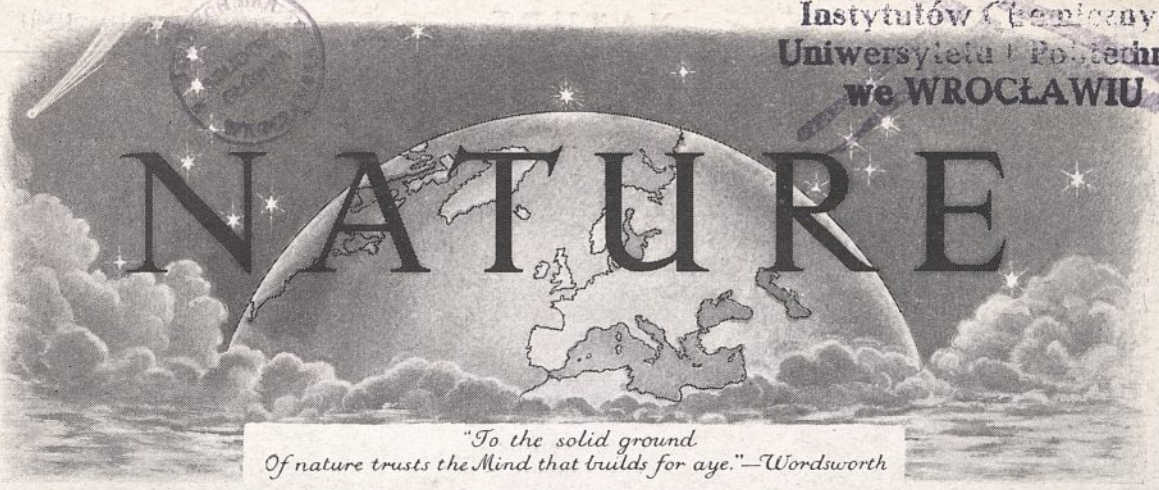

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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PRESENT-DAY PROBLEMS OF YOUTH

SOME weeks ago, the National Youth Committee set up by the Board of Education announced that the Government had no intention of allowing a recurrence of the social problems of the War of 1914–18. Despite this assurance, familiar youth problems have again presented themselves and new ones have been created. A number of these were probably inevitable ; others could probably have been avoided. It is not easy to resist the conclusion that, in certain important matters, the Government departments concerned with the social services have shown themselves to be regrettably lacking in foresight.

Nor is it easy to resist the further conclusion that some of them are exhibiting very little alacrity, method or determination in dealing with problems which appear to many to be urgent. Doubt on this point may be permissible, for it is probable that their hands are being tied by the Treasury, through reduction in financial assistance. But it might not have arisen at all, if these departments had shown more frankness in their pronouncements. Nothing is more likely to stiffen the task of the Director of Home Publicity at the Ministry of Information—that of making public opinion receptive to political decisions—than an accumulation of unanswered or half-answered queries on such matters.

If bewilderment is produced in this way, further psychological difficulties are created. In some cases, formidable resentment is built up ; in others, apathy becomes all-pervasive. During recent weeks, both these reactions have been exhibited plainly ; and nowhere more clearly than among those concerned directly and indirectly with problems of juvenile employment. In their treatment of a number of these problems, some departments seem lately to have displayed neither frankness nor wisdom.

Why, for example, has the Home Office had to undertake to consider applications for exemption from those sections of the Factories Act of 1937 which regulate the hours of work of juveniles ? Surely the evidence collected during the War of 1914–18 by the Health of Munition Workers' Committee suggested strongly that even the regulations of the Act of 1937 were not entirely adequate ? It is not to be doubted that the factory inspectors of the Home Office will use their new powers with great discretion, but it is more than likely that some of them will feel compelled at times to declare decisions which they will reach with considerable reluctance. From various parts of the country it is already reported that two of the most evil consequences of unsuitable working hours—listlessness and loss of 'further education'—have once more manifested themselves. In his recent King George Jubilee Trust report, "The Needs of Youth", Dr. A. E. Morgan remarked, "British industry will not be ruined by being deprived of the privilege to exploit half-educated boys and girls". This pungent comment is as true in war-time as it is in times of peace. Even in factories which retain their pre-war time-tables, the *tempo* of production is apparently increased sometimes to such a pitch that the physical and psychological state of the slower workers is seriously affected.

Has the Home Office decided, in the face of all the evidence available on this subject, to surrender to the Ministry of Supply ? If the outlook indicated by this ruling is maintained, what will be the quality of Britain's democracy at the end of the present conflict ? For some workers, possibly even for the younger ones, patriotism may provide an

additional incentive; but, as Dr. H. M. Vernon reminded his hearers at a meeting reported in NATURE of February 3, p. 174, "Nature cannot be defied indefinitely."

Again, why has the Ministry of Labour permitted the suspension of certain of the vocational guidance and after-care activities of its Juvenile Advisory Committees? Why has the Ministry's scheme for the transference of young workers apparently ceased to function, while the need for it continues? And why have some at least of its hostels for these boys and girls closed their doors? Even when allowance is made for difficulties created by evacuation, such actions are bound to perplex those who had been led to believe that the Ministry took a broad view of its responsibilities towards young people. It is perhaps significant that its war-time opinions on vocational guidance and after-care have not been accepted without question by other experts. Its advice has been ignored by many local education authorities who have juvenile employment officers of their own and in whose districts the Ministry is only in indirect command. The very fact that acute disagreement exists here suggests that the Ministry's case for curtailing its activities is by no means unarguable. The 'rebels' are unquestionably right in maintaining that, both from the point of view of the individual, who needs a congenial occupation if he is to exert himself fully, and from the point of view of the nation, which urgently requires efficient workers, sound vocational guidance is at least as necessary now as it was before the War. If the Ministry feels unable to continue this branch of its work, it might well ask local authorities whether they will take it over. The machinery for such a transfer already exists.

Furthermore, why have the Civil Service Commissioners had to suspend their normal examinations for entry to this Service? A very considerable number of able boys and girls—and their parents and teachers—have lately been profoundly disturbed by the Commissioners' unexplained move. In all parts of the country, secondary school principals, who are in a good position to judge the public reaction to it, are voicing strong criticisms of the Government's attitude to this problem. It is understood that alternative proposals, put forward by the staff side of the National Whitley Council, are being considered. Consideration of them should be completed speedily and positively. Purely negative decrees on employment matters by the Government can scarcely be held to provide good examples for private employers; nor can they easily produce the occupational incentives which are so much needed by young people at the present time.

Indeed, the negative character of the official attitude to many employment matters is extremely disconcerting. No reasonable person would expect the Government to show unerring foresight in making plans for dealing with situations which might never arise. But there is, unfortunately, much evidence which suggests a marked lack of constructive and co-ordinated thought. A striking example is to be found in the astonishing absence—an almost total absence—of official comment on what has been called the "16 to 20" problem.

Lord Derby has suggested that voluntary labour camps should be provided for boys of secondary education who fall within this age-range. His proposal has been discussed at length in the correspondence columns of *The Times*. It is doubtful whether the space devoted to it has been commensurate with the usefulness of the suggestions put forward, or, indeed, with their relevance; for most of them—not unnaturally, perhaps—have been concerned primarily with the comparatively limited problem of the boy whose parents have been able to send him to a public school. The Ministry of Labour's contribution to the discussion—communicated through *The Times* Labour Correspondent—has been a statement of the conditions under which boys in this age-group may be admitted to its ordinary technical training centres. Is it surprising that the head master of a large south of England secondary school reports that his boys are "simply bewildered" about their futures?

Could not the Ministry of Labour at least stress frankly the need for considering the post-War effects of such schemes as those proposed by Lord Derby and his supporters? They certainly need consideration; for many of the suggestions seem to have been based on false assumptions. One is that many boys in the 16–20 group have sufficient money and influence to enable them to make an entirely fresh occupational start after the War and therefore need not worry if, in the period prior to their military service, they are called on to do something which bears little relation either to their abilities or to their interests. Another is that, when the War is over, the national recovery will not be hindered by the presence in the community of large numbers of middle-class young men devoid of occupational training and experience suitable

to their talents and temperaments. The vast majority of those leaving secondary schools cannot afford, even in war-time, to be ushered silently into unsuitable 'stop-gap' occupations; nor can the nation afford it. It is clearly important that these youths should be regarded, not as unfortunate liabilities to be put temporarily into places where they will create a minimum of trouble, but as citizens-in-training. The head master of Winchester College, who is chairman of the Head Masters' Conference, has very properly insisted that, in any work scheme produced for the 16–20's, the opportunities offered should be *real*.

Is it too late to suggest that this problem should be tackled experimentally by the Ministry and the Board of Education? Individual head masters here and there are doing this in their own way, and according to their own ideas: for example, by providing special commercial courses for senior boys who would normally have entered clerical occupations this year but have been unable to do so, and by increasing the amount of time devoted to O.T.C. activities. The Board of Education has already dealt with one of its own difficulties by allowing non-graduate students to enter its teachers' training colleges at the age of seventeen. The Y.M.C.A. has proposed the formation of a Boys' Land Army. A number of professional training organizations have begun to provide shortened courses of instruction. One well-known rubber company has announced its intention of awarding a certain number of 'scholarships', providing free training and maintenance grants, to boys between the ages of 17½ and 19. Could not these experiments be co-ordinated and extended? If this were done, a great deal of the resentment and apathy noticeable at present might rapidly be dissipated and much valuable data might be gathered. But it will have little worth if it be not done seriously and with a determination to act on the results obtained. The adoption of an experimental approach, which might well make use of psychological techniques of vocational guidance and selection, must not be made an excuse for shelving decisions by bestowing semi-official blessing and inadequate funds on ardent advocates of reform, in the hope that the problem will quickly lose its urgency by the absorption of young men into the Fighting Services. An appropriate first step would be the appointment, by the departments concerned, of a director of research.

SCIENCE FOR A NEW AUDIENCE

Science and Everyday Life

By Prof. J. B. S. Haldane. Pp. 284. (London: Lawrence and Wishart, Ltd., 1939.) 5*s*. net.

THOSE who subscribe to the *Daily Worker* are privileged to read every week some of the most successful expositions of popular science in contemporary journalism. It is not possible to discuss the implications of this fact in a brief review; but if Prof. Haldane's modesty would permit him to admit that he is both a first-class man of science and a first-class educator, his faith would make him insist that he would be neither were he not a first-class Marxist. This collection of articles is certainly as political as it is scientific, and its author would believe it less scientific if it were less political.

The book should be read not only by the general public but also by all those who aspire to make science intelligible to the general public. To these the author's technique will be a liberal—as well as a Marxist—education. Why is it so successful? Apart from the blustering, ozone-laden style through which Haldane introduces himself to his readers, rather as the *homme moyen sensuel* than as the ascetic scientist, there is the picture which he seems to carry in his eye of what his reader is like. He does not write for readers in their capacity of consumers willing to fill a leisure hour with science gossip, but rather as producers into whose labours science has already entered at every point. He creates a synthesis between the theories of scientists and the actions of workers, miners, chemical manufacturers, barmen, who are applied scientists by virtue of economic necessity. He does not describe disease as an abstraction but shows it always to be occupational, a function of the social environment.

Above all, the politician in him prevents Prof. Haldane from committing the commonest error of men of science trying to write for the man in the street, namely that emotion, or personal equation, is as deadly then as in the writing of a monograph for the *Philosophical Transactions*. He believes that the voice of honest indignation is the voice of science and so he writes.

Occasionally Prof. Haldane permits himself the luxury of statements that, taken at face value, could no doubt be challenged. For example, he says that "By postponing marriages, the Means Test not only causes unhappiness, but actual mental defect". It is improbable that Prof. Haldane could produce evidence that the means test has actually increased mongoloid imbecility, but then he would point out that the only sort of person likely to take him up on such a point would be "Reactionary biologists" some of whom think "that the unemployed should be sterilized".

Two passages especially suggest how far we have gone since the day when popular science catered chiefly for ladies who sought a change from fancy sewing. The first is where Prof. Haldane sums up against astrologers in Sunday papers : There is no righteous indignation ; astrology is not an insult to that abstraction, scientific truth ; "Astrologers and palmists are very useful to the cause of capitalism. They help to persuade people that their destinies are outside their control. . . . If enough people learn how the joint fate of us all can be altered, things begin to happen which mean the end of capitalism as well as of astrology and palmistry".

The other passage gives a significant criterion for judging between cause and cause. "We are quite right," Prof. Haldane points out, "to emphasize the environmental factors in tuberculosis just because we can control them. We say that a house caught fire because someone threw down a cigarette end, and not because there is 21 per cent of oxygen in the air". Implicit here is the doctrine that the duty of the scientist is not to explain the world but to alter the world, and implicit on every page of the book is the author's belief that his duty as an educator is not to help his readers simply to understand phenomena but to become the *primum mobile* of their evolution.

JOHN LANGDON-DAVIES.

CHEMISTRY OF ORGANIC COMPOUNDS

(1) Ausführliches Lehrbuch der organischen Chemie

Von Wilh. Schlenk. Band 2. Pp. xvii + 896. (Wien und Leipzig : Franz Deuticke, 1939.) 30 gold marks.

(2) The Chemistry of Organic Compounds

A Year's Course in Organic Chemistry. By Prof. James Bryant Conant. Revised with the assistance of Dr. Max Tishler. Pp. x + 658. (New York : The Macmillan Company, 1939.) 18*s*. net.

(3) Introduction to Practical Organic Chemistry

By Dr. Frederick George Mann and Dr. Bernard Charles Saunders. Pp. ix + 191. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1939.) 4*s*. 6*d*.

THE three books under review are so closely related to modern organic chemistry that they are conveniently taken together. They represent in a very marked manner the kind of organic chemistry which the young man of the present day, and perhaps for the next twenty-five years, will have to learn if he desires either to make the subject his life-study or intends to use it merely as a stepping stone to other walks of life.

(1) The reputation of Prof. Wilh. Schlenk as a writer and teacher was established when Vol. 1 of the text-book was published. The appearance of Vol. 2 enhances that reputation. To an earlier generation the two volumes must show a striking resemblance to that wonderful treatise started by Victor Meyer and Jacobson, the first volume of which appeared before Victor Meyer's death but which was finished later by Jacobson and others. It was the first volume that contained both knowledge and wisdom and showed that even a book on organic chemistry could be made readable and interesting to the lay mind. The book contained such a wealth of knowledge expressed in such beautiful phrasing that it is doubtful whether we shall ever see its like again.

Vol. 2 of Schlenk's book, in general treatment and in power of expression, follows, with Vol. 1, as commendable modern equivalents of the first volume of Meyer and Jacobson. Like Victor Meyer's book, it is no mere record of an endless number of compounds, but deals only with such substances or group of substances as lead to or enforce the establishment of some theoretical point of value in the discussion of some principle underlying the science. The discussions on these points are by a master mind and make excellent reading. They give the book an interest unusual in a scientific text-book. According to the short preface the author intends to publish a Vol. 3 to complete the issue. If the third volume is as good as the other two, the whole work will form a striking addition to our chemical literature. There is, of course, the difficulty of language for the English reader, a difficulty which is not overcome

by a translation, if such were possible nowadays. The true charm of the book lies in the expression in the German language of the enthusiasm of a man who loves his subject and is prepared to give all he possesses in unstinted measure to those who can appreciate the gift. An English translation would be but a dead-sea apple and turn to dust and ashes in the mouth. It would be lifeless. Despite present circumstances, we must place a mastery of the German language in the forefront of our educational schedule. The Germans as scientific people rank high and we should be curiously handicapped if we failed to understand or to appreciate any new discovery they might make, the lack of a knowledge of which might stand us in ill-stead.

The free interchange of knowledge as it was say forty years ago, no longer exists. Many things have caused the change, notably the supposed need for commercial secrecy. It is true that many firms permit publication by their employees, provided all requirements of the patent laws have previously been met. This involves, usually, some little delay, but can scarcely be regarded as a hardship. Other firms, unfortunately, do not grant such privileges, and much useful and perhaps essential knowledge is buried in their archives. Team work in industry has come to stay because it is by far the best means of attacking a general problem, and although the team worker is individually the loser by sharing any new discovery with others, it is made up to him in other ways and the new discoveries can be published by the firm under the names of the team-workers concerned. For it is essential that new knowledge should be published, annotated and recorded, otherwise progress will be impossible. One can scarcely realize what the present position of knowledge would be had the research workers of the past evaded the path of free publication. Nevertheless, with good will and co-operation between industrialist and scientist, the terms being used merely to denote two different types of scientist, all will be possible and the goal reached by which all new knowledge will be annotated and pigeonholed for the benefit of succeeding generations.

Let us, for example, be certain that a book like Schlenk's is full and unrestricted and that nothing is held back either by reasons of commercial exigencies or for any cause whatever. It is surely in the interests of industry itself that there should be unrestricted publication of all new knowledge, for it is unthinkable that new knowledge can be discovered if any industry buries the information it has gained on account of some real or supposed desire to prevent a competitor from taking advantage of it. By burying its knowledge, a firm reaps no real benefit but injures itself by checking the advance of knowledge in other branches of the subject with which it deals. The research worker is thereby prevented from knowing what has been discovered, the progress of discovery is inhibited and the direction on which all true progress depends is lacking.

(2) President Conant is a great administrator, and his power as an author has been shown in many ways, notably by his publication of organic syntheses and by the first edition of the book under review. The revised edition is published after six years with the assistance of Dr. Max Tishler, research chemist at Mercks. The new matter deals mainly with the advances made in that region which lies between abstract organic chemistry and biology, because it is undoubtedly along the lines of organo-physiology and organo-pathology that discoveries of vital importance to mankind will be made.

It is doubtful whether we shall succeed in discovering the true chemistry of life, but we shall get sufficiently near to that discovery to enable us to prepare biological substances the lack of which in the human system leads to disease and death. It is perhaps impossible to renew the worn-out human machinery but by the application of essential organic compounds, which the ageing system fails to produce, it will be possible to prolong life far beyond the three score years and ten of the Psalmist. Whether this is desirable or not is an open question, for youth is not likely to view with equanimity the picture of seniors active and virile at the age, say, of one hundred and twenty. Values must, however, adjust themselves in this ever-changing world, and if men can retain all their faculties at one hundred and twenty years of age, they are not likely to consider the objections of youth in the matter.

In Conant's book, although it bears the subtitle—"A Year's Course in Organic Chemistry" and is therefore written for those other than the men who intend to make organic chemistry a life-study, much of the higher biology is given in full detail. It is clear that the authors understand the great truth which all those who appreciate the science must recognize, namely, that it is only by the combination of organic chemistry and biology that progress can be made. Ultimately, the empiricism of biology will disappear and the new science of biochemistry will be based on organic structure and principles. When this happens, the clouds will pass away and in the brilliant light of the unfettered sun, discoveries will be made of far-reaching importance to the human race.

(3) This practical organic chemistry is doubtless a useful book for laboratories in which the course of laboratory work followed is in accordance with the text. For it happens that text-books of

this kind are usually written for the course chiefly to assist the teacher; it is rarely that the course is dependent on the text-book, although in some instances this may be the case. The present book is probably written of the Cambridge laboratory course and shows incidentally that teaching in these laboratories is based on right principles. The book, no doubt, will serve for any of the organic courses in our universities and university colleges, but there it will have to compete with a host of similar books, some written for the requirements of a course, which are practically unassailable, having become firmly established by usage, others of general application which again have been established by long usage and are also practically unassailable from outside.

Nevertheless, the book under review is a good one and deserves fully all the success it can obtain. It is difficult to say, however, that it has any outstanding features which render it a book apart from its many competitors.

JOCELYN THORPE.

ENZYMES

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement. Band 1 (zu Band 1, Specieller Teil: Haupt-Teil 7–12.) Pp. xii+782. Band 2 (zu Band 2, Specieller Teil: Haupt-Teil 13–22). Pp. x+783–1738. (Den Haag: Dr. W. Junk, 1936, 1939. 2 vols., £12 10*s*. Bibliography (1924–1938). Pp. 1–128.

FORTY years ago probably relatively few chemists or physiologists had any knowledge of enzymes, which were considered to be somewhat mystic bodies; the biochemist, if he existed, was regarded as a hybrid. Emil Fischer had put aside the sugars for the time and commenced his work of taking the proteins to pieces.

To-day it requires a book of 1,738 pages in order to give concise information about the enzymes, and this is a supplement to an equally large volume, and consists mainly of new matter and not a repetition of the old. The preface to the supplement is dated August 1936 so that it has been three years in preparation, obviously three years of hard labour for the compiler.

The constitution of the enzymes is largely unknown; they cannot be listed and formulated in the graphic chemical shorthand which has so facilitated the progress of chemistry and enables the expert to achieve so much with the vast majority of natural and synthetic substances. This makes it doubly difficult to deal with the enzymes in books: they have to be classified by what they do, by the reactions for which they act as catalysts, rather than by what they are.

The difficulty has been largely overcome by Oppenheimer by an elaborate division into classes and frequent subdivision into entities resembling a zoological catalogue, and ultimately into numbered paragraphs. In consequence, with the aid of the schedule of contents it is as easy to look up a particular enzyme as it is to look up a compound of known structure in an organic chemical dictionary.

The task has been accomplished and the book contains the latest up-to-date information about each and every enzyme, in the space of a few pages in paragraphs, subject only to the time lag of publication. It has been issued in parts, at irregular intervals during the three years, of which ample reviews have been given in these columns with the object of keeping workers on particular enzymes in touch with the progress of the supplement.

