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Electrical Interference with Broadcasting

ONE of the difficulties in ensuring the good reception of broadcast programmes is that many of the various electrical appliances and plant in common use emit radiation which travels to neighbouring radio receivers, and there produces a noisy disturbance mixed with the broadcasting programmes. Some three years ago, the Council of the Institution of Electrical Engineers set up a committee, representative of all sections of the electrical and radio industry, to study this problem, and to make recommendations as to the steps, if any, to be taken to secure the elimination or mitigation of electrical interference with radio reception. This committee, under the chairmanship of Mr. C. C. Paterson, has recently issued its report, copies of which are now available from the Institution of Electrical Engineers (price 6*d.* post paid).

Even before the formation of this committee, the Post Office had commenced the investigation of complaints of interference received from the general public. This work has been continued, and at the present time the appropriate staff deals with about 40,000 complaints a year. As a result of this activity, a considerable measure of radio interference correction has taken place by the voluntary application of the indicated remedies by the owners of the plant or apparatus concerned. The Post Office has no powers in this matter, however, and it has been found that in a small proportion of cases the owners of the offending apparatus refuse to do anything to remove the trouble.

The Committee has expressed the opinion that the desirable objective is defined by the statement that with the field strength of the wanted radio signal of 1 millivolt per metre, when the modulation is 80 per cent, the maximum permissible

interfering field strength should be 40 decibels below this value. With this objective in view, a method of measurement has been agreed upon, and instruments have been developed which are capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus creating trouble. Such apparatus comprises lifts, trolley-buses and trams, household electrical appliances, small electric motors, neon signs, rectifiers and electro-medical apparatus. While at the present time automobile and aircraft ignition systems produce no appreciable interference with broadcast reception on its present wave-lengths, it is possible that trouble may be expected from such systems if they remain uncorrected when television service begins.

During the work of the main committee, a considerable amount of investigation of the problem has been conducted by four sub-committees working in co-operation with the British Broadcasting Corporation, the Post Office, the British Electrical and Allied Industries Research Associations, the British Electrical and Allied Manufacturers Association and various supply authorities and transport undertakings. Also, in view of the necessity of catering for the interests of export trade, representation was obtained on a special international committee set up by the International Electrotechnical Commission in 1934. The British Standards Institution has also set up committees to draft various specifications for components, apparatus and measuring instruments, and these are now in course of publication.

As a result of all this work, the committee now considers it necessary to ensure that all electrical appliances should conform to these specifications and be sold as being free from interference. It

therefore suggests first, that the Electricity Commissioners should be given powers to draw up regulations in respect of any apparatus or plant, new and existing, which may cause interference with radio reception; and secondly, that the Post Office should be given powers to enforce these regulations. No special difficulty is seen in applying the regulations to new apparatus, and the cost of the mitigating devices is in most cases only a small percentage of that of the appliance. In the case of appliances already in use, the question of who is to meet the cost of suppression is considered to be a matter for the legislature to decide.

The report shows that a somewhat complicated subject has been explored in a very thorough and fruitful manner by the co-operative effort of representatives of all the parties concerned, and the conclusions reached and recommendations made will, in general, be regarded as very satisfactory. It will probably be some considerable time before legislation and regulations can be made effective, and in the meantime, the Institution of Electrical Engineers appeals to the general public to continue the goodwill on which the Post Office has been enabled to build up its very successful work in suppressing interference with broadcasting.

The Medical Curriculum

AT a meeting on May 29, the General Medical Council adopted certain resolutions in regard to professional education. These will come into operation on January 1, 1938, and include the following:

In the pre-registration requirements, it is laid down that every applicant for registration as a student by the Council or for admission to the medical curriculum proper should have passed (a), a recognised preliminary examination in general education as laid down in the Regulations of the Council; and, in addition (b), an examination or examinations conducted or recognized by one of the licensing bodies.

The subjects to be included under (b) are:

(1) One or two subjects of general education, other than chemistry, physics, or biology, at a standard higher than that of the preliminary examination, for those who have received their instruction in these subjects before entering universities, university colleges, or medical schools.

(2) Chemistry (theoretical and practical), the elementary principles of general and physical chemistry, and of the chemical combination of elements, including carbon.

(3) Physics (theoretical and practical), the elementary mechanics of solids and fluids, the elements of heat, light, sound, electricity and magnetism.

The examination in biology (theoretical and practical) may be taken either before or after registration as a student.

