamental aspect. That community of ideals and tradition has, however, been admirably illustrated and emphasized in successive speeches of President Roosevelt—for example, in those four reprinted under the title "Mr. Roosevelt Speaks" in the first of a series of pamphlets, "America Faces the War", issued by the Oxford University Press. They are equally displayed in the speeches of the late Lord Lothian, of Lord Halifax, of Mr. J. G. Winant, and notably in Mr. Eden's speech of May 29.

Mr. Eden's speech no less than Mr. Winant's notable address to the English-Speaking Union on May 14 reflected the depth of those common ideals and the firmness of the common resolve to defend them and to ensure that the four freedoms of which Mr. Roosevelt has spoken should be the lot of all men and not the privilege of the few. Mr. Eden indeed, after welcoming Mr. Roosevelt's message on the freedom of the seas as the condition of the continued existence of free nations everywhere, dealt chiefly with the third of those freedoms, namely, social security or freedom from economic want, and what it would involve in the days immediately after the War.

This fresh assurance to the world that the British Commonwealth means to co-operate with the United States in the creative task that President Roosevelt has described as his main purpose gives further point to the study of American history, institutions and traditions, particularly by the rising generation in Great Britain. Without at least an understanding of the American tradition, even scientific collaboration between the two countries—the pooling of information, the development of joint activities and the exchange of students and research workers, described by Prof. A. V. Hill in a recent article in *The Times*—cannot attain its full effect. A determined effort in this field is an essential for the fruition of the conception of American partnership with the British Empire in world leadership, of which the twentieth century has seen the birth.

Mr. Mumford's book now under notice is a valuable contribution to such a mutual understanding. Written in the United States and addressed exclusively to his own countrymen, as the author points out in a preface to the English edition, the first response has come from the British people. In the searching test of the summer and autumn of 1940, they set an example of what free men throughout the world must demand of themselves if any life worth living is to survive. Mr. Mumford's book throws a vivid light on the ideals and faith on which Anglo-American co-operation is based. It is a summons to realistic thinking and a challenge to action, rather than a statement of a creed or a faith upon which he insists all courageous and noble living must be based.

The moral cement that held democratic Western society together had practically disappeared by 1930, largely because the twentieth century inherited a morality for which it had never worked, which it had never examined or assimilated and which, accordingly, it was incapable of reproducing in fresh forms. This is, in Mr. Mumford's view, the fundamental cause of the drift, inertia and despair which have given Nazism its opportunity. That faith can only be countered effectively by one as strong and passionate, equally capable of fostering devotion and loyalty, and commanding sacrifice.

Mr. Mumford fully recognizes the role of reason and the significant contribution of science to human personality itself as the most effective method man has discovered for securing agreement in areas

where rational demonstration is possible. But he sees, too, how failure to take account of the material and spiritual needs of man has now endangered the world-wide co-operation upon which the growth of science, technical development and industrial wealth depends, and he writes scathingly of those who are blind to the values of truth, justice, freedom and love, which are the basis of society, and who can see only the destructiveness of war.

Mr. Mumford's searching scrutiny of the failure of the Churches is not unfair or unsympathetic to the values they represent, but he insists on the necessity for a central core of purpose, for a re-birth of the positive values of life, for a new and passionate loyalty to the spirit which gave the Churches their power, and the capacity for sacrifice which gives power to life. Searching for a new faith for living, Mr. Mumford does not indeed give us much more than this. His vision is wide and he sees life steadfastly and as a whole. He urges a return to a true regional, family and personal life and an economy of sacrifice instead of comfort. He indicates the opportunities which are ours, rather than points the way to a new faith. But his passionate sincerity makes his book as vital as his keen analysis and constructive thought. Like the Hebrew prophets, he mingles stern warning with a call to high endeavour, and the sanity and balance of the book should give it particular appeal to the many scientific workers who are already bending their efforts to the forging of firm links between the Anglo-Saxon democracies in their resistance to the gravest threat which the world has yet known to man's spiritual, moral and cultural heritage. Upon the response to that challenge may well depend the success of Anglo-American co-operation whatever form it takes.

R. BRIGHTMAN.

CHEMISTRY IN RELATION TO MEDICINE

Chemistry and Medicine

Papers presented at the Fiftieth Anniversary of the Founding of the Medical School of the University of Minnesota.
Edited by Prof. Maurice B. Visscher. Pp. vii+296. (Minneapolis: University of Minnesota Press, 1940.) 4.50 dollars.

IN 1939 the University of Minnesota Medical School celebrated its fiftieth anniversary. The committee of the Medical Faculty which had been appointed to draw up a scientific programme appropriate to the occasion decided to invite a number of distinguished men of science to deliver lectures upon different aspects of the single theme of "Some Trends in Medical Progress with Particular Reference to Chemistry in Medicine". The publication of these lectures in a single volume under the title of "Chemistry and Medicine" should be warmly welcomed by all those in Great Britain, research workers and teachers alike, who are interested in the medical sciences, and certainly will be by those who, like the writer of the present notice, believe that our own university medical schools would fulfil their proper functions of training medical students and of carrying out original research more efficiently if something of the American attitude towards the basic sciences —particularly towards chemistry—were adopted.

In his foreword to this volume the Dean of the Medical Faculty states that "this subject was chosen not because it is more important than other fields of medicine but because it represents one of the most recently developed and more rapidly expanding aspects of medical science". The view expressed in the latter half of this statement appears to sum up very well the general attitude towards the basic sciences which is found in the leading medical schools in the United States. Doubtless there would be few in the medical schools of Britain who would challenge its essential correctness, but while the Americans have the courage of their convictions and act in accordance with them, we have not and do not. Thus we pay little more than lip-service to the importance of chemistry and physics in our medical curricula; courses are provided in these subjects that are scarcely more suitable as a preparation for the study of biochemistry and physiology than are the ones provided in our secondary schools. We are, in fact, in grave danger of forgetting that the latter subjects, which may be said with considerable justification to form the basis of modern scientific medicine, have advanced so much during recent years that they can no longer be properly understood with only a schoolboy's knowledge of chemistry and physics. Considerable reforms in our medical curricula are clearly desirable and inevitably must be instituted sooner or later. It is perhaps not too much to hope that this University of Minnesota publication may indirectly expedite the institution of these much-needed reforms by bringing home to medical faculties of British universities the realization of the extent to which they have lagged behind the Americans in their attitude towards the more scientific aspects of medicine.

The fourteen articles which the volume contains are grouped under four headings : "Progress in the Application of Physical Chemistry to Medicine", "Some Recent Investigations in Metabolism", "Some Aspects of Immunity and Chemotherapy", and "Some Approaches to the Nervous Control of the Organism". All the articles are good and are packed with information, although in some the subject-matter is presented in a much more interesting manner than in others. The ones which the present writer particularly enjoyed reading were those by Prof. J. P. Peters on "Some Reactions by which Solutes may be Differentially Concentrated by the Kidney", by Dr. M. Heidelberger on "Recent Chemical Trends in the Study of Immunity", and by Prof. W. B. Cannon on "The Argument for Chemical Mediation of Nerve Impulses".

Prof. L. E. Smith's article on "Organic Chemistry in the Pursuit of Vitamin Research" contains an excellent and comprehensive account of recent chemical work on vitamins E and K. The article is so full of 'meat', however, that one cannot help wondering whether Prof. Smith's audience did not suffer slightly from mental indigestion. Prof. R. G. Green's article on "The Biology of Animal Viruses" will be valuable as a corrective to those who have too enthusiastically embraced the view that all viruses are chemical compounds rather than living organisms in the generally accepted sense of that somewhat vague term. It is difficult, however, to pass without comment Prof. Green's statement that "Work on crystallisation has fostered the general belief that viruses are relatively simple chemical compounds". Surely proteins the molecular weights of which amount to several millions can scarcely be properly described as "relatively simple chemical compounds".

Although not all the articles in this volume can strictly be said to be chemical in outlook, they form as a whole a most striking testimony to the value and importance of the recent contributions to medical knowledge made by chemistry, and in particular by American biochemistry.

G. F. MARRIAN.

THE GROWTH OF SCIENCE

A Short History of Science to the Nineteenth Century

By Charles Singer. Pp. xiv+400. (Oxford : Clarendon Press ; London : Oxford University Press, 1941.) 8*s*. 6*d*. net.

CONTEMPORARY events have given the study of the history of science a new and profound importance. It is evident that science is having cataclysmic effects on human society. The investigation of the nature and origin and possibilities of science, in addition to its advancement, has become an urgent necessity as a preliminary to any considered action for human betterment. The old antiquarian notions of the history of science have been submerged in a new living attitude to the subject, which has been forced forward by present needs.

For these reasons, the appearance of Dr. Singer's new book is particularly welcome. He has aimed at the presentation of the salient facts in the development of science from Græco-Roman times until the middle of the last century. He finds the origin of science in the struggles of early man with his environment. He instances the cave drawings of bison with arrows sticking in the heart, which record the beginnings of anatomical and physiological knowledge. The foundation of astronomy was associated with the development of agricultural societies, which require a calendar for the determination of the seasons for sowing and reaping. The very word geometry means 'earth-measurement', and the invention of numerical notation was associated with the development of commerce.

These, and many other examples, show the age of scientific activities, and how they are embedded in the evolution of man and his societies.

Dr. Singer is not satisfied with the definition of science as a body of knowledge. He remarks that history has shown repeatedly that a body of knowledge which is not in process of growth rapidly withers, and ceases to be science at all. Science must therefore be an active process. He points out that the word 'scientific' means by derivation 'knowledge-making', and no static definition of science as a body of knowledge is satisfactory.

Dr. Singer starts his history, however, with the Greeks, not because they were the first men of science, but because they were the first who were conscious of science as a distinct process. He treats the history of Græco-Roman science in four chapters. The first deals with the emergence of the idea of mental coherence in Ionia, and its development by the Pythagoreans and the

Athenians. The second contains an account of the work of Plato and Aristotle and their immediate successors, which he describes as a great adventure in search of unitary systems of thought. Then the work of the Alexandrians is analysed. The divorce of science and philosophy is noted, together with a failure of intellectual nerve.

In the Roman period, science became the handmaid of practice, and was accompanied by a general failure of intellectual inspiration. This was followed by an almost complete failure of knowledge during a whole millennium. Then there was a revival of humanism and an attempted return to the culture of antiquity. The downfall of Aristotelianism was accomplished at the start of the seventeenth century, and was accompanied by new attempts to give a synthetic description of the universe and Nature. The Newtonian mechanistic scheme and determinism were enthroned, and have endured until recently. Dr. Singer finds no change of method since the seventeenth century, but only an immense extension of scientific knowledge.

His comments on the relations between the Christian outlook and the development of science are very interesting, and are supported by excellent quotations from St. Augustine and other fathers of the Church. He discusses with unusual illumination the contributions of Syrian and Jewish scholars, and he shows how much of what passes as Arabic science was really due to them.

The stages of the change of ideas during the passage from pagan to Christian thought are most conveniently summarized in half a page. The fundamental premises of alchemy are epitomized in the same way, and there are similar summaries of Goethe's contributions to biology ; Schwann's theory of the cell, Claude Bernard's conception of the internal environment, and the origins of the theory of evolution.

Dr. Singer's learning is always exact, as befits the senior British historian of science. His book is full of fascinating information, and will at once become a standard work on the history of science both for the man of science himself and the general reader. J. G. CROWTHER.

STUDIES IN BACTERIOLOGY

General Bacteriology

By Prof. D. B. Swingle. Pp. xii+313. (London : Chapman and Hall, Ltd., 1941.) 16*s*. net.

THE method of presentation of a subject taught at every university by a writer of another nationality differs, of course, from that customary in Great Britain. It is only fair to say that the distinction may be more apparent than real, and that it is usually a question of manner, not of matter.

Prof. Swingle has a standing in his subject which transcends mere geographical boundaries. A textbook by him therefore on his own subject rightly arouses interest. He has drawn freely on his own experience in teaching and research in determining the lines on which he has drawn it up.

Micro-organisms are closely related to the whole problem of disease ; they play also an important part in the manufacture of certain industrial commodities, such as dairy products and alcoholic beverages, and incidentally the curing of tobacco. The importance of these relations explains why bacteriology tends to be given a secondary place in that it is usually considered from the angle of one or other of its effects or uses. Prof. Swingle rightly prefers to present the subject as a science in itself ; thus therapy alone is permitted a homogeneous and complete description. The details, helpful or otherwise, of the activities of micro-organisms in their practical aspect are by no means neglected but are given proportion corresponding to their importance.

"General Bacteriology" thus offers a systematic approach to the subject as a whole. The fundamental principles are fully covered and proper space allotted to the important aspects of classification, morphology, reproduction, growth, nutrition, relations to environment and the products of bacteria. After covering this groundwork, Prof. Swingle goes on to micro-organisms of soil, of water, air, sewage and foods, proceeding in natural sequence to discuss contamination of food, industrial micro-biology, and the relations of bacteria to disease processes, infection and immunity.

Prof. Swingle writes in a simple, straightforward style, easy and readable. The illustrations are adequate in number and in applicability. The book can be commended as a thoughtful and balanced presentation of the subject of bacteriology as a whole. J. GEOGHEGAN.

Entomophagous Insects

By Curtis P. Clausen. (McGraw-Hill Publications in the Zoological Sciences.) Pp. x+688. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 49*s*.

THE last thirty years, or thereabouts, have been productive of great advance in our knowledge of entomophagous insects. This accumulated information is largely the outcome of the increasing use made of the biological method of pest control, which has stimulated investigation of both parasites and predators. Mr. Clausen is a distinguished entomologist on the staff of the U.S. Department of Agriculture. His own studies have been mainly directed to the parasitic Hymenoptera and he is well qualified to write a book of this kind.

The subject-matter is arranged under the orders and families concerned, beginning with the Hymenoptera and ending with groups of lesser importance. The author adheres closely to the limits imposed by the title of the book, and consequently little or nothing is said regarding other carnivorous insects attacking various invertebrates, birds or bats or other mammals. As it is, the book is one of very considerable dimensions for so specialized a subject, but it is a veritable mine of carefully collated information. The extraordinary adaptations to various modes of life, and the great diversity of larval forms betrayed by so many of the insects under consideration, provide unique material for a most interesting biological story.