The extent of the interest in enzymes is evidenced by the amount of published work on them. The research has gone on side by side with that on vitamins and hormones, and some connexion or relation between these and the enzymes is beginning to appear. Their significance as catalysts of vital reactions has long been realized, but the stage has now been reached of understanding the mechanism of such reactions and the manner in which enzymes take part in them. Vitamins and hormones have become therapeutic agents, they are injected or taken by the mouth so that a deficiency in the body of such 'reaction-promoting' materials can be corrected. This is scarcely true as yet of the enzymes though they are sometimes administered; more probably, the giving of hormones liberates enzymes which were previously dormant and brings them into action.

Apparently; vital reactions take place in a chain though, as this term has been appropriated by the physical chemists to connote another type of reaction, it is necessary to substitute the term 'series of substances'. Each compound in the series does something to or with another; the presence of each is necessary for the completed reaction. Some of the compounds are ordinary normal products of the cell, some are present only in minimal quantity, others are in the resting state as part of larger complexes and have to be unlocked, so to speak, before they react. A satisfactory book of reference contains the facts or indications of such, from which the worker can

build up further experiments and check his own theories.

From time to time there arise individuals, diligent and of orderly mind, gifted at cataloguing and summarizing the literature. Beilstein has done this for organic, Mellor for inorganic, Abderhalden for physiological chemistry, Oppenheimer for enzymology. The completion of this work entitles him to be ranked with these others as a benefactor to experimental science.

All of them have made it easier for workers to-day to press forward their experimental investigations by which alone, slowly but surely, the truth is unveiled. E. F. ARMSTRONG.

BIOLOGY FOR SCHOOLS

(1) A School Course of Biology
With Suggestions for Practical and Field Work. By L. J. F. Brimble. Pp. x+470. (London: Macmillan and Co., Ltd., 1939.) 6*s*.

(2) Biology for Junior Forms
With Instructions for Simple Practical Experiments. By M. R. Lambert. Pp. 320. (London: Macmillan and Co., Ltd., 1939.) 3*s*.

(1) IN the preface to his book, Mr. Brimble writes that "the teaching of biology is still in the experimental stage, and thus the completely satisfying course which covers the period allocated to it in secondary schools is still to be formulated". It is inherent in the nature of progress that this completely satisfying course may never be attained, but it stands to the author's credit that here, as in his "Intermediate Botany", he has made a valuable contribution to biology teaching. "A School Course of Biology" bravely attempts to deal with biology as a whole science in which no use is made of the "convenient" divisions into botany, zoology and physiology. The other general feature of importance is that the elements of human biology are liberally distributed throughout the text, and here lies the reason for much of the intrinsic value and attractiveness of the book.

Although the requirements of candidates for school certificate and matriculation examinations are more than adequately provided for, whenever possible the author has carefully diverted the issue to deal with matters that make up the natural and ever-present interests of pupils. Great prominence is given to economic uses of plants and animals, and attention is focused upon the human being in a section on human anatomy and physiology, with the attendant medicine, hygiene, health and fitness. Historical references are repeatedly inserted to illumine the facts presented. The pupil is invited to consider familiar plants and animals before attempting the unfamiliar. Another feature of considerable value is represented by the author's attempt to inculcate the spirit of inquiry by the frequent inclusion of suggestions to the effect that though much is known in science, the vast ocean of discovery lies largely uncharted.

Each chapter contains suggestions for practical work and, as an aid to examination candidates, some two hundred typical questions are provided. The 355 diagrams and photographs have been collected from many sources and are varied in appearance. The great majority of the diagrams have been prepared by the author himself; these are uniformly excellent. It is to be desired that, when the book reaches its second edition, the author should even further extend its attractiveness by replacing the few poorer diagrams by yet more of his own. There are a few inaccuracies which are of a trifling nature. The only outstanding omission is that no reference is made to the pasteurization of milk, and the section dealing with soil might have been extended.

Mr. Brimble's book should soon find its way to all schools where biology is taught and should be a real boon at present to teachers whose schools have been evacuated.

(2) "Biology for Junior Forms" is the adapted third book of a series that was written for senior schools. This series was written using a concentric system so that each of them would cover a year's course. The third book has accordingly been published for use in the junior forms of Secondary Schools. It is doubtful, however, if it will achieve the same success in its present form as in the original. The pace of the introductory chapters appears to be too rapid for younger pupils, strange terms frequently being introduced without adequate explanation. The references to the earlier books of the series might also be disturbing to pupils having no previous acquaintance with them, while the exclusive divisions into botany, zoology and human physiology could scarcely be permitted in a book that is meant to be the foundation for Mr. Brimble's book on biology.

This little volume contains much useful material, however, and with a different presentation would perform valuable service in the lower forms of secondary schools. T. H. HAWKINS.

CIRCULATION OF THE BLOOD

The Control of the Circulation of the Blood
By Prof. R. J. S. McDowall, with the assistance of Lt.-Col. G. E. Malcomson and I. McWhan. Pp. xv+619. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 73*s*. 6*d*. net.

PROF. McDOWALL is to be congratulated on the production of a comprehensive 'Handbook' on the control of the circulation of the blood, with seven thousand references to other works. It is surprising that he has found time to write it without interrupting either his teaching or his research work. His book covers the ground as completely as such books can, and does not follow the easy course of disposing of early work by reference to previous reviews, but contains much discussion of work published before 1900, where such work is still considered important.

A few minor errors are inevitable, and a warning to this effect is contained in the preface. They can do little harm, since no serious man of science would rely on a monograph without referring to the original literature. The 38 figures are all taken from the author's own experiments, and their even distribution through the book reflects his close practical knowledge of all the problems discussed.

There are 150 pages dealing with the control of the blood vessels in various parts of the body, 100 pages on the heart, 80 pages on adrenaline, and chapters on the effects of carbon dioxide, anoxæmia, temperature, sleep, exercise, posture, hæmorrhage, the pituitary, the hypothalamus, and vasodilator substances. The action of ions and the chemical transmission of nervous impulses are deliberately and wisely omitted; but it is a pity that there is no adequate account of the various theories that have been propounded to account for vascular shock. Perhaps the explanation is that the book has been confined to physiological phenomena, and shock is excluded as pathological.

All physiologists who work on the circulation will covet this book, which will give them a long list of references, and a considered summary of many problems. It will save some of them from arduous searches in libraries and others from the publication of facts already known.

J. H. GADDUM.

STUDIES IN TELEPATHY

Experiments in Telepathy
By René Warcollier. Edited and abridged by Gardner Murphy from "La Télépathie", articles in the *Revue Métapsychique*, and recent Unpublished Studies. Translated by Josephine B. Gridley. Pp. viii + 250. (London: George Allen and Unwin, Ltd., 1939.) 7*s*. 6*d*. net.

THIS book is a collection of material taken from various publications by M. René Warcollier and put together with a foreword by Prof. Gardner Murphy of the Department of Psychology of Columbia University.

For some thirty years, M. Warcollier has been studying the phenomena ascribed to telepathy, and in this volume he sums up his impressions of what he has learnt and gives numerous examples of successes in the reproduction of drawings, diagrams, etc., many of which are clearly not due to chance alone.

The main object of this collection of papers is not so much to offer fresh evidence for the existence of a telepathic faculty as to study and discuss the mental processes involved, and to try to ascertain how to produce the phenomena at will and thereby to initiate a detailed examination of the laws underlying them. Although the author was not successful in discovering any basic laws, his notes provide suggestive material for future experimenters. Thus some of his results indicate that ideas repressed by the agent seem to be transmitted better than those upon which his attention has been concentrated; whilst the factor of the agent's own activity as compared with that of the percipient is seen in a number of experiments. On the other hand an increase in the number of agents seems to lessen their influence, whereas the opposite is true as regards the percipients, who, in certain cases, appear to be in mental rapport with one another.

Although much of M. Warcollier's work does not seem to be open to the kind of statistical treatment which is now being applied to problems of this kind, and through which we may hope to gain a greater insight into the questions involved, his work is of considerable interest, since he is particularly concerned with the kind of mental factors at work if the phenomenon is a real effect and not due to unascertained normal causes.

THE PUBLIC RELATIONS OF SCIENCE*

By Dr. Wesley C. Mitchell,
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UNTIL recently the attitude of the public toward science seemed to be growing more appreciative. There have always been folk who objected strenuously to the supposed implications of certain scientific hypotheses, but on the whole science was generally esteemed the most progressive factor in culture, man's best hope for bettering his lot upon earth. Of late this tide of approval has ebbed. There is a widespread disposition to hold science responsible for the ills men are bringing upon themselves—for technological employment, for the rise of autocracies, for the suppression of freedom, for the heightened horrors of war. For their part, scientific men are appalled at the hideous uses to which their discoveries are put. They feel an urge to combat the misuses of science, to protect the social values they cherish, but what they can do is not clear. The quandary is one that all who cherish science should face, however unwelcome and difficult the task.

I

Let me start by recalling certain changes in the relations of science to society that may help us see our present problems in historical perspective.

The beginnings of scientific knowledge have been traced to man's dealings with the implements of his daily life—the sticks and stones, the skins, fibres, and clay he shaped to his uses, and in the shaping learned to know. At a later stage of cultural advance, thinking about natural phenomena, like thinking about religious observances, tended to break away from direct associations with daily work. Such efforts to understand the world as the Middle Ages made were concerned chiefly with problems of a divine dispensation. Observation was not pertinent, and factual tests of conclusions were not possible.

The re-birth of science in the sixteenth and seventeenth centuries was accomplished by turning from the study of concepts back to the study of Nature. The new orientation was characterized by close observation, by the invention of devices to make observation more penetrating and accurate, by purposeful experimentation to simplify the processes observed, by close attention to quantity as well as to quality, by the practical application of mathematics to express the relations observed, by reformulation of concepts to fit the findings, by critical checking of one investigator's work by others, by the cumulation of tested conclusions in old fields of research, and by the extension of this mode of inquiry to new fields. Inventing instruments for observing, setting up experiments, measuring, and testing brought science again into intimate touch with the practical arts. Investigators took a keen interest in current affairs, sought to profit by the skill of craftsmen, and to put what they learned to practical uses. Discoveries were applied not only to the production of goods, but also to navigation, fortification, ballistics, and administration. By the close of the seventeenth century the dramatic achievements of 'natural philosophy' were leading many to expect an almost limitless advance, and the promotion of science was recognized as a proper object of public policy. Kings lent their patronage to scientific societies. Philanthropists followed the royal precedents by offering prizes for improvements in the arts and later by endowing research.

Of course the public relations of science were not uniformly harmonious in this age of genius. But the celebrated clashes between scientific discoveries and beliefs held by churchmen did not affect many lines of inquiry and did not gravely retard the rising tide of investigation. Not less characteristic of the age than Galileo's troubles were Newton's services to churchly teachings and to the State. Scientific men have lamented that he devoted his later years to arguing the validity of biblical prophecies; they have paid less attention to his work as Warden of the Mint. It was adjustments in the weights of the guinea and the shilling suggested by Newton that gave England a *de facto* gold standard in the eighteenth century.

An even more striking example of close relations between research and service to mankind is the life of Benjamin Franklin. The foremost American discoverer of his time, he was foremost also in applying and disseminating science to make life more comfortable, more secure, more interesting, more humane. These activities were incidents in the life of a busy printer, editor, politician, postmaster, legislator, colonial agent, and diplomat. But while we wonder at the extraordinary versatility of a man who could become both a scientific discoverer and a great statesman under any conditions, we must remember that in Franklin's day science was still in its 'natural philosophy' stage.

* From the address of the retiring president of the American Association for the Advancement of Science, delivered on December 27 at Columbus, Ohio.

With the cumulation of results, science became a more exacting mistress, requiring of her votaries more exclusive attention. But science did not draw away from the material tasks of daily life as it had in Greece. On the contrary, these relations were becoming more intimate, while scientists were learning to speak symbolic dialects less and less intelligible to the public or even to one another. Let me illustrate the seeming paradox by the relations between science and industry.

To most of us the modern age is characterized by technological progress as markedly as by scientific discovery. We think of the two achievements as interdependent. This interdependence was less obvious to Franklin's contemporaries than to us. Theirs was a century of great inventions, but inventions made mostly by men not trained in science. The captains of industry who carried the Industrial Revolution through its youthful phases were often technical experts, business executives, and capitalists united in one person. Men of this versatile type are still to be found even in 'big business'; but they are becoming as rare as once they were common. For, as technology was elaborated, experts with special training were required to supervise its operations.

The economic results produced by this unplanned organization of mutually stimulating activities astonished mankind. Industry after industry reorganized its processes time and again to take advantage of the latest engineering applications of scientific discoveries, and new industries kept cropping up. The efficiency of human labour increased greatly, *per capita* income rose, and hours of labour declined. Higher standards of living, and applications of science to the prevention and cure of disease, reduced death-rates and prolonged the average duration of life. Population grew rapidly in the nations that led the scientific procession, and spread where it would over the earth, dominating, exploiting, sometimes exterminating the non-scientific peoples. Life became ampler if not easier for the beneficiaries of science.

What industry owed science it repaid in many ways. It provided in bewildering variety laboratory equipment more accurate and powerful than that made by hand. It stood ready to construct any new contrivance an investigator designed, and often improved upon the original plans. Fortunes accumulated in business were the source of many scientific endowments. Business corporations granted research funds to universities, and set up research staffs of their own, which were sometimes permitted to work upon fundamental problems.

Governments recognized the social importance of science by making place for an expanding array of scientific courses in public schools and universities, and by undertaking wide-ranging programmes of research. In the United States, the Federal Government became the largest employer of scientific men. At the time of the Civil War it chartered the Academy of Sciences, and in the War of 1914–18, the National Research Council to advise it upon scientific problems; in 1934, it set up the organization that has developed into the National Resources Planning Board, with affiliations covering the full gamut of the sciences.

Finally, the public at large had a share in these great changes. It was the ultimate beneficiary of reductions in costs of production, of increasing *per capita* output, of new types of consumers' goods, of shorter working hours, of better protection against disease, of free education.

In short, this policy of *laisser-faire* worked wonders. Science helped industry and industry helped science. Even the backward art of agriculture, which faces so many difficulties and uncertainties, was benefiting by research. The dreaded 'law of diminishing returns' seemed to be overbalanced by improvements in practice based upon the work of soil chemists, botanists and geneticists. The frightful prospect of overpopulation that Malthus had taught the thoughtful to fear seemed to be dissipated by scientific agriculture and scientific techniques of contraception. Best of all, science seemed to have found the secret of illimitable progress.

II

I doubt that any scientist ever accepted without qualification this idyllic version of the benefits science confers upon mankind. Certainly there were numerous protests from scientific quarters against misuses of the new technology. Geologists and economists warned against the rapid depletion of mineral deposits. Chemists feared for the nitrogen content of the soil. Geographers and meteorologists protested that wholesale cutting of forests and the ploughing of grass lands produced deserts. Biologists lamented the extinction of animal species and anthropologists the callous stamping out of simpler cultures. Social scientists found much amiss within the countries that were most progressive. Urban and rural slums persisted as centres of disease and crime. The need of securing capital to utilize the new technology put control over it into the hands of the propertied classes. Labour was often grievously exploited. Huge fixed investments that could be used for only one purpose made competition destructive. The obvious escape from these hazards was to form monopolistic combinations. That was pleasant for the monopolists, but not for other business men or for consumers. Besides the obvious dangers of

exploitation, many feared that the great combinations might purposely slow down technological advance because it threatened rapid obsolescence of their equipment.

Business did not manage even its own interests properly, for every few years it generated a crisis and depression in which it suffered along with the whole community; and the international relations of the scientifically advanced peoples showed at his worst "the old savage in the new civilization". Demonstrations of the economic advantages of free trade no more stopped the imposition of protective tariffs than demonstrations of the horrors of war kept peace. Militant nationalism seemed to be spreading and growing more passionate. An appreciable fraction of scientific energy was devoted to contriving weapons of destruction. Thus against the glowing pictures of science as a benefactor of mankind could be set a dark picture of science putting more power into the hands of certain individuals, classes, nations, generations, giving them a differential advantage over others which they exploited according to their several natures.

Though some of the Jeremiads I have been recalling belong to an earlier time, they did not produce a profound effect upon the public relations of science until recently. The ills complained of could be regarded as 'growing pains'. They represented social 'problems', which should be dealt with by arousing public opinion in a campaign of education that would lead to remedial legislation. Problems that could not be solved by this time-honoured method would yield presumably to the slower processes of general enlightenment.

This optimistic attitude was particularly characteristic of democratic nations. It assumed tacitly that experts could devise whatever 'reforms' were needed, and that the majority of voters were intelligent enough to understand, and well disposed enough to support, desirable changes. Science had a stellar role in this programme for remedying the ills incidental to progress. It did not claim knowledge of good and evil; but it enabled men to make their value-judgments more intelligent by tracing the consequences of actions. Many people were devoting their energies to the study of social problems; they spoke optimistically of their subjects as social 'sciences'. It seemed not too much to hope that science might presently begin to guide social practice in somewhat the same fashion as it guided practice in industry and medicine.

III

That the public relations of science have recently become disturbing both to the public and to scientists is due, not to any change in the character of science or the behaviour of scientists, but to changes in social conditions. While most people approved on the whole of the applications of science before 1914, they have come to dislike many of the effects produced by later applications. To be specific: when scientific improvements in one industry after another threw men out of work in earlier decades, the victims might suffer in silence or protest riotously and perhaps smash machines. But the public at large was not deeply concerned over their sufferings; it repressed disorder, expected the displaced men to find new jobs for themselves, and blessed science for reducing costs of production. Now that a larger part of the public suffers from loss of work or obsolescence of investments, science is blamed for technological unemployment. When the modern arts of communication were used to facilitate the political processes of democratic nations, they were extolled on all sides. Now that these arts, further improved, are controlled in some countries by autocratic Governments and used to suppress opposition, many good people treat science as the culprit. When the scientific nations used their superior arms against backward peoples, only a few sensitive souls were wrathful over the unfairness or iniquity of the procedure. Most people felt that science was good when it gave them a decisive advantage over those they wished to 'civilize'. Now that these same nations are threatened by still more terrible weapons in the hands of their peers, their moral horror is sincere, and they wish scientific warfare back to the pit from which it was digged.

This shift in attitude toward science as one happens to benefit or suffer from its applications is doubtless a mark of human frailty, but it is one at which scientists should not cavil without recalling a similar frailty of their own. Now that we are on the defensive, we discover that science is neither good nor bad in itself, but is merely an instrument that can be put to good or bad uses, and that the blame for bad uses should be visited upon those responsible for them. But when science was being lauded for good works, who among us argued that the credit belonged, not to science, but to those who used it for the benefit of mankind?

We made this discovery when difficulties forced us to think more carefully about the place of science in society. Well as the old policy of *laisser-faire* in public relations worked for a time, it had encouraged in us an indolent complacency foreign to the critical spirit of inquiry. We may not enjoy the shocks that have aroused us any more than an investigator rejoices over facts that disprove an elegant hypothesis; but we must face the situation and see what we can do to mend it. I venture to suggest an obvious proposition that seems to me of controlling importance, and to

point out certain corollaries that should guide both our attempts to understand the public relations of science and our future policy concerning them.

IV

The fundamental proposition is that scientific research is a social process as much as business, political, or religious activities are, and as such is interwoven with all other social processes, influencing them and being influenced by them. It is one among many social activities carried on by the peoples of our culture. Like all such processes, it is carried on by men who learn in childhood languages ill-suited to close thinking; by men who wish to eat, to make love, to win approval as well as to know; by men who are reared in an environment of emotional likes and dislikes; by men who become so absorbed in their technical tasks that they have little energy to criticize the non-scientific parts of their own make-up. These scientific men form a tiny fraction of their communities. So far as they succeed in emancipating themselves from the misconceptions and prejudices prevailing in their social groups, they become by virtue of their partial emancipation queer creatures whose judgment most people mistrust outside of their specialties. Both the temperament that inclined them to research and the habits they form in research tend to make them awkward, ineffective, reluctant in appealing to the emotions that are so potent in influencing men.

It is difficult to see how a few scattered individuals, each accustomed to think for himself and to be critical even of his fellow inquirers, can guide public opinion except by slow educational processes. In the long run, their thinking may rule the world, just because it serves the purposes of mankind better than the traditional thinking it gradually replaces. But in the short run, others take of scientific discoveries only the parts that have an immediate application, and put these parts to such uses as they see fit—uses that serve whatever aims these others pursue. The prompt and potent influence of science upon society comes from these uses, good and bad, which scientists control only in small part.

Even in democratic countries, then, scientific men find it hard to bridge the gulf between their attitudes and those of the general public. In autocratic States the Governments might give scientists fuller opportunities to direct public policies than they enjoy in the democracies. But the autocratic States known to us are not built on that model. They are avid for science, to be sure, but only for science that is an uncritical servitor of ends the rulers determine. As between the difficult public relations confronting them in democracies and the shackling of free inquiry confronting them in autocracies, scientists cannot hesitate. Theirs is a world of intellectual freedom, not perfect alas, but the freest world the mind of man has yet created, and to let any authority under any pretence prescribe what conclusions they shall accept as scientific is to stultify the spirit of science.

V

What, then, can scientists do to improve their public relations in communities where they are relatively free?

As I see the situation, they have two sets of opportunities and responsibilities; first, their opportunities and responsibilities as citizens; second, their opportunities and responsibilities as investigators.