It will be remembered that about a year ago a conference of representatives nominated by the

Universities of Oxford, Cambridge and London; the Royal College of Physicians of London; the Royal College of Surgeons of England and the Society of Apothecaries of London published a report on the medical curriculum (see NATURE, July 20, 1935, p. 90, and Nov. 2, p. 706). The report stressed the need for a continuance of the general education of intending medical students of post-School Certificate stage, and therefore recommended that "the Licensing Bodies consider the possibility of allowing and encouraging exemption from the 1st M.B. examination by means of a Higher School Certificate Examination conducted by any recognised Examining Body in which, in addition to the three principal scientific subjects, a subsidiary non-scientific subject be taken".

The Higher School Certificate Examination is the normal objective of the post-School Certificate student in public and secondary schools, and if the licensing bodies would recognize for the purpose of exemption from the second examination stated in pre-registration requirements those subjects in which a student has passed a Higher School Certificate Examination (chemistry, physics, biology to 'Group' standard and non-scientific subjects to 'Subsidiary' standard), they will impart to the Higher School Certificate examination a value which has been questioned in the past by so many intending medical students. The recognition would also lead to greater uniformity in the education of post-School Certificate students in the schools, and would go a long way towards removing the evil of segregation of intending medical students from the rest of the school.

Teaching Elementary Physics

(1) College Physics

By Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys. Pp. xi+592. (Boston, New York, Chicago and London: D. C. Heath and Co., 1935.) 3.76 dollars.

(2) A Complete Physics written for London Medical Students and General Use

By W. H. White. Pp. vii+848. (London: Richard Clay and Sons, Ltd., n.d.) 15s.

(3) Experimental Electricity

By M. M. Das. Pp. xvi+334. (London: English Universities Press, Ltd., 1935.) 4s. 6d.

(4) Light and Sound

By H. G. Lambert and P. E. Andrews. (Elementary Science Series.) Pp. vii+183. (London: University Tutorial Press, Ltd., 1935.) 2s. 3d.

(5) School Certificate Examples in Physics

By Dr. W. G. Davies. Pp. vii+176. (London: Edward Arnold and Co., 1935.) 2s. 6d.

(6) Laboratory Manual in Physics

By Prof. A. A. Knowlton and Prof. Marcus O'Day. Second edition. Pp. xi+137. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 7s. 6d. net.

(7) Praktische Physik:

zum Gebrauch für Unterricht, Forschung und Technik. Von F. Kohlrausch. Siebzehnte vollständig neu bearbeitete Auflage. Herausgegeben von F. Henning. Pp. x+958. (Leipzig und Berlin: B. G. Teubner, 1935.) 32 gold marks (inland); 24 gold marks (abroad).

THE present system of examinations has recently been subjected to much adverse criticism, and the possibility that good may have arisen from the system seems rarely to be considered. This system in general has led to systematic teaching, and the results of this are clear in the present standard of training in elementary physics compared with that of twenty years ago. Physics was then in many schools rather a neglected subject, whereas there is now a reasonably high general level of attainment. Of course, it is always possible to sacrifice the teaching so that passing an examination becomes its main purpose; but the examination can scarcely be held wholly responsible for this evil.

The need for systematic teaching has in turn produced the need for suitable text-books, and while most of these keep an eye on some examination, they generally contribute something to the advancement of the subject. A general need has

been created for the production of books of an elementary nature calculated to help beginners in the subject. The frequent publication of new books and fresh editions indicates a lively interest in teaching the subject. The variety shown in their methods of treatment assures us that the subject will not become too standardised in character, each teacher bringing some fresh ideas to the subject as the result of his own enthusiasm. No one but an enthusiast who has at least a few new ideas to communicate is likely to embark upon the task of writing a text-book of physics. Thus each of the books now considered should in its own way add something to the teaching of the subject, and particularly to the originality of the treatment.

(1) "College Physics" by Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys provides an introductory course in the subject, and its most striking feature is the logical and clear development of physical ideas throughout the work. It is surprising how much ground is safely covered in a book which is not unduly bulky. The authors rightly recognise that there can be no real distinction between 'classical' and 'modern' physics, and do not hesitate to introduce new ideas which take their place naturally with the rest. The effort which the authors have made to show that many of the basic ideas of modern theory are not essentially more difficult to follow than those of the older physics has certainly been worth while. There are interesting chapters on the constitution of matter, vibrations and waves, radio, photoelectricity, radioactivity and atomic structure, and the whole is written from a modern point of view. The readable section on thermodynamics includes an account of steam and internal combustion engines and refrigerating machines.