The book is one written essentially from an entomologist's point of view, and those who consult it will find therein a great deal of information that has not previously appeared in any manual. A feature of special value is the 46-page bibliography at the end of the last chapter. The general biologist who peruses its pages will feel some disappointment in the restricted treatment of the remarkable phenomena associated with insect parasitism and their theoretical implications. Notwithstanding this limitation, the author is to be commended on having written a valuable and, in some ways, unique volume. It is to be regretted, however, that it has been found necessary to price this work at so high a figure, thus placing it out of reach of many of the younger potential purchasers. A.D.I.

The West Highlands and the Hebrides

A Geologist's Guide for Amateurs. By Alfred Harker. Pp. xxiii+128. (Cambridge : At the University Press, 1941.) 8*s*. 6*d*. net.

THE West Highlands and Islands had a warm admirer in Alfred Harker, and it is therefore not surprising that he had long contemplated the writing of a book by which he might share his knowledge of the region. Unfortunately, Harker died before his project was fully completed, but with the help of others the book is now published in homage to his memory. A pathetic interest is attached to the biographical sketch of Harker contributed by Sir Albert Seward ; it was written shortly before his own death.

Harker's plan was to describe the region in terms which would appeal to travellers and others interested in geology and scenery. This has been accomplished in chapters arranged as a series of excursions, and his description of the richly varied character of its rock formations will prove useful to geologists and geographers alike. The volume is profusely illustrated by simple but effective outline sketches drawn by the author, and these have been augmented by the inclusion of geological and topographical maps. An excellent glossary meets the needs of the layman unfamiliar with the names of rocks and minerals.

There is little room for criticism ; but the editor's omission of Kimmeridge rocks in the table of strata may be noted and, like the reference to the Permian, a footnote might have been inserted to explain that the greater part of the Durness Limestone is of Ordovician age.

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1940. Edited by Dr. M. Epstein. Pp. xiv+478. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1941.) 35*s*. net.

SINCE 1758 the Annual Register has not failed to make its yearly appearance. The current volume maintains all the established traditions of the series. More than half the volume is occupied with the history of the year, first and in most detail British and Imperial, and then foreign history. For 1940 these chapters are virtually a history of the War and of Nazi intrigue. The story is told objectively. The remainder of the volume has the usual summary reviews of literature, art, finance and law, and obituaries of distinguished men and women. The public documents, printed in full, include notes regarding United States destroyers and naval and air facilities for the United States in British transatlantic territories ; Memorandum of Agreement with General de Gaulle regarding French Forces ; the Three-Power Pact of Germany, Italy and Japan ; and the Norwegian Government's White Paper of April 1940 on German Aggression in Norway.

British Museum (Natural History). Instructions for Collectors No. 4A: Insects

Compiled by Dr. John Smart, with the assistance of other Members of the Staff of the Department of Entomology. Pp. vi+164. (London : British Museum [Natural History], 1940.) 1*s*. 6*d*.

THIS little manual is a great improvement on its predecessor and, for its very modest cost, provides practically all the information likely to be wanted for collecting and preserving insects. A useful addition is the well-illustrated section dealing with how to recognize the main groups of insects, when to collect and how to collect. The book should do much to aid potential and other collectors in obtaining material of scientific value and preserving it in a manner enabling the best use to be made of it. It can be highly recommended also to university and college students and to school natural history societies.

SCIENCE AND FAITH

SIR WILLIAM BRAGG's Riddell Memorial Lecture on "Science and Faith", delivered before the University of Durham at King's College, Newcastle-upon-Tyne, on March 7, which has now been published*, will interest all who wish for harmony between the different spheres of human thought.

The 'natural knowledge' which has grown so amazingly in the last three centuries is not so distinct in character from other knowledge that it is to be considered entirely by itself.

"The whole knowledge at our disposal is far greater than our modern science, as the whole is greater than the part. It includes the observations of countless generations of men, their experiences of life and the record of their thoughts thereon and the comments of their interpreters and lawgivers, the histories of the actions of nations and individuals especially in relation to the faiths on which they have acted, all in fact that men have learnt since they first began to learn."

Modern science is only a part of this mass of knowledge. If it is a new chapter in our book of knowledge, does it throw light on the chapters that have gone before? Is it going to help men towards a solution of the great problem of the choice of an attitude to life? Men have adhered to certain faiths: does science affect their present choice of a faith? Such are the questions raised by Sir William Bragg in his lecture.

"I would describe Science", writes Sir William, "as a collection of observations of Nature. There is an old word 'observables' which aptly describes the facts that the scientist is on the look-out for. Science observes the observables, tries to see what is noteworthy and records it. Gradually a mass of knowledge is accumulated which is sufficiently stable and reliable, so that it is worthy of study and can be used safely."

The man of science as he works must draw temporary conclusions from what he sees because in so doing he finds guidance in the next effort of discovery. If he made no attempt to plan his work he would lose himself in a mass of uncoordinated facts; hence he must try to find correlations, rules and laws. To grasp what he has already got would be impossible unless he did this.

"He therefore makes hypotheses. But it is to be observed that all such hypotheses are tentative, and are to be amended constantly as knowledge grows. There is no finality in these attempts to draw conclusions. Some are more enduring than others, but it can never be said of any law formed and used by the scientist that it is good for all time."

Sir William Bragg supplies three notable instances of universally accepted and to all appearance permanently secure hypotheses which in due course had to be revised in view of new knowledge. Such were the atomic theory of matter and the Newtonian theory of gravitation. Yet in neither case, Sir William points out, was the work of those who formed the superseded theory wasted or wholly invalidated. Chemists can still work with the atomic theory, knowing that the chances of any atom breaking down while in their hands are so small as to be negligible. And though Einstein has shown that there is a point beyond which Newton's theory begins to lack perfection, the astronomer's work is not affected.

The third instance of a scientific theory which had to be modified is a fine example of this need to abstain from dogmatism, which science teaches continuously. In his "History of the Inductive Sciences" Whewell spoke of the undulatory theory of light as the perfect example of a true and complete theory since it not only explained all that was known but also continually predicted new phenomena which were then found to exist.

"Yet there came a sudden end to this certainty when the properties of X-rays were made plain, and it became certain that they and light itself had corpuscular as well as undulatory properties. When, however, the work of the long years of development of the wave theory was reconsidered, it was found to be still well done and without flaw: the light really was a wave motion. Yet the new discoveries cannot be readily explained on any but a corpuscular hypothesis.

"Here then is a case where not only was the accepted and trusted theory in need of modification, but there is the added complexity that two hypotheses which are both supported by quantities of excellent proof seem to be mutually exclusive. There is as yet no simple explanation, in the sense that no clue has been found which would lead simply from one hypothesis to the other. A mathematical formula can be found which covers the two cases, and that is all."

There is thus a position "which seems nonsensical and is nevertheless true". This surely is a test case of science's dislike of dogmatism.

* Science and Faith. By Sir William Bragg. (University of Durham: Riddell Memorial Lectures, Thirteenth Series, delivered before the University of Durham at King's College, Newcastle-upon-Tyne, on March 7, 1941.) Pp. 24. (London: Oxford University Press, 1941.) 1s. 6d. net.

Passing on to the other side of his subject, Sir William Bragg accepts the definition of faith found in Hebrews xi, 1, that it is "the substance of things hoped for, the evidence of things not seen", which he calls "an unforgettable sentence obviously full of earnestness and meaning". The Greek would appear to convey the meaning that faith consists in regarding as already actual, things which are only as yet hoped for, and in an assurance that things not yet seen are nevertheless real. The writer of Hebrews supplies a number of instances of persons who "died in faith", that is, lived until death without surrendering this attitude of mind and will. Thus Sir William's interpretation of the sentence is sound, namely, that the writer's faith, "the faith which he held himself and preached to others, was a hypothesis so firmly held and trusted that he would and did stake his life upon it".

Hypothesis is therefore integral alike to science and to faith, and so forms a link between the two, and this is being more generally recognized on both sides.

"It seems to me that in recent years the way of the scientist and the way of the seeker for a good way of life have come to have more features in common than in the past, more than is generally recognized. If the scientist was ever unduly dogmatic he has ceased to be so : this one-time self-assertion at a time within living memory was in no small degree a weapon of offence and defence which he felt himself compelled to assume. In part it was a mistake of his own making. I should think that the theologian's dogma is now becoming more and more like the scientist's hypothesis, so probable of course that he accepts it and acts upon it always. If the theologian says that I am not justified in my statement, I shall still suspect that the disagreement is subject to a misunderstanding."

His point that hypothesis is of the essence of science and faith alike is of such importance that perhaps it deserves to be examined more closely than the limits on his space enabled Sir William Bragg to do. Are the two hypotheses, that of science and that of faith, the same in kind, or is a radical distinction to be drawn between them ? The scientific hypothesis can be proved or disproved here and now by referring the matter to a controlled experiment ; the appeal is to sense-experience and to 'facts'. But that the religious hypothesis cannot always be so proved is indicated by what the writer of Hebrews says of his exemplars of religious faith, "These all died in faith, *not having received the promises*". These people, some of whom he says died in torments, never received confirmation of their faith—at least not in this world. Even the last recorded words of the Founder of Christianity were "My God, my God, why hast thou forsaken me ?"

It is, of course, true that the Christian 'way of life' can be tested in practice as to whether or no it 'works'. This is clearly what Sir William Bragg has in mind when he writes :

"Science is experimental, moving forward step by step, making trial and learning through success and failure. Is not this also the way of religion, and especially of the Christian religion ? The writings of those who preach that religion have from the very beginning insisted that it is to be proved by experience. If a man is drawn towards honour and courage and endurance, justice, mercy, and charity, let him follow the way of Christ and find out for himself that it leads where he would go. No findings of science hinder him in that way, nor do they give any direct proof that it is the right one to follow."

Of course a pragmatic test of this sort must not be pressed to carry a weight of proof of which it is incapable. It can never establish the Christian religion as a body of principles with metaphysical validity. But is such a thing necessary ? Science can dispense with metaphysics, so why not religion ? But *can* science dispense with metaphysics altogether ? Are there not involved certain "absolute presuppositions", as Prof. R. G. Collingwood calls them, which are of a metaphysical nature, and without which science could not stir an inch ? For example, the idea of the uniformity of Nature, the conception of the rationality of things, and the idea of causation itself ? Hume long ago claimed to have shown that the validity of the causal relation is not founded in experience, since experience only shows us that one event follows another, and does not exhibit to us the inner necessity of their union. In short, the idea of causation is a hypothesis, rather different from the type of hypothesis illustrated by Sir William Bragg, since science cannot afford to change it, but perhaps not dissimilar from the type of hypothesis, or "absolute presupposition", which religion seems to need.

Of course the man of science is quite justified in taking the idea of causation and other similar ideas for granted ; if he did not, his researches into natural happenings would never begin, still less arrive anywhere. And perhaps the mistake the exponents of religion make is not in having metaphysical doctrines, but in placing them on the threshold of religion, where they often prove an obstacle to people trying to enter the house. It may be that Sir William Bragg has this kind of obstacle in mind when he says towards the close of his lecture :

"I am not sufficiently informed to know how all types of mind are affected by the demand for the

absolute acceptance of definite items of faith as a preliminary condition to progress. I believe I can safely say that to many minds this is an impossible demand. Conviction of the truth of any faith, so far as a man can measure the truth, is to be gained by practice, and it is here that the scientist finds an illustration in his own work. Every man, in the circle in which he finds himself, it may be a small circle, his means may be small also, can try the Christian way, and discover for himself and acquire his own convictions. He tests his faith. He has ever in front of him the hope that he will by doing his service play his part in binding the community together."

Speaking of his own youth, Sir William writes: "What we boys asked was the meaning of the word 'believe' when it so often laid down a condition which must be satisfied before a man could be 'saved'. '. . . they that have done evil into everlasting fire. This is the Catholick Faith: which except a man believe faithfully he cannot be saved'. Had we passed the test, or had we not? We were terrified by the threatened consequences. To the youth daily instructed in the need for accuracy and the careful interpretation of words, this was indeed a dreadful saying. If anyone took them at their face value, drew them towards him and explored their significance he would necessarily be driven mad, unless indeed he was deprived of feeling by some drug."

It is a pity that the zeal of the theologian should have converted his "absolute presuppositions" into a barbed-wire entanglement menacing the pilgrim who would explore his temple.

PSYCHOLOGICAL EFFECTS OF AIR RAIDS

By Dr. Robert H. Thouless

University of Cambridge

THE experiences of war through which Great Britain is passing pose many psychological problems of urgent practical importance. Knowledge has been gained in many directions which can now be put to practical use. Detailed studies of evacuation, such as the Cambridge Evacuation Survey, the findings of which have recently been published*. enable us to assess both the general success of the evacuation policy and the particular steps which must be taken to avoid failure in special cases. The problems of shelter life have been studied by medical men, by psychiatrists, by shelter lecturers, and by psychologists who have lived in shelters because they have been bombed out of their homes, and it is now possible to gain some idea of the intricate social psychological problems of shelter life. The effects on morale of air-raid experiences have been studied both by academic psychologists and by mass observation, and it is to be hoped that their findings may be made use of by those Government departments responsible for civil morale. These problems were considered at a discussion of the problems of air-raid shelters, evacuation and the effects of air raids at a general meeting of the British Psychological Society on July 26.

Psychologists and psychotherapists have approached the problem of shelter conditions from many different angles; the problems for future research have been clarified and some knowledge has been gained which can be made the basis for practical proposals. The transfer of authority attitudes from within the family to the officials of shelter groups (shelter marshals, etc.) was suggested as an important factor in determining whether defence mechanisms against raid shock would be adequate. It was noticed that a greater sense of security was given by underground shelters than by surface shelters and that the presence of crowds and of the various shelter officials also reduced anxiety. For both of these reasons, individual Anderson shelters were generally neglected and communal underground shelters were preferred. Of those who went to communal shelters, 95 per cent were reported to have got adequate sleep; weight lost at home was regained and neurotic symptoms disappeared. It seems clear, therefore, that the provision of communal shelters rather than of individual ones is, in general, the best policy.

Studies of those who went through air raids as children in the War of 1914–18 showed the importance of adult attitudes of mental calm as a means of protecting children against raid anxiety, and also the reduction of fear by the provision of suitable spontaneous activities. While lectures on such subjects as first aid have been provided for adults and adolescents in some areas,

* The Cambridge Evacuation Survey. Edited by Dr. Susan Isaacs. Pp. ix+236. (London: Methuen and Co., Ltd., 1941.) 8s. 6d. net.

it may be suggested that more effort should be made by those responsible for shelter policy to provide apparatus for suitable activities generally and particularly for children. One area was described in which shelter provision was very inadequate when raids started and a generally apathetic and inert attitude was found among the shelterers. There was little activity ; some knitted, few read. Co-operative activity under a leader did not generally develop spontaneously ; but when a suitable leader was chosen, the amenities of the shelter were greatly improved by co-operative effort. In one shelter, the selection of a good leader resulted in Oxo service, lectures and Christmas decorations, whereas there had previously not been even a broom to sweep the shelter clean.