What scientific men can do as citizens is like what other intelligent men can do. If democracy is to work well, many people must form considered judgments upon a wide variety of problems. In forming a considered judgment on a given issue, what experts have to say should be taken into account. Who these experts are depends upon the character of the issue; more often than not contributions are needed from several kinds of specialists. All the many species of the genus scientist belong at one time or another in the list of desirable technical advisers; so also do lawyers, business organizers, labour leaders, social workers, educators, civil servants, politicians, and so on. When matters within the competence of some group of scientists are involved, they should contribute what they know, whether formally invited to do so or not. To make their advice effective they should welcome help from people more skilled than themselves in the arts of popular presentation. On matters concerning which a scientist has no special knowledge, he should listen to others and form the best judgment he can from what they advise. To an individual this task of sifting and weighing different opinions is time-consuming and difficult. On complicated issues organization is needed to bring into focus all the intelligence available in the community. Hence one of the civic duties incumbent upon all scientific men in common with other citizens is to support vigorously but critically the nascent movement toward organizing all the intelligence we possess for constructive study of social problems, before they become pressing emergencies that have to be dealt with in a hurry that allows no time for careful thinking.

The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not merely does no individual have more than a tiny

fraction of the knowledge that is needed ; all the scientists of the country put together do not know enough to solve many of the problems that a democracy faces. In addition to the responsibilities they share with all other citizens, scientific men have the special duty of trying to increase the kind of knowledge required to deal intelligently with public problems. Their opportunities and responsibilities as citizens merge into their opportunities and responsibilities as investigators.

From the social point of view, the most urgent item in the unfinished business of science is to increase knowledge of human behaviour. If we had keener insight into individual psychology, we might not be able to alter fundamental drives, but we might be able to direct them into beneficent channels. Preaching righteousness doubtless prevents men from being as bestial as they might otherwise become. Appeals to reason prevent them from making as many errors as they otherwise might. But the moralist and the rationalist admit that the results of their efforts are grievously disappointing. Scientific men with any gift of self-analysis realize that they have their own shares of selfishness and animosities. To subdue traits in oneself is hard enough to give an inkling of the difficulty of controlling them in society at large. Perhaps—and perhaps is all we can say—if we can come to a clearer understanding of how we behave, we can learn how to condition men so that their energies will go less into making one another miserable.

We all know that the social sciences lag far behind the natural sciences. That is because they deal with phenomena more complicated, more variable, and less susceptible of experimental manipulation. Since social investigators cannot experiment at will upon social groups, they cannot effectively apply to their problems the methods that have made the laboratory sciences strong.

Yet the case of economics and its sister sciences is not hopeless. The rapid growth of statistics is providing mass observations upon social behaviour of many kinds ; the equally rapid growth of statistical technique enables us to learn more from a given array of data than our predecessors could. These materials and methods are making it possible to measure many social factors, some rather accurately, some roughly. Uniformities appear not only in averages, but also in the way in which individual items are distributed about their means. Statements in terms of probability can be substituted for vague statements about the effect a certain cause 'tends' to produce. True, work on this observational basis encounters many difficulties. It is limited by the variety, extent and accuracy of reliable data upon human behaviour. It is laborious, slow and expensive. In presenting his work a realistic investigator begins with a critique of his data and methods ; he ends by setting forth the probable errors and limitations of his results, and the road from the beginning to the end may be long. Instead of definitive conclusions he thinks others should accept, he presents tentative approximations he expects others to improve. The work has not even the advantage of calling for less hard thinking than speculative theorizing ; for the relations among the variables in the problem are seldom manifest of themselves. All that can be claimed for this type of work is that it deals with actual experience, that its results stand or fall by the test of conformity to fact, and that it grows cumulatively after the fashion of the observational sciences. But that is enough to give mankind strong reason for following this lead in seeking the knowledge required to improve social organization.

But science cannot flourish in the future and yield the fruits for which we hope unless freedom of thought prevails. The democratic way of life and the scientific way of thinking grew up together, each nourishing the other. If one now fails, the other will falter. Where democracy is suppressed to-day science is fettered ; for autocracy cannot brook disinterested criticism of its dogmas or its practices. Freedom of scientific work in the years to come can be guaranteed only by preserving the institutions that secure freedom to all citizens.

Perhaps scientific men have more at stake than any other social group in the struggle to maintain democracy. To this struggle they can make a crucial contribution. The fact of free societies hangs upon the wisdom or folly of mass decisions. The gravest dangers to democracy come from within, not from without. They are ignorance, and propaganda that turns ignorance to its uses. The best way of dispelling ignorance is by diffusing knowledge. The most effective defence against meretricious propaganda is critical inquiry. John Dewey is warranted in saying that "the future of democracy is allied with spread of the scientific attitude". To foster this attitude among their fellow citizens by all means within their power is a duty incumbent upon us who cherish science. As teachers in schools and colleges we can help thousands to develop respect for evidence. As citizens we can be brave opponents of prejudice and hysteria. We can promote general understanding of the methods and results of science through our own writings or those of allies more skilled in popular exposition. These things we should do, not as high priests assured that they are always right, but as workers who have learned a method of treating problems that wins cumulative successes, and who would like to share that method with others.

A NEW APPLICATION OF ECHO-SOUNDING

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FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE

BY 1937 the biological researches at Wray Castle had reached the stage when a detailed bathymetric survey of Windermere was desirable as a basis for studying features of the lake bed. The Hydrographer to the Admiralty kindly agreed to co-operate on the technical side, and a survey was carried out by Lieut.-Commander Farquharson, of the Admiralty's hydrographic staff, using a magneto-striction recording echo-sounding machine of Admiralty pattern manufactured by Messrs. Henry Hughes and Son, Ltd. The main feature of the recorder (Fig. 1) is a drum which is rotated at a constant speed by an electric motor. An arm attached to the drum carries a metal 'pen' which traces the record on paper moistened with solution of potassium iodide and propelled slowly through the machine. Contacts on the drum are arranged in such a manner that a supersonic sound impulse is transmitted from an oscillator, below the surface of the water, for an instant when the revolving pen has just begun its transit across the paper. The sound impulse, directed downward, is reflected from the bottom, is picked up by a receiving oscillator also mounted in the water, is amplified and passed to the pen. The rises in voltage at the pen point, consequent on the transmission and return of the signal, cause electrolysis of the potassium iodide and produce brown stains of iodine on the paper—one, the zero mark, at the instant of transmission, and the second on the reception of the echo. The distance along the arc of the pen's track between these two marks represents the depth of water, and the process, repeated at each revolution of the drum, gives a continuous record of depth. The whole equipment, consisting of the recorder, amplifier, oscillators and 12-volt accumulator, can be mounted comfortably in a small launch or rowing boat.

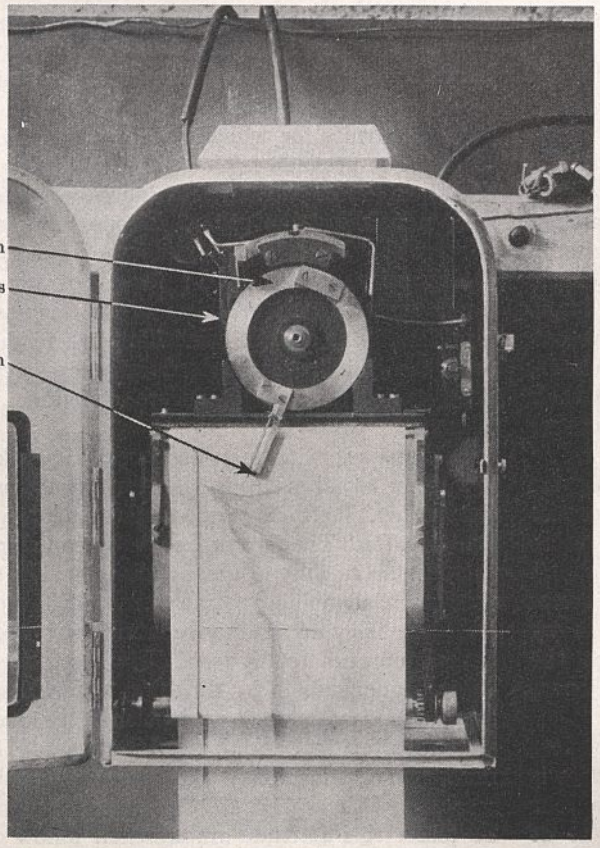

Fig. 1.
THE HENRY HUGHES ADMIRALTY PATTERN ECHO-SOUNDING RECORDER.

In the survey of Windermere 260 cross-sections, representing some 150 miles of continuous sounding, were recorded during five weeks, and the measurements of depth were afterwards made available by the Admiralty on the 6 in. to a mile scale, with certain areas in greater detail on 25 in. to a mile maps. The results of this survey, sufficiently valuable in the information they provided regarding the depth of water, proved to be of much interest in quite another way. Many of the records not only showed an echo from the floor of the lake, but also a second, though fainter, echo, and sometimes more, at vertical distances (measured on the records) of up to 13 metres below the lake floor. It is known that much of the lake bottom is covered by soft mud of considerable depth, presumably overlying rock or glacial clays which formed the floor of the lake at the conclusion of the Ice Age. Therefore, it seemed that the double echo shown on the records

could be explained on the assumption that only some of the sound waves transmitted by the machine were reflected from the interface between mud and water, and that others penetrated the waterlogged deposits and were reflected by the harder glacial clay or solid rock underneath. In other parts of the lake (*A* in Fig. 2) the bottom appeared as an intense black mark with one or more fainter marks below, at apparent distances below the bottom equal to the depth of water. In such cases it seemed justifiable to assume that all the sound waves were reflected from a hard bottom and that, since an air-water interface reflects supersonic sound, they were afterwards re-echoed to and fro between the surface and bottom. If these interpretations were correct, the echo-sounding machine could be used to give information regarding the kind of bottom and the depth of soft deposits. Accordingly, the research was followed up by (1) making observations on the deposits themselves, and (2) carrying out surveys with the echo-sounder on fourteen other of the larger lakes in the district.

In the first of these projects, sections such as that shown in Fig. 2 were examined and it was confirmed by the use of lead and grab that at *A* the bottom is bare rock, at *B* it is soft mud, at *C* stiff clay overlain by a thin deposit of soft mud. At *D* beds of water weed (Potamogeton) growing in the mud were under the oscillators as the superficial marks made their appearance on the record, and at *E* a stony bottom could be seen through the shallow water. Direct measurements of the actual depth of soft deposit were made with a probe of special design constructed by Dr. J. A. Ramsey of Cambridge. Of twenty-one such measurements made under favourable conditions, all showed depths which agreed to within a foot with the depth of deposit as indicated on the echo records. In addition, cores of the deposits have been obtained from some parts of the lake, first with a simple tube driven into the bottom and later with a special core-sampler

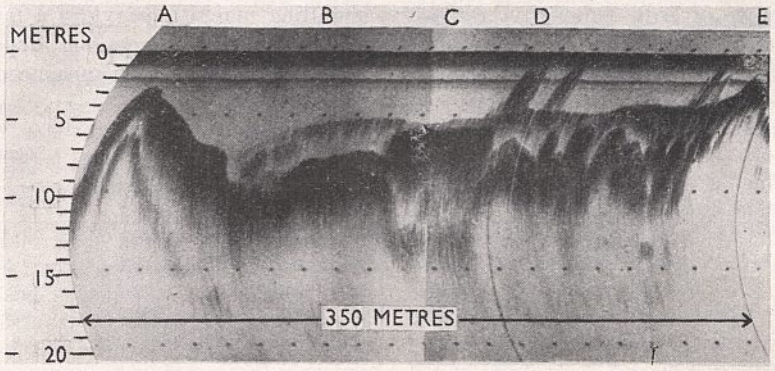

Fig. 2.

ECHO-RECORD OF A SECTION ACROSS LOW WRAY BAY, WINDERMERE.
X are time marks recorded every thirty seconds.

described previously[1]. The examination of cores is important because many of the echo-records (for example, at some points in Fig. 2) indicate stratification of the deposits. Moreover, the cores throw light on the post-glacial history of the lake basin: they show fine varving in the deposits, and there is an alternation between periods in which inorganic, probably ice-eroded, particles are predominant with periods when the bulk of the deposit is made of the shells of diatoms. The succession of diatom and other organic remains in these cores is being studied by Miss W. Pennington of the University of Reading.

The surveys of other lakes, made by members of the staff at Wray Castle, serve to confirm the main bathymetric features as determined by H. R. Mill[2].

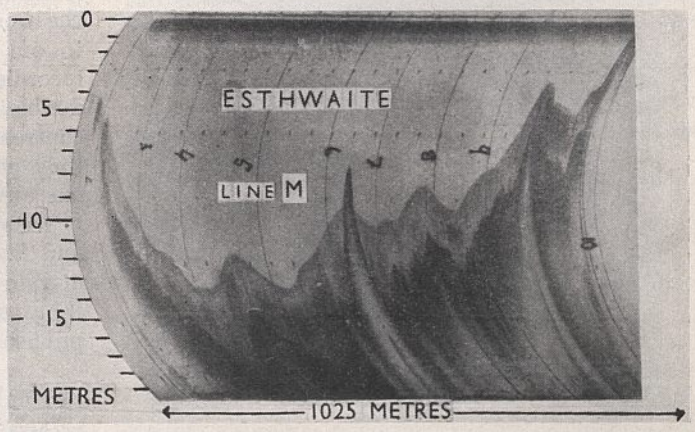

Fig. 3.

ECHO-RECORD OF SECTION ACROSS ESTHWAITE WATER.

These surveys were not of the same detail as that of Windermere, but sufficient sections were recorded to obtain a good idea of the bottom characters. The photograph of a representative record from Esthwaite Water, reproduced in Fig. 3, shows a mound of hard bottom projecting through an even layer of soft deposit. Over the rest of the section the thickness of soft deposit is roughly uniform and the mud profile follows in smoother outline the irregularities of the hard floor below.

	Mean depth of water (metres)	Mean depth of deposit (metres)	Volume of deposit (10^6 cubic metres)	Drainage area (sq. km.)	Volume of deposit / Drainage area	% drainage area on uncultivated hills
Haweswater	12·0	0·52	0·7	29·1	2·4	92
Ennerdale Water	18·9	0·88	2·5	44·1	5·7	94
Coniston Water	24·1	1·09	5·4	60·7	8·9	78
Windermere	23·8	1·62	24·1	230·5	10·5	70

In other cases, for example at *D* in Fig. 2, such irregularities are masked by a level blanket of mud. Fig. 4 shows another type of sedimentation in a region—the narrows joining the north and south basins of Windermere—in which an appreciable water flow is to be expected. The figure shows a scoured channel on one side with a mud bank on the other, a condition which might be expected from the configuration of the locality. A more complex kind of sedimentation, in which the deposit appears to be divided into a series of strata, is suggested by other records. All these types of record have been exactly reproduced over the same positions at different times by two recorders having differences in the details of construction, and recording on different scales.

It must be emphasized that further direct observations on the deposits are required before the interpretation of the echo-records can be accepted without reserve. The speed of travel and the penetration of supersonic sound in water-logged deposits have yet to be determined, and the nature of the interfaces from which it is reflected awaits investigation. But it seems probable from the results mentioned above that the echo-sounding machine provides a means of measuring the result of subaqueous deposition over long periods of time. Such measurements would be of practical use in connexion with reservoirs and harbours where the deposition of soft deposit on a hard floor often takes place rapidly. They would also be of much interest to hydrographers, geologists and limnologists. For example, in each lake so far examined, the total volume of soft deposit, as computed from the echo-records, is found to be related to the size and character of the drainage basin. This is illustrated in the accompanying table of values for selected lakes.

The figures in the last column but one represent the depth of deposit in centimetres if it were spread evenly over the whole drainage basin, and may be regarded as an index of silting rate. Pearsall[3] showed the controlling influences of the silting rate on the distribution of aquatic plants; his classification of the lakes of the district on this basis is corroborated by the new data from echo-sounding.

Since the work described above was carried out, the work of Stocks[4] and Rust[5] has been brought to our notice. Using a different type of non-recording echo-sounder in Kiel Bay, they obtained double and multiple echoes over soft bottoms in contrast to single echoes over hard bottoms, and they put forward an interpretation similar to the one advanced here.

We are much indebted to Messrs. Henry Hughes and Son for the loan of echo-sounding machines and to those scientists who have given help in the work. A fuller account of the surveys is being published elsewhere[6].

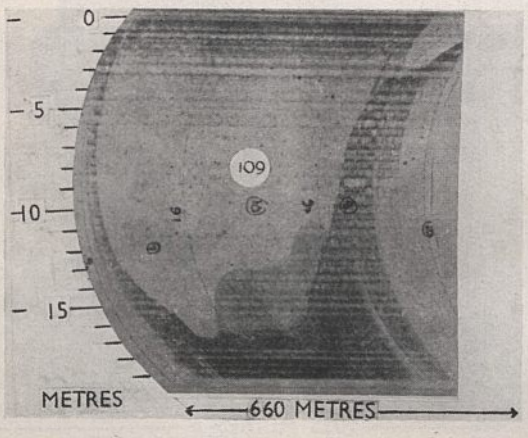

Fig. 4.

ECHO-RECORD OF SECTION NEAR THE FERRY, WINDERMERE.

[1] Jenkin, B. M., and Mortimer, C. H., NATURE, **142**, 834 (1938).
[2] Mill, H. R., *Geog. J.*, **6**, 46–73, 135–166 (1895).
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OBITUARIES

Prof. F. K. Richtmyer

THE death of Prof. Floyd K. Richtmyer on November 7 has removed a notable figure from scientific circles in the United States. Born in 1881, he graduated at Cornell, most of his academic life being spent as a member of the staff of this same University. His doctoral dissertation was on the subject of photo-electric phenomena, and studies on physical photometry occupied several years of research, during which time he worked under the guidance of E. L. Nichols.

During the War of 1914–18 the urgent need of optical information and instruction in connexion with the development of military instruments and with numerous problems of vision not only led to the rapid growth of the Optical Society in London but also to the foundation of a strong sister society in America. Dr. Richtmyer, appointed in 1918 to a full professorship at Cornell, was a leading figure in the American Society from the beginning, and played a most important part in the subsequent development of the American Institute of Physics.

At various times he was elected to the presidency of the Optical Society of America, the American Physical Society, and the American Association of Physics Teachers. He was associate editor of the *Journal of the Optical Society* from 1917 onwards, and in 1932 he became editor-in-chief of the *Journal* and the *Review of Scientific Instruments*. In the same year, he was elected to the National Academy of Sciences.

Anyone who knows the characteristically friendly meetings of the Optical Society of America, held fairly frequently at various centres in the States, will fully appreciate the careful organization that must have been carried out by a group of which Richtmyer was one of the leading figures. His careful and thorough work as editor of the *Journal* has benefited many who appreciate the high standard which is maintained in its pages. Perhaps he is best known to present-day students of physics through his text-book "Introduction to Modern Physics", in which his great gifts as a teacher and expositor are reflected.

In recent years Richtmyer had many administrative duties at Cornell, that most pleasant of universities with its tree-shaded campus high above the blue waters of the Senaca Lake, but he found time to direct the studies of a class of graduate students in a laboratory where the atmosphere is progressive and stimulating. His chief recent interests lay in the fields of X-rays and spectroscopy, and many papers have borne witness to his thoroughness and care in experimental work.

The many in the United States who relied on Richtmyer's judgment and experience will miss him greatly and their regret will be shared by many in Great Britain who had the privilege of meeting him.

L. C. MARTIN.

Mr. G. Herbert Nall

THE death of Mr. G. Herbert Nall at the age of seventy-nine years occurred on January 14. Mr. Nall was educated at Shrewsbury and at Queen's College, Oxford, where he took a second class in Classical Moderations (1881) and in Lit. Hum. (1884). He was appointed lecturer in Queen's College in 1884 and was classical master and librarian at Westminster during 1886–1922. He was housemaster of the Home Boarders from 1895 and edited many books of the classics for use in schools.

As well as being a classical scholar, Mr. Nall had a bent for natural history which was developed by angling in Great Britain and the Scandinavian countries while he was at Westminster. After he retired he took up the scientific investigation of the life of freshwater fish and in particular of sea trout and trout. Working under the auspices of the Fishery Board for Scotland (now the Fisheries Division of the Scottish Home Department) he applied the technique of scale reading to, and became the recognized authority on, this species. As his work developed, it became clear that the life-story of the sea trout was more complicated and liable to greater variations than that of the salmon, and if a true picture was to be obtained an extended and detailed investigation would be necessary. This laborious task Mr. Nall attacked wholeheartedly. In spite of the size of the undertaking he was never daunted by detail and never thought any trouble too great in order to be sure of his material or of the facts which he elicited from it. His main work was in Scotland, but in addition he did much in England and Wales : he also did not omit Ireland and certain European countries from the scope of his survey. He finished his fortieth paper (publication of which will unfortunately be delayed by the War) for the Scottish fishery department a few minutes before he died. Many other papers by him were published in various journals. His latest work did nothing to disturb his conclusions reached a few years ago, and his "Life of the Sea Trout" will for long remain the standard work on that subject. It is not too much to say that our very complete knowledge of the life-history of the sea trout is due almost entirely to his efforts.

In the death of Mr. Nall, freshwater fishery research in Great Britain, and particularly in Scotland, has lost an enthusiastic and painstaking worker who has accomplished much. In his passing those who knew him have lost a quiet, humble soul and one who never failed to help others.

We regret to announce the death of Sir Gilbert Morgan, O.B.E., F.R.S., formerly director of chemical research, Department of Scientific and Industrial Research, on February 1.