To cover so much ground in one book has meant the careful pruning of unessential material. The result is that the book is very pleasant and interesting to read because the development of important ideas is always kept in mind. Many students who have taken more advanced courses in physics would do well to read and master this fundamentally simple account, so as to obtain a connected view of the subject. Although it is the work of three authors, the outlook and method of treatment are very uniform. The book is attractively printed with many valuable diagrams.

This book, which tells what physics is about, is easier and more interesting to read than many popular works on the subject, so that the general reader could profit from its perusal. There seems

little doubt that it will obtain a well-deserved success.

(2) "The Complete Physics" by Mr. W. H. White is essentially different in character, and has been written chiefly for the use of London medical students, frequent references being made to their examination requirements. The book covers the usual ground of an elementary text, but the many references to practical applications have been chosen to be of special interest and of value to the one class of students. Although it has clearly been written for examination purposes, nothing could be less like a typical 'exam' book on the subject. Any student who passes his examination under its friendly guidance will deserve his success. The author has tried to recapture something of the attractions of the old natural philosophy and many interesting applications show that he brings this attitude to bear on the whole subject. It is written with the unconcealed enthusiasm of an experienced teacher with a fresh and youthful outlook. The writing is in a frank and conversational style unusual in scientific text-books, and this may prove rather bewildering to the weaker students who are seeking to obtain the simple essentials of the subject. It seems likely that the book will serve those best who have already a fair elementary knowledge of physics, and it should be invaluable in enabling such students to apply their knowledge to medical purposes. Every teacher of medical students should read the book, as he cannot fail to extract much new matter from it. It brings an attitude to the subject differing greatly from that generally produced by examination requirements.

Many of the references are of a recent character and the book deals adequately with the modern developments of the subject. The author clearly recognises the dangers of his style and at the end says "maybe I have told you twice too much". Maybe he has, but much of the material is of an unusual character which cannot easily be found elsewhere. This unusual book ends with a photograph of the author at the end of the last chapter. It is a fitting way of ending a work essentially personal in character, the writing of which has clearly been a labour of love.

(3) The work of Mr. M. M. Das is suitable for students in technical colleges and secondary schools. The author makes it clear that the book has not been written with the sole object of enabling students to pass examinations; but the matter is intended to be adequate for matriculation, professional entrance, and most technical college examinations. If the book is read with the help of a teacher who will stress the fundamental principles, it should serve to excite the curiosity of the student and create enthusiasm by the variety of the practical applications of the subject. Thus

there are notes on the manufacture and heat treatment of iron and steel, interesting chapters on electromagnets with practical applications, on electrolysis and its applications, and on the use and care of electrical apparatus.

It seems a pity even in an elementary book to express the units of resistivity in "ohm per cm. cube", after it has been correctly defined; but no doubt the author will think fit to change this in a later edition. The book contains rather more technical information than is generally required in a secondary school, but this would probably cause it to have added interest to many boys.

(4) The book on "Light and Sound" by Mr. H. G. Lambert and Mr. P. E. Andrews is intended as a first course for the lower science forms of public and secondary schools, and for those preparing for the general science examination of the School Certificate. It deals with the theoretical principles, and gives a series of experiments which might be performed. This suggests that it is intended for the book to be worked through systematically by both teacher and pupils. Whether any experienced teacher would be willing to submit to such restrictions in his methods is very doubtful. At such an early stage, it is inevitable that pupils will be more interested in practical cases and applications of the subject rather than in the logical presentation of general principles. If it is necessary for the pupil at this stage to have a text-book giving a clear and concise account of the subject, then this book meets the case admirably. But are such text-books really required? The excellent and interesting scientific information now available in children's magazines seems to offer greater attractions.

As a means of summarizing and revising what has already been taught, this book would serve a very useful purpose. It would also be of value for a young teacher who is mapping out such a course of elementary lessons.

(5) Dr. W. G. Davies's book contains more than nine hundred examples including both numerical and descriptive exercises of the type usually set in School Certificate examinations. No one will question the value of numerical exercises even in the elementary branches of the subject. Experience shows that the candidate who can work out such examples correctly has a firm grasp of the subject. The experienced teacher will generally have a set of suitable exercises with which to illustrate and drive home the principles of the subject, but this book cannot fail to provide some new ideas.

Some of the questions are in the form of exercises on laboratory work, which may assist in avoiding the common fault of the student who knows all about the experimental details while failing to understand the underlying purpose. Of course,

if such exercises are used instead of laboratory measurements they would constitute an evil which is certainly not contemplated by Dr. Davies.