The problem of the evacuation of children less than five years of age was one that aroused great interest and keen discussion. The general undesirability of evacuating children of this age without their mothers was recognized. On the other hand, it was pointed out that mothers of young children are now often doing war work and that the choice might be between adequate care away from the mother and neglect at home. It was also mentioned that experience at hostels for young children has shown that many of those evacuated from badly bombed areas show neurotic symptoms and unsatisfactory relations with their mothers, and that a period of separation from their mothers in a hostel produces marked improvement in both respects. Some of those present at the meeting consider that a foster-home is more suitable for a young child than a hostel if separation from the mother is necessary or desirable. Other solutions of the problem were mentioned. The Society of Friends has hostels for young children accompanied by their mothers, but these experience the difficulties that have been found in all plans for evacuation of mothers. The mothers do not wish to desert their husbands. A plan that was reported to have been very successful where it has been tried is the provision of nursery centres where children can be left while their mothers are at work. The children may be anxious at first, fearing that their mothers will not return to fetch them in the evenings, but when the experience of a few days proves that this fear is unfounded the children become very happy and contented in the centres. As an alternative to evacuation, this plan suffers obviously from the disadvantage that it may mean that young children remain in danger areas exposed to the risk of physical injury and that this risk must be balanced against the danger of mental injury through separation from the mother.

The general feeling of the meeting seemed to be that evacuation of the mother and young child together is the ideal solution, but that since circumstances might make this impracticable and even in some cases undesirable, psychologists should be prepared to advise alternative methods in particular cases.

One of the defects of the original arrangements for evacuation found in many districts was the lack of provision for those children whose behaviour problems are such as to make them an intolerable burden to the ordinary householder. In many places hostels are provided for such children, but many of these hostels were and still are by no means suitable for this purpose. Some of those present described bad hostels, unsuitably equipped and staffed, where the staff have no idea whatever of the problem child's difficulties or how these might be treated, and where the incidence of certain problems (such as enuresis) is made unnecessarily high by unsympathetic treatment. One speaker described an ideal hostel for treatment at Aylesbury which is housed, equipped, staffed and managed with the aim of relieving the problem child of the burden of his problems. Elsewhere psychological clinics have done excellent work among problem children although the combination of clinic with hostel for treatment appears to be the ideal where practicable.

It is generally felt that a satisfactory hostel is one which makes provision for treatment and is not merely a dumping ground for problem children. There is, no doubt, also a place for the hostel which is merely a clearing house for children who have billeting difficulties, but billeting in such a hostel should be regarded as only a preliminary to treatment. It is felt that psychologists are now in a position to state the requirements of a treatment hostel in equipment and staff, and it was agreed at the meeting that such a statement should be made.

It is not unlikely that the ideal requirements of the social psychologist in provision for problem children will not be met on grounds of expense. It must be remembered, however, that we now have unique opportunities of dealing with the problems of maladjusted children at an early stage and that the provision of reformatories and prisons for the maladjusted members of the community is also a heavy expense to the community.

Investigations in heavily raided areas other than London seem to show that, although morale was in general good, there were failures of morale and a definite tendency for it to deteriorate, particularly in areas which had a number of heavy raids with long periods of calm between them. Deterioration of morale was shown by unauthorized and unnecessary evacuation, general depression about the War, and criticism of the Government. It was interesting to notice that while people in the most

heavily raided areas were more critical and depressed, they were nevertheless more active in A.R.P. work and saved more money than in less raided areas. They were also more inclined to reject the idea that we should undertake reprisal raids on German towns.

The necessity was pointed out of confidence (and justified confidence) in the shelter provided. In some areas shelters have been unsafe, with bad psychological effects. The possibility was pointed out that even where there are no dramatic failures to stand up to bombing (such as psychoneuroses), there might be long-term effects which were little noticed at the time, and that morale might become worse during this winter. It is necessary that there should be propaganda directed towards the strengthening of morale and that psychologists should play a part in the development of a morale policy.

One possible effect of war conditions which has aroused some concern is their influence on the education of children. It is disturbing to learn that, in Glasgow, achievement tests showed that, in one subject (reading), children were on the average about one year behind mean school level. It is also suggested that the situation may be worse in areas which have been raided over a longer period than Glasgow. On the other hand, there must be a considerable proportion of children in reception areas whose education has been relatively little retarded. It seems very desirable that there should be more extensive studies directed towards discovering the amount of educational retardation in different areas and the proportion of children showing marked educational retardation, and if this is found to be generally serious that steps should be taken to prevent the matter from becoming worse. Many of the advantages of universal education and the additional advantages hoped for through a raising of the school-leaving age will be lost if there is continued educational retardation through enemy action.

SOLID CARBON DIOXIDE AS AN EXCITER OF VIBRATIONS

By Mary D. Waller

London (R.F.H.) School of Medicine for Women

IT is well known that solid carbon dioxide produces noises or squeaks when it is brought into contact with metal objects such as a hammer or chisel, and so long ago as 1932 the fact that a bicycle bell could be made to emit a chattering ring by touching it with the material was brought to my notice by an itinerant vendor of ice-creams[1]. This strange phenomenon has since been investigated very thoroughly and the results published in a number of papers[2]. As the solid carbon dioxide method of producing vibrations is in certain respects unique and can be applied to various problems, it seems desirable that a short account of it should be put on record.

Production and Maintenance of Pure Loud Tones

When a tuning-fork of ordinary pitch is touched with solid carbon dioxide, a chattering noise is produced. When glass is touched there is no sound. When, however, a fork of say 2000–3000 c./sec. is tried, provided the contact between the two solids is light and the area of contact small, an intense pure note may be produced and maintained for several minutes. The demonstration of this phenomenon is very striking.

Quality of the Exciter. Compressed 'snow' solid carbon dioxide is not satisfactory. A high density 'ice' variety, such as 'Drikold', which is manufactured by Imperial Chemical Industries, Ltd., may be recommended. The material may be conveniently stored for some days in a large thermos flask, and handled with lined gloves or a piece of flannel or tweezers. It may be broken up, so as to obtain suitable pointed pieces, by means of a hammer and chisel.

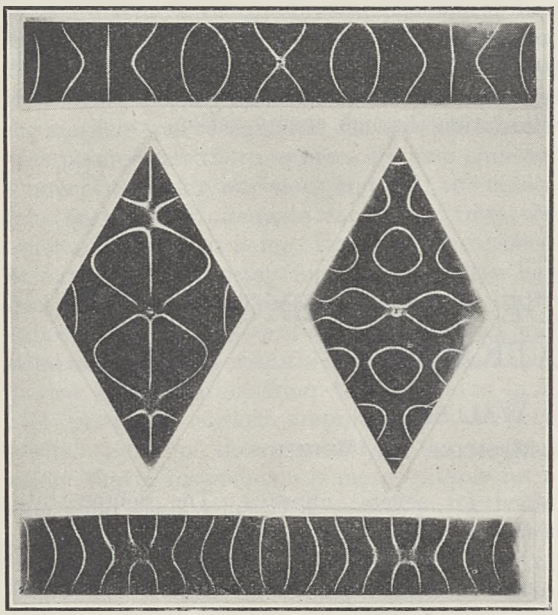
Nature of the Vibrating Object. Tuning-forks, suspended brass bars, tubes, rings and metal plates are easily set into vibration, since they are good thermal conductors and possess adequate vibrating properties (see also below).

External Conditions. The atmosphere must be dry. Excitation may be rendered independent of the hygroscopic conditions by gently warming the vibrating object and surrounding air by means of a bowl electric radiator, care being taken that the heat is not sufficient to alter either the elastic or damping properties of the material of the object.

Manipulation. It is very important that the

pressure between the two solids be very light and the area of contact small, and it is desirable generally to use pointed pieces of solid carbon dioxide. It does not appear possible to substitute a mechanical device for the hand, and the skill of the operator in sensing the onset of vibration, the amplitude of which grows with remarkable rapidity, increases with practice.

The range of frequencies most easily excited by means of solid carbon dioxide lies between about 1000 and 4000 c./sec. and depends but little upon the size, shape, mass, or material of the vibrating object. When objects of low fundamental frequency are touched with solid carbon dioxide, as mentioned above, a rattling noise may be produced,



CHLADNI FIGURES PRODUCED BY SOLID CARBON DIOXIDE

but when the technique described in the last paragraph is adhered to carefully, it becomes possible to excite the overtones which lie in the preferred range of 1000–4000 c./sec.

MECHANISM OF PRODUCTION OF VIBRATIONS

Solid carbon dioxide sublimes at −80° C. Large pressures are accordingly produced when the material is brought into contact with the warmer metal, due to the formation of gas. The source of energy is the heat which is transferred from the one solid to the other, and the phenomenon may be compared with the Trevelyan rocker, where, however, the vibrations are gravitational, not elastic, and are sometimes slow enough to become visible. The vibrating object, of course, governs the frequency of vibration, and each time the object approaches the exciter it receives an impulse due to the irresistible molecular forces of sublimation which are operative at the moment of contact. Each impulse lasts only a fraction of the total period, when the localized pressure is then very great as compared with that which exists during the rest of the vibration. It is also possible to offer an explanation, in terms of the mean free path of the carbon dioxide molecule, of why the solid carbon dioxide is selective in the matter of the range of frequencies which it will excite[2].

VIBRATING PLATES

One of the most interesting applications of the solid carbon dioxide method of producing vibrations is to the production of Chladni figures on plates. A few illustrations of the possibilities of the method are given in the accompanying figures and the reader will find numerous others in the papers[3,4], in which the systematic study of vibrating plates of several different shapes are described.

Excitation is very intense and the fact that it can be effected at any point on the surface, and that mechanical pressure (other than that of the gas) is absent makes the method peculiarly simple and effective. Moreover, since the exciter possesses no natural period of its own, no adjustments of frequencies are necessary as in the case of excitation by electrical methods, and the possibility of producing forced vibrations is also excluded. When a divider is used judiciously to fix the position of the nodal lines, any normal figure may be rapidly produced at will. It has been possible, for example, to produce every single one of the fifty-one normal nodal figures of the first six octaves of the free circular plate and to arrange their photographs in a systematic manner on a single diagram. The nodal designs of the square plate have been treated in a similar manner and also those of the right-angled triangular plate[3].

FURTHER APPLICATIONS

Some of the nodal designs, especially when two normal modes of near period combine, are very beautiful and have been used for decorative designs executed in metal or wood and for embroideries.

Want of uniformity or flaws in plates may be discovered by the distortions in the normal nodal figures which result therefrom. Semi-conductors may be distinguished from insulators, a matter which is of some interest to the geologist. I have actually used the method successfully to find, at short notice, a long-lost quartz lens which had been placed among a large number of glass lenses. Similarly, diamonds and pearls may at once be distinguished from their counterfeits, inasmuch

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(*Continued in next column*)

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ANDREW BENNETT,
The University, Secretary and Registrar.
St. Andrews, July 1941.

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PHYSICS DEPARTMENT

Full particulars of the Lectures and Laboratory Courses in Physics, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, SEPTEMBER 25.

UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER in MATHEMATICS. Duties to commence September 29, 1941. Stipend £300 per annum. Qualifications in Pure Mathematics essential.—Applications, not later than Friday, August 23, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

UNIVERSITY COLLEGE OF SWANSEA

The Council of the College invites applications for the post of Professor of Mathematics. Salary £850 per annum. The appointment will date from January 6, 1942.

Further particulars may be obtained from the undersigned, by whom applications must be received on or before September 13, 1941.

EDWIN DREW,
Singleton Park, Swansea. Registrar.

KING'S COLLEGE, NEWCASTLE-UPON-TYNE

(UNIVERSITY OF DURHAM)

A Lecturer in Agricultural Chemistry is required from October 1, 1941. Salary £300 to £350 per annum according to qualifications and experience. Ten copies of applications and testimonials (or, in place of testimonials, the names of three referees) should be lodged not later than August 26, 1941, with the undersigned, from whom further particulars may be obtained.

W. G. B. OLIVER,
King's College, Registrar.
Newcastle-upon-Tyne, 2.

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as the real articles emit a rattle or squeak when touched with solid carbon dioxide.

It is also noteworthy that the object to be excited need not be rigidly supported. Another characteristic is the picking out of single overtones in objects of irregular shape which emit but a jangle of notes when struck with a hammer. This might be applied to find the resonances in either small pieces of machinery or in small-scale models of larger machines.

Finally, looking to the future, it is worth recording that the demonstration of the production of Chladni figures by means of solid carbon dioxide is an excellent subject for scientific television[5] since, while the patterns grow on the screen, the corresponding note is heard by the ear. The success of the demonstration is assured by the dry, warm conditions which necessarily prevail under the fierce illumination necessary for the projection.

[1] NATURE, 135, 475 (1935).
[2] *Proc. Phys. Soc.*, 45, 101 (1933); 46, 116 (1934); 49, 522 (1937).
[3] *Proc. Phys. Soc.*, 50, 70 (1938); 51, 831 (1939); 52, 452 (1940); 53, 35 (1941).
[4] NATURE, 143, 27 (1939).
[5] *The Listener*, 527 (1938).

CENTENARY OF W. H. HUDSON

By H. J. MASSINGHAM

W. H. HUDSON, the centenary of whose birth is celebrated this month (see NATURE of August 9, p. 160), was unique as an interpreter of Nature, and that is perhaps the reason why he has had neither followers nor predecessors. The school of modern ornithology and natural history acknowledges no debt to Hudson; its highly specialized activities would, indeed, have been abhorrent to a naturalist who wrote "To specialize is to lose your soul". Its prophets and teachers have been Edmund Selous, Eliot Howard and the biologists, not Hudson. Nor is it possible to trace any line of descent or genealogical tree between him and such great or less dynamic names as John Evelyn, Gilbert White, Dorothy Wordsworth, Edward Jesse, Thomas Miller, Charles Watterton, Frank Buckland, Richard Jefferies, and others, all of whom are to be gathered from the 'herbarium' of the English rural tradition. If we prospect English writers who have immortalized foreign scenes like Bates, Darwin, Wallace, Belt and their kin, we shall find only a superficial resemblance between their works and the Hudsonian corpus of exotic reminiscence like "Far Away and Long Ago", "Idle Days in Patagonia", "The Purple Land", "El Ombu" and "The Naturalist in La Plata". The only exception to so general a statement is perhaps "Argentine Ornithology", written avowedly as a text-book and in conjunction with W. C. Sclater, a professed man of science. But even in this work Hudson is plainly cramped and ill at ease, while his descriptions are constantly flooding the scientific banks of classification and the presentation of strictly relevant data.