NEWS AND VIEWS

Two Eminent Swedish Chemists

THE year 1840 saw the birth of the two Swedish chemists, Per Theodor Cleve and Lars Fredrik Nilson, the former of whom was born at Stockholm on February 10. Cleve was the son of a merchant, Nilson the son of a farmer of Ostergothland. Both of them became students at the University of Uppsala, where they came under the influence of L. F. Svanberg, who had been the friend of Berzelius. After graduating, and teaching chemistry at Uppsala, Cleve worked in Wurtz's laboratory in Paris, and in the mineralogical laboratory at Stockholm; he then made a geological excursion to the West Indies. After his return home, in 1870 he was given a post at the Stockholm Technical Institute, but on Svanberg's retirement became professor of chemistry at Uppsala and held this position until shortly before his death. Like his contemporary Nilson, he did valuable work on the rare earths, and he showed that scandium, the element discovered by Nilson, was identical with the eka-boron of Mendeléeff. It was partly for his work on the rare earths that he was in 1894 awarded the Davy Medal of the Royal Society. Towards the end of his life he became absorbed in biological studies. For the Chemical Society, of which he was a foreign member, he wrote the memorial lecture on the Swiss chemist J. C. G. de Marignac (1817–94). He died at Uppsala on June 18, 1905.

While Nilson was also known for his investigations on the rare earths, he rendered great service to his country as an agricultural chemist. Farming was in his veins, and he always retained an interest in the prosperity of his native district. After holding the chair of analytical chemistry at Uppsala from 1878 until 1883, he was called to Stockholm as professor of chemistry in the Royal Academy of Agriculture. In the next sixteen years, while engaged on his official duties, he published nearly sixty papers on soils, manures, etc., and his inquiries led to the draining and cultivation of the swamps of Gothland, and to the introduction of the sugar beet. He was elected a foreign member of the Chemical Society in 1888. He died on May 14, 1899, in his fifty-ninth year.

The Parliamentary and Scientific Committee

A MEETING of the Parliamentary and Scientific Committee was held at the House of Commons on January 31. In the absence of the chairman, Captain D. F. Plugge, M.P., the chair was taken by Major H. A. Procter, M.P. The Secretary announced that the following bodies have now definitely agreed to support the new Committee: Association of Scientific Workers, Institute of Chemistry, British Association of Chemists, National Veterinary Medical Association, Institution of Structural Engineers, Institution of Marine Engineers, British Association for the Advancement of Science, Institution of Mechanical Engineers, Pharmaceutical Society of Great Britain, Institute of Fuel, Institute of Gas Engineers, Thames Barrage Association, Oil and Colour Chemists Association, Institution of the Rubber Industry, Association of Applied Biologists, Universities Federation for Animal Welfare.

The Secretary also reported that the following Members of Parliament had agreed to become members of the Committee: Captain Plugge, Colonel Baldwin-Webb, Mr. Markham, Mr. E. W. Salt, Mr. Alan Chorlton, Dr. Haden-Guest, Sir John Graham Kerr, Mr. R. R. Stokes, Sir Murray Sueter, Mr. David Adams, Mr. Henry Haslam, Sir Ernest Graham-Little, Major Procter, Mr. Kenneth Pickthorn, Mr. W. Higgs, Mr. R. H. Morgan, Mr. W. R. Duckworth, and Mr. I. C. Hannah. It was agreed to give all possible support to affiliated scientific and technical bodies in ensuring fair treatment for scientific and technical workers in connexion with military service, not only so far as the list of reserved occupations is concerned, but also with the view of ensuring that the special qualifications of scientific and technical workers enrolled in the Fighting Services should be properly appreciated and developed. Discussion also took place on the report of the sub-committee which has been investigating the question of the nutritive value of bread, having regard to the importance of bread as an article of diet in war-time.

Venereal Diseases in War-time

AT an extraordinary general meeting of the British Social Hygiene Council, held on January 29, attention was concentrated upon the circular letter recently dispatched by the Ministry of Health to local government authorities relating to the control of venereal disease in war-time. During the War of 1914–18, some 400,000 members of the armed forces were treated for venereal disease, necessitating the withdrawal of the majority of the patients from active service for periods varying between five and six weeks. To-day, the Ministry is anxious that the great reduction in the numbers of people suffering from venereal disease since 1918 should be at least maintained during the social upheavals that are caused by war conditions. The movements of population from towns to the vicinity of munition factories, military camps and aerodromes in the country districts bring grave problems.

In the circular the Ministry of Health emphasizes the need for the maintenance of existing measures for the treatment of the diseases, while, in areas where the services provided are deficient, it is suggested that clinics and personnel should be adequately augmented. The introduction of fully

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equipped mobile clinical units is suggested for increased efficiency. It was pointed out at the meeting that no financial assistance is provided, and the burdens now borne by local authorities are such that without assistance from the national exchequer little can be done. Further, it is felt that the Ministry's circular pays insufficient attention to the enlightenment of the public as a preventive measure and makes no mention of the needed increase in the number of trained venereal disease almoners. The omission of any reference as to the means whereby local authorities are to be financially re-imbursed for providing these services has caused considerable dissatisfaction. A strongly worded resolution to that effect was adopted.

Development of International Health Organizations

In a recent paper (*Ann. Med. Hist.*, 3 ser., 1, 519; 1939), Dr. Robert A. Lyon, of Cincinnati, points out that before the nineteenth century individual nations or cities tried to check the entrance of disease by the application of quarantine laws at ports and land frontiers. It was not, however, until the early decades of the nineteenth century that international co-operation in health matters was first sought by countries on the Mediterranean. In 1839, Turkey invited representatives of other nations to meet a Sanitary Commission at Constantinople for better co-operation in the enforcement of quarantine regulations. A few years later, Egypt made a similar request, and in 1869 the Egyptian Council at Alexandria undertook the medical supervision of traffic through the Suez Canal. In 1851 the first International Health Convention met in Paris, and since then thirteen similar conventions have been held in different European cities and at Washington for the purpose of formulating regulations concerning the notification of cholera and plague and arrangement of medical inspection of crews and passengers as well as the inspection and disinfection of cargoes.

In 1909 there was established in Paris an International Hygiene Office, the function of which has been to collect and unify the many national laws of sanitation and quarantine, to supervise the health laws applicable to pilgrims, to establish medical facilities for the treatment of venereal disease in ports in all parts of the world, to investigate the transmission of disease by aerial navigation, to publish public health information, and to carry out specific investigations. The organization of a Health Section of the League of Nations began in 1920, and in 1921 it became part of the permanent secretariat of the League, with offices in Geneva. The Section consists of three divisions, namely, a directing committee, a consulting committee of experts consisting of the directors of the International Health Office, and an executive staff composed of public health experts, statisticians and clerks who devote their whole time to the work. The Section has done valuable work in the control of epidemics, the standardization of medical procedures, and the collection and publication of medical information.

Black-Headed Gull Survey

The survey of the black-headed gull (*Larus ribibundus*) carried out by P. D. Hollom, with the help of 160 other observers for the British Trust for Ornithology (*British Birds*, Jan. 1939), gives a total number of 70,000 breeding pairs in 124 gulleries in England in 1938 and 6,000 in 34 gulleries in Wales. There were 145 gulleries in Scotland and 39 in Ireland; but it is believed that more birds exist in these two countries, which were not fully surveyed. The larger part of the gull population is in the north of Britain, and although there has been a great increase at many places this century, there were probably larger numbers of gulls in the country a century ago, and at many northern gulleries there has been a decline in recent years. The largest British gullery, at Ravenglass, Cumberland, has 50,000 birds—five times that of the next largest and two thirds of the total gull population of England. There are no gulleries of this species in the Isle of Man, and strikingly few in the counties bordering the Bristol Channel.

Nearly forty per cent of the colonies are twenty miles or more inland from the sea and the highest at 1,925 ft. above sea-level at Greensett Moss, Great Whernside, Yorkshire, formed in 1921, where 200 pairs nested in 1938. The total number of colonies in the British Isles is given as 488, but there is also a very lengthy list of deserted colonies. Some of the gulleries, as the Delamere Forest of Cheshire, date back to the early seventeenth century. There seems to be no truth in the belief that use of these eggs for food during the War of 1914–18 depleted many of the present gulleries and tended to disperse the gulls over a wider area, as this started before 1914 in many instances. Cumberland and Yorkshire are very rich in these gulleries, the former county having 19, many of them on the Solway marshes, and the latter county having 29.

Marriage-Rate in War-time

The November issue of the *Statistical Bulletin* of the Metropolitan Life Insurance Company of New York contains a review of the course of the marriage-rate during the War of 1914–18 in the countries immediately concerned. With the outbreak of hostilities in 1914 the marriage-rate of all the belligerent countries fell precipitously. In France, for example, the rate dropped from a level of about 8 per 1,000 during the period 1851–1913 to a minimum of 2·3 in 1915. In Germany the pre-war average rate of about 8 per 1,000 sank to 4·1 in 1915 and 1916. In Italy the rate fell to 2·7 in 1917. In England and Wales the rate, which for a long time had been about 8 per 1,000, showed a transient rise to 9·7 in 1915 and then fell to 6·9 in 1917. In the United States the minimum reached in 1918 was not far below an average of 10·4 for 1914–16, the years preceding the entrance of the United States into the war. The end of the War was followed by a prompt rebound to unusually high figures. Thus in France the rate rose from 5·5 per 1,000 in 1918 to 14·0 in 1919 and 16·0 in 1920, and similar though less

pronounced rises took place in Germany and most of the other belligerent countries. Even some of the neutral countries showed a distinct reaction, which in the case of Switzerland was more marked than that of England and Wales.

Rehabilitation of Adult Prostitutes

EXPERIENCE shows that the problem of prostitution tends to acquire particular importance in time of war, not only for the countries directly involved but also for other countries, and the publication by the League of Nations Secretariat of a third and concluding volume of studies on this subject is therefore opportune (League of Nations Pamphlet, iv, 4, Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1; 1939. 3*s*. 6*d*. net). An endeavour is made in this volume to elucidate the controversial question of possibilities of reclaiming prostitutes for re-entry into the normal life of the community. Institutional training is discussed at some length, and an account is given of the different approaches made by various types of institutions, religious and lay, to the problem. The Advisory Committee which studied this question came to the conclusion that, if certain principles are applied and certain psychological factors recognized, rehabilitation of adult prostitutes is, within limits, both feasible and successful. The volume should be useful not only to those directly concerned with the problem of rehabilitation, but also to all social workers who have to deal with the very complex question of prostitution in general.

London School of Hygiene and Tropical Medicine

THE report for 1938–39 of the London School of Hygiene and Tropical Medicine, incorporating the Ross Institute, is, as usual, of great interest. It should be realized that studies which seem minute and insignificant, such as the survival and fertility of insects under highly unfavourable conditions, may be of the utmost importance to planters and owners of big estates. They should subscribe more generously to a School which does so much for their welfare. The Institute, while busy at home with many discoveries, including bacterial survival for well over a century, has been continuing the attack on the problems of *Anopheles minimus* in Assam, a mosquito which can be controlled more effectively by shading than by the use of drugs.

It is very satisfactory to learn that in the chief field stations of tea estates in India it has been possible to train a staff of Indians as surveyors of malaria and laboratory assistants. The annual malaria control course for laymen which started at the Institute in 1929 is free, and from small beginnings has now attracted more than a thousand learners. Ceylon has had in the past great outbreaks of malaria due to drought, but the failure of two monsoons during the year under survey did not lead to the major outbreak that might have been expected. The Ceylon Government and the Estates Malaria Control scheme confined the trouble to minor eruptions. This is a specimen of the remarkable work that is done. The energies of the Institute are, indeed, far flung. They have been extended to the Gold Coast and the question of mass emigration of refugees from Central Europe to British Guiana. Dr. Chester Beatty's speech at the annual 'Mosquito Day' luncheon dwelt rightly on the comparatively meagre support given. Some of the travelling specialists are constantly employed and clearly overworked.

A New Type of Wood-Burning Stove

A NEW stove, developed by the Connecticut Forest and Park Association in co-operation with Prof. L. E. Seeley, heating expert of Yale University, burns wood with an efficiency estimated at ninety per cent. It is capable of heating two or three rooms and requires filling only once or twice a day. A report issued by Science Service, of Washington, D.C., says that the new heater holds about two and a quarter cubic feet of wood, or slightly more than 50 lb. It is estimated that it will generate about 40,000 B.T.U./hr. for an eight-hour period without attention. This amount of heat is sufficient for two or three rooms in cold weather. In mild weather the heater will easily run more than twenty-four hours without attention.

The new heater differs radically in design from the usual type of wood-burning stove. Air supply is limited as in any tight heater, but all air is not directed into one space, as is customary; instead, provision is made for pre-determined amounts of air to enter the combustion chamber, while a separate air supply is allowed to mix with the highly heated gases formed by the burning wood. The wood gases are passed through small passage-ways called combustion ports where they are burned separately from the wood. The process is a partial distillation of the wood producing charcoal and gas, and the products are burned in different spaces. The result is high efficiency with a minimum of loss in soot, creosote and ash. The Governor of Connecticut, who has expressed interest in the establishment of a permanent outlet for the firewood now being wasted in the State for lack of a market, has made possible a small-scale commercial experiment in the use of wood as fuel in State institutions.

Electrical Thawing

DURING the recent cold spell, serious inconvenience has been caused in many households by the freezing of water services. In the *Electrical Review* of February 2, a letter from Mr. C. W. Salt, the city electrical engineer to Carlisle, is published describing an effective and easily applied method of thawing frozen water services, when a public A.C. supply is available. In Carlisle, where the voltage is 230, a double-wound single-phase transformer is used, the ratio being 230/12, with a regulating resistance on the primary side and an ammeter scaled 0–250 on the secondary side. The primary is plugged into a 15 amp. radiator socket and the secondary leads are attached to a tap or pipe inside the house and to the stopcock of a neighbouring house. The regulating resistance is adjusted until the secondary current flows through

the frozen pipe at about 150 amp. It is found that the normal ½-in. lead service pipe thaws out in five to seven minutes. Mr. Salt says that in cases of sickness where there is no water supply and consequently no kitchen fire or other means of providing hot water, this remedy has been much appreciated.

New Physical Apparatus

PROF. C. J. OVERBECK of Evanston University, Illinois, directs attention to some of the recent improvements in apparatus for physical research developed in the United States during the last four years, in a twelve-page illustrated article in the January issue of the *Journal of Scientific Instruments*. He deals with fractionating oil-diffusion pumps of both glass and metal and with the use of sylphon (metal bellows) for producing adjustments in evacuated spaces from outside without interfering with the vacuum. He describes a centrifuge suspended and run in a vacuum, a new apparatus for determining e/m for electrons, and a device for renewing the emitting surface of an oxide cathode. The Bureau of Standards apparatus for attaching to free balloons which signals its records and weighs only 5 lb. is also mentioned. Some examples of the use of Polaroid for stress analysis are given, and a vacuum grating spectrograph for investigating infra-red rotation spectra is described. The advantages of the new synthetic lithium fluoride crystals combined with quartz in a lens doublet, achromatic over a wide range of wave-lengths, are illustrated by spectrograms. References to thirty-one sources of further information are given, and Strong's "Procedures in Experimental Physics" (New York, 1938) is mentioned as of great value for its up-to-date laboratory devices.

Seedlings in Transit: a New Method

SCIENCE Service, of Washington, D.C., reports the extensive use of a new and simple method of protecting young seedlings of tomato and cabbage from drying out during transit, which may have considerable importance in Great Britain at the present time. Dr. R. N. Du Puis of Chicago suggested that the plants might survive better if the sphagnum in which the roots were wrapped were moistened with a glycerine solution instead of with water. After encouraging large-scale experiments in 1939, the method was brought into commercial use, more than 75 million seedlings being shipped from the south to the north under these conditions. The new method apparently saved much loss from drying out and is also stated to give protection against fungus troubles.

The National Book Council

IT was a wise statesman who said that we must educate our masters, the democracy of to-day, and the National Book Council's latest report, 1938–39, is full of a well-backed forward movement with a new Consultative Committee designed to promote more book-reading. At present, the public libraries are used by about 15 per cent of the population, which remain in ignorance of the chances they have to improve their knowledge, or at least get sound information about their hobbies and the special line of reading they prefer. "Four to Fourteen" for young people has already become a standard bibliography, and "Summer Holiday Reading", a select list of new books, has led to demands beyond the large number printed. Such guides through the present overgrown jungle of books are essential to-day.

The 38-page "Catalogue of Books for the Services" is a good and wisely catholic selection, due to the Council and the Society of Authors acting together. It gives learned and popular theology on one page and on another a choice of thrillers by Dorothy Sayers, science, plays, essays, and fiction, old as well as new. We notice one omission in the judicious section of poetry; Kipling's two early books of soldier jingles are included, but where is the "Collected Verse" of his more mature years? That volume holds many well-known pieces and celebrates the work of our Navy with the "Wet Litany", "Mine Sweepers", "The North Sea Patrol" and other vivid things not easily forgotten. Evacuees, both young and adult, have raised new problems of book-supply, in towns and villages unequal to the demand, and the Council has suggested to the Board of Education sound plans to arouse interest and supply the books needed.

Earthquakes in Greece

STRONG earthquakes were experienced last week in the town of Ekaterini at the foot of Mount Olympus on the shores of the Gulf of Salonica in Greece. On the morning of February 1, several tremors and one or two earthquakes occurred to the accompaniment of loud and long-continued underground rumbling. Some houses collapsed. On February 2 the shocks continued, there being eighteen in all. About 120 buildings, including some schools, the law courts and the post office, collapsed or became severely damaged. The casualty numbers have not yet been published. Tents have been erected as temporary dwellings and the postal headquarters are reported to be temporarily in a tent. Medical supplies and anti-typhoid vaccines have been sent from Salonica. It will be remembered that a severe earthquake wrecked several villages in the Chalcidice district of Greece on the night of September 27–28, 1932. The epicentre was then estimated to have been between Salonica and Mount Athos (NATURE, October 8, 1932, p. 537), which is to the north-east of the present epicentres.

Earth Tremors in Scotland

SLIGHT earth tremors are reported to have occurred on February 3 at Stirling in Scotland. No damage has been done. The tremors may have been occasioned by slipping along a local fault. Similar tremors were reported from Roslin, near Edinburgh, on February 10, 1934, though the most active region seismically in Scotland is near Comrie in Perthshire, where the slight tremors are considered to be due to slipping along the Highland Boundary Fault system.

Other Recent Earthquakes

SEVERAL severe earth tremors and moderate to strong earthquakes have also been experienced recently in widely separated areas in Italy. On January 25 a severe tremor was felt at Genoa in Italy. This did no damage. On February 1, early in the day, a severe earthquake shock caused considerable damage to the famous cathedral town of Siena in Italy. A less severe shock was felt at Florence, and, presuming it was the same earthquake, the epicentre was close to Siena (lat. 43° 20′ N., long. 11° 20′ E.) On the same morning three shocks were felt in Bucharest, in Rumania. No damage was done. The epicentre of this earthquake was estimated in Bucharest to have been in the Black Sea, five hundred miles east of Bucharest.

Earthquake Recorded on Magnetograph

IN *Earthquake Notes*, the publication of the Eastern Section of the Seismological Society of America (11, Nos. 1 and 2, September 1939), it is stated that the earthquake with epicentre latitude 20·8° N., longitude 66·0° W. on June 12, 1939, which was felt in San Juan, was recorded at the San Juan Magnetic Observatory. The recording was on the magnetograms of both the declination and the horizontal intensity instruments, but there was no trace of a disturbance on the vertical intensity magnetogram.

Francis Amory Septennial Prize

IN compliance with the provisions of the will of the late Francis Amory, the American Academy of Arts and Sciences, as trustee of a fund given by the testator, announces a prize to be known as "The Francis Amory Septennial Prize", to be awarded for conspicuously meritorious work performed during the immediately preceding septennial period, "through experiment, study or otherwise, in the treatment and cure of diseases and derangement of the human sexual generative organs in general, and more especially for the cure, prevention or relief of the retention of urine, cystitis, prostatitis, etc." If any work of quality warrant it, the first award will be made in 1940. The total amount will exceed 10,000 dollars, which may be divided at the discretion of the Academy among several nominees. While formal nominations are not expected and no essays or treatises in direct competition for the prize are desired, suggestions are invited. Communications should reach the Francis Amory Septennial Prize Award Committee not later than May 15, 1940, and should be addressed in care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., U.S.A.

Paris International Trade Fair

THE thirty-second annual Paris International Trade Fair will be held during May 11–27. The international aspect of the Fair will be developed to an even greater extent this year. Already national sections have been promised from Italy, Holland and Spain, as well as the usual displays from Switzerland, Belgium, etc. In deciding to hold the Fair this year at the Porte de Versailles, the Committee and exhibitors alike are showing the same courageous spirit as in 1917, when a similar decision was made although the German trenches were only 100 kilometres from the Capital.

An Inventions Competition is being organized, as usual, in connexion with the Fair. Last year 769 inventions were submitted by 517 competitors, representing fifteen countries. The value of the prizes this year will be 25,000 francs, as on previous occasions. In addition, there will be a number of medals, diplomas and prizes. Application forms, obtainable from the London office of the Fair at 17 Tothill Street, S.W.1, or direct from 23 rue N.D. des Victoires, Paris 2, must be returned not later than March 31.