There is doubt as to what extent such a book of examples should be left in the hands of the student. Care will be required in the selection of examples by the teacher, and no student will be subjected to the lifeless drudgery of working through the whole book. Many text-books do not give suitable examples so that this book of exercises, many of which are of considerable physical interest, cannot fail with proper care to be of real service.

(6) The "Laboratory Manual in Physics" by Prof. A. A. Knowlton and Prof. Marcus O'Day provides a series of experiments suitable for a first-year university course. Every laboratory tends to have its own rather specialized apparatus which has gradually grown up with it. This constitutes a difficulty when considering the general adoption of any text-book of practical physics. The extent to which such a book would be useful to the student depends upon how far the available apparatus corresponds to that actually described. The book, however, would be of considerable assistance to any teacher arranging an elementary course.

The authors have aimed at producing more than a mere collection of experiments. They have tried to give a selection of exercises covering the

more important concepts, and rightly stress the ideas involved, more than the manipulative details of the exercises.

The book covers all the ordinary branches of physics, including exercises on the balance and on electrostatics which are frequently omitted. It is well produced and pleasant to read.

(7) The publication of the seventeenth edition of Kohlrausch's "Practical Physics" is a matter of importance. The general editor, Dr. F. Henning, and his numerous collaborators have produced a new and thoroughly revised work. This book is different in character from those which we have been considering, as it can scarcely be said to deal with elementary physics. It is suitable for advanced students, and as a general reference book for those engaged upon research in either pure or technical physics. In addition to the detailed descriptions of certain experiments, it contains valuable general summaries of experimental methods and numerous recent references to original papers. Such references would be of the greatest help to those beginning a new line of investigation. The book opens with a general introduction on units and measurement, and then deals with mechanics and sound, heat, optics, electricity and magnetism, corpuscles and energy quanta, and concludes with a reasonably comprehensive series of tables. There seems no doubt that this edition will be as successful as its predecessors. T. L. I.

Mycoses of Man and other Mammals

Medical Mycology:

Fungous Diseases of Men and other Mammals. By Prof. Carroll William Dodge. Pp. 900. (London: Henry Kimpton, 1936.) 42s. net.

IN this work, for which Prof. C. W. Dodge is to be congratulated, the dermatologist will find a mine of information on the technical mycological details of the causative organisms which underlie that immense number of diseases of the skin and other regions of the body grouped under the generic term 'mycoses'. These are subdivided into sub-groups, such as the dermato-mycoses, etc.

In the opening chapter, the author gives a good description of the different elements which comprise the several types of fungi. In dealing with the physiology of fungi, the importance of the hydrogen ion concentration of the media and the action of buffers is stressed. The discussion of the exact meaning of both these terms, somewhat baffling to the average medical man, is clear and understandable.

The author takes a wide view of the different species described under the various genera. He indicates that many of the former may eventually be proved to be synonymous: nevertheless, the worker in mycology is given the benefit of all the published views of many authors to guide him in his studies without obtruding the author's personal views to the exclusion of the general knowledge of the subject.

Another prominent feature of this book is the extensive bibliography given after each section, which is particularly useful in following up research on an individual organism.

The reviewer is struck by the clear unbiased discussions concerning each type of infection: a good example is the preliminary dissertation on malassezia. After a general résumé of the accepted facts of distribution of lesions, embryology, age and sex incidence, etc., the author shows how the different varieties of malassezia attack the sebaceous glands, and exposes many fallacious

schisms perpetrated by some of the less recent authors, who did not realise the importance of fungi in so many of the diseases under review. This is followed by the reference to some 1,375 articles bearing on the subject—a truly comprehensive and international bibliography.

Another section of the work of particular interest to the dermatologist is that on the Trichophytoneæ. The different clinical types are described with methods of prophylaxis. Many cultural methods are given to suit the various types of specimen and organism, and the therapeutical agents in common use are enumerated from two points of view: first, the drugs used by dermatologists in practice, and secondly the result of many inhibitant substances used *in vitro* in laboratories. These do not coincide, because of the differences of the conditions *in vivo* from those obtaining *in vitro*. This is attributed largely to differences in the pH value of the horny layer of the skin to which the lesions are confined, temperature of this layer and of the media, and the

oxygen pressure present. The Trichophytoneæ are frequently carried in the blood stream, but do not develop in tissues other than the horny layer of the skin. The experiments proving this contention are well described, as are the allergic phenomena in infections with the Trichophytoneæ.