On the other hand, the problem of assessing Hudson's place in science or letters or both or neither is by no means solved by assuming, as his fellow and contemporary observers of Nature were inclined to do, that he was first an artist and only secondarily a naturalist. This was an error of the first magnitude. Hudson's contributions to our knowledge of South American fauna and flora were both extensive and profound. To say nothing of his intimate studies of Argentine and Patagonian birds, particularly in courtship, migration, social habits and melody, his masterly discoveries into the living characteristics of such pampa or desert animals as puma, vizcacha, huanaco, dolichotis, semi-domesticated cattle and horses (not to mention the feral Indian and gauchos) alone entitle him to take his place among the chieftains in the hierarchy of natural observation. His original records of English wild life were of scarcely less permanent value and novelty. Instances are numerous—I need only refer to his accounts of *Locusta viridissima* in "Hampshire Days", of such rare species as the Dartford and marsh warblers, of the continued mating of starlings after the breeding season in "Birds in a Village", of the behaviour of shepherds' dogs in "A Shepherd's Life", of the perceptual senses of deer in "A Hind in Richmond Park", to his criticisms of Darwin's theory of sexual selection, and there are at least a score of further examples which reveal Hudson as a pioneer in the investigation of natural phenomena alone.

Yet it is obvious that to claim Hudson for the remembrance of posterity upon no other ground than this is to compass only a fragment of the man. Hudson was essentially a mysterious and paradoxical figure, and this central truth about him gave much handle to misunderstanding both among men of science and the general public. The latter realized his greatness so little as to ignore his enrichment both of science and literature for the first thirty years of his English life after leaving the Argentine. He was compelled to live in London (in the

dingier part of Bayswater) because he could not afford to escape from it into his natural environment, which was the country, and the wilder the better. He was not recognized as of any deep significance in authorship until he was an old man, and then, as he told me himself more than once, when fame and the less straitened means that accrued from it were of little account to him. To the learned he was suspect because he mixed up natural history with religion, poetry, animism, fancy, emotion and the humanities. He would not fit in to the current definition of the arts because of his naturalism and his crusading spirit or into that of scientific analysis because such elements as vision and fantasy were considered irrelevant to it. That is the trouble of being something unique : escaping all the categories, it earns either their hostility or indifference. And it must be confessed that it is difficult to come to terms with a man who is neither one thing nor the other, but both in one, a oneness that is specifically neither.

Nevertheless, I think it is possible to arrive at a true conception of this enigmatic spirit, though without dispelling a certain mystery that clothes him and is part of the mystery of life itself. But only on one condition. It is that we should regard him not as standing apart from Nature and examining its manifestations in the detachment of subject from object, but as a being living and speaking within Nature and in an organic relation with Nature extremely difficult for modern man to comprehend. Withdrawal from Nature is the attitude of modernism, and distance in this instance lends not enchantment but diminution to the view. By looking at Hudson as a kind of human embodiment out of Nature, we are not only enabled to see him more clearly and to resolve the apparent contradictions and antitheses in his make-up, but also to enlarge our own perception of Nature itself, or, as Hudson would undoubtedly have said, of Nature herself.

The most remarkable quality of Hudson as a writer was his articulate primitiveness. This went very deep, and was by no means confined to his habitual and entirely unsophisticated preference for the wildness in Nature. He wrote, if I may be pardoned the apparent antimony, as a richly cultivated wild man, and to an extraordinary degree he shared certain characteristics of primitive man which in the most natural way he embodied into his writings. The animistic tendency is one, closely allied with the mythopœic and with story-telling. Hudson could scarcely write a page without bringing some tale into it, tales not only of fact but also of invention, not only of the concrete, but also of the fantastic, and the curious thing is that his reader is not in the least jolted by their seeming incompatibility. Myth and actuality were strangely blended, and his anthropomorphic bent (heinous to the scientific mentality !) was just as 'real' in him as were his chronicles of animals or peoples, whose bona fides nobody would think of doubting.

Yet in other aspects Hudson was a good deal more modern than the moderns. His vision of Nature—and we are bound to speak of it as such—was consciously pantheistic, often expressing itself in exalted (though always simple) idiom and imagery that remind us of the much more intricate seventeenth-century 'metaphysicals'. His idea of man's place in Nature, utterly contrary to Huxley's, as gathering to a point the joy and exuberance of natural life and through it finding contact with the unseen world, as drinking deep of the life of Nature but observing a royal impartiality towards its phenomena and refraining from interference with its balances and interdependences, this mental approach is a philosophical rendering of a primitive feeling. Hudson loathed all human rapacity towards Nature, but disdained the sentimentalism of reproaching "the cruelty of Nature" in raptorial bird or beast. His mind was entirely estranged from that of civilization because its home was both behind and beyond it.

The Russian lecturer, Nicolas Berdyaev, directs a searching criticism against the modern theory of progress on the ground that it disintegrates time into past, present and future, which are spectral in the sense that each devours the other. Hudson's work is an apt illustration of these three divisions of time in a mutual and non-destructive relation to one another. To Hudson the primitive past was the deepest source of his inspiration, and through it he envisaged a future of the relations between man and Nature which would enshrine their reconciliation. His most famous book, "Far Away and Long Ago", reveals a more personal fusion between boyhood and old age (it was written when he was seventy-six) inexplicable from the point of view of an enkindled memory alone. This minutely detailed record of his childhood on the Argentine pampas is perhaps the most astonishing example of re-animation in our literature. The entire wild scene with its people, its flowers and animals, its effects of light and shade, together with his own sentiments and adventures and reactions, are presented as a living whole with such immediacy that the gaps both of time and space are annihilated. Hudson *senex* evokes a Hudson *puer* not of yesterday, but contained within the present, and there is no other word for this but mystery.

A passage in "The Land's End" illuminates this merging between past and present, boyhood and age, beginnings and ends, the primeval and the more-than-civilized from another and yet stranger aspect. One of a party of grey pilgrims looks over

the sea from the end of all the land, the ancient Bolerium :

"He sees only what his heart desires—a silent land of rest. No person will greet him there, he will land and go up alone into that empty and solitary place, a still grey wilderness, extending inland and upward hundreds of leagues, an immeasurable distance, into infinity. . . . The sky in that still land is always pale grey-blue in colour, and the earth, too, is grey like the rocks, and the trees have a grey-green foliage—trees more ancient in appearance than the worn granite hills. . . . There he will remain motionless and contented for ever in that remote desert land where is no sound of singing bird nor of running water nor of rain or wind in the grey ancient trees. . . ."

This "illimitable wilderness" is antediluvian and post mortem, the beyond and the uncreate ; it is the Land's End and it is Patagonia that he loved even better than his estancia-home of La Plata, where the bright birds sang in the peach-grove ; it is the goal of age and the longing of youth ; it is intensely symbolic and yet an actual scene. It is all these things in one, and it is thus a conquest of time in total opposition to the modern "conquest of nature" and enslavement to a time arbitrarily sliced up into three divisions.

We shall never understand Hudson unless we see him bathed in this mysterious light, unless we look for him within the heart of Nature where the visionary is inseparable from that which is observed, beauty and romance are fused with an objective natural history and where to see, to know, and to feel are a triune experience. Only one link in the chain of integration is missing, and that is the craft of husbandry, where Nature and man meet on equal terms. But the primitive wildness that was the heart of Hudson did not permit him to surmount the last impediment to a final synthesis. Yet in closing the division between natural truth and poetic beauty without doing violence to either, he, the primitive, must surely rank among the very greatest of modernists. The war of aggression against Nature by means of the machine and the combine would have been profoundly antipathetic to both these elements of his complex being.

As a 'stylist' Hudson is impossible to anatomize. His is not a literary way of writing at all, still less has it any affinity with modern cultism in self-expression. He wrote just as he thought, narrated, described, and speculated—namely, as a child of Nature raised to a high degree of self-consciousness. His manner of writing, that is to say, is the natural manner of growth in the plant, of flight in the bird, and of movement in the wind or the sea. There are no spot-lights in metaphor or imagery, nor is there any sense of manufacture in the structure of the sentences. At times a page will be a flat monotone like a dull day ; at others like a spring morning, when the dew is on the spray. His argument, whatever it may be, unfolds itself like a vine tendril or a clematis shoot making its unobtrusive way into the sunshine. Or the pace quickens and a tuft of bright-coloured flowers appears on the green background. His style is thus a method of articulation in perfect harmony both with his subject and his own mystical and intuitive contact with the childhood of mankind. The man who identified himself with all creation and through it felt the touch of the unseen conveyed into his writing the sense of a lost world "where the rose has got Perfume that on earth is not", an Adamite paradise of Nature which has haunted the imagination of the more sensitive among men since the days of Hesiod.

OBITUARIES

Prof. A. J. Clark, F.R.S.

By the death, on July 30, of Prof. A. J. Clark, at the age of fifty-five, pharmacology has lost its leading exponent in Great Britain. He was born in Somerset in 1885, went to Bootham School, and obtained one of the first major entrance scholarships in science at King's College, Cambridge. After an unexpectedly brilliant performance in the Tripos, he went as a student to St. Bartholomew's Hospital, London, and took the degree of M.B. in 1910. He worked with Zunz for a time, and then became Cushny's assistant at University College, London. He was professor of pharmacology in Cape Town, and then succeeded Cushny, first at University College, and then in Edinburgh, where he had been since 1926.

During the War of 1914–18 Clark served in the R.A.M.C. as a captain, and was awarded the M.C. During the present War it was natural that he should be appointed physiological and medical adviser to General Headquarters. He went out to France in 1940 as a lieutenant-colonel just in time to play his part in the withdrawal of the British forces.

He married Beatrice Powell, daughter of the late Dr. Hazell of Cape Town, in 1919, and had two sons and two daughters.

Clark's restless energy and wide knowledge were evident both in his work and in his conversation, and were always available for the assistance of his colleagues, but his general knowledge was also great, and his advice was valued by all. He was a member

of the Medical Research Council from 1934 until 1938 and from 1939 until the time of his death.

He was a great experimentalist, and his interests, both in physiology and pharmacology, were so varied that it is difficult to select a representative list of his discoveries. No one else knew so much about frogs' hearts and how to control them, and no one would have thought it possible to extract so much information from them. He found that the action of digitalis was dependent on the presence of calcium. He found that the washings from frog's heart and serum both contained unknown substances which increased the force of the beat. He published important studies of the pharmacology of peptone and of potassium. With Broom he devised a well-known method for the assay of ergotoxine. In 1927 he published a book on "The Comparative Physiology of the Heart", and in 1938 he published another on "The Metabolism of the Frog's Heart", which was largely based on his own work with various collaborators.

Clark's main interest was in the light thrown by quantitative pharmacological experiments on the fundamental problem of how drugs act. He wrote a book called "The Mode of Action of Drugs on Cells" (1933), and a supplementary volume to Heffter's Handbook called "General Pharmacology" (1938), in which he codified a large number of papers in this field. The original authors had treated their results in all sorts of ways, and reached all sorts of conclusions. Prof. Clark replotted, recalculated and tabulated their results by uniform methods. He emphasized the danger of fitting simple curves to observations on complex living tissues by showing that the results could often be equally well fitted by several different simple curves. He cleared the air by demonstrating that "an intensive study of any particular pharmacological action nearly always results in showing it to be more complex than was at first supposed". His wide knowledge provided a very rich mine of examples to illustrate his arguments, which were upheld by many experiments of his own and his students. In all this work he was testing the validity of fundamental quantitative generalizations. He was seldom content with direct empirical observations of the effect of chemical structure on pharmacological action.

Clark's "Applied Pharmacology" was first published in 1923, and six more editions appeared in the next seventeen years. This book, in which particular emphasis is laid on experiments on man, has played an important part in the development of the science of experimental therapeutics; it serves as a link between the laboratory and the ward.

J. H. GADDUM.

WE regret to announce the following deaths:

Dr. Frank Haydon, formerly Secretary of Apothecaries' Hall and for many years oculist to the Southern Railway, on August 1, aged seventy-nine.

Dr. A. L. de Morais Sarmento, the well-known Portuguese physician and Rector of the University of Coimbra, on August 11, aged fifty-three.

NEWS AND VIEWS

Sir Robert Robinson: First Paracelsus Medallist

A DELIGHTFUL function took place at the Dorchester Hotel on August 6, when the Swiss Ambassador, in an after-luncheon speech, presented to Sir Robert Robinson, F.R.S., Waynflete professor of chemistry in the University of Oxford, the Paracelsus Gold Medal of the Swiss Chemical Society. This is the first occasion upon which the award has been made, and it is gratifying that the Swiss chemists should recognize in this manner Sir Robert's pre-eminence in the scientific world. His versatility is such that he has enriched every branch of organic chemistry, but it is perhaps as a master of the synthetic method that he has gained special fame. His outstanding gifts in this direction became evident early in his career, when in 1917 he effected a synthesis of tropinone, noteworthy on account of its extraordinary novelty and simplicity. The concept upon which this and other alkaloid syntheses was based was a direct outcome of a comprehensive theory of biogenesis of plant products which was contributed to the Chemical Society in the same year, and which marked an epoch in alkaloid chemistry.

Other outstanding achievements in this field include a large number of inspiring memoirs on the indole group of alkaloids, the morphine group, including a modification of Knorr's morphine and thebaine formulæ and finally the establishment of the correct structures of strychnine and brucine. Robinson's interests have, however, extended far beyond the alkaloid field. One recalls the brilliant work carried out in association with W. H. Perkin, jun., on the constitution of brazilin and hæmatoxylin; from this arose his interest in pyrylium salts, leading to elegant synthetic work on anthocyanidin structures and culminating in the striking achievement of the synthesis of the anthocyan flower pigments themselves, one of the finest pieces of research of our generation. And now another trail is being blazed, this time on the synthesis of steroids and sex hormones; here, as always, with Robinson's work, one is struck by the simplicity and freshness of approach and the ingenuity displayed in building up the required ring-systems. No account of Robinson's work would be complete without mention of his important contributions to the theory of organic reactions, crystallized finally in terms of modern electronic hypotheses relating to the nature of valency bonds. The theory which collates on a common basis a diverse mass of data in organic chemistry, has had an important influence in the development of the science.