Lectures at Marx House, London

THE spring programme of lectures to be given by the Faculty of Science, Marx House, Clerkenwell Green, E.C.1, begins on February 12 when Prof. J. B. S. Haldane will give the first of a series of five lectures on "How the Human Body Works". In this course, which will run on consecutive Mondays at Marx House, Clerkenwell Green, at 7.30 p.m., Prof. Haldane will deal with "Is Man a Machine?" "Blood", "Digestion and Excretion", "The Nervous System" and "The Regulation of Bodily Functions". On February 16, Dr. P. Dienes will give the first of five lectures on "The Science of Thinking", in which he will deal with logic and arithmetic. These lectures, which will be at the University Labour Club, 15 Percy Street, W.1, will be held on consecutive Fridays at 8 p.m. Prof. J. D. Bernal is also to give a lecture, followed by a discussion, on "The Structure of Matter" on March 3. Further information can be obtained from the Secretary, Marx Memorial Library and Workers' School, Marx House, Clerkenwell Green, E.C.1.

Announcements

THE National Association for the Prevention of Tuberculosis has decided to devote its activities in war-time chiefly to propaganda and the care and rehabilitation of tuberculous patients and their families.

PROF. JOHN F. FULTON, professor of physiology in the Yale University School of Medicine, has been requested by Mrs. Cushing to write a biography of her husband, the late Dr. Harvey Cushing. Dr. Fulton will be grateful for letters, anecdotes or other pertinent material available.

THE Langley memorial prize, value £21, is open for competition among officers of the Colonial Medical Service who are serving or have served in West Africa, and will be awarded for the best paper on one of the following subjects: (*a*) tropical medicine or surgery, (*b*) tropical hygiene and sanitation, (*c*) tropical entomology and parasitology. Papers, which may consist of published or unpublished work, should be sent to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, by October 1.

LETTERS TO THE EDITORS

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

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 228. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

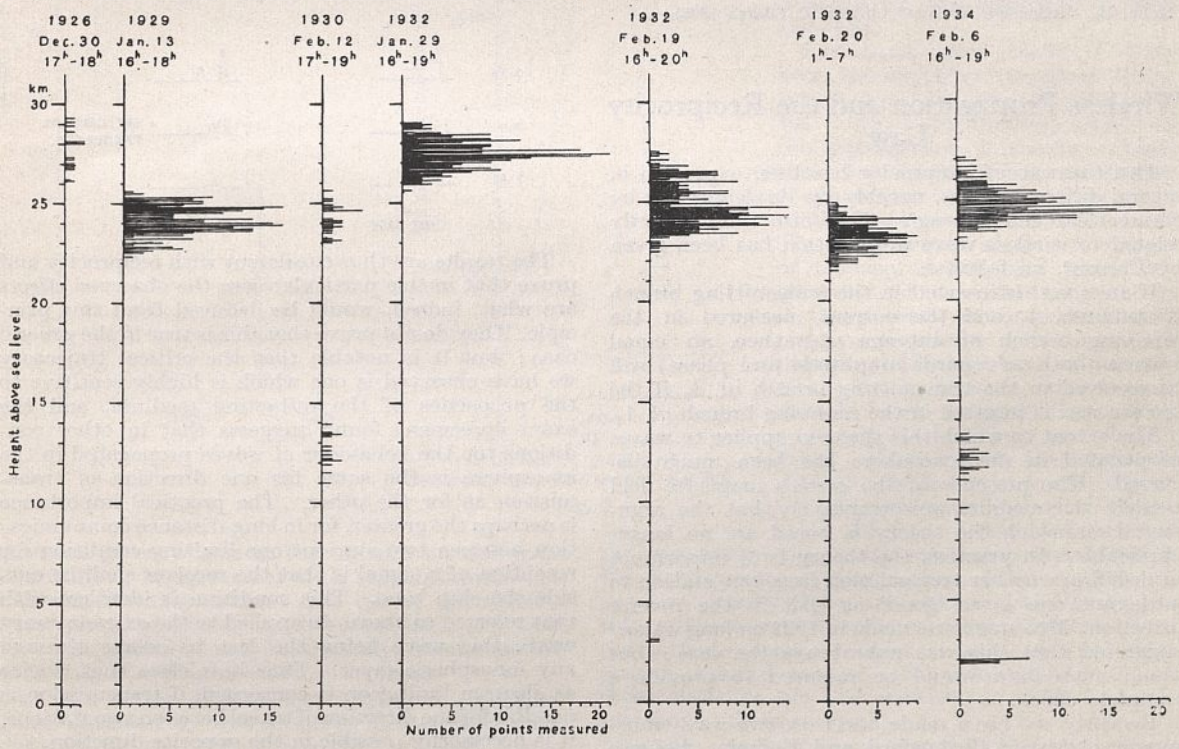
Height of Mother of Pearl Clouds observed in Southern Norway during 1926-34

IN two letters in NATURE[1,2] I gave the first results of the photographic height measurements of the mother of pearl clouds over southern Norway. The whole material obtained in the years 1926, 1929, 1930, 1932 and 1934 is now worked out and a detailed report will be given in *Geofysiske Publikasjoner*, Oslo. The results of the 1,122 measurements of height are given in the accompanying diagram.

MOTHER OF PEARL CLOUDS.

	1926 Dec. 30	1929 Jan. 13	1930 Feb. 12	1932 Jan. 29	1932 Feb. 19	1932 Feb. 20	1934 Feb. 6
P	2	38	7	42	44	29	24
N	15	235	28	238	253	138	215
H	27·7	24·1	24·0	27·4	24·8	23·2	24·7

On February 12, 1930, and February 6, 1934, cirrus clouds were lying under the mother of pearl clouds, as indicated in the diagram. The altitude of



For each date we have chosen as abscissa the number of cases for each given height, and as ordinate the height in kilometres. The time is central European time.

As will be seen, the height was greatest on December 30, 1926, mean 27·7 km., and on January 29, 1932, mean 27·4 km. Of special interest is the fact that the clouds during the night of February 19–20, 1932, were lower down than in the afternoon on February 19, with a difference of 1·6 km. between the means.

these cirrus clouds was rather great, being 11–14 km. On February 6, 1934, they were arranged in great waves. For such a wave, the distance between the bottom and crest was measured and found to be 20 km., and the vertical difference about 1·5 km. Still lower down, at 2–3 km., fracto-cumulus clouds were observed on two occasions drifting with the Föhn wind towards the south-east.

In the above table a summary is given. Here *P* is the number of sets measured, *N* the number of measured points, *H* the mean height in kilometres.

The velocity of the clouds was 75 metres a second on December 30, 1926, towards the south-east, but on the other occasions rather small, 10–20 metres a second in the same direction. The astronomer Sigurd Einbu has written to me that he observed mother of pearl clouds from Dombaas on February 16, 1934, which moved towards the south-east with a velocity of 90 metres a second, the height being supposed to be 25 km.

A series of forty-one successive pictures of a cloud on January 29, 1932, showed rapid changes probably due to turbulence with successive evaporations and condensations in the layer from 26 km. to 28 km.

As already remarked in my former letter in NATURE[2], measurement of a corona round the moon in the night of February 19–20, 1932, led to a diameter of the particles of the cloud not exceeding 0·0025 mm.

Series of observations of mother of pearl clouds were also received from northern Scandinavia and from Finland.

As to the accompanying meteorological conditions, they were the same as those described by H. Mohn in a paper in 1893[3].

CARL STÖRMER.
Institute of Theoretical Astrophysics,
Blindern, V.Aker.

[1] NATURE, **123**, 260 (1929).
[2] NATURE, **129**, 941 (1932).
[3] Mohn, H., "Irisierende Wolken", *Meteor. Z.* (March 1893).

Wireless Propagation and the Reciprocity Law

THE theorem of reciprocity has been expressed in several different forms, notably by Rayleigh[1] and by Sommerfeld and Pfrang[2]. The form most directly related to wireless wave propagation has been given by Carson[3], as follows :

If an E.M.F. is inserted in the transmitting branch of antenna A_1 and the current measured in the receiving branch of antenna A_2, then an equal current (both as regards amplitude and phase) will be received in the transmitting branch of A_1 if the same E.M.F. is inserted in the receiving branch of A_2.

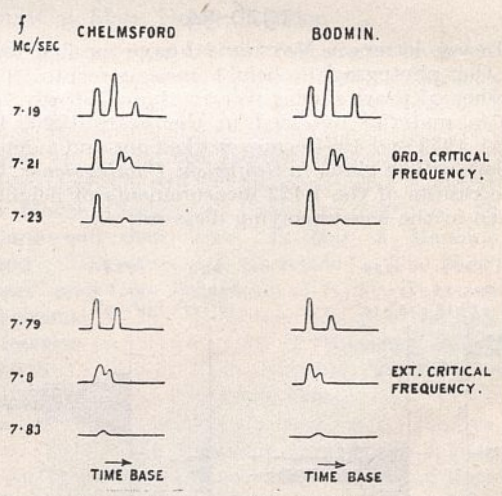
The extent to which this theorem applies to waves propagated in the ionosphere has been much discussed. The presence of the earth's magnetic field renders the medium anisotropic, so that the arguments on which the theory is based are no longer applicable. In practice, the theory is of importance in deciding whether transmission from one station to a distant one is as 'good' as that in the reverse direction. Measurements made in 1922 on long waves[4] suggested that this was not always the case ; but much more data would be required to provide a complete check.

Recently we have made tests on two-way transmission between Chelmsford and Bodmin (distance 393 km.), using pulses in each direction. Provision was made for varying the frequency of both transmitters, and for observing at each station on a cathode ray tube the 'echo pattern' due to the distant transmitter. Some interesting results concerning the reversibility of the waves have been obtained by this means.

Experiments were made in which the frequencies of the two transmitters were varied together in small steps over a range embracing the critical frequency of the F layer (for oblique reflection).

On each frequency the echo pattern was observed at the two stations, and the exact point of disappearance of the signal was thus determined. The results at the two ends were then compared. The experiment was repeated a large number of times, and was carried out covering the critical frequencies of both the ordinary and extraordinary waves.

The results obtained were of the type shown in the accompanying figure. Each critical frequency is marked by the convergence of two rays, a high and a low angle[5], and the final point of disappearance of each could be estimated to an accuracy of about 0·02 Mc./sec. They show a remarkable agreement between the critical frequencies for propagation in the two opposite directions, this being equally true for either magneto ionic component : the frequencies can be said to be within 0·03 Mc./sec. for the two directions in either case.



The results are thus consistent with reciprocity and prove that in this particular case the observed effects are what, indeed, would be deduced from this principle. They do not prove that this is true in the general case ; but it is notable that the critical trajectory we have observed is one which is highly sensitive to the properties of the refracting medium, and the exact agreement found suggests that in other conditions too the behaviour of waves propagated in the ionosphere is the same for one direction of transmission as for the other. The practical importance is perhaps the greater, for in long-distance communication between two stations one limiting condition for reception of a signal is that the receiver shall be outside the skip zone. This condition is identical with that referred to above, as applied to the extraordinary wave, this wave being the last to escape through any ionospheric layer. Thus it is clear that, so far as electron limitation is concerned, if transmission is possible for one direction of travel between two stations, it is necessarily possible in the opposite direction.

T. L. ECKERSLEY.
S. FALLOON.
F. T. FARMER.
W. O. AGAR.
Research and Development Dept.,
Marconi's Wireless Telegraph Co., Ltd.,
Chelmsford. Jan. 9.

[1] Rayleigh, "Theory of Sound".
[2] *Z. hochfreq. Tech.*, **26**, 93 (1925).
[3] *Proc. Inst. Rad. Eng.*, **17**, 952 (1929).
[4] *J. Inst. Elec. Eng.*, **63**, 953 (1925).
[5] *Proc. Phys. Soc.*, **50**, 956 (1938).

Energies of β-Particles from Uranium-X_2

THE end point energy of uranium-X_2 given in "Tables Annuelles de Constantes" is 1·66 Mev.[1] (from Wilson chamber measurements) in contradiction to the values found previously by absorption methods[2,3] and magnetic focusing[4].

At first sight, the Wilson chamber measurements might be considered more accurate than absorption methods, and an apparent end-point of 1·6 Mev. was obtained in this Laboratory from measurements of the curvature of β-ray tracks in a Wilson chamber (Fig. 1). However, when the energy spectrum of a very thin film of uranium-X_2 was measured with a magnetic spectrometer and coincidence counter[5], the spectrum given was as in Fig. 2, with an end point at 2·3 Mev., in agreement with the absorption and magnetic focusing values. The use of the spectrometer gives, of course, much greater accuracy than the other methods, and, incidentally, entails far less work than the Wilson chamber method.

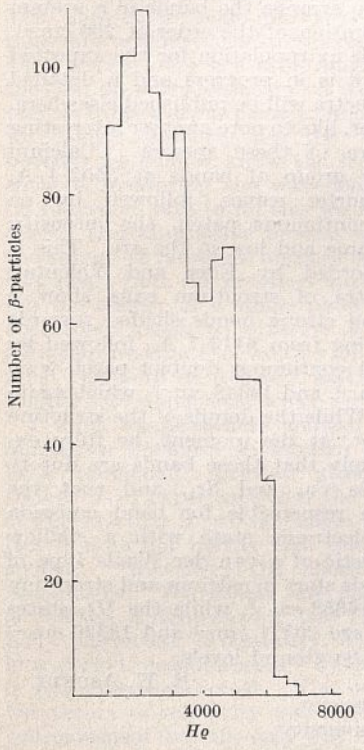
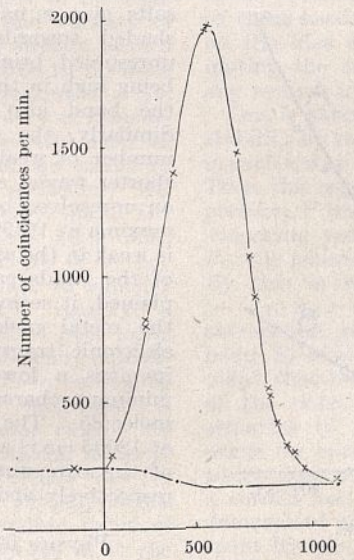


Fig. 1



— x — x, uranium-X_2 points; — · — ·, background with lead shutter over slit.

Fig. 2

In view of the discrepancy between the measurements obtained by this accurate method and those obtained by the Wilson chamber method, energy spectra derived from the latter should evidently be accepted with reserve.

D. ROAF.

Clarendon Laboratory,
Oxford.
Dec. 28.

[1] "Tables Annuelles", **26**, 13 (1938).
[2] Sargent, *Proc. Roy. Soc.*, A, **139**, 659 (1932).
[3] Feather, *Proc. Camb. Phil. Soc.*, **34**, 115 (1938).
[4] Ward and Gray, *Canadian J. Research*, **15**, 42 (1937).
[5] Roaf, *J. Sci. Inst.*, **17**, 17 (1940).

Determination of h/e by the Method of Isochromats

IN recent years several determinations of h/e from the short wave-length limit of the continuous X-ray spectrum have been made. The results obtained from this method, however, disagree definitely with the value of h measured by other methods. According to Kirchner[1] the most accurate determinations of h/e by the method of isochromats give $h = 6{\cdot}614 \times 10^{-27}$ erg sec., provided $e = 4{\cdot}803 \times 10^{-10}$ E.S.U., $e/m = 1{\cdot}759 \times 10^{7}$ E.M.U./gm. and $R_\infty = 109{\cdot}737$ cm.$^{-1}$. This discrepancy has not yet been explained. Also the shape of the isochromats, especially in the vicinity of the short wave-length limit, causes a problem. Instead of running straight down to zero, thus giving a sharp radiation limit, the isochromats run asymptotically down to zero. This 'foot' of the curve indicates that some electrons hit the anticathode with a velocity which is greater than that corresponding to the voltage applied on the X-ray tube. Various hypotheses have been put forward to account for the existence of such electrons.

For some time back, I have been investigating the short wave-length limit in order to determine h/e. As a preliminary result of the investigation, it has been found that the phenomenon mentioned above seems to be a simple effect of the vacuum in the X-ray tube. Thus a pressure of 5×10^{-4} mm. of mercury in the tube gives isochromats of the usual shape, but if the pressure is diminished sufficiently, this shape will change. A pressure of $1{\cdot}5 \times 10^{-5}$ mm. of mercury gives an isochromat, which runs straight down to zero, thus giving a sharply marked short wave-length limit. Further, the isochromat is slightly displaced towards higher voltage, corresponding to a higher value of h/e. This influence of the pressure in the X-ray tube upon the shape of the isochromats may be explained as an effect of gas ions generated by the electron current in the tube. These ions release secondary electrons from the cathode, some of which have a velocity component directed towards the anticathode. Hence these electrons hit the anticathode with a correspondingly greater velocity.

In any event it seems necessary for an accurate determination of h/e to give greater attention to the vacuum than has been done in previous investigations.

PER OHLIN.

Physical Institute,
University,
Uppsala.
Jan. 12.

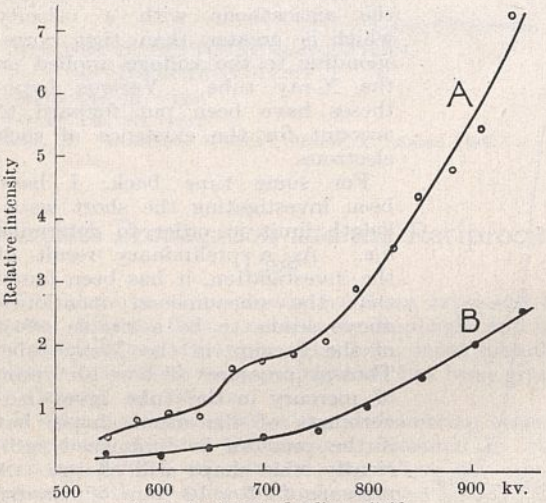
[1] Kirchner, F., *Ergebn. exakt. Naturwiss.*, **18**, 26 (1939).

Bombardment of Nitrogen and Oxygen with Protons

A REACTION of considerable interest in connexion with Bethe's theory of energy production in the stars[1] is that involving the capture of protons by the isotope of nitrogen ^{14}N.

$$^{14}N + {}^{1}H \rightarrow {}^{15}O + h\nu, \quad . \quad . \quad . \quad (1)$$

since this process is one of those involved in his cyclical scheme of nuclear processes. The occurrence of this process was detected by measuring the radioactivity produced in targets of sodium nitride (found to be one of the few compounds of nitrogen that is stable under bombardment). The period of the radioactivity was two minutes, in agreement with the known value[2] for ^{15}O, and the excitation function for the reaction is as shown in Curve *A* in the accompanying graph. Some slight evidence of resonance features is present, but the low yield of the active product prevented very accurate measurement. The yield was found to be $1{\cdot}5 \times 10^{-11}$ positrons per proton of energy $0{\cdot}96 \times 10^{6}$ ev.



Curve *A*: target of sodium nitride.
Curve *B*: target of aluminium oxide.

Experiments were carried out to show evidence of the process involving the heavier isotope, ^{16}O,

$$^{15}N + {}^{1}H \rightarrow {}^{16}O + h\nu, \quad . \quad . \quad . \quad (2)$$

but without success. The use of targets of nitrogen specially enriched with ^{15}N might produce information concerning reaction (2).

Curve *B* shows the excitation function of ^{17}F of period 70 seconds, formed according to

$$^{16}O + {}^{1}H \rightarrow {}^{17}F + h\nu. \quad . \quad . \quad . \quad (3).$$

This was measured in the course of the above experiments but is a result of value in itself. The curve exhibits no special features and the cross-section for the reaction at low proton energies is extremely small. The measured yield was $8{\cdot}0 \times 10^{-12}$ positrons per proton at 950 kv. This small yield explains the fact that the threshold for the reaction has been given previously[3] as $1{\cdot}4 \times 10^{6}$ volts.

S. C. CURRAN.
J. E. STROTHERS.

Cavendish Laboratory,
Cambridge.
Jan. 2.

[1] Bethe, *Phys. Rev.*, **55**, 434 (1939).
[2] McMillan and Livingstone, *Phys. Rev.*, **47**, 452 (1935).
[3] Du Bridge, Barnes and Buck, *Phys. Rev.*, **51**, 995 (1937).

Flame and Arc Spectra of some Calcium and Strontium Salts

A STUDY of the flame and arc spectra of chlorides, nitrates and oxides of calcium and strontium, in the first order of 10 ft., and 21 ft., gratings, indicates that the spectra of the halides are mixed up with those of the oxides, particularly in the strontium salts; the mixed spec ra appear to be present even in spectrograms taken for the halide with arc in an atmosphere of hydrogen[1]. This has caused many bands due to the oxide to be mistaken for SrCl bands. The anomalous doublet separation (~ 600 cm.$^{-1}$) observed[2] in SrCl seems to be due to such a complicated disposition of the oxide and halide bands. If the oxide bands are fully eliminated, it appears possible to arrange the bands in a system with a doublet separation of the order of 260 cm.$^{-1}$, which is a reasonable extrapolation for the expected doublet level. Work is in progress and a detailed description of the spectra will be published elsewhere.