Aspergillaceæ and Actinomyceteæ are dealt with in the same complete and thorough manner.

In the reviewer's opinion, this work is a very important contribution in which an immense amount of the relevant bibliography is quoted and collected in its appropriate place to assist the student and research worker, and further it epitomizes the available modern knowledge of the subject. Apart from the botanic interest and classification, the ever-increasing appreciation of the medical profession of the importance and frequency of the incidence of these fungous infections in the human subject demands that every dermatologist should read this valuable book.

C. CRAWFORD-JONES.

Society and the Institution of Marriage

The Future of Marriage in Western Civilization

By Dr. Edward Westermarck. Pp. xiv + 281. (London: Macmillan and Co., Ltd., 1936.) 12s. 6d. net.

PROF. WESTERMARCK has applied his world-wide knowledge of the institution of marriage and his life-long experience in analysing its various forms and manifestations to the practical question of the present position and the future of marriage in modern Western civilization—a question indeed which has been much discussed of late years, but at present, momentarily perhaps, seems less insistent. He examines the question here from all sides. Its defects, real or alleged, and the suggested remedies are taken seriatim and discussed with a broad-minded tolerance befitting the impartial attitude of the man of science and the philosopher. This is a point which it is not otiose to make, as Prof. Westermarck has been accused by some of his critics of a bias which makes the monogamous marriage the touchstone of his conclusions as the ultimate and highest development of the institution—in other words, that his arguments have an ethical rather than a scientific background.

History, we are often told, repeats itself. It is interesting to note that whatever the problem under consideration, whatever the remedy which has been tried or is being discussed, Prof. Wester-

marck has an apposite parallel to cite from the vast store of his knowledge of primitive, barbarian or extra-European culture and from all time. Yet with all this wealth of detail at his command, no mechanical citation of parallels, as he explains in summing up his thesis, has been allowed to offer a speciously facile solution of the problem. He probes more deeply, seeking the underlying causes, that is, the emotional urges which, persistent and perennial, have moulded and will continue to mould the union of the sexes in their chief function, that is, the continuance of the species.

In other words, Prof. Westermarck believes the continued existence of the monogamous marriage as an institution, whatever subsidiary relaxations may be admitted for more aberrant or special needs, is assured as the permanent, and in the long run predominant, form of union. This depends mainly, if not completely, upon its function as the bond of the family, into which children are born and in which they are reared—this only, however, while there is no change in the fundamental urges of human nature as they have existed and persisted up to the present day.

To some it may seem that this conclusion begs the question and leaves the problem unresolved. To Prof. Westermarck, with his world-wide outlook, however, present discontents are but as transient ripples on the pool.

Foundations of Physics

By Prof. R. B. Lindsay and Prof. H. Margenau. Pp. xiv+537. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22s. 6d. net.

THERE is a type of theoretical physics which consists in the mechanical use of mathematical apparatus; it is to be met with at all stages. The intermediate student develops a fatal facility in the handling of $1/v + 1/u = 1/f$, knowing little and caring less about the physics that is involved. Later, his theoretical physics is summed up in certain differential equations of the second order and, arrived at the boundaries of his subject, we may see him later still employing the most recent technique in matrix theory and in vector algebra, finding in this technique an instrument for saving, rather than for stimulating, thought.

The authors of this most valuable volume by no means despise mathematical aids, but mathematics is always the servant, and there is no danger of losing the physical argument in a maze of mechanically handled mathematical symbols. The book is a real study of the foundations of physics, and whether the authors are engaged in the exposition of the bases of classical mechanics, or in explaining the statistical point of view, the electron theory and special relativity, or the latest developments in quantum mechanics, they are clear, critical and stimulating.

It is not too much to say that the book is one of the best attempts that have yet been made to survey the foundations of modern physics in a manner at once thorough and yet not over-detailed. It may be unreservedly commended to the notice of students in the honours schools of physical science. A. F.

Logic in Theory and Practice

By Prof. C. G. Shaw. Pp. xvii+428. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 8s. 6d. net.

AN additional text-book of logic will not necessarily improve the "low ranking in popularity" of that subject. Yet, Prof. Shaw has written one with the object of trying to make logic "as vital and interesting as its frigid forms will permit". It is difficult to say whether the author has succeeded in this undertaking, as the response has to come from the student rather than from the teacher. But in so far as the latter is concerned, he will find little in this new book to justify its substitution for other similar works. A point in its favour is the fact that the author tries to be more human in his exposition of the traditional theories: his treatment of the logic of judgment and of the hypothetical syllogism are good illustrations of this characteristic. But on the other hand, there are many points of scientific method which he has deliberately overlooked, though they have their place in the scheme of the inductive process. The additional chapters of the theory of knowledge are not at all out of process, though they raise more problems than they can attempt to solve. The writing and the production of the book show, nevertheless, that logic still has a good following and that it deserves a still greater one. T. G.