Prof. Edgar Allen: Bayly Medallist

PROF. EDGAR ALLEN, to whom the Bayly Medal of the Royal College of Physicians has just been awarded, is professor of anatomy in the Yale University School of medicine, a post to which he succeeded in 1933 after a very fruitful period of office in the University of Missouri. In both universities his department has proved a vigorous centre of research on the sex hormones, and his own contributions to the subject form an essential foundation to modern knowledge of the endocrine action of the ovaries. Before 1917 attempts to isolate ovarian internal secretions were seriously handicapped by the lack of a specific test for what to-day is called œstrogenic action. In that year Stockard and Papanicolaou showed that the œstrous cycle in the guinea pig is associated with cyclical changes in the vaginal epithelium. Shortly afterwards Allen found that in the mouse, too, œstrus is associated with a specific vaginal phase, and from this discovery it was a short step to his and Doisy's successful application of the vaginal smear technique as a test for the œstrogenic action of ovarian extracts. Once extracts with demonstrable œstrogenic activity were made available, the door was open to the chemical isolation, analysis and synthesis of pure œstrogens. Although Allen did not share in this later chemical work, there can be little question that it would have proved impossible without the simple bio-assay method which he developed.

Allen's second major achievement was his demonstration in 1926 of the fact that the follicular phase of the uterine cycle in monkeys and man is under the control of œstrogenic hormone. All later work on the primate cycle emerges from this finding, and Allen's own subsequent investigations have a significant place in the structure of present knowledge of the subject. His contribution does not rest here. Allen is that rare combination of research worker and administrator who is able to stimulate in younger men a strong and lasting interest in research. His laboratory is one of the most productive in the United States, and while the Bayly Medal is a recognition of past work, endocrinologists the world over know that Allen's laboratory will prove no less successful in the future than it has in the past.

Mr. Orville Wright

MR. ORVILLE WRIGHT celebrates his seventieth birthday on August 19. It was he who, together with his late brother, Wilbur, first flew a heavier-than-air machine on December 17, 1903, at Kitty Hawk, North Carolina, and, also with his brother, invented the system of control used in flying machines to-day. The first flight lasted only twelve seconds, but further experiment and trials resulted in the development of an aeroplane which established a new record on September 12, 1908, by remaining in the air for seventy-five minutes. The Wright brothers began their investigations on kites and gliders in 1900. Then they introduced two improvements: (1) the elevator for steering the machine in a vertical plane, which, though now usually attached to the tail, was placed by them in front of the main planes; (2) flexing of the rear edge of the main planes so as to vary the lift on either or both, thus maintaining balance. A petrol motor-driven screw was added in 1903.

The Wright brothers were also great exponents of the use of the wind tunnel in aeronautical investigations. The first motor-driven machine which was used by the Wright brothers in their pioneer flight on December 17, 1903, is now exhibited in the Science Museum, South Kensington. Wilbur died on May 30, 1912. Both brothers have been the recipients of several medals, honorary degrees and other honours. We offer our congratulations to Mr. Orville Wright on the attainment of his seventieth birthday.

Scientific Workers in Industry and Public Affairs

SIR ROBERT PICKARD's address to the Society of Chemical Industry on the occasion of the presentation to him of the Society's Medal, was entitled "The Influence of Science on National Life", but his treatment of this theme was far less broad than the title. Before 1900, work by Faraday and Playfair, by E. Frankland and Roscoe, influenced the living conditions of the people through their respective investigations on the purity of water supplies and the purification of sewage effluents. Up to then, few research chemists were employed in industry, but between 1914–18 and the present time their number has much increased; and this is also particularly true of the lesser scientific workers (testers, etc.). Science has safeguarded and improved civilized life in innumerable ways; nevertheless doubts and questions have arisen whether the nation makes adequate use of the scientific ability at its disposal. On the whole, Sir Robert is satisfied with the tremendous improvement in such matters that has occurred in the last twenty-five years. Scientific men are not specially competent to deal with certain political and social questions, but they can reasonably claim to be consulted before decisions are made.

Though many of the recent criticisms of the Civil Service seem to Sir Robert to be unjustified, those concerning reluctance to take decisions and lack of foresight in formulating problems, appear to be valid; if so, they are due in part to the cloistered life the Civil Servant has to lead. The same cause may operate among scientific workers employed in industry, and Prof. A. V. Hill's plan of regular interchange between scientific staffs in the civil and municipal services, and in university laboratories, should at least offer a partial remedy. As fellows of the Royal Society are, when elected, nearly all specialists of the highest, but narrowest, type, their services to the nation are most likely to be effective when the problem is entirely novel. We in Britain have "led the field" in applying science to the older industries; in the newer industries, based upon recent discoveries, American scientific workers have made "greater bulk endeavours". The modern central research association is also a typically British product, but there is need of reform in current methods of electing directors or heads of such bodies; such heads have in the past been largely "thrown up

by the tide", and we must now seek some method of training the successors of those men who are the present leaders. A head can be a success only if he agrees to cease his work as an expert, after appointment.

Great Britain and the U.S.S.R.

THE British Association has received the following message in reply to a resolution recently forwarded through M. Maisky to the U.S.S.R. Academy of Sciences (see NATURE of August 2, p. 135): "The Academy of Sciences of the U.S.S.R. sends warmest greeting to the Committee for Social and International Relations of the British Association for the Advancement of Science. With the help of scientists of both our countries the united peoples of Great Britain and the Soviet Union will triumph in the war for the liberation of humanity from Fascist tyranny. Otto Schmidt, vice-president, Academy of Sciences of the U.S.S.R."

U.S.S.R. Academy of Sciences: Air Raid Damage

ACCORDING to the British United Press, it can now be revealed that German raiders recently set fire to the library of the U.S.S.R. Academy of Sciences, one of the most famous landmarks in the city. The fire was put out, however, before any of the three million valuable books in the library were destroyed. It may be recalled that the Germans, during the early raids on Moscow, boasted that the Academy of Sciences had been destroyed.

Black-out *v.* Controlled Lighting for Air-raid Defence

THERE has always been controversy upon this subject, and while Britain has adopted the complete black-out in this War, there is a considerable opinion held in the United States that some form of uniform lighting, to disguise landmarks, would be equally effective and less hampering to the inhabitants of the district. Experiments are being carried out, but the problem is not capable of any very precise solution, as the results are entirely dependent upon the personal estimation of the observers from the air. Even in an actual attack, the results of bombing depend upon so many variable factors that it would by no means follow that the concentrated bombing of a certain district was due to its ineffective concealment.

The principal arguments against a black-out are the impossibility of hiding rivers, railways and long, straight roads; fires and enemy agent signals are more obvious; dropping of flares effectively lights up at least a limited area. It adds to the difficulties of all forms of defence and A.R.P. work during an attack, and it hampers all work and social life as it is necessarily applied continuously, since it has been proved that it is impracticable to bring black-out into operation only when an attack is expected. It is claimed that a uniformly spread mantle of light would not make a town any more obvious, and could be made to disguise any particular object equally well.

The difficulty lies in obtaining uniformity, with the different classes of buildings, open spaces with no buildings or roads, and the irregular contour of the city that could be co-ordinated with a map. There is the further problem of enforcing that uniformity when it is attained. Watching the observance of a complete black-out is easier than seeing that a certain standard of illumination from windows, roof lights, etc., is not exceeded. Uniform lighting was used in London and certain other towns towards the latter part of the War of 1914–18, but this was introduced as an alternative to a black-out not nearly so completely worked out or rigidly enforced as the present one. There is also the wider problem of using individual towns as landmarks for navigating purposes. A series of lighted patches, indicating towns, could easily be followed successively with the aid of a map, and made to lead to any desired district. Uniformity of lighting in this respect could only be attained by illuminating the whole country-side—a task of gargantuan magnitude.

Fire Prevention in War-time

MANY of the subjects covered in a lecture delivered to the Royal Society of Arts by Colonel G. Symonds, fire adviser to the Home Office, are of more than general interest. After discussing questions of organization and the need for adequate fire-fighting parties to take immediate action, Colonel Symonds dealt with the 'protective levels' required for resisting penetration by a 1 kgm. incendiary bomb. The figures he gave were: reinforced concrete $2\frac{1}{2}$ in. thick; steel plate $\frac{3}{16}$ in. thick; a paving-stone 2 in. thick with a well-tamped standard sand-bag also gives adequate protection. As regards internal protection, floors can be made fire resisting with 2 in. of sand, $2\frac{1}{2}$ in. of brick rubble passing through $\frac{3}{8}$ in. mesh, or with material conforming to BSS/ARP 27. Less certain protection, but enough to enable a fire party arriving within five or six minutes to cope with the bomb, before floor boards started to burn, would be provided by BSS/ARP 47. Structural timber should be treated with a flame-resisting material. Communicated fire can be stopped by $2\frac{1}{2}$ inch jets supplied with 1,200 gallons of water a minute. Where an 80-ft. space is unobtainable as a fire break, windows facing a lesser gap should be bricked up, or failing this, protected with wired-glass and fire-resisting shutters. An unperforated 14-in. brick party wall with good mortar carried 10 ft. above floor-level on the line of the break will often stand up well to a 'near miss'.

Biochemistry at the Franklin Institute

THE Biochemical Research Foundation Laboratory (formerly the Cancer Research Laboratories), under the direction of Dr. Ellice McDonald, has recently moved from Philadelphia, Pa., to Newark, Delaware. The buildings at Newark are new and specially designed for the work of the Foundation. One wing insulated from the main rooms contains a cyclotron for preparing radioactive substances for use in medical and biochemical problems. The laboratories

appear to be admirably equipped for research in physics, physical chemistry and biochemistry. Miss G. E. Woodward is still carrying on with her researches on the metabolism and structure of amino acids. In this new institute it is expected that close co-operation between chemists, physicists and biologists will lead to new advances.

Rapid Black-out of a Factory

A DESCRIPTION is given in the *Electrical Review* of July 11 of a method of almost completely blacking-out in a few seconds a factory by simply pressing a button. A camouflage installation recently completed at a large factory provides for blacking out 550,000 sq. ft. of roof lights in 15 sec. Originally hard wall-boards were fitted to the outside of all the north lights and other windows. Alternate panels have been removed from the north light windows and fixed into a frame in their respective positions over the windows, the frame being made to move laterally across the whole span of lights through grooves cut in the sections fixed to the glazing bars. Steel cables were fixed to each end of the frame, passed over spring-tensioned pulleys and secured to a winch mounted on the wall inside the factory. The winch is operated by a ¼ h.p. D.C. compound-wound G.E.C. Witton motor. The forward and reverse movements of the shutters are obtained by reversing the direction of the motor, which is controlled by forward and reverse contactors operated by two limit switches. The latter are tripped by 'fingers' mounted on steel rods secured by the cables, which travel up and down through a distance equivalent to the movement of the steel frame. Each span of lights of approximately 1,000 sq. ft. is operated by one ¼ h.p. motor, and more than 500 motors have been installed. In the event of damage to the electrical equipment, the motors can be disconnected and the winches operated by hand in each individual bay.

New Tone for Dial Telephone Systems

IN long-distance telephony when messages or signals have to be transmitted simultaneously over wire networks, an error in dialling may result in reaching a group of numbers not assigned for service. In such cases a special tone may be used to inform the customer of his error, and this special development in switching is widely used in the Bell System networks of the United States. In the *Bell Laboratories Record* of April, Mr. M. E. Krom communicates a paper giving the development of the 'no such number' tone. The new tone varies continuously in frequency, like that of a siren, alternately rising and falling at half-second intervals. The sound is quite different from any other tone used in the Bell system. At the lowest pitch the fundamental frequency is 200 cycles per second, and at the highest pitch, 400 cycles. Harmonics up to 6,000 cycles are in both tones, and these give the latter a richness not found in single-frequency waves. The tone is generated by a 'relaxation' oscillator consisting of a vacuum tube, condenser and resistance. The tone is amplified by another vacuum tube which raises the level above that of the dial and busy tones. To lengthen the life of the vacuum tubes, the plate circuits are closed only when the tone is required; the filaments are continuously heated, however, to maintain the circuit in readiness for instant service. During field trials it has reduced circuit-holding time on numbers wrongly dialled and resulted in a higher percentage of correct numbers on the second dialling.

Egyptian Astronomy

HERBERT CHATLEY has given in a paper on "Egyptian Astronomy" (*J. Egypt Archæol.*, 26, 120; 1940) certain conclusions regarding the various figures found in the Egyptian "celestial diagram", of which nearly twenty copies from the Eleventh Dynasty down to Roman times are in existence. The general deductions that have been made about the figures are included under eight categories, but limits of space do not permit any detailed description; those who are interested in Egyptian archæology will find it profitable to study the paper carefully. It is difficult to discover from reading the account of the constellations, Dekanal Band (the dekans were 10-day stars from the helical risings of which the ten-day week of the Egyptian year was marked), Meta-Dekans, etc., how much astronomical knowledge the Egyptians really possessed. Popular belief credits ancient Egypt with extensive knowledge, but archæological research scarcely supports this view in the realm of astronomy. The records show very little regarding the actual observations of their inventors, and many of them are of a magical or religious nature the object of which was to protect or assist the dead. The author has previously expressed the opinion that the dekanal lists were revised about the beginning of the New Kingdom, about 1600 B.C., and he conjectures that the celestial diagram was invented then as a talisman which concentrated the power of the heavenly bodies into one form.

Mathematical Problems in Seismology

A. BLAKE has recently directed attention to many outstanding problems in mathematical seismology (*Trans. Amer. Geophys. Union*, 1940). The following problems are, more particularly, mentioned: (1) Problems in the theory of seismic waves due to inhomogeneities in the media and other causes, and to new methods available for the study of the interior of the earth. (2) Problems of instrumental seismology including the new strain meter and rotation seismograph. (3) Problems relating to the complexities encountered in determining the response of engineering structures to the motion of a strong near earthquake. (4) Problems of statistical seismology, especially the periodicity problem. In many cases Blake states that seismological calculations may be performed by machines such as the differential analyser and punched card machines.

Concerning strong-motion problems, Blake says that the analysis of the response of a structure into characteristic or normal components satisfying linear equations depends on the treatment of the strain-

energy function as quadratic. But the purpose of investigating the response to destructive earthquake motions requires consideration of strains much exceeding the limits within which Hooke's Law remains valid. According to the author, the linear theory can then only be used as a first approximation and the effects of the various components of ground motion cannot be treated separately. The Rayleigh dissipation function may be important but the case of small damping including the existence of normal modes of oscillation has been encountered in the case of buildings, bridges and tank towers. The paper will act as a signpost towards further progress in mathematical seismology.