We would, however, like to note another interesting characteristic feature of these spectra. Calcium salts give a narrow group of bands at 5552·4 A. shaded towards shorter waves, followed by an unresolved bright continuous patch, the intensity being high in the flame and low in the arc. This is the band also recorded by Eder and Valenta[3]. Similarly, the spectra of strontium salts show a number of weak and strong bands shaded towards shorter waves, starting from 6113·7 A., followed by an unresolved bright continuous doublet patch with maxima at 16499 cm.$^{-1}$, and 16548 cm.$^{-1}$, which again is weak in the arc. While the details of the structure of the bands cannot, at the moment, be fully explained, it seems likely that these bands are due to the metal molecules Ca_2 and Sr_2, and that the electronic transition responsible for band emission involves a lower electronic state with a shallow minimum characteristic of a van der Waals type of molecule. The bands start in calcium and strontium at 18005 cm.$^{-1}$ and 16352 cm.$^{-1}$, while the $^3D_3$ states of the two atoms[4] are 20371 cm.$^{-1}$ and 18320 cm.$^{-1}$ respectively above the ground levels.

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Physics Department,
Benares Hindu University,
Benares.

B. K. VAIDYA.

Department of Chemical Technology,
University of Bombay,
Bombay.
Jan. 4.

[1] Parker, A. E., *Phys. Rev.*, **47**, 349 (1935).
[2] Hedfeld, K., *Z. Phys.*, **68**, 610 (1931).
[3] Eder, J. M., und Valenta, E., "Atlas Typischer Spektren" (Wien, 1928).
[4] Bacher, R. F., and Goudsmit, S., "Atomic Energy States" (New York, 1933).

Red-Shifts in Nebular Spectra and Scientific Practice

IN a recent issue of NATURE[1], Dr. K. R. Popper discusses various interpretations of the nebular red-shifts. He asserts that "as basis of a measuring system for cosmological purposes" we may use, for time measurement, "*AC* (atomic clocks)" or "*LC* (light clocks)", implying the constancy of atomic frequencies and the velocity of light respectively;

and, for space measurement, "*MR* (material rods)" or "*LR* (light rods)". Three combinations of these 'instruments' are possible: $AC + MR$; $AC + LR$; and $LC + MR$; and Dr. Popper proceeds to show that the corresponding interpretations of the red-shifts are "logically equivalent, and therefore do not describe alternative *facts*, but the same facts in alternative *languages*".

I have not attempted to follow the arguments in detail because it is immediately clear that if the basis of measurement is granted the logical equivalence follows. What I wish to point out, however, is that that basis is itself baseless, since 'atomic clocks' cannot be used for measurement. In order to establish the accuracy of a time-measuring instrument and so make it usable, we must be able to check its readings. The 'light clock' scale allows us to do this: we can take any ordinary clock, and regulate it so that the hand moves over the same number of divisions on the dial on every occasion on which a beam of light travels from a given point to another and back. But we cannot similarly use the 'atomic clock' scale because we cannot know the frequency of an atom without measuring the wave-length and velocity of its radiation, and to do this we must already have a clock. (An alternative process would be to measure the energy of radiation and use the equation $E = h\nu$, but, apart from the practical impossibility of measuring the energy of a single photon, we still need an antecedent clock to measure E, and we must, in addition, assume the validity of the equation.) AC must therefore be rejected, and the only one of Dr. Popper's combinations which survives is $LC + MR$.

I think we have here another example of a very dangerous tendency in modern physics, to which I have previously directed attention[2]; namely, a retreat from experience into the world of pure logic. It appears that if two languages are logically equivalent it does not matter that one of them cannot be spoken. Moreover, the choice of 'languages' is remarkable. We *cannot* use an atomic clock; we *do not* use a light clock; and the rotating material body (corrected, if necessary, in a specified way for long-period measurements[3]) which we actually *do* use is not even mentioned. The outstanding value of the theory of relativity was that it awoke us to the consciousness that the only way to progress in science is to apply our logic strictly to experience, and to experience alone. It is to be feared that the stimulant has become a narcotic: we are fast asleep again.

HERBERT DINGLE.

Imperial College of Science and Technology,
London, S.W.7.
Jan. 13.

[1] NATURE, **145**, 69 (1940).
[2] NATURE, **139**, 784 (1937).
[3] NATURE, **144**, 888 (1939).

Distributional Stability

CONSIDER a conservative dynamical system with n degrees of freedom for a fixed value of the energy constant. Suppose that the corresponding $(2n - 1)$-dimensional energy surface, S, has a finite $(2n - 1)$-dimensional volume measure. Through every point P of S there is a solution path; its point belonging to the time t will be denoted by P_t. According to the classical definition of Lagrange and Dirichlet, the solution path P_t, $-\infty < t < +\infty$, is called stable (with reference to the isoenergetic system), if the distance between the points P_t and Q_t remains arbitrarily small along the infinite t-axis whenever the initial position Q is sufficiently close to P.

The results of the efforts of the last sixty years, as represented by the geometrical investigations of Poincaré, Hadamard, Levi-Civita and Birkhoff, are to the disappointing effect that this classical notion of stability must be considered as a rather exceptional phenomenon; a phenomenon which can practically never occur, unless the solution is a solution of equilibrium, that is, unless P_t is independent of t. The reasons may be roughly stated to be Diophantine in nature, and are formally represented by the appearance of an irrational rotation number in the geometrical theories of periodic motions, and, equivalently, by the celebrated 'small divisors' in the theory of astronomical perturbations. Actually, the extreme scarcity of motions which are stable in the classical sense cannot be surprising from a dynamical point of view. In addition, this notion of stability has scarcely anything to do with the needs of statistical mechanics. In order to take care of these needs, I propose a notion of stability based on the idea of asymptotic distributions, thus eliminating the anomaly that practically no motion of any system is stable.

One is naturally led to this notion of distributional stability by restating the ergodic theorem of Birkhoff[1] in such a way as to make it free of arbitrary functions. Then the ergodic theorem states that if the initial position P on S does not belong to a certain set of vanishing volume measure, the corresponding path P_t will possess an asymptotic distribution function. By this is meant that if V is any small 'cube' $(-\varepsilon < x_i - a_i < \varepsilon)$ in $S = (x_i)$, there exists an asymptotic probability, say, $\varphi = \varphi_P(V)$, that the point P_t of the path belonging to P be in V; provided that the hyperplanes determined by the faces of the cube V do not belong to an enumerable sequence of hyperplanes[2]. In other words, there exists for every such cube V, and for every path P_t which does not belong to initial positions P forming a certain set of vanishing volume measure, a well-determined asymptotic amount of time, $\varphi = \varphi_P(V)$, spent by the path P_t in the subdomain V of S. In addition[3], it was recently shown that this asymptotic probability $\varphi = \varphi_P(V)$ is distinct from zero whenever the path P_t belonging to P penetrates at least *once* the arbitrary subdomain V of S. The function $\varphi_P = \varphi_P(V)$ of the variable subdomain V of S may be considered as describing the asymptotic distribution of the path P_t belonging to the initial position P. Obviously, $\varphi_P(S) = 1$ for every P.

It now appears that a notion of stability which is adequate from the point of view of statistical mechanics is the following: The path P_t in S has distributional stability if the asymptotic distribution function φ_Q tends to the asymptotic distribution function φ_P whenever the initial position Q of the path Q_t tends to the initial position P of P_t. It is understood that this convergence to $\varphi_P = \varphi_P(V)$ is required for *every* V of the type specified above; and that points P and Q belonging to the excluded set of vanishing volume measure must be omitted.

The conditions of this definition are such as to be satisfied not merely in exceptional cases, and are compatible with the Diophantine intricacies alluded to above. In fact, it is easy to see that all motions of every system of the integrable type of Liouville-Stäckel satisfy this condition (but not, of course, the

stability requirement of Lagrange-Dirichlet). In addition, the conditions are satisfied in the other extreme case of complete non-integrability, as represented by the case of metric transitivity, a case underlying the classical ergodic hypothesis of statistical mechanics. In fact, this case is characterized by the condition that $\varphi_P(V)$ be always the ratio of the volumes of V and S; so that, in particular, $\varphi_P(V)$ is independent of P.

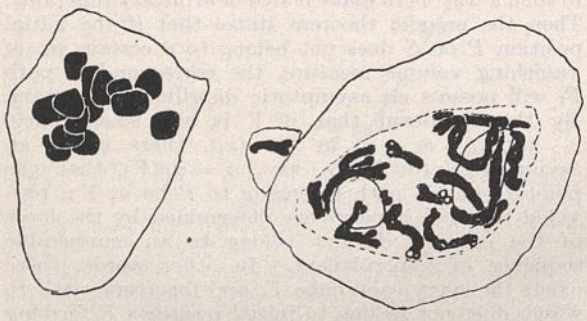
AUREL WINTNER.

Johns Hopkins University,
Baltimore.
Jan. 2.

[1] Birkhoff, G. D., *Proc. Nat. Acad. Sci.*, **17**, 656–660 (1931).
[2] Wintner, A., *Proc. Nat. Acad. Sci.*, **18**, 248–251 (1932).
[3] Wintner, A., and Hartman, P., *Amer. J. Math.*, **61**, 977–984 (1939).

Genetical Sterility in Pisum sativum

COMPLETELY sterile plants were observed by Miss Pellew in the offspring of a plant chimærical for structural hybridity. The fertile and half-sterile branches both gave a certain proportion of sterile plants. This character has been further studied in material kindly supplied to us by Miss Pellew. The sterility, which is occasioned by a complete failure of pairing at meiosis, is present on both male and



a *b*

Fig. 1 (× *c.* 2100)

female sides. Illustrated are two stages in meiosis from the ovule showing in Fig. 1*a*, metaphase I with 14 univalents, and in Fig. 1*b* prophase II after a 13 : 1 distribution of chromosomes. The general behaviour at meiosis would appear to be similar to the case reported for Datura by Bergner, Cartledge, and Blakeslee[1]. The character is inherited as a recessive, the following segregation values having been obtained from semi-sterile F_1's : 73 semi-steriles ; 57 fertiles ; 33 steriles, and from fertile F_1's : 29 fertiles ; 14 steriles. Five out of eight fertiles, and seven out of ten semi-steriles tested were found to be heterozygous for sterility. Sterility may be due to a single gene, but it is more probable, in view of its origin, that a complex of genes, due to a deficiency or duplication associated with the reciprocal translocation, is involved. This is being further investigated.

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Dec. 18.

[1] Bergner, A. D., Cartledge, J. L., and Blakeslee, A. F., *Cytologia*, **6**, 19–37 (1934).

A Pigmented Nucleus

IN the course of our work on growth-promoting substances, we have cultured many different kinds of pollen tubes as test subjects during the last two years. We discovered a very unusual kind of nucleus in the tube of *Hymenocallis tubiflora*. The germinal nucleus is naturally pigmented and is of a reddish-brown colour. This was particularly fortunate for us because it permitted us to follow changes in form and position of the nucleus in the various stages of germination, from the time that the grains were sown, up to the time when the well-developed tube burst at the tip and the nucleus emerged and came to lie free on the surface of the culture medium. The favourable colour made it easy to photograph the nucleus in different phases while it was alive.

So far as we are informed, no previous mention of a pigmented nucleus has been made.

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Mechanism of the Enzymatic Phosphorylation of Thiamin

WE have previously demonstrated that thiamin pyrophosphate may be synthesized from the free vitamin by the action of enzymes present in alkaline washed brewer's bottom yeast, provided that hexose-diphosphate and certain factors present in boiled aqueous extracts of animal tissues are present[1,2]. Synthesis under these conditions was completely inhibited by 0·005 *M.* sodium iodoacetate, but was relatively unaffected by 0·04 *M.* sodium fluoride. More recently[3], we have demonstrated that cozymase and acetaldehyde may be substituted for the boiled tissue extract with no change in the degree of synthesis or of the iodoacetate inhibition. Phosphoglyceric acid may also be substituted for the boiled tissue extract, but under these conditions iodoacetate fails to affect the synthesis while fluoride causes complete inhibition[3]. Using specially prepared alkaline washed yeast, we have found that cocarboxylase synthesis with phosphoglyceric acid is considerably diminished. It may be restored, however, by the addition of catalytic quantities of adenylic acid. As a result of these experiments we have proposed the reaction

adenosinetriphosphate + thiamin → adenylic acid + cocarboxylase

Experiments performed in an attempt to test this equation directly showed that synthesis may be performed with adenosinetriphosphate, but only after a lag of 40–60 minutes. The velocity of the synthesis in the presence of phosphoglyceric acid is considerably greater. The degree and velocity of the synthesis with adenosinetriphosphate may be stimulated by the addition of cozymase, and it is inhibited by iodoacetate. These results may be explained by the finding that glucose inhibits the synthesis of cocarboxylase in the presence of phosphoglyceric acid and adenylic acid. The poor synthesis with only added adenosinetriphosphate may be explained on the basis of the competition of other phosphate

acceptors present in the alkaline washed yeast with thiamin for the available phosphorus. The greater and more rapid synthesis in the presence of phosphoglyceric acid is due to the ability of this compound to regenerate adenosinetriphosphate from adenylic acid. The stimulatory effect of cozymase on the synthesis in the presence of added adenosinetriphosphate is due to the fact that in the presence of these compounds carbohydrate present in the alkaline washed yeast is broken down with the resynthesis of adenosinetriphosphate. The inhibitory effect of iodoacetate upon the synthesis in the presence of adenosinetriphosphate is due to the inhibition of carbohydrate breakdown.

The degree of cocarboxylase synthesis under our conditions appears to be limited by the saturation of the carboxylase enzyme[3]. In addition, the competitive effect of phosphate acceptors present in the alkaline washed yeast appears to be so great that more than 200 micromoles of phosphoglyceric acid may be fermented with the production of only 3 micrograms of cocarboxylase.

Weil-Malherbe[4] has recently employed a soluble yeast protein freed from thiamin pyrophosphate for experiments upon the synthesis of cocarboxylase. Under these conditions he has secured results which appear to be similar to those obtained in our laboratory.

We are indebted to H. von Euler and F. Schlenk for a sample of pure cozymase and to Prof. C. F. Cori for adenosinetriphosphate.

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Dec. 29.

[1] Lipschitz, M. A., Potter, V. R., and Elvehjem, C. A., *Biochem. J.*, **32**, 474 (1938).
[2] Lipschitz, M. A., Potter, V. R., and Elvehjem, C. A., *J. Biol. Chem.*, **124**, 147 (1938).
[3] Lipton, M. A., and Elvehjem, C. A., *Cold Spring Harbor Symposia on Quant. Biology*, **7** (1939).
[4] Weil-Malherbe, H., *Chem. Ind.*, **58**, 1021 (1939).

Hydration of Stearanilide

A PHENOMENON of some interest was observed during the preparation of stearanilide. The finished product, recrystallized from absolute alcohol and from chloroform, melted at 93° C. When recrystallization from alcohol was being carried out, a portion of the alcoholic solution was poured into a large excess of cold water. A white material of much greater bulk than the dissolved stearanilide was thrown down. Initially of a gelatinous character, it became granular on standing. It was filtered off at the pump, washed with water, and dried *in vacuo* over fused calcium chloride for ten days. After drying, the material consisted of an amorphous white powder, dry to the touch and easily crumbled between the fingers. The powder had no definite melting-point but decomposed quite sharply at 88°–89°, yielding a drop of colourless liquid and a white solid. This white solid melted at 92°–93°.

A more detailed investigation was then carried out. Weighed samples (1–2 gm. each) of the amorphous white powder were heated to constant weight in ovens at different temperatures. In the accompanying table are recorded the oven temperatures, the hours of heating required to achieve constancy in weight, and the percentage loss in weight:

Temperature	Hours	% Loss in weight
55°	14	79·8
80°	9·5	79·1
90°	3·5	79·1

When drying was complete the residue in every case melted at 93° C.

Thus after drying *in vacuo* over fused calcium chloride for ten days the powder contained almost 80 per cent water. It is suggested that the powder is a hydrated form of stearanilide. The existence of such material is remarkable, as stearanilide is generally described as being very hydrophobic. Calculation shows that, in the material examined, about eighty water molecules were associated with one molecule of stearanilide.

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Jan. 10.

Lyell's Geological Texts

RECENTLY, while referring to Charles Lyell's "Elements of Geology", it was found that the Yale Library copy, of date September 12, 1839, had been sent by the publishers to Benjamin Silliman. This was the first American edition from the first London edition as published by Kay Bros., Philadelphia, with 316 pages and 295 figures in the text. After one hundred years this fine text, one of the world's great books, should again be noted. Earlier, the same publishers had brought out an American edition of Lyell's "Principles of Geology", as was duly noted by Silliman in his *Journal* (now the *American Journal of Science*) at the time. Quoting: "Lyell has done much to recall geologists from extravagant speculations, and to allure them back to a course of strict induction; thus placing Geology side by side with the other sciences of observation".

Nevertheless, after several tens of years advance in geology there came Huxley's famous fling: "Geologists had imagined that they could tell us what was going on at all parts of the earth's surface during a given epoch; they have talked of this deposit as being contemporaneous with that deposit, until from our little local histories of the changes at limited spots of the earth's surfaces they have constructed a universal history of the globe as full of wonders and portents as any other story of antiquity". As justly though, Huxley admitted that, "It was Lyell who had smoothed the road for Darwin".

Re-reading the "Elements" and "Principles" to-day leaves the same fine impression of clarity and of lucidity that proved so arresting one hundred years ago. So much is this true that it would seem that any university student who now finds difficulty in following the subject of geology would get from even a brief, if attentive, reading of Lyell's famed texts the sure initial stimulus so helpful in any far-set or over-strange subject. There blaze the colours of the sunrise of the first real hundred-year day in geology. Starting thus aright, and coming down through that day, the student may the better scan the shadows of that far-set twilight land perhaps destined to be lighted clearly during the second century of geology.

In the "Elements" (p. 57) there are curious notes on the subject of petrifaction, telling of the palæobotanist Goeppert's attempt to "imitate the process" of replacement, by steeping animal and vegetal substances in waters holding siliceous, calcareous, or metallic matters. Strange, indeed, that after a hundred years such an entrancing problem should be as far from a forthright solution as ever.

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Jan. 11.

Antimony Treatment of Kala-Azar

SIR LEONARD ROGERS has recently pointed out[1] the value of antimony in the treatment of kala-azar. We note that all his examples refer to India, China and the Mediterranean, and we would point out that these happy results do not apply to kala-azar in the Anglo-Egyptian Sudan.

Since the early failures reported by Archibald[2] in cases treated on the lines advocated in India, it has been the experience of the majority of British medical inspectors working in kala-azar areas that the immediate results, though apparently successful in many cases, are no criterion of final cure, as a considerable proportion of cases relapse within two years. There is also evidence to indicate that such relapsed cases are very resistant to further antimony treatment, and most of them terminate fatally.

In brief, we consider there is sufficient evidence to demonstrate that antimony is by no means a satisfactory specific for kala-azar in this country, although it is fair to state that up to the present time, it has been the only drug of any value.

We agree with Sir Leonard Rogers that the problem of treatment in a poor country—and the Sudan is a poorer country than India—is still far from being satisfactorily solved.

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Jan. 1.

[1] Rogers, L., NATURE, **144**, 1003 (1939).
[2] Archibald, R. G., *Amer. J. Trop. Med.*, **3**, 307 (1923).

[Sir Leonard Rogers informs us that cases are also occasionally met with in India that are completely resistant to any form of antimony treatment.—EDITORS.]

Points from Foregoing Letters

C. STÖRMER submits a diagram summarizing the results of more than a thousand measurements of the height of mother of pearl clouds observed from Norway during 1926–34. The mean height varied from 23·2 km. to 27·7 km., and the clouds moved south-east at a high velocity.

By means of two separated transmitters the oblique critical frequencies of the *F* region were measured by T. L. Eckersley *et al.* for the two opposite directions of propagation. These frequencies were found to be identical for the two directions, both for the ordinary and extraordinary waves, showing that so far as electron limitation is concerned the conditions for propagation in one direction are the same as in the opposite direction. This special case of reversibility suggests that the law of reciprocity may be more generally valid in the ionosphere, since the critical rays examined are particularly sensitive to the properties of the refracting medium.

The end-point energy of uranium-X_2 has been measured by D. Roaf in a magnetic spectrometer using a new coincidence counter. The end point is found to be 2·3 Mev. This is not in agreement with Wilson chamber measurements.

P. Ohlin has investigated the short wave-length limit of the X-ray spectrum to determine h/e. He finds that the observations are very sensitive to the pressure in the X-ray tube ; this may account for the discrepancies in the values of h/e obtained by this and other methods.

The excitation functions for the reactions $^{14}N + {}^{1}H \rightarrow {}^{15}O + h\nu$ and $^{16}O + {}^{1}H \rightarrow {}^{17}F + h\nu$ have been measured by S. C. Curran and J. E. Strothers. The yields expressed in positrons per proton were found to be $1{\cdot}5 \times 10^{-11}$ and $8{\cdot}0 \times 10^{-12}$ at $0{\cdot}96 \times 10^{6}$ and $0{\cdot}95 \times 10^{6}$ volts respectively.

From a study of the flame and arc spectra of certain alkaline earth compounds, R. K. Asundi and B. K. Vaidya report the possibility of rearranging the SrCl bands with a doublet separation of about 260 cm.$^{-1}$ instead of 600 cm.$^{-1}$. They further point out that the bright continuous bands associated with the spectra of these salts are probably due to metal molceules of the van der Waals type.

H. Dingle suggests that the statement recently made by K. R. Popper, that 'atomic clocks' are equivalent to 'light clocks' for scientific measurements, exemplifies a tendency in modern physics to divorce theory from experience.

The classical definition of mathematical stability will not meet the requirements of the problems of statistical mechanics. A. Wintner derives a new definition by use of a suitable formulation of Birkhoff's ergodic theorem. It turns out that, in a precise sense of statistical averages, the stability condition is satisfied both for the case of systems of classical integrable type and for the opposite extreme case of complete ergodicity.