Das Grosse Moos im westschweizerischen Seelande und die Geschichte seiner Entstehung

Von Werner Lüdi. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 11.) Pp. 344+13 plates. (Bern: Hans Huber, 1935.) 19.80 francs.

"DAS GROSSE MOOS" is the name of the extensive plain lying between the lakes of Neuenburg (Neuchâtel), Bieler (Bienne) and Murten (Morat) in western Switzerland at the foot of the Jura range. The area has been subjected to considerable floodings, to remedy which artificial drainage on a considerable scale has been undertaken and has led to the lowering of the water-level in all the lakes and an increase in cultivated land. The volume under notice includes a very full account of the existing ecology and of the history of the area.

By a combination of methods, it is shown that there have been considerable fluctuations in water-level in the lakes, and the surrounding area, during post-glacial times. These fluctuations have been mapped mainly by the construction of pollen-diagrams, based on the examination of samples from the peat deposits, and on the correlation of the variations in pollen content with archaeological and geological evidence and comparison with similar results obtained in other parts of Europe.

The work is essentially a very careful and detailed account of the influence of post-glacial climatic changes, working especially through erosion, and of man, on the topography and vegetation of a limited area in Central Europe. As such it is a valuable contribution to the accumulating knowledge of the history of European plant-life. W. B. T.

A Documentary History of Primitivism and Related Ideas

Vol. 1: Primitivism and Related Ideas in Antiquity. By Arthur O. Lovejoy and George Boas: with Supplementary Essays by W. F. Albright and P. E. Dumont. Pp. xv+482. (Baltimore: The Johns Hopkins Press; London: Oxford University Press, 1935.) 22s. 6d. net.

THIS imposing undertaking, of which the first volume is under review, proposes to give direct evidence of the views held throughout Western civilization on primitivism and related ideas. Its chief interest lies in the compilation and classification of the various quotations selected by the authors; so that it is really with a source book about the conceptions of Nature as shown through the ages that we are concerned. This first volume deals with the Greek and Roman authors, of which it gives several and large extracts. Though there is little to say about the extracts themselves, it may be pointed out that half of the labour done is of little value, for each extract is followed by a translation. The latter alone would have been sufficient.

The publication of the book, which is bound to have a limited appeal, is, however, symptomatic. For it gives an encouraging background to the advanced views about the individual and society, which are held and defended in some quarters.

The Progress of Man*

THE necessity of considering a number of controversial topics can be avoided by omitting to define the term progress, but it is generally agreed that progress, like degeneration, involves change, and while progress leads upward from a starting point, degeneration takes a downward course.

The material needs and aims of man claim first attention of a technologist. They may be grouped in a relatively small number of 'types of satisfactions'. Each of these has acquired in course of time a greater and greater variety, and a more and more involved technique of means of fulfilment, comprised in part of methods and natural materials, in part of artefacts, in varied combinations. We do not perhaps estimate the level of a culture by the nature and multiplicity of its aims; but it must be recognized that progress has depended on proliferation of aims, as much as on the multiplication of means. It might gratify our self-esteem if we could think that man's progress was determined by persistence in his aims; but this is only true of civilized communities, in which directional investigation has transformed the quest of means by inflation of the aims.

Much importance must be attached to man's attitude towards the possibility of progress in a general sense; and it is necessary to emphasize the fact that the idea is not inherent in the human mind. It is a conception of future possibilities, developed from the study of past actualities, and adopted as a framework of modern thought. We are justified in assuming that, to the early discoverers and inventors, the general idea of progress was lacking. It may be justifiably asked, however, whether the lack of a general idea of progress must be fatal to progressive steps in human culture. Since man had made great material advances long before the idea was formulated, it is clear that these were not due to perseverance in an aim that he had set before himself. As in so many spheres of human thought, theory followed practice.