Epicentres of the Earthquakes of April 20 and 21

THE U.S. Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentres of two recent strong earthquakes. The first on April 20, 1941, at 17h. 38·3m. G.M.T., had an epicentre near lat. 37° N., long. 69° E., which is in Afghanistan and some 160 miles north of Kabul. The second, on April 21, 1941, at 2h. 54·1m. G.M.T. was near lat. 53° N., long. 166° W. which is in the neighbourhood of the Aleutian Islands. Both these areas are well known to be frequented by earthquakes, the Aleutian Islands area having been particularly active in recent months.

Forestry in Uganda

IN the annual report for the year ending December 31, 1940 (Entebbe, Govt. Printer, Uganda, 1941), the Conservator, after detailing the total areas of forest under control, says that under a reclassification of the forests the area of protection reserves has increased at the expense of production reserves. Except for forty-eight square miles of high forest, all the new areas gazetted were savannah land or bush-covered hills with some gallery forest in the valleys. For those with an acquaintance of local African conditions this reservation of savannah and bush lands is of the greatest significance and the Forest Department may be congratulated on its action. It is not the less disturbing, therefore, to read that "Reconnaissance continued on a reduced scale and there are still some 1,000 square miles in the Eastern and Western Provinces which are known to require reservation. In Buganda the need for reconnaissance and reservations was recognized by Government, but staff was not available to make a start." This question, the inadequacy of staff, has interrupted other valuable work in progress. It cannot but be disheartening to Forest Departments when the Administration responsible are unable to realize that forest property and management differ widely from the short-term (in years) policy with which agricultural lands can be treated. In the general interests of the communities as a whole, especially when more or less directly dependent upon the forests, not even the stresses of an Empire War should be allowed to imperil the future of such forest areas.

The Health of Canada

THE April issue of the *Statistical Bulletin* issued by the Metropolitan Life Insurance Company of New York contains an instructive editorial on the health of Canada in 1940. During the last three months of 1939 and almost the whole of 1940 the mortality record in Canada was very favourable; but it showed some rise in December and the first quarter of 1941 owing to the epidemic of influenza which occurred at the end of 1940. As a whole, however, the standardized death-rate of the Canadian Industrial policy holders less than seventy-five years of age was only 592·1 per 100,000, or 12·1 per cent below the average rate for the five preceding years. Among children the drop in mortality was as much as 30 per cent. The greatest improvement took place in the acute and infectious conditions, while cancer and diabetes showed higher rates than in previous years. The decline in the principal infectious diseases in children, namely, measles, scarlet fever, whooping cough and diphtheria was 43 per cent since 1935–39. For measles and scarlet fever the rate was less than two thirds of the average for the preceding five years, and for diphtheria the 1940 rate was little more than one half of the earlier rate. Whooping cough, with a rate of 5·1 per 100,000 in 1940, or more than that for the other three combined, is to-day the most serious of these diseases of childhood. Diseases of the heart, arteries and kidneys together accounted for more than one third of the mortality. As regards tuberculosis the death-rate for the first time fell below 50 per 100,000, the decline since 1935 being 15 per cent. Child-bearing has become definitely safer in Canada, the puerperal death-rate having fallen to 6·2 per 100,000 in 1940 from 9·0 in the preceding five-year period. Lastly, there was an appreciable decline in deaths from violence.

Public Health in Haiti

ACCORDING to Dr. Rulx Léon, Under-Secretary of State in Charge of the Health Service and Public Assistance, a major concern of the Health Service of Haiti is the lack of adequate drinking-water facilities, which is particularly serious in the capital. During the past year, the Government created a public welfare organization which established several hospitals in different parts of the country. 31,202 cases of malaria were treated in hospitals and Government rural clinics. Dysentery and intestinal parasitism existed in endemic form. Outbreaks of measles, ringworm and influenza were quickly controlled. A mild epidemic of diphtheria broke out in the capital. The principal causes of death were tuberculosis, malaria, enteritis, syphilis and pneumonia. A total of 47,950 births and 12,907 deaths was recorded.

Historical Medicine and Science

UNDER the title of "Medical Miscellany: List A" Schuman's, of 730 Fifth Avenue, New York, have published a catalogue of 150 works of historical medicine and science. Of special interest are Abernethy's Hunterian Oration for 1819, von Behring's early contributions on the specific treatment

of diphtheria and tetanus, anthrax, immunity, etc. (1893), the works of Fabricius ab Aquapendente (1619–20), James Lind's "Essay on Diseases incident to Europeans in Hot Climates" (1792), the Life and Letters of Michael Faraday (1870) and George E. Ellis's Biography of Count Rumbold (1871).

The principal feature in Schuman's List B is the inclusion of nine items concerning Paracelsus, the fourth centenary of whose death takes place this year. These items are a Latin translation of one of his principal works, embodying much of his work on chemical therapeutics (1578), his surgical writings in Swiss-German (1605), English translations of Leonardo Fiorovanti's work (1653), Paracelsus's hermetic and alchemical writings (1894), and his one hundred and fourteen experiments and cures (1652), Franz Hartman's "Life of Paracelsus" (1896), the first edition of Browning's poem (1835) and an early seventeenth-century portrait of Paracelsus from the G. Ritter von Frank collection.

Colour Changes in the Paradise Fish

It is well known that the paradise fish, *Macropodus opercularis*, is capable of changing its colour. Y. C. Chin and J. C. Li (*Peking Nat. Hist. Bull.*, 15 ; 1941) have shown that such changes can be induced by changes in light intensity, temperature and the environmental colour. Their experiments indicate that in the performance of this reflex the eyes act as the receptors and the melanophores as the effectors. The receptor and effector systems communicate in the medulla oblongata. The melanophore nerves appear to be of two kinds, one concentrating and the other dispersive. The actual changes in the melanophores are brought about by the secretion of neurohumours secreted at the ends of the nerves and these are not transmitted by the blood but diffuse from cell to cell. The authors have attempted to express the results in quantitative terms that will permit of more accurate comparisons in future work.

Sawflies of the Berkhamsted District

Mr. R. B. Benson has given students of Hymenoptera valuable help with his paper "Sawflies of the Berkhamsted District" (*Trans. Herts. Nat. Hist. Soc.*, 21, 177–231 ; 1940). The work is divided into three parts: (*a*) Introduction, (*b*) List of Species, and (*c*) References.

In (*a*), among other matters, the author compares on a percentage basis the number of species—313—taken in Hertfordshire with the other insect groups which have been collected in the county, but takes care to point out that the results tend to show what groups have been best collected rather than the relative abundance of any one of them. The sawflies head the list with 72 per cent, a figure which on either count speaks much for the energy and untiring patience which the author has brought to the task of collecting these insects. Attention is directed to the fact that the abundance of a species may vary within very wide limits over a large number of years. Zoogeographical and ecological aspects are also discussed. Range of locality in Hertfordshire, frequency of occurrence, times of appearance and food-plants of the species are given. The table of references comprises fifty-five items.

Prof. Olof Hammarsten (1841–1932)

Prof. Olof Hammarsten, the celebrated Swedish biochemist, was born at Norrköping in Sweden on August 21, 1841. He received his medical education at Uppsala, where he qualified in 1869, and was assistant at the laboratory for clinical chemistry and the physiological institute. In 1877 he was appointed extraordinary professor of physiology at Uppsala, where he became professor of medical and physiological chemistry in 1883 ; he held this post until his retirement in 1906. His chief work was his textbook on physiological chemistry, which for many years stood almost alone as a work of reference and was translated into several foreign languages. He had previously won a high reputation by numerous contributions to biochemistry, including the milk-curdling properties of gastric juice, the behaviour of rennin, the role of calcium in the clotting of milk and blood, the proteins of the blood and the mucous substances in the bile. In 1906 he was the recipient of a *Festschrift* which contained a bibliography of his writings up to 1905. He died on September 21, 1932.

Announcements

Prof. J. C. Drummond, professor of biochemistry in the University of London and scientific adviser to the Ministry of Food, has been elected Fullerian professor of physiology in the Royal Institution in succession to Sir Frederick Keeble.

Prof. C. Lovatt Evans, Jodrell professor of physiology in University College, London, has been elected a foreign member of the Royal Physiographical Society of Lund, Sweden.

At the recent conferring of degrees at the Queen's University, Belfast, the degree of doctor of science was conferred on Bryan A. Toms, of the Department of Chemistry of the University.

The Swedish International Press Bureau reports that a board for the control of incorrect or misleading advertisements of medical preparations has recently been appointed in Sweden consisting of representatives of the Royal Medical Board, the Swedish Medical Association, the Federation of Swedish Industries, the Advertising Association and the Newspaper Publishers' Association.

The next award of the Rolleston Memorial Prize, now worth about £100, will be made in Trinity term, 1942, and graduates or research students of the Universities of Oxford or Cambridge, within ten years from matriculation, are eligible. The prize is given for original research in animal and vegetable morphology, physiology or pathology. Essays should be sent to the Assistant Registrar, University Registry, Oxford, before March 31, 1942.

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.*

Reactions of Carboxylic Esters

ALTHOUGH, as pointed out in a recent review[1], acid or alkali catalysed hydrolysis or esterification and, it may be added, alkoxy interchange, usually take place by mechanisms in which the bonds of the alkoxyl carbon atom are not disturbed (mechanism I), the alternative mechanism (II) does, however, occur, and probably to a greater extent than has previously been recognized, when the alkoxyl group R″ has electron-releasing properties.

$$R'CO\frac{|}{|}OR'' \text{ (I)} \qquad R'.CO.O\frac{|}{|}R'' \text{ (II)}$$

This fact was brought to our notice during the preparation of some optically active αγ-disubstituted allyl alcohols. Whereas in the alkaline hydrolysis of the hydrogen phthalates of a large number of optically active saturated aliphatic alcohols under varying experimental conditions no racemization has ever been observed, the optically pure hydrogen phthalic esters of the substituted allyl alcohols, when submitted to hydrolysis with only a slight excess of alkali, yield the partly racemized alcohols; when larger proportions of alkali are used optically pure alcohols are obtained[2]. Mechanism (II) implies dissociation of the ester into a carbonium cation and an anion. If the cation is mesomeric, as it is in the esters of the substituted allyl alcohols, rearrangement is to be expected[1], leading to a mixture of alcohols when mechanism (II) is operative. This has, in fact, been observed: α-phenyl-γ-methylallyl hydrogen phthalate, on hydrolysis by means of a slight excess of 5*N* aqueous sodium hydroxide, yields a mixture of α-phenyl-γ-methyl- and γ-phenyl-α-methylallyl-alcohols[3].

We have further observed that esters of these optically active unsaturated alcohols, when warmed with carboxylic acids or with alcohols, yield esters or ethers with extensive loss of optical purity and therefore, presumably by mechanism (II)[4]. This behaviour is in marked contrast to that of esters of saturated aliphatic alcohols: the hydrogen phthalate of octan-2-ol, for example, can be recrystallized unchanged from hot glacial acetic acid[5]. We also find that esters of phenylmethylcarbinol and of the naphthylmethylcarbinols react in a similar way with acids and with alcohols; we have not, however, observed the occurrence of racemization during the alkaline hydrolysis of the hydrogen phthalates of these carbinols.

The powerful electron-releasing effect of the *p*-methoxyl group causes the above-mentioned reactions to occur very readily with esters of anisylmethyl- and anisylphenylcarbinols. These esters, moreover, are easily decomposed, yielding *p*-methoxystyrene and αα′-di-*p*-methoxyphenyldiethyl ether and αα′-di-*p*-methoxyphenyldibenzyl ether respectively. The hydrogen phthalic esters of these two carbinols when warmed with dilute alkali yield the neutral esters (di-anisylmethylcarbinyl- and di-anisylphenylcarbinylphthalate).

All these observations are explainable on the assumption that the esters dissociate according to mechanism (II), and detailed descriptions of the reactions are in preparation. An analogous reaction is the racemization, without any observable evidence of decomposition or side-reaction, of the acetate of octan-2-ol, when heated in acetic acid solution with one molecular proportion of a strong acid (for example, *p*-toluenesulphonic or sulphuric acids). This reaction, which may be due either to dissociation or to a continued series of Walden inversion reactions, is at present the subject of further study.

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J. KENYON.

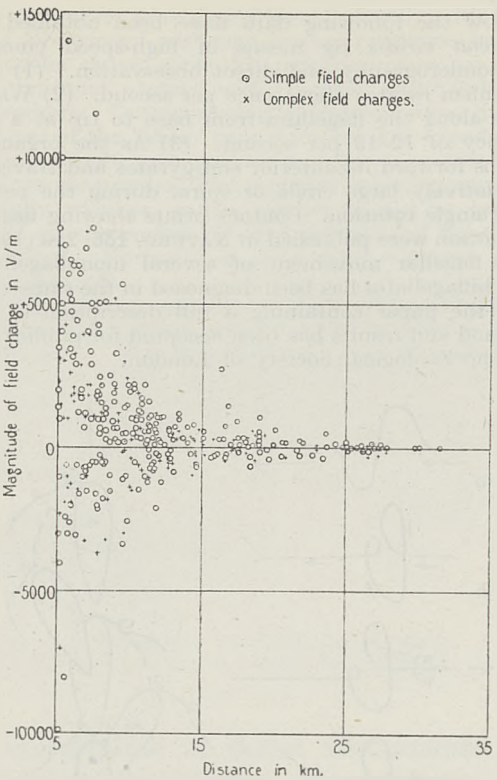
Chemistry Department,
Battersea Polytechnic,
London, S.W.11.
July 18.

[1] Watson, Ann. Repts. Progress of Chemistry, 27, 229 (1940).
[2] Arcus and Kenyon, *J. Chem. Soc.*, 1912 (1938).
[3] Kenyon, Partridge and Phillips, *J. Chem. Soc.*, 216 (1937).
[4] Reference (2) and unpublished results.
[5] "Organic Syntheses", 6, 68.

Errors of Observation due to Instrument Scale Limitations

IN the course of a recent investigation of the lightning discharge[1], it was found that scatter diagrams showing the variation with distance of the field changes set up by lightning flashes are liable to misinterpretation owing to a limitation in the recording apparatus which misses all records falling below a certain level. The effect of this limitation has been partly recognized by C. T. R. Wilson[2] in his investigations of the lightning flash, but has been overlooked in later publications on this subject[3]. The misleading effect due to this limitation is demonstrated below, and it is shown that a similar error of interpretation is liable to occur in many other cases in which a statistical analysis is based on data obtained with apparatus having a similar limitation.