E. R. and F. W. Sansome report the occurrence of a genetical type of sterility in *Pisum sativum* occasioned by a complete failure of chromosome pairing at meiosis in the mega- and micro-sporocytes.

M. A. Lipton and C. A. Elvehjem show that the production of cocarboxylase and adenylic acid by the enzymatic phosphorylation of thiamin can be accelerated in the presence of phosphoglyceric acid. Synthesis is stimulated by the addition of cozymase and inhibited by iodoacetate. This is explained by the fact that glucose inhibits the synthesis of cocarboxylase in the presence of phosphoglyceric acid and adenylic acid.

B. A. Toms describes the formation of hydrated stearanilide which after drying contained almost 80 per cent of water.

RESEARCH ITEMS

Gypsy Luck in Serbia

THE function of luck among Serbian gypsies is formulated as follows by Alexander Petrovič in his continuing study of their beliefs (*J. Gypsy Lore Soc.*, Ser. 3, 19, 1–2; 1940). As they have no personified god, *O Del* (heaven) gives, and *Kar* (lingam) creates, but it is *Baχ* (luck) which gives to man the ability to use what these give and create. Some gypsies believe that Good Luck is a pretty girl, a nymph living in the woods, while Bad Luck is an old man or a toothless old woman, but the Serbian gypsies understand *Baχ* rather as some property of a man, animal or object. He who possesses such a capacity brings luck into the home, and this means health to the household and progress and success in every venture. In a household the wife's luck is the most important; and if a man is unsuccessful in business it may be the fault of his wife, and he may change the luck by being temporarily unfaithful to her. Luck may attach to the bag which a woman carries on her begging expeditions. One woman had had fourteen bags of which only the first was lucky. She always kept a scrap of rag from this one and carried it about with her. Luck may also reside in a whip or an article of clothing. If things or people are not luck bringers they may obtain this power by blessings, as when a wife throws water over her husband as he starts on a journey, saying, "Good luck to thee on thy way", or when a smith begins to use a new hammer and his neighbours say, "May thy hammer be lucky." In the same way certain persons, animals, things may bring bad luck (*Bibaχ*). If a child is unlucky it must be avoided. It must not pour water on you in the morning or talk to you early in the day. It should not approach the anvil, nor should tools be put in its hand; and if a boy it must not become a smith.

Maori Bowls

UNLIKE the Melanesians, the Polynesians never acquired the art of making pottery, but used as receptacles for a wide variety of purposes wood, supplemented to a certain extent by gourds and baskets of totara bark. The general style and perfection of finish of Polynesian and Melanesian wooden bowls vary considerably with different localities. The most perfect come from Hawaii. The Maori bowls show great variety of form, ranging from crudely hollowed out logs to beautifully finished examples, ornamented with carving. Some agree very closely in *motif* with Hawaiian bowls, while others have a distinctly Melanesian character. The collection of Maori bowls in the Auckland Museum, New Zealand, comprises more than forty examples. These have been described, with others not in the collection, but included for comparative purposes, by A. G. Stevenson, assistant ethnologist of the Museum (*Rec. Auckland Inst. Mus.*, 2, 4; 1939). The specimens are divided roughly into five classes mainly according to shape: long, trough-like bowls, short, broad and usually deep bowls, bowls of approximately equal length and breadth, the rim outline being between a square and a circle, bowls in which the bottom internally is flat, while externally they are hemispherical with or without a flat hemispherical base, and in the fifth class two bowls of distinctive type, one almost circular in outline on a small flat oval base, and the other in which the rim is almost circular, but thickens out to a point externally at each end. There are also a number of bowls of unusual form. The bowls, being primarily for use, are not ornamented as a rule, but there are notable exceptions, in which handles or spouts are carved to represent conventionalized human faces. Most of the bowls were of totara wood; but immersion in swamps over a prolonged period often makes exact identification of the wood impossible.

East Indian Gastropods

Drs. Adam and Leloup, in "Résultats scientifiques du Voyage aux Indes Orientales néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique" (Mém. du Musée d'hist. nat. de Belg., Bruxelles, 2, Fasc. 20; 1939), have concluded their study of the gastropods. The present volume deals with pulmonates, scaphopods and bivalves. There are five text figures, seven plates of shells and a map showing localities. The résumé of all the molluscs found, with localities, will be useful to collectors. Altogether nearly six hundred species are listed, but of these only a small number, comprising one amphineuran, one opisthobranch and seven pulmonates are new. This volume contains the last twelve families of pulmonates and one new species, *Ptychodon misoolensis*, which is not described, as an account of it appears elsewhere. The work is systematic and deals with shells and radulæ.

Fossils from the Belgian Ordovician

IN "L'Ordovicien de Sart-Bernard" (Mém. 86, Mus. Roy. d'hist. nat. de Belg., Bruxelles, 1939) E. Maillieux describes the fossils extracted from the Arenigian and Llandeilian strata of Sart-Bernard. There are three plates. From the Arenigian, graptolites, Lingula, trilobites and the Nebalian Lamprocaris are described, and resemble those of other Belgian rocks of the same age. From the Llandeilian one brachiopod, Pionodema, gastropods, lamellibranchs and trilobites are listed. As a whole the species are those peculiar to the Ordovician of Bohemia, except for *Conularia rugulosa*, which occurs also in Normandy, and the two species *Liospira æqualis* and Tentaculites n.sp. which have not been found in Bohemia. The first is a Scottish species. The two Belgian specimens of the second were unfortunately imperfect, so that no specific name is given to them.

Leaf-Growth as a Systematic Feature in Ammocharis

Milne-Redhead and Schweickerdt (*J. Linn. Soc.*, 52; 1939) have re-investigated the systematic position of the genus Ammocharis and related genera, especially Crinum. Whilst some species of

Crinum are readily distinguished by spiral leaf arrangement, others have distichous leaf arrangement as in Ammocharis, but the leaves are always sheathing at the base and are never biflabellately arranged. A peculiar feature of the leaves of Ammocharis, earlier described by Herbert, is that the leaves die down to the bulb but the same leaves resume growth and form new blades the next one or more seasons. The occurrence of this manner of leaf growth in *Crinum Tinneanum*, *C. heterostylum* and *C. angolense*, and probably in *C. Baumii*, associated with biflabellate leaf arrangement, indicates that these species should be transferred to Ammocharis. The same peculiar feature of growth has been observed in some species of Crinum (subgenus Stenaster), but in these cases the spiral leaf arrangement, sheathing leaf bases and flower characters distinguish them readily from Ammocharis.

Graft Blight of Lilac

AN interesting case of delayed incompatibility between stock and scion of a graft union is described by C. H. Cadman in the *Gardeners' Chronicle* of January 13. Lilac buds upon privet stocks make good growth in the first season, but the foliage becomes rolled and mottled with yellow in the second year of joint growth. Leaves fall from the plant prematurely in subsequent seasons, and the ultimate result is a misshapen bush with thin, spindly shoots. The paper also reviews work by Chester, of the Arnold Arboretum, which shows that the trouble is non-pathogenic, and due solely to the incompatibility between stock and scion of the graft union. Use of common *Syringa vulgaris* for a stock, or burying the Syringa-privet union so that the scion can ultimately form its own roots, are suggested as control measures. It is also possible to propagate the common varieties of lilac by cuttings or layers, though a longer time is necessary to produce plants of saleable size by these methods.

Origin of Lake Toba, North Sumatra

THE history of Lake Toba provides one of the most convincing examples of a genetic connexion between tectonic and volcanic forces. In *De Ingenieur in Ned.-Indië* (**4**, No. 9, 126–140; Sept. 1939) van Bemmelen discusses the geological and volcanic evolution of the region and shows that the arching-up of a mountain range can, at least in part, result from the rise of magma or migma. The Toba cauldron is situated on the crest of a tumour-like culmination of the Barisan mountain range; it has an area of about 2,000 km.^{2} and a volume of 1,000–2,000 km.^{3}. On the top of the 'tumour' fissure eruptions occurred during the late Pleistocene, with a main paroxysmal phase of acid tuffs, followed by domes and outflows of acid lavas. The tuffs covered an area of 20,000–30,000 km.^{2} in Sumatra and extended to Malaya, where the thickness is still 5–20 ft. The volume of the tuffs is of the same order as that of the cauldron itself, which came into existence during or directly after the main outburst. The cauldron is therefore regarded as a 'super-caldera'. Van Bemmelen considers that a migmatitic batholith rose from the depths until it nearly reached the surface, arching up its cover and finally blowing out the gas-laden contents of its upper part through fissures in the roof. The paper is well illustrated and contains some interesting speculations on the origin of 'Pacific' magmas.

Heat Flow in the Earth's Crust

A. E. BENFIELD (*Proc. Roy. Soc.*, A, **173**, 428; 1939) has investigated the outward flow of heat in the earth at a number of points in England by investigating the thermal conductivities of rock specimens taken from boreholes and using a knowledge of the temperature distribution in the same holes. The thermal conductivities were found by placing a carefully prepared rock slice between the ends of a divided brass bar in which heat was flowing; the thermal contact at the interfaces was eliminated by comparing results on specimens of different thickness. The conductivities found range from 0·017 C.G.S. (rock salt) to 0·0014 (shale), and the heat flows calculated vary between 0·7 and $1·5 \times 10^{-6}$ cal. per sec. per cm.^{2}. In the deep bores there was evidence of temperature disturbances consistent with the presence of an ice sheet on the surface up to 9,000 years ago. This necessitates a correction which brings the mean equilibrium heat flow up to $1·4 \times 10^{-6}$ cal. per sec. per cm.^{2}. E. C. Bullard (*Proc. Roy. Soc.*, A, **173**, 450; 1939) has made similar conductivity measurements on rocks from deep bores on the Witwatersrand, and L. J. Krige (*ibid.*, 474) has made careful temperature measurements in these bores. The mean heat flow found is $1·2 \times 10^{-6}$ cal. per sec. per cm.^{2}. Both this value and Benfield's similar value in England are lower than those formerly estimated. It appears that there cannot be molten rock under England at a less depth than 20–30 km., while in the South African case, the layer of radioactive granite cannot be thicker than 12 km., and it is probably underlain by an intermediate layer as indicated by certain seismological observations.

Sun's Speed of Galactic Rotation

G. L. CAMM has published an important paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 1; November 1939) which leads to a much higher value for the velocity of the sun's galactic rotation than that generally accepted. The method adopted is to find the greatest difference between the angular speeds of rotation of the sun and of other objects in the galaxy, preferably those at great distances from the galactic axis, because their angular speeds would be small. Obviously a lower limit to the angular, and hence to the linear, speed of the sun can be determined in this way. Twenty-six globular clusters were divided into three groups, and it was found that the outer group, ranging from 12,000 to 38,000 parsecs from the galactic axis, appeared to be rotating as a rigid body—a view very difficult to sustain on dynamical grounds. Camm adopts the more reasonable hypothesis that the six clusters forming this group constitute a non-rotating frame, and their apparent motion is really caused by the opposite rotation of the sun. As an apparent angular velocity of -410 ± 50 km./sec. per 10,000 parsecs for the outer clusters was found, the speed of rotation of the sun is 410 ± 50 km./sec. If it is assumed that the outer clusters are rotating, the absolute linear speed of the sun will exceed 410 km./sec. The other groups ranged from 10,000 to 6,000 parsecs and from 4,000 parsecs to the galactic axis, and it was found that the clusters have a differential motion; quantitative agreement exists between this motion and that of other types of objects. This, with other established facts, helps to confirm Lindblad's theory of sub-systems within the galaxy, each with its own speed of rotation.

THE SUTTON HOO SHIP-BURIAL

THE outbreak of war followed so closely on the gift to the nation of the antiquities from the Saxon ship-burial at Sutton Hoo, Suffolk, by the owner, Mrs. E. M. Pretty, which was announced on August 23, 1939, that there had been little opportunity for detailed examination of most of the objects, nor is any further occasion likely to arise while they are stored against damage. In these circumstances even the partial account to which the current issue of the official publication of the British Museum (Bloomsbury) (*Brit. Mus. Quart.*, 13, 4; 1939) is devoted affords information which will be welcome to archæologists and others, pending further study. A general account of the circumstances and character of the discovery and a description of the gold ornaments by Mr. T. D. Kendrick is followed by notes on the silver by Mr. Ernst Kitzinger, the coins by Mr. Derek Allen and other finds by Mr. T. D. Kendrick, who adds some reflections on the relation of the find to Anglo-Saxon archæology.

Mr. Kendrick points out that while some of the more important objects had been confided to the Museum as excavated, yet many of the notable objects, as, for example, the shield-boss and shield fittings, the helmet and sword have not yet been examined, and only hastily made record-photographs have been available for study.

It will be remembered that the barrow in which this ship was found was the largest of a group of twelve. The form of the ship, as traced, is more of the type of the fourth century type Nydam ship at Kiel than of the type of the Viking ships. The funeral deposit lay amidships under a collapsed wooden shelter in the form of a house with high-pitched roof, and constituted the richest series of grave goods ever found in England.

The richness and rarity of the finds is established by a brief description of their arrangement within the burial chamber measuring about 17 feet long by 8 feet wide. They were disposed H-wise, the horizontal bar corresponding with the keel of the boat and the uprights consisting of accumulations of offerings at the ends of the funeral chamber. At the west end was a standing bowl of bronze with drop handles and in this was a bronze hanging-bowl with elaborate enamelled ornaments, itself containing a wooden object with jewelled mounts that is probably a small stringed musical instrument, and other objects. By these bowls were heads of iron spears and augons, an ironbound wooden bucket, a huge lavishly decorated shield-boss and gilt shield-mounts, a gilt object believed to be a gaming board and among other objects an enormous ceremonial whetstone. Moving eastward, there was found the group of ornamental silver bowls and silver spoons, the remains of a magnificent helmet, the sword with a jewelled hilt of gold and the prodigious array of jewelled gold ornaments, sword harness and the outer trappings of a costly attire including the purse and its contents—gold coins and two ingots. Beyond these jewels were the remains of silver-mounted drinking horns, the great Anastasius and fluted silver dishes and a remarkable collection of miscellaneous objects.

Although the grave furniture was that of a man, there were neither vestiges of the buried body nor the ashes of cremation. Further, there was no single personal ornament of the deceased. Whatever may be the explanation, whether the barrow be cenotaph or grave, it is indubitably the monument of a pagan or semi-pagan royal personage possessed of huge wealth, who on the evidence of coins in his purse died before the first half of the seventh century. He may have been, it is suggested, Redwald, King of East Anglia, Bretwalda of England in 616 who died probably in 625.

The Gold Ornaments. In the fittings of the sword harness and outer apparel of their royal owner, all the pieces are contemporary and the work of one school, possibly of one man—one of the greatest of the many goldsmiths who worked in the cloisonné technique from the latter half of the fifth century onward. The most impressive single object is the massive gold buckle adorned in interlacing ornament and riello inlay, while next in importance comes the purse with its gold frame jewelled with garnets and mosaic glass and enriched with filigree bindings, its flanges, clasp and mountings ornamented in cloisonné and champlevé technique, while a number of minor ornaments are jewelled in garnets only.

The Silver. The outstanding find is the huge dish 27 inches in diameter, with a decoration of mixed ornamental designs. Byzantine control stamps, on which the monogram is of Anastasius, show it to be the work of a silversmith in the period A.D. 491–518. As a whole the silver objects are inferior as works of art to the gold. They belong to a decadent period of Mediterranean art, but within their own class they are important archæological documents. The large dish and the spoons throw new light on early Byzantine metal industry, and the smaller bowls appear to represent the art of certain semi-barbaric border regions of the Byzantine world which yet remain to be more clearly defined.

The Coins. The forty gold coins and two gold ingots found in the purse are the most inartistic objects in the whole burial, but nevertheless are of great importance, for it is on their evidence primarily that the dating of the burial must rest. They are of the denomination of tremissis or third of a solidus, and were all struck at Merovingian mints within or on the borders of France. Of none of the Sutton Hoo coins can it be said definitely that they were struck by a particular king, nor is any one of the moneyers known from historical sources. A rough dating is not before A.D. 600 nor likely to be before 640 or even 670.

Other Finds. Though intrinsically not the most valuable, the great ceremonial whetstone is archæologically the most amazing. Originally it was about 2 ft. long, square in section, the extremities adorned on each face with bearded masks, the stone ends in lobed bosses coloured red and enclosed in a bronze fitting with an empty and apparently useless cup-shaped terminal. Nothing like this stone exists anywhere else. Of equal importance archæologically is the bronze hanging bowl, with a mount from the

centre of the interior floor consisting of an oddity in the form of a substantial bronze fish, perched on a rod rising from a circular base, enamelled in the same style as the borders of the exterior mounts.

Sutton Hoo and Anglo-Saxon Archæology. The salient fact of the Sutton Hoo discovery is that, taken as a whole, it is a revelation of a new Pagan Saxon art and archæology in England. It is both unfamiliar and startling. It is more than a pale reflection of the Jutish culture in Kent; it is the independent Golden Age in East Anglia confirming the historical fact of a dawning political ascendancy. Further, it will not be wise henceforth to debate the origins of our Christian art without paying respectful attention to this new evidence from Suffolk.

MINERAL RESOURCES

By Prof. R. N. Rudmose Brown

IT has been said, with a considerable measure of truth, that one of the decisive factors in war is the accessibility of either side to essential minerals. These include in addition to iron, as the basis of steel, various less widely spread minerals such as the ores of nickel, manganese, titanium, tungsten, etc., and also the ores of copper, zinc, lead, aluminium, etc., and of course coal and above all mineral oil. The statistical summary for the years 1936–38 afforded by this issue of an annual publication* is specially valuable in giving, for most metals, the amount of the ores produced in each territory of the British Empire and also, in many cases, the metal content of the ore.

The import and export for each country, including for some materials not only the crude materials but also the principal derivatives and semi-manufactured materials, are given. Unfortunately, for some important materials detailed figures are not available for all countries in 1938. To take first iron-ore, the world's production in 1938 was 165,000,000 long tons, of which 21,520,000 tons were from the British Empire and 28,700,000 tons from the United States. The other large producers were France with 33,000,000 tons, the U.S.S.R. with 27,000,000 tons and Sweden with 13,700,000 tons. Germany, Austria, Czechoslovakia and Poland between them produced about 16,000,000 tons. Of the great producers only France, with 15,200,000 tons and Sweden with 12,500,000 tons, were great exporters, while of the importers Germany was far ahead of all other lands with 21,500,000 tons. The report does not indicate the sources of this huge import, but Sweden and France were the chief contributors. The United Kingdom imported only 5,100,000 tons of iron-ore: the rest was mainly home produced but a small quantity of pig iron was imported. In 1938 the United States led the world in steel production with 28,000,000 long tons, followed by Germany with 23,000,000 tons, the U.S.S.R. with 17,500,000 tons and the United Kingdom with 14,000,000 tons. With her imports of iron-ore and iron curtailed, the German steel figure must show a great reduction in current times.

Nickel is an essential constituent of certain kinds of steel. Of the total world production in 1938 over 84 per cent came from Canada, another 10 per cent from French New Caledonia, a few tons from the U.S.S.R. and none from Central Europe. The two greatest importers of nickel were the United Kingdom and Germany, the latter probably leading, though different figures disagree. These two countries between them took well over half the world's output. There is now no important source of nickel available to Germany. Chrome ore is more widely spread, but at least forty per cent of the world's output is in the Empire, with South Africa and Rhodesia producing most. Other considerable outputs are in Turkey, Greece, Yugoslavia, Cuba, the Philippine Islands and New Caledonia. Germany used to be the greatest importer of this ore in Europe, producing none herself. Manganese ore is widely found. The Empire has about thirty per cent of the total production and though Germany has none, the U.S.S.R. has a great production and in recent years exported much.

Molybdenum ores are mainly in the United States, but Norway has large resources. Tin and cobalt ores are now almost inaccessible to Germany. One third of the output of lead-ore is from the British Empire, but some is still accessible to Germany from her own lands, the U.S.S.R. and Yugoslavia. Bauxite for aluminium can be obtained from Hungary and Yugoslavia, but supplies will be short.

Tungsten ores are not found abundantly in the Empire outside Burma, nor are there any considerable amounts in Europe outside Portugal. For several years Germany has been a large importer. Copper is another important metal of which the Empire produces about a third of the world's output, and the United States, Chile and the U.S.S.R. much of the remainder. Germany, producing little, used to be a great importer and still has access to Yugoslav copper ore.

Lastly, the position in regard to mineral oil may be noted, without going into details of quality and by-products. In this mineral the Empire is poorly endowed. In 1938 the Empire produced less than three per cent of the world's crude petroleum, the only lands producing a notable amount being Trinidad, the Bahrein Islands and Burma, and none of these produced one per cent of the world's total. The largest producers were the United States with 60 per cent, the U.S.S.R. and Venezuela, each with about 10 per cent of the world's total. Other considerable but much lower producers were Iran (3·8 per cent), Netherlands East Indies (2·7 per cent) and Rumania (2·4 per cent). Outside Rumania there was no noteworthy production in Central Europe: the Polish and Czechoslovak output were quite inconsiderable. The U.S.S.R. was a great exporter, by sea, of petroleum and allied products, but this trade she shared with all the large producers as well as Rumania. Thus even if the United Kingdom has ample sources of mineral oil within reach, it can scarcely be said that Germany is deprived of possible sources of import. There are, of course, problems of transport that may modify the position.