That the natural environment plays an influential part in the early stages of cultural progress is obvious enough. Only in proportion as the natural environment is swamped by the artificial, does man acquire a freedom which enables him to overcome the limitations of his habitat. His success in this direction has at various periods resulted in a cultural momentum,

which has taken him far from his starting point. In spite of the fact that the achievement of a high material equipment, and even a domineering empire, has often been succeeded by a crash, there has always been a continuity in many cultural elements, upon which further progress could be based. The cultivation of plants, the domestication of animals, the working of iron, and much else, once learnt, have never been forgotten, and there has, therefore, been a fluctuating continuity in human progress. But although there has been this continuity in important elements of culture, there are many instances in which its absence is conspicuous. There have been numerous false starts, numerous blind ends in human progress.

Observation and applied discoveries arise out of the opportunism that takes advantage of the accident which reveals a possibility. Here we must postulate a limited amount of foresight, leading to an adaptation or combination of known processes and methods to produce a new result. But it is the habit of the discoverer and inventor to proceed along any line that gives immediate results, and he is unable to choose the route of greatest promise. The human mind has seemed to wander without guidance—though usually in the end arriving somewhere—amongst the many possibilities of discovery and invention, striking into paths that ended blindly, returning to an old starting point, creating spurious needs and multiplying superfluities, and, in general, moving forwards, backwards, or sideways in or out of control, without knowing what its destination might turn out to be.

If material progress has been of this nature, it is clear that social progress, whether in the higher or the lower grades of culture, has had no better guidance. The customs and laws of human communities are the objective, though immaterial, products of the human mind, reacting through the ages to the stresses and strains of the environment, natural and artificial. They are comparable with the more substantial products of discovery and invention. In both, there has been an evolution, which has trespassed far beyond the biological necessities, and we are entitled to inquire whether the mind of man has been moulded in response to, and in correlation with, the exuberance of his egoistic culture. It is often said that "human nature doesn't change". Does it, or doesn't it? If it does not, can it?

The conception of the nature of human progress, here set forth, makes no allowance for an expansion

* Substance of the presidential address entitled "Concerning Human Progress" delivered by Dr. H. S. Harrison before the Royal Anthropological Institute on June 30.

of man's inherited capacity for taking pains successfully. The assumption has been made that ancient man and modern man are on the average essentially alike in potential brain-power. It might seem that the remarkable control over natural materials and forces, with the resulting creation of miracles of mechanism, is evidence that modern civilized man must be born with faculties of a higher order than those of the early representatives of *Homo sapiens*. But most of our 'miracles' are the products of the last few hundred years, and the more spectacular have emerged within the present century. In the time of Queen Elizabeth, the civilization of Europe could boast of little that was much beyond the material achievements of the old civilizations of the Near East. It can scarcely be asserted that the brain of a modern Englishman is of better quality than that of an Elizabethan. Since early times, there have been no processes of artificial selection, no eugenic measures, that can have aided in fostering types with better brains. If anything, the methods of civilization often appear to have the opposite result.

The earliest and first type of *Homo sapiens* to appear on the spade of the archaeologist is Aurignacian man, and the proposition may be argued that his physical likeness to ourselves was not accompanied by any innate and fundamental dissimilarity in brain-power. In the evolution of his material culture, man still relies upon the faculties that served his prehistoric ancestors, and if we feel less confident in making the same assumption as regards his innate moral and intellectual qualities, we need only look upon the stage of large parts of Europe and Africa to-day to realize that the experience and wisdom of millennia have failed to establish the brotherhood of man on a reciprocal basis.

If modern man, as compared with ancient man, has undergone a change of heart and mind, we are entitled to inquire by what biological compulsion this has come about. Since the human mind has determined human progress, we must consider whether those factors which are believed by some biologists to have been active in organic evolution in general can have been working on the human brain during the time that has elapsed since *Homo sapiens* first and finally became the man of modern type.

Of the various factors which have been suggested as responsible for the production of the highest type of tailless ape, natural selection, orthogenesis and use-inheritance alone concern us, as it is directional factors we seek. Yet of these it can be shown that, however much modern man may owe to natural selection for his neanthropic characters, since the directions in which it may have acted as regards man's intellectual and moral qualities are those determined by his arti-

cial social conditions, the selection can scarcely be regarded as natural. We may admit that intra-communal selection, even in civilized societies, may foster the development of some qualities at the expense of others; but it is not evident that these qualities are such as can play a part in piloting man's progress along successful lines.

In like manner, if the increase in the size of the brain of mammals were due to an inexplicable momentum, which is imperfectly explained as orthogenesis—an inner urge towards a pre-determined end—we cannot assume that the process has led, or will lead, to the production of human minds capable of distinguishing the side-tracks of moral and social progress from the highways. We cannot credit orthogenesis with the power of directing the social organism to a pre-determined and desirable end.