The accompanying graph shows as an example the variation of the electrostatic field changes due to comparatively near lightning flashes. The recording electrometer, which was set to reproduce accurately the highest field changes that might be expected from nearby strokes, has a minimum recording limit which, as can be shown, excludes an increasing number of small values as the distance increases. This is shown directly by the fact that, assuming a uniform distribution of flashes, the number of records should from geometrical considerations increase with distance, whereas it decreases rapidly in the diagram reproduced. Again, while the spread of the data at any distance up to about 10 km. shows a ratio of about 50 : 1 between the maximum and minimum values recorded, this ratio decreases to about 10 : 1 at a distance of 20 km., though such variation has no foundation in the mechanism of the lightning



VARIATION OF FIELD CHANGES DUE TO LIGHTNING FLASHES WITH DISTANCE OF ORIGIN (WORMELL).

discharge. Finally, as the distance increases, the mean value shows a definite shift towards higher positions within the distribution of available test records, also indicating that an increasing proportion of the lower end of the distribution is lost.

If it be assumed that the average value at about 10 km. in the graph is correct, the variation of the electrostatic field changes with increasing distance can, as a first approximation, be assumed to vary inversely as the cube of the distance. In the accompanying table, calculated values are compared with the average values derived from the graph.

Distance, km.	10	15	20	25
Calculated, volts per metre	1385	413	175	89
From graph, volts per metre	1385	495	285	125
Appleton and Chapman, volts per metre	700	210*	88*	45

*Interpolated.

The table also includes field changes due to individual lightning strokes from Appleton and Chapman's observations[4]. As a first stroke of a multiple flash causes about one half of the total field change, it will be seen that the agreement of the latter with the calculated values is quite good, while the graph gives values which become increasingly too high as the distance increases.

Similar considerations probably apply to the observation of the variation of other radiation phenomena with distance, and the same fundamental difficulty will also arise elsewhere. For example, the attenuation of surges during their propagation along high-voltage transmission lines was first studied experimentally[5] by recording the amplitudes of surges due to lightning strokes at various points along such lines by means of the klydonograph. Whereas this method produces correct results for surges which show measurable amplitudes at more than one recording point, other surges which attenuate so quickly as to fall below the recording level of the instruments used at the second recording point will be neglected, and their omission will tend to suggest a rate of attenuation which would be too small if all waves had been taken into account. Later investigations with artificial surges confirm that the rate of attenuation as derived by the method described above was too small.

Still greater difficulties in the interpretation of test results are encountered in the determination of the average breaking strengths of insulating materials in a pendulum-type impact testing machine. In such tests, for which, as a rule, only a few specimens are available, the energy to be measured is that which is absorbed by the specimen when it is completely fractured. If the amount of energy absorbed is only a small fraction of that stored in the pendulum, it may be too small to be measured with the desired accuracy and the result is neglected. The same procedure is adopted if the energy of the pendulum is too small to produce fracture of the specimen. It is obvious from what has been said above that these omissions introduce an error in the determination of the average breaking strength additional to those already recognized[6].

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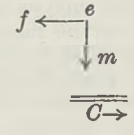
July 22.

[1] Bruce, C. E. R., and Golde, R. H., *J. Inst. Elec. Eng.* (in the press).
[2] Wilson, C. T. R., *Phil. Trans. Roy. Soc.*, A, 221, 75 (1921).
[3] Lewis, W. W., and Foust, C. M., *Trans. Amer. Inst. Elect. Eng.*, 50, 1139 (1931). Lutkin, F. E., *Proc. Roy. Soc.*, A, 171, 285 (1939). Norinder, H., *J. Frank. Inst.*, 218, 717 (1934). Wormell, T. W., *Phil. Trans. Roy. Soc.*, A, 238, 249 (1939).
[4] Appleton, E. V., and Chapman, F. W., *Proc. Roy. Soc.*, A, 158, 1 (1937).
[5] Lewis, W. W., *Trans. Amer. Inst. Elec. Eng.*, 47, 1111 (1928).
[6] E.R.A. Report, Ref. A/S36, *B.E.A.M.A. Journal*, 42, 19 (1938).

A Relation between 'Motional' and 'Transformer' Induction

THE experimental facts about the action of electric currents on charges may be represented, with some mnemonic advantage, by the accompanying diagram.



C is a current of electrons, e a single electron in or out of a metal, m its direction of motion (which may be all round the clock), f the direction of the force on it due to C, when C is steady. When C is accelerating, e experiences a force in the same direction as if it were moving towards C.

The following remark by Cullwick[1] will be generally agreed to: "It would naturally be very satisfying if the two methods of inducing an e.m.f. could be shown to be particular cases of one general law, but

attempts to do this make use of philosophical speculations which are outside the realm of what is physically definable."

Now, the point in common between motion towards C, and increase in velocity of C, is increase in the angular velocity of an electron in C about the electron e. If v is velocity of the C electrons, and r the distance of e from the nearest element (charge q) of C, $d(v/r)/dt$ positive represents motion towards C, and we may write

$$F = -qe\frac{d(v/r)}{dt}.$$

For v constant, $F = \frac{qev}{r^2}\,dr/dt$, which is Ampere's Law.

For r constant, $F = -\frac{qe}{r}\,dv/dt$, which is Neumann's Law.

It would be interesting to know whether this relation has been already noted. If it could be generalized further to include motion of e parallel with C, the general law covering all forms of induction could be stated without any hypotheses concerning modes of action at a distance.

H. STAFFORD HATFIELD.

Thatch End,
Hildersham,
Cambs.
July 10.

[1] Cullwick, E. G., "The Fundamentals of Electromagnetism" (Cambridge, 1939), p. 83.

Mechanics of a Flagellum

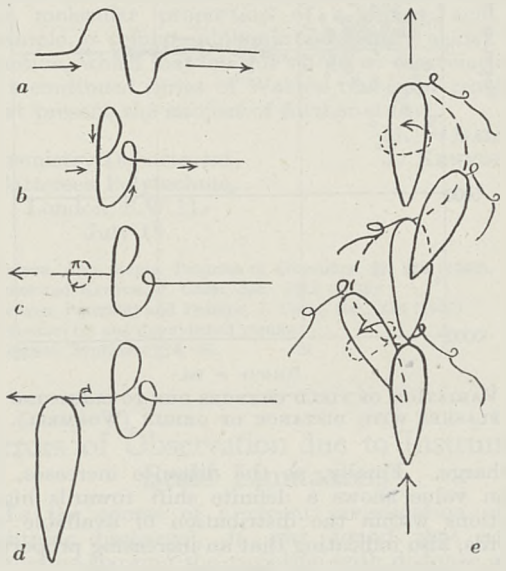
CONSIDER a simple homogeneous filament with a wave passing in the direction indicated and suppose that the filament is immersed in water (*a*). Allow also that the wave is passing along the filament with both an increase in velocity and amplitude and hence an increase in resistance from the water. It is then obvious, I think, that the wave must take up the form indicated (*b*). Thus the wave will pass along the filament with rotation in a clockwise or anti-clockwise direction. Let it be assumed that the rotation is anti-clockwise.

We are not concerned here with the nature of the force producing a wave, but that due to the wave acting on the water can be resolved into two components acting in different planes. The greater of the two forces will be one which would tend to force the filament to the left while the other would be acting in a clockwise direction with the main axis of the filament as its centre (*c*).

Now if we consider the filament to be a flagellum attached to a single cell such as that indicated (*d*) the one (the main) force of the flagellum would tend to push the attached end of the cell to the left while the other would tend to push the same tip of the cell below the plane of the surface of the paper. If, however, the inertia of the cell were greater than that of the distal end of the flagellum the effect would be to raise the greater part of the flagellum above the plane of the paper instead.

The continuous effect then of a series of waves passing along the flagellum at regular but frequent intervals would be to cause the tip of the cell to gyrate and rotate slowly as indicated in the diagram *e*, but it is obvious that the frequency of the waves passing along the flagellum must be high compared with the rate of rotation of the cell.

Now the following data have been obtained for *Euglena viridis* by means of high-speed cinema-photomicrography and direct observation. (1) The organism rotates about once per second. (2) Waves pass along the flagellum from base to tip at a frequency of 12–13 per second. (3) As the organism swims forward its anterior end gyrates and traverses a relatively large circle or spiral during the period of a single rotation. Contact prints showing flagella in motion were published in NATURE, **136**, 210 (1936). The flagellar movement of several monoflagellates and biflagellates has been diagnosed in the same way, and the paper containing a full description of the method and results has been accepted for publication by the Zoological Society of London.



It is commonly assumed that these monoflagellates possess a *tractellum* or a flagellum in which the waves start at the tip and travel towards the base and thus draw the organism through the water. There seems to be no concrete evidence of the existence of such tractella.

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Plymouth.
July 20.

Prevention of Seed-Borne Diseases in the Flax Crop

FURTHER to references[1,2] already made with regard to the prevention of seed-borne diseases in the flax crop, it may now be stated that the seed disinfectant RD.7846 prepared by Messrs. Imperial Chemical Industries, Ltd., and containing tetramethylthiuram disulphide as its active constituent, has been named 'Nomersan'. Through the good offices of Messrs. Imperial Chemical Industries, Ltd., and Messrs. Plant Protection, Ltd., 'Nomersan' was made available in bulk for the dressing of flax seed sown in Northern Ireland in the present season, and upwards of two thousand tons of seed were treated. Disinfection machines of the Strickland pattern were found to be very suitable for the continuous treatment of seed in large quantities, and machines of this type were used throughout the work.

No difficulties were experienced generally with the use of 'Nomersan', although in very occasional cases the powder caused some skin irritation when coming into continual contact with the faces and hands of the workers. During sowing operations when hand machines of the 'fiddle' type are used it is expedient for the sower to wear goggles in order to protect his eyes from the powder. This is of particular importance in windy weather, as the powder is apt to cause general eye discomfort, which is increased if the eyes are rubbed. Normally, it is of short duration and soon passes off.

A considerable quantity of seed was treated by the short-wet method using 'Ceresan U.564' as the disinfectant. For this purpose the 'Kontramix' machine was found to be quite satisfactory for the continuous treatment of seed in bulk.

Up to the time of writing, the crops from seed treated by either method are in good condition and no phytocidal effect has been noted.

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July 12.

[1] Muskett, A. E., and Colhoun, J., NATURE, **146**, 32 (1940).
[2] Muskett, A. E., and Colhoun, J., NATURE, **147**, 176 (1941).

Examination of Burnt Documents

IN present circumstances, the examination of documents recovered from receptacles which have been exposed to intense heat has become a matter of some importance, which has already been referred to in NATURE[1]. Many of these burnt documents have been incinerated at a high temperature in the virtual absence of oxygen and can better be described as 'carbonized' than as 'charred'. Such documents do not necessarily behave in the same way as specimens produced in the laboratory by incineration in air.

Carbonized documents are usually fragile, and those which are submitted for examination are presumably of value. It is a safe rule, therefore, to regard each document as a fresh problem in itself and to employ photographic methods of examination to the exclusion of any treatment which might damage or destroy the specimen.

I have, however, been employing a method for the treatment of carbonized documents written in ink, which appears safe and to give such good results as to merit its wider trial. It has been successful where other methods, including infra-red photography, have shown little if any trace of the writing. The method was devised by Superintendent Cherrill of New Scotland Yard and is published by permission of the Commissioner of Police of the Metropolis.

As I use it, the method consists in placing the carbonized sheet upon a glass plate in the bottom of a clean photographic dish and pouring over it a 5 per cent aqueous solution of silver nitrate. A second glass plate is lowered into the solution by one edge so as to exclude air bubbles. If the sheet is distorted, or especially fragile, it may be protected from the weight of the top plate by two glass rods placed parallel to the sides of the sheet. The dish should be protected from direct sunlight. Within about three hours the writing should be clearly visible as a black image against a grey background and is best photographed while the sheet is in the solution. The result obtainable, in contrast with that given by infra-red photography, which exhibits but little more detail than is visible to the eye, is shown in the accompanying illustrations. For permanent record the sheet may be rinsed in several changes of distilled water and then dried rapidly.

Where the original writing is faint, a weaker solution of silver nitrate may be employed, but it should then be allowed to act longer.

The method is simple and has the advantage of bringing up an image which is visible to the naked eye. It has been tried upon a limited number of printed documents (one die-printed letter heading and a number of letterpress printed bill headings) with positive results. It does not seem to be applicable to carbonized typewritten documents, and, since it would appear that the image may be produced by the reduction of nitrate silver, it is possible that the method is applicable only to those documents which have been printed or written with an ink containing a metallic constituent having reducing properties after incineration. Such inks would include the blue-black writing inks, and printing inks containing metallic driers.

Fig. 1.
RESULT OBTAINED WITH INFRA-RED RAY PHOTOGRAPHY.

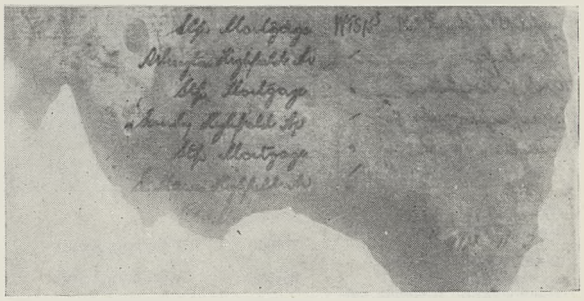

Fig. 2.
AFTER TREATMENT BY SUPERINTENDENT CHERRILL'S METHOD. THE REVERSED IMAGE ON THE RIGHT-HAND SIDE IS SHOWING THROUGH FROM THE BACK.

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July 14.

[1] NATURE, **147**, 417, 676 (1941).

CARRIER WEIGHTS OF CONJUGATED PROTEINS

By DR. E. E. BRODA AND DR. C. F. GOODEVE, F.R.S.

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IT has recently been observed[1] that the carrier weights, that is, the weight of protein carrying one gram-equivalent of prosthetic group, of a class of conjugated proteins, the chromoproteins, is in many cases equal to the Svedberg unit of about 17,600 gm. In no case is it appreciably less. Data for various conjugated proteins have since become available, and are shown along with the previous data in the accompanying tables. References for the latter data are given in the previous paper[1]. The carrier weights given include the weights of the prosthetic groups, and are therefore too high. The latter are, however, mostly unknown, but as they are certainly comparatively small (4 per cent in hæmoglobin, 1 per cent in the flavins) this error is not serious; moreover, the same systematic error is incurred in calculating the Svedberg unit from ultracentrifugal molecular weight determinations.