* The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary 1936–38. Imperial Institute. (H.M. Stationery Office, 1939.) 7*s.* 6*d.* net.

FACSIMILE TRANSMISSION

AN instructive paper, by G. Herrick, describing the progress in the United States of facsimile transmission, that is, the transmission of the printed page, drawings, photographs, documents and original messages by radio or wire telegraphy, appears in the *Electrical Review* of January 19. Certain electrical problems, more commercial than technical, have yet to be solved, and further development makes it necessary to use the best type of paper for recording purposes. Recently when President Roosevelt went to Canadian waters on a fishing trip, on board the U.S. Cruiser *Tuscaloosa*, he received a total of about 50,000 words of news on a facsimile receiver in his office-cabin, while the ship's officers received the same news on a duplicate receiver in the vessel's office.

The information transmitted was gathered by Trans-Radio News, set in type by the Koppel Printing Co. in New York, and broadcast from Cartaret, N.J., by the Finch system of transmission over the regular 780 kc. used by the station WOR of the Mutual Broadcasting Co. The transmissions were received in the afternoon in the *Tuscaloosa*, which reached a maximum distance of 650 miles from the transmitter. As the ship returned and neared New York, the smaller transmitter at the Finch Telecommunications Laboratories in Broadway, New York, took over transmission. For the transmission, alternating current at 110 volts and 60 cycles was used to energize both the transmitter and receiver. One of the difficulties to be overcome in the development of facsimile transmission is the fact that the power stations in different States often vary in frequency.

At present three systems of facsimile transmission of printed material and pictures are being developed. The R.C.A. system is controlled by the Radio Corporation of America and uses what is called 'percussion' recording through varying electrical impulses, which record lines on any grade of paper through the medium of a carbon sheet. The drawback is that it operates at only about three feet an hour.

The system controlled by Finch Telecommunication Laboratories records on special paper that is basically black and coated with an 'eggshell' surface. Across this an electric stylus travels, being regulated by impulses received at standard radio frequencies, or over a telegraph or telephone wire. The stylus draws a hundred lines to the inch and, by oxidizing the surface coating to a greater or lesser degree, records a variety of shades from grey to black.

The system of J. V. L. Hogan, consulting engineer of New York, was used with interesting results at the Toronto Fair by the *Globe-Mail* of that city. This method also employs the stylus principle of recording. Instead of oxidizing a specially coated paper, a series of points that are in contact with specially sensitized paper in rolls delivers varying electrical impulses to the paper and develops the required type of picture as the paper unrolls in the receiver. This system is extremely clear and can record very minute details, such as a photograph of a lace tablecloth or type down to 6-point. All the three differing systems require the material to be transmitted to be placed on a revolving drum, so that it is scanned by a point of light with which is associated a photo-electric tube that reacts to the reflections of light from light and dark substances, varying the impulses sent out.

In the United States, development of this kind of transmission has been delayed by the public and technical interest taken in television. To-day, with television making satisfactory progress, facsimile transmission is being developed rapidly. What the public want is low-cost synchronizers which are both efficient and do not slow down transmission. Some of the synchronizers in use necessitate low speed. The transmissions to the *Tuscaloosa*, for example, were received at three feet an hour.

Photographs both by radio and wire are being sent across the Atlantic at the present time. As an indication of future possibilities, consider the dissemination of news from one city to another by transmitting entire printed pages with illustrations, which would be multiplied by photo-offset printing, and could be sold in the streets within two hours after being sent. This plan envisages the use of wired rather than wireless transmission; technicians engaged in facsimile development suggest that their experiments have indicated that wired facsimile may be less certain than wireless, except in certain sections.

Unlike the television receiver, facsimile apparatus can be built at low cost because it is comparatively simple. The cheapest television sets in the United States cost about £39, but it is believed that a standard facsimile receiver could be constructed to retail at £10.

The Finch organization has recently brought out mobile facsimile transmitters and receivers. Several police motor-cars in Bergen County, New Jersey, just across the Hudson River from New York City, have been equipped with facsimile two-way units that can send and receive alternately. A New York newspaper is experimenting with a motor-car into which is built transmitter, receiver and a dark room. It has a tiny writing space and typewriter for the news man.

The Finch Company has developed a method of utilizing any telephone; strangely enough, the method has been approved by the telephone company, which has rigorous rules against tampering with its lines or equipment. The unit is an inductive coupling and cable. With one end of the cable attached to the transmitting and receiving unit in the motor-car or special truck, the other end of the cable is carried from the kerb into the nearest public or other telephone. The user then calls the telephone operator and says, "Do not interrupt, this wire is being used for a facsimile transmission". The use is thereafter charged at the ordinary telephone rate. During the transmission of news and pictures in this way, it is not necessary to use the telephone, as the office of reception can transmit messages of instruction back to the truck transmitter by writing and having them scanned on its own transmitting drum.

Similar testing of facsimile is being done by the U.S. Army, and the Navy is understood to be increasingly interested in possible use of facsimile for intercommunication between naval ships and messages to and from bases.

PROPAGATION OF RADIO WAVES ALONG THE EARTH

THE mode of propagation of electric waves along the surface of the earth has been investigated theoretically since the earliest days of practical radio communication, and a paper by A. Sommerfeld published in 1909 has since become a classical treatise on this subject. After a period during which attention was mainly confined to the study of wave propagation through the ionosphere, the inception of broadcasting and the practical application of ultra-short waves have caused renewed interest in the problem of propagation along the ground.

Two papers having a direct bearing on this subject have recently been issued by the Institution of Electrical Engineers, and would, in normal circumstances, have been read before a meeting of the Wireless Section on January 3. The first, by Dr. J. S. McPetrie and Miss A. C. Stickland, is entitled "Reflection Curves and Propagation Characteristics of Radio Waves along the Earth's Surface"; it deals with the evaluation of the reflection coefficient of the earth's surface, and then with the application of this knowledge to the study of propagation along the earth. A collection of curves given in this and an earlier paper enables the reflection coefficient for radio waves of any frequency and state of polarization to be determined for any angle of incidence and for various values of electrical constants of the earth.

It is pointed out that the ray theory, on which the reflection from a surface is assumed to be equal to the radiation from an image of the transmitting aerial, is not applicable at grazing incidence unless the heights of the transmitting and receiving aerials are comparable with the wave-length. From an analysis given by K. A. Norton, however, it is deduced that, when the ray theory does not apply, the field at the receiver is equal in most practical cases to the vector addition of two fields; the first is the field given by the simple ray theory while the second, which is independent of the heights of transmitter and receiver, corresponds to the surface wave first postulated by Sommerfeld for vertically polarized waves. The ratio of the magnitudes of the surface wave to the image fields is much less for horizontally than for vertically polarized waves, so that the ray theory is applicable over a wider range of angle of incidence in the former case. As the surface wave is independent of height, this results in the well-known experimental fact that the vertical field from a low transmitting aerial increases in magnitude with height at a much smaller rate than the horizontally polarized field.

The second paper, by Dr. J. S. McPetrie and Mr. J. A. Saxton, describes the results of an experimental investigation of the characteristics within optical range of the propagation overland of radio waves of length 2 and 3 metres. Measurements of the field strength received at various distances from the transmitter confirm the theoretical deduction that, provided the heights of both transmitting and receiving aerials are comparable with the wave-length, the propagation at grazing incidence is the same for both horizontally and vertically polarized waves. In either case, the field strength is proportional to the product of the heights of the transmitter and receiver, and inversely proportional to the square of the distance between them. It was found that, within the optical range of the transmitter, the propagation characteristics corresponded to the condition of a plane rather than a spherical earth, although the varying contours of the path of transmission produced a marked effect on the received field strength. Over a town area, the ratio of the measured to the theoretical field strength was less on a wave-length of 2 metres than on 3 metres.

CAVE FAUNAS

THE specialized cave faunas of the world have been investigated extensively during the last fifty years, and to this prolific literature is now added the results of exploration in the numerous caves of Belgium. Dr. R. Leruth contributes "La Biologie du Domaine Souterrain et la Faune Cavernicole de la Belgique" (Mém. 87. Musée Royal d'histoire naturelle de Belgique, 1939), and in the same series, Mém. 88 by Dr. C. R. Boettger is entitled "Die Subterrane Molluskenfauna Belgiens".

The vast grottoes near Han-sur-Lesse furnished much of the material, although forty-eight subterranean regions were explored. The collections were submitted to specialists for identification. A general section deals with the ecological and geological conditions affecting the Belgian cave faunas, and Dr. Leruth classifies the inhabitants as permanent, temporary or accidental cave-dwellers. The first are completely adapted to their mode of life, the second can live either within or without underground areas, and the third are ill-adapted to cave life and are incapable of breeding there. There are also parasites and scavengers. The terrestrial fauna is poor in species, but the aquatic fauna is relatively rich. Of approximately six hundred species, one genus and sixteen species are new. Bats, mice and rats are the chief mammals, while badgers and foxes penetrate into the smaller caverns. Neither fishes nor amphibia are recorded. Among invertebrates, flatworms, roundworms and ringed worms, arthropods of all kinds and in large numbers, and some molluscs were found.

Dr. Boettger describes the collections of Dr. Leruth and Prof. Séverin. Pisidium is the only lamellibranch genus. Among prosobranchs there are several members of the Hydrobiidæ. Pulmonates are common, especially as the faunas of crevices and underground water channels are included. A blind land snail, *Caecilioides acicula*, and the freshwater prosobranch, *Avenionia bourguignati*, are true cave forms, the latter being a French species recorded for the first time in Belgium.

MINE RESCUE TELEPHONE

MR. R. C. WOODS, of the Ericsson Telephones, Ltd., London, communicates a description of a mine rescue telephone to the *Ericsson Review* of 1939 (No. 2). The Coal Mines Regulations require owners of mines, to which the regulations apply, to make definite provision for rescue work in mines after an explosion, fire or other accident. Telephone communication between the rescue brigade and its base is of great importance. Ericsson Telephones, Ltd., in collaboration with the Mines Department Testing Station, have constructed a mine rescue telephone which was officially tested last year, after which the production was immediately undertaken.

When a rescue corps is called to a mine, a base is immediately established in fresh air but as near as possible to the zone where the air is so foul as to be unbreathable. As the team of from eight to five men will be wearing breathing apparatus, speech is impracticable and communication has to be established by other means. Uniform codes of signals are prescribed, one for use between members of a brigade, for which each man carries a bulb hooter, and one for electric signalling. While the existing mine telephone system may provide for the telephone communication between the rescue corps and the base, it cannot be depended on and it would rarely prove convenient, speech not being practicable owing to the breathing apparatus, both of which are vital factors in such an apparatus, which only comes into use in severe conditions.

The mine rescue apparatus constructed by Ericsson's consists of two units, a base station and an advance station, connected continuously by a light but tough cable. In the constructional features of the design, particular attention has been paid to strength and low weight.

Signals in both directions are effected by a buzzer, using a special code. The note is distinct and penetrating, the high frequency avoiding any chance of confusion with other noises. In addition, the base party can speak to the advance party, both speech and signals being received on the loud-speaker at the advance station unit. After much consideration it was decided to limit to key signals only communications from the advanced party. If both-way speech were provided, the additional equipment would appreciably reduce the mobility of the advance party.

The base station unit is about 24 cm. square with a depth of 16 cm. On the front of it there is fitted a sensitive transmitter, a small loud-speaking receiver and a high-frequency buzzer. When the keys are in their normal position, the loud-speaking receiver is connected directly to the trailing cable and hence to the advance station unit. Any signal sent out by the advance party is thus immediately reproduced by this receiver. The batteries are of the ordinary cycle lamp type so that replacements are readily obtainable. Battery voltages are 6 and 3 volts respectively for the use of the base and advance party units.

Safe operation in dangerous atmospheres is a feature of this system. If during rescue operations it is desired to extend beyond the first cable length, a further advance party instrument can be connected by a simple plug and the circuit transferred from the first to the second unit.

SEVENTY YEARS AGO

NATURE, vol. 1, February 10, 1870

The Royal Commission on Science

"THE Council of the British Association for the Advancement of Science was received on Friday last by Earl de Grey, Lord President of the Council, as a deputation to urge on the Government the issuing of a Royal Commission to inquire into the state of Science in England.

"The main points for a Royal Commission to throw light upon are these. First, is it right that science should be aided by the State ? Secondly, is the aid now given exactly what is needed—neither too much nor too little ? Thirdly, the degree and direction in which science should become a State business having been settled, what will be the best organisation for the purpose ? Not one of these points has ever yet been thoroughly considered in England."

Microscopical Investigation of Meteorites

PROF. N. S. MASKELYNE, of the British Museum, provided a full abstract of his recent paper on this subject presented to the Royal Society. Transparent sections of small fragments cut from meteorites were studied under the microscope. They showed that "a meteorite has passed through changes and that it has had a history of which some of the facts are written in legible characters on the meteorite itself and, one finds, that it is not difficult roughly to classify meteorites according to the variety of their structure. One also recognises constantly recurring minerals ; but the method affords no means of determining what these are". The chief use of the microscope was as a means of sorting out the various minerals from "the bruised débris of a part of the meteorite", investigating each by the goniometer and by analysis, "and finally returning to the section to identify the actual minerals present".

The Work of the Sea

IN an article by C. W. Whitaker, M. Quenault is quoted as concluding, with regard to the depression of the land : "One gathers from all these evidences, that the movement, since the eighth century, has been about two metres a century. If it continues at the same rate for ten centuries more, the peninsula of Cotentin will be an island and all the ports of La Manche will be destroyed. Some centuries later and Paris will be a seaport, waiting only to be submerged in a score of centuries. Thus in a period, less than half as long as that during which the pyramids of Egypt have braved the ravages of time, Paris itself—if it is not burned down during one of the revolutions of its inhabitants, as amiable and *spiritual* as they are inconsistent—Paris will probably be engulphed in the Atlantic, a master before whom the intractable Parisian must haul down his flag. Let him take warning !"

WITH reference to the "situation" at the Paris Observatory [see NATURE of February 3, 1939, p. 198], the action "of the French Government has been of the promptest and M. Le Verrier is no longer Director. This step indicates very clearly—too clearly we fear—the strength of the case put before the Minister of Public Instruction. . . . The document was signed by Villarceau, Marié-Davy, Wolf and Loewy. . . .

It is to be sincerely hoped that M. Le Verrier may be able yet to do service to astronomy, in some other capacity, some position where his great talents alone will be called into play."

"A NEW office has been constituted under the Public Works Department and Mr. Douglas Galton, C.B., F.R.S., has been appointed to it with the title of Director of Works and Buildings. We may congratulate ourselves that our public building will be looked after by one so eminently qualified by his high scientific attainments and great experience in such matters."

M. Vérard de Sainte-Anne read a memoir before the Paris Academy of Sciences on a project for establishing communication between France and England. The author proposed the establishment of a railway bridge, either open or tubular, across the Straits of Dover.

APPOINTMENTS VACANT

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

COMMISSIONED ORDNANCE MECHANICAL ENGINEERS in the Indian Army Ordnance Corps—The Secretary, Military Department, India Office, Whitehall, S.W.1 (quoting 'O.M.E. Recruitment') (February 14).

DIRECTOR for the British Institute in Milan—The British Council, 3 Hanover Street, W.1 (quoting 'Milan') (February 15).

RESEARCH OFFICER for Bacteriological work—The Secretary, Agricultural Research Council, 6a Dean's Yard, Westminster, S.W.1 (March 31).

RADIO ENGINEERS by the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), War Office, Hobart House, Grosvenor Place, S.W.1.

MECHANICAL AND AUTOMOBILE ENGINEERS by the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), War Office, Hobart House, Grosvenor Place, S.W.1.

ENGINEER AND SHIP SURVEYOR for the Department of the Surveyor-General of Ships, Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9066).

TEMPORARY FORECASTERS, Grade II (Male), in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March 1939. Pp. viii+172+15 plates. (London : H.M. Stationery Office.) 3*s*. 6*d*. net. [221

Department of Scientific and Industrial Research : Water Pollution Research. Summary of Current Literature. Vol. 13, No. 1, January 1940, Abstracts Nos. 1–137. Pp. iv+36. (London : H.M. Stationery Office.) 2*s*. net. [241

University of Liverpool : Social Science Department, Statistics Division. The Economic Status of Coloured Families in the Port of Liverpool. Pp. 23. (Liverpool : University Press of Liverpool, Ltd.) 1*s*. net. [251

Medical Research Council. Special Report Series, No. 236 : Medical Uses of Radium ; Summary of Reports from Research Centres for 1938. Pp. 49. (London : H.M. Stationery Office.) 1*s*. net. [291

Ministry of Health. Memorandum on the Production of Artificial Immunity against Diphtheria. (Memo. 170 Med.) Revised edition. Pp. 8. (London : H.M. Stationery Office.) 1*d*. net. [291

Other Countries

Bernice P. Bishop Museum. Bulletin 142 : Marquesan Insects, 3. (Pacific Entomological Survey, Publication 8.) Pp. v+220. Bulletin 159 : Review of the Fauna of the Marquesas Islands and Discussion of its Origin. By A. M. Adamson. (Pacific Entomological Survey, Publication 10.) Pp. ii+94. Bulletin No. 163 : Archaeology of Mangareva and neighboring Atolls. By Kenneth P. Emory. Pp. 76+6 plates. Bulletin 164 : Report of the Director for 1938. By Peter H. Buck (Te Rangi Hiroa). Pp. 32. Index to Pacific Entomological Survey Publications. (Bulletins 98, 113, 114, 142.) Pp. 36. (Honolulu : Bernice P. Bishop Museum.) [231

Bernice P. Bishop Museum. Occasional Papers. Vol. 14, No. 14 : Fouling Organisms in Hawaii. By Charles Howard Edmondson and William Marcus Ingram. Pp. 251–300 (9 plates). Vol. 14, No. 15 : Revision of the Fijian *Ottistirini* (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 301–312. Vol. 14, No. 16 : A New Species of *Byttneria* from Mangareva. By E. D. Merrill. Pp. 313–316. Vol. 14, No. 17 : The Genus *Phanerostethus* in Fiji (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 317–322. Vol. 14, No. 18 : *Cypraeidae* from Makatea Island, Tuamotu Archipelago. By William M. Ingram. Pp. 323–326. Vol. 14, No. 19 : Endemic Hawaiian Cowries. By William M. Ingram. Pp. 327–334. Vol. 14, No. 20 : Preliminary Revision of the Fijian *Baridinae* (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 335–348. Vol. 14, No. 21 : *Santalum ellipticum*, a Restatement of Gaudichaud's Species. By Frank E. Egler. Pp. 349–358. Vol. 15, No. 1 : New Hawaiian Species of *Clermontia*, including a Revision of the *Clermontia grandiflora* Group. By Harold St. John. (Hawaiian Plant Studies, 6.) Pp. 20 (6 plates). Vol. 15, No. 2 : New Hawaiian *Lobeliaceae*. By Harold St. John. (Hawaiian Plant Studies, 7.) Pp. 21–36 (7 plates). Vol. 15, No. 3 : Notes on Polynesian Grasses. By F. R. Fosberg. Pp. 37–48. Vol. 15, No. 4 : Taxonomy of the Hawaiian Genus *Broussaisia* (Saxifragaceae). By F. Raymond Fosberg. Pp. 49–60. Vol. 15, No. 5 : Bees from the Caroline and Palau Islands and Yap (Hymenoptera, Apoidea). By T. D. A. Cockerell. Pp. 61–66. Vol. 15, No. 6 : Reports on Fossil Mollusca of Molokai and Maui. By Jens Mathias Ostergaard. Pp. 67–78. Vol. 15, No. 7 : New or Interesting Ferns from Micronesia, Fiji and Samoa. By E. B. Copeland. Pp. 79–92. Vol. 15, No. 8 : Supplement to the Manual of Hawaiian Mosses. By Edwin B. Bastram. Pp. 93–108. Vol. 15, No. 9 : The Genus *Ficus* in the Samoan Islands. By V. S. Summerhayes. Pp. 109–118. Vol. 15, No. 10 : *Diospyros ferrea* (Ebenaceae) in Hawaii. By F. R. Fosberg. Pp. 119–132. Vol. 15, No. 11 : Studies of the Pacific Bees in the Collection of Bishop Museum (Hymenoptera, Apoidea). By T. D. A. Cockerell. Pp. 133–140. Vol. 15, No. 12 : *Thysanoptera* collected by the Mangarevan Expedition. By Dudley Moulton. Pp. 141–148. Vol. 15, No. 13 : The Canoe Making Profession of Ancient Times. Translated by Mary Kawena Pukui, Edited and annotated by Kenneth P. Emory. Pp. 149–160. Vol. 15, No. 14 : A New Species of *Zoraptera* from Fiji. By Ashley Buell Gurney. Pp. 161–166. (Honolulu : Bernice P. Bishop Museum.) [231

Smithsonian Miscellaneous Collections. Vol. 98, No. 25 : List of the Fishes taken on the Presidential Cruise of 1938. By Waldo L. Schmitt and Leonard P. Schultz. (Publication 3551.) Pp. ii+10. (Washington, D.C. : Smithsonian Institution.) [231

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Division of Fish and Game of California : Bureau of Marine Fisheries. Fish Bulletin No. 54 : The Fishes of the Family *Sciaenidae* (Croakers) of California. By Tage Skogsberg. Pp. 62. Fish Bulletin No. 55 : Report on Returns of Drift Bottles released off Southern California, 1937. By Richard B. Tibby. Pp. 36. (Terminal Island, Calif. : State Fisheries Laboratory.) [241

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