The new data confirm that the Svedberg unit is the lower limit of the carrier weights. Moreover, the tables show strikingly that all sufficiently well-defined compounds have carrier weights close to simple multiples of the unit, the 'permitted' carrier weights having the same values of the multiples, namely, 1, 1·5, 2, and probably 4, etc., as Svedberg[13] found for molecular weights. On account of their lower accuracy, conclusions concerning higher multiples appear premature. The existence of Group 1·5 is of especial interest in view of the fact that gliadin and hordein, two simple proteins, have molecular weights of 1·5 Svedberg units. These relationships provide new experimental evidence, *quite independent of molecular weight determinations*, to show the importance of the Svedberg unit.

CARRIER WEIGHTS (NUMBER OF GRAMS OF PROTEIN PER GRAM-EQUIVALENT OF PROSTHETIC GROUP).

Substance	Carrier weight R	Chemical nature of the prosthetic group (on which R is based)
GROUP 1:		
Hæmoglobin (horse)*	16,200	Hæme
Myoglobin (horse)*	16,200	An Fe compound
Erythrocruorin (Cyclostomata)	17,500	An Fe compound
Cytochrome C (horse, ox)*†	16,400	An Fe compound
Hæmocuprein (ox)*	18,700	A Cu compound
Hepatocuprein (ox)	18,700	A Cu compound
Laccase (*Rhus succedanea*)[3]	18,700	A Cu compound
Carbonic anhydrase (ox)[3]	19,800	A Zn compound
Carboxylase (yeast)[4]	18,700	A Mg compound
Thyroglobulin (man)[5]	18,100	An I compound
Average carrier weight: 17,900. Mean deviation from 17,600: 6 per cent. Greatest individual deviation: 12 per cent.		
GROUP 1·5:		
Hæmocyanin (*Helix pomatia*)	25,900	A Cu compound
Hæmocyanin (*Busycon canaliculatum*)*	25,900	A Cu compound
Hæmocyanin (*Octopus vulgaris*)*	25,400	A Cu compound
Hæmocyanin (*Loligo pealei*)*	24,400	A Cu compound
Conjugated protein (tyrosinase ?) from *Lactarius piperatus*[6]*	24,500	A Cu compound
Average carrier weight: 25,200. Mean deviation from 1½ × 17,600: 4 per cent. Greatest individual deviation: 8 per cent.		
GROUP 2:		
Hæmocyanin (*Limulus polyphemus*)	36,700	A Cu compound
Hæmocyanin (*Homarus americanus*)	34,000	A Cu compound
Hæmocyanin (*Dromia vulgaris*)[7]	37,400	A Cu compound
Average carrier weight: 36,000. Mean deviation from 2 × 17,600: 5 per cent. Greatest individual deviation: 6 per cent.		

* Crystallized preparations.
† See, however, Theorell, *Science*, 90, 67 (1939).

CARRIER WEIGHTS OF HIGH VALUE OR OF POORLY DEFINED COMPOUNDS.

Substance	Carrier weight R	Chemical nature of the prosthetic group (on which R is based)
Visual purple (frog)	< 26,500	(from photosensitivity)
Polyphenol oxidase (*Agaricus campestris*)	< 21,200	A Cu compound
Polyphenol oxidase (potato)	ca. 31,800	A Cu compound
Ascorbic oxidase (squash)[8]	< 41,000	A Cu compound
Phycocyan, Phycoerythrin	ca. 30,000	Phycobilin
'Old' yellow ferment*	70–80,000	Phosphorylated flavin adenin dinucleotid
Heart flavoprotein (pig)[9]	70,000	do.
Amino-acid oxidase† (sheep kidney)	< 87,000	do.
Milk flavoprotein[10, 11]	140,000	do.
Catalase (beef liver)[12]*	124,000	Hæme
Ovoverdin	144,000	Astaxanthene

* Crystallized preparations.
† Calculated below.

The molecular weight divided by the carrier weight obviously gives the number of prosthetic groups per molecule of protein. This may vary over a wide range; it is unity for cytochrome *C* and some of the flavoproteins, 4 for hæmoglobin, about 40 for thyroglobulin and 240 for hæmocyanin (*Helix pomatia*), etc. Clearly it must not be less than unity. On this fact was based an early method[14] of calculating minimum molecular weights of proteins long before the Svedberg unit was discovered.

Carrier weights of conjugated proteins, which dissociate into protein and prosthetic group, can be calculated for the state of suppressed dissociation. For example, for amino-acid oxidase the experiments of Warburg and Christian[15] can serve as a basis. The enzyme activity of the solutions containing varying quantities of protein and prosthetic group is proportional to the bound prosthetic group only. The activity of a solution containing $5{\cdot}4 \times 10^{-11}$ mol of the prosthetic group and a large excess of protein, that is, of a solution where practically the whole of the prosthetic group was bound, was 1·76 units, or $1{\cdot}76/5{\cdot}4 \times 10^{-11}$ units per mol. In another solution containing 2×10^{-5} gm. of protein and a large excess of prosthetic group, that is, in a solution where the protein was saturated with prosthetic group, the activity was 7·51 units and this solution must therefore have contained $\frac{7{\cdot}51}{1{\cdot}76} \times 5{\cdot}4 \times 10^{-11}$ mol of bound prosthetic group or 1/87,000 per gm. of protein. The carrier weight is therefore 87,000. As according to Warburg and Christian the protein was not quite pure, the true carrier weight may well come down to the value for the 'old' yellow ferment, that is, 70–80,000. An independent confirmation is provided by the result of Negelein and Brömel[16],

who found that reduction of the prosthetic group by alanin (which stops as soon as the bound prosthetic group is reduced because the reduction product sticks to the protein) proceeds only until one mol per 100,000 gm. of the (not quite pure) protein has reacted.

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[2] Keilin, D., and Mann, T., NATURE, **143**, 23 (1939).
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[13] cf. Svedberg, Th., and Pedersen, K. O., "The Ultracentrifuge". Oxford University Press (1940).
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ETHNOLOGY OF THE LAU ISLANDS, FIJI

THE great interest held by the Lau islands for the ethnologist lies in the fact that they are situated between Fiji and Tonga, on the border where Melanesia and Polynesia meet. They had been subjected, therefore, to different impacts, both physical and cultural, even before the advent of Western civilization. For this reason the author of a recent paper* chose a group of islands in southern Lau which owing to its isolation and lack of valuable natural resources had been left comparatively untouched by Western influences, and on one of these, Kambara, she lived for five months making an intensive study of its culture. Owing to lack of time she was unable to devote much attention to material culture and concentrated rather on the social system as being more evanescent.

After a short account of the physical types and the geography of the island group, including a census of the chief village of Kambara, the author gives a full description of the social organization of the people. This is very complicated owing to the different influences that have impinged on the islands, but she has worked out the different social groups. The largest unit, the phratry, consists of groups of clans with the same mythical ancestor or group of ancestors. The clans are divided into subclans and these again into families or households. Through all these runs a deep-seated and elaborate system of rank; not only each phratry, clan, subclan, family and individual, but also each village and chiefdom holds a different rank in the scheme. This is all clearly set out, and in subsequent sections marriage and relationship are discussed, followed by an account of the ceremonial usages and the economic life and material culture of the islands. The author also found time to excavate some archæological sites, principally fortresses on the various islands.

In her conclusion the author suggests that Lauan culture consists of three complexes: that of its own aboriginal (Melanesian) inhabitants, which is similar to that of the low Fijian culture of western Viti Levu. Some three hundred years ago, according to genealogies and tradition, a group of immigrants from eastern Viti Levu introduced a highly organized culture of a Polynesian type with a complicated system of rank, and they also increased production and developed industry to a high degree. The third impact came from the west with Tongan contact in the late "prehistoric" period. Its outstanding contributions were the concept of divine chieftainship with attendant ceremonial, of kava drinking and dancing, while on the material side came the introduction of the western Polynesian oval house and the technique of pasting tapa into long sheets. Thus Lauan culture is truly marginal and presents a unique fusion of Melanesian and early and late Polynesian complexes.

The bulletin is illustrated by maps, tables and photographs, and contains a bibliography and complete index.

* Bernice P. Bishop Museum. Bulletin 162: "Southern Lau Fiji: an Ethnography." By Laura Thompson. Pp. iii+228+5 pl. (Honolulu, 1940).

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

ANNUAL CONGRESS

THE South-Eastern Union of Scientific Societies has, for the second time, been obliged to curtail its annual congress to a single day of sessions and excursions; this was held at Kingston-upon-Thames on July 26.

A representative assembly to transact the business of the seventy constituent societies was held during the forenoon, in the Queen Elizabeth Grammar School. Dr. W. E. St. Lawrence Finny, who has been mayor of the Royal Borough of Kingston no fewer than seven times, was elected president for 1941–42; in recent years he has served the Union as president of the Archæological Section.

"The Church of the Saxon Coronations at Kingston" was the title of Dr. Finny's presidential address. He described the ancient form of the Coronation Service, tracing its origin to the Court of Charlemagne, and showed lantern slides of such evidence as now exists of the church in which the Saxon kings must have been crowned. At Kingston the principal

exhibit is the original Coronation Stone of which the early history is unknown, but a coin is preserved showing Dubnovilaunus, a king of Kent, seated upon a stone of similar size and shape. Another local relic is a fragment of a Saxon commemorative cross bearing an interlaced design of a type not found elsewhere south of the Midlands. In the Lady Chapel of the Coronations there used to be fourteenth-century paintings of five of the Saxon kings crowned at Kingston as well as one of King John: it was the latter who gave the first extant charter to Kingston, the oldest of the three 'Royal Boroughs'—the other two being Windsor and Kensington. The original paintings upon wooden panels of these kings were accidentally discovered in 1813 during the renovation of Baston Manor House in Kent. One of these panels is now preserved in the hall of the Society of Antiquaries, and its Latin inscription gives conclusive proof that Athelstan was crowned at Kingston.

Dr. Finny's address had been preceded by separate sessions for business and the reading of sectional addresses, which will appear later in an abbreviated volume of the *South-Eastern Naturalist and Antiquary* (vol. 46).

The address to the Archæological Section was given by Edward Yates, on "The Early History of Hampton Court Palace". A feature of the Palace is the ease with which the buildings can be dated by the character of the brickwork and fenestration. The address to the Botanical Section was given by Dr. J. Ramsbottom, who spoke on "The Preservation of our Flora". The address to the Geological Section was delivered by Dr. R. L. Sherlock on "The Red Rocks as Indicators of Past Climates". In view of the Thames swan upping having been completed at Henley the previous day, it was appropriate that the presidential address to the Zoological Section should be by N. F. Ticehurst, upon "The Mute Swan on the Thames", illustrated with lantern slides of the old local swan-marks and upping ceremonies. Owing to lack of time, some further papers were taken as read. The Zoological Section papers had been prepared in the form of a *Bulletin* (No. 76). It includes a short paper by Miss Z. V. Waloff, of the Imperial Institute of Entomology, on "The Migratory Locust in the British Isles" and a "Preliminary Note on Dragonfly Migration" as an appendix to the annual report of the Insect Immigration Committee. The latter showed that the regular migration was upon a small scale comparable with that of 1937, and with a similar invasion of the large white butterfly, *Pieris brassicæ* L., the subsequent larvæ of which did considerable damage in market gardens (see *Entomologist*, 74, 54–62).

Dr. Finny conducted a party to Lovekyn's fourteenth-century chantry chapel and to other places of local antiquarian interest. Geologists went to Mickleham to examine fresh exposures in the Chalk recently cut for the Dorking by-pass road; a junction of the Middle and Upper Chalk here exhibits fossils of the *Terebratulina lata* and *Holaster planus* zones. R. V. Melville described the history of the Mole Gap and showed a fine swallow-hole near Mickleham Church.

No definite arrangements for the 1942 Congress were announced; but, in view of its jubilee, it was suggested that a suitable centre for an abbreviated Congress would be the Haslemere Educational Museum.

T. D.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Rubber Producers' Research Association. Publication No. 9: The Kinetics of the Polymerization of Isoprene on Sodium Surfaces. By J. L. Bolland. Pp. 20. Publication No. 10: The Proteins of *Hevea brasiliensis*, 2: Analysis of a Product isolated from Crepe Rubber. By G. R. Tristram. Pp. 4. (London: British Rubber Producers' Research Association.) [307

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 4, No. 10 (July–December 1940). Pp. ii+489–504. (London: Royal Meteorological Society.) 2*s*. 6*d*. [18

Other Countries

United States Department of Commerce: Weather Bureau. Monthly Weather Review, Supplement No. 44: Fifty Years' Weather in Kansas City, Mo., 1889–1938. By Andrew M. Hamrick and Howard H. Martin. (W.B. No.1316.) Pp. iii+53. (Washington, D.C.: Government Printing Office.) 20 cents. [307

U.S. Office of Education: Federal Security Agency. Pamphlet No. 93: Trends in Industrial Arts. By Maris M. Proffitt. Pp. iv+20. (Washington, D.C.: Government Printing Office.) 5 cents. [307

U. S. Department of Agriculture. Circular No. 600: Mortality of the Apple Maggot in Fruit held in Cold Storage. By P. J. Chapman and A. D. Hess. Pp. 10. 5 cents. Circular No. 602: Field Infestation by Insects that injure Rice in Storage. By W. A. Douglas. Pp. 8. 5 cents. Farmers' Bulletin No. 1566: The Sorghum Midge, with Suggestions for Control. Originally prepared by C. H. Gable, W. A. Baker and L. C. Woodruff, and slightly revised by E. V. Walter. Pp. ii+10. 5 cents. Farmers' Bulletin No. 1860: Gladiolus Diseases and Insects. By Lucia McCulloch and C. A. Weigel. Pp. ii+18. 5 cents. Technical Bulletin No. 774: Life Histories and Habits of some Grasshoppers of Economic Importance on the Great Plains. By Robert L. Shotwell. Pp. 48. 20 cents. (Washington, D.C.: Government Printing Office.) [307

Henry Lester Institute of Medical Research. Annual Report, 1940. Pp. 60+3 plates. (Shanghai: Henry Lester Institute of Medical Research.) [317

South Australia. Annual Report of the Director of Mines and Government Geologist for 1939. Pp. 6. (Adelaide: Government Printer.) [317

South Australia: Department of Mines. Mining Review for the Half-Year ended 30th June 1940. (No. 72.) Pp. 95. (Adelaide: Government Printer.) [317

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