Lastly, the factor which, if it could be shown to have been effective, would explain much of the past, and would open up a prospect for the future, namely, use-inheritance, is so strongly repudiated by most biologists that it can only have a speculative value. This is unfortunate, as an easy way to explain the origin of the modern type of man would be by acceptance of the view that both brain and hand were guided to the climax of their neanthropic powers by the summation of inherited ability, increasing through the generations. But if we accept the biological repudiation of this theory, it cannot be applied to man. In any event, we must be prepared to admit that in size and general structure the brain of man appears to have been at a standstill since early neanthropic times.

By way of provisional conclusion, it would seem that the progress of man of the species *Homo sapiens* cannot be regarded as resulting from a correlated and progressive change of heart and mind. What he was, he is, and what he is, he will be. As an opportunist, born and bred, he will go on building and re-building an environment for himself, the specifications for which are but little in advance of the construction. He knows what he is doing to-day, but to-morrow is out of sight. The mind of man has little sense of direction, and if it may be said to have an ultimate aim, that aim is too obscure for formulation. In the course of ages, man has coerced many of the forces and products of Nature to his will, but this has been a simple task compared with that upon which he is now more and more insistently engaged—the task of reconciling the fundamental weakness of his mind, and especially his power of foresight, with the social and material complexities in which he has involved himself. His hope is in himself, and not in any speculative prospect of a mental transmutation.

Low Temperatures and their Industrial Uses

IN connexion with the Very Low Temperatures Exhibition held recently at the Science Museum in South Kensington, a series of lectures was arranged, dealing both with the production of low temperatures, and with the services which low temperature work renders to technology and to pure science.

Several of the lecturers referred to the history of the successive reduction of the various gases to the liquid state, from the time when Faraday classified as 'permanent' those gases which failed to respond to his technique, up to the liquefaction of helium by Kamerlingh Onnes in 1908. Faraday's method was to compress the gas until it liquefied. Two different processes have since been used in the attainment of still lower temperatures. Both were invented in 1877, in which year they were applied to reduce oxygen to the liquid state. One process, due to Cailletet, uses the work done during expansion to liquefy the gas, whilst the other, originated by Pictet, depends on the Joule-Kelvin effect. Cailletet's method was used by Wroblewski and Olszewski in 1885 for the liquefaction of hydrogen, and was developed commercially by Claude for the production of liquid air. It has recently been modified by Simon for hydrogen and by Kapitza for helium. The alternative method, that of the Joule-Thomson effect, was used by Linde and by Hampson for the large-scale production of liquid air, by Dewar about 1896 for liquefying hydrogen in quantity and by Onnes for the liquefaction of helium, which occurs just above 4° K.

The attainment of temperatures below 1° K., that is, the passage to temperatures below that at which helium has a reasonable vapour pressure, is a very recent achievement, although the magnetic process which has since proved successful was suggested so long ago as 1923. In dealing with this subject, Dr. F. Simon pointed out that the conception of entropy as a measure of orderliness gives a simple physical explanation of the new magnetic technique, which has enabled experimenters to reach temperatures of the order of 0.01° K., and is available down to 0.001° K. Beyond this, there will be the possibility of using the nuclear paramagnetism—the magnetism due to the spin of the nuclei of atoms—and even this will not enable us to reach absolute zero. This, like the mathematician's infinity, cannot be attained, but can be approached as nearly as may be desired; in fact, as Dr. Simon pointed out, so long as there remain properties which vary with

temperature, so long can we continue to use those same properties to reach lower temperatures.

In the domain of very low temperatures, where the vapour pressures of all known materials are quite negligible, the problem of insulating the cooled solid scarcely exists. There is no gas in which conduction or convection can occur, and radiation at these temperatures is extremely slight. So good, in fact, is the insulation, that the difficulty in the early experiments was to cool other bodies by contact with the paramagnetic salt which was used as 'refrigerant'. This is now overcome by making a pellet in which the substance to be cooled is in intimate contact with the cooling medium.

Turning now to the contributions which low temperature research has made, and is still making, to pure science, we must not overlook the fact that its contributions to industry are also contributions to pure science, for any material which is put cheaply on the market may be of value to the academic research worker.

In a more direct way, low temperature investigations are of value to the worker in pure science, in that they permit him to study the properties of matter under the condition where the heat motion of the atoms or molecules is reduced to a minimum, and where consequently these motions offer less of a masking effect to the actual inter-atomic forces. It is thus natural that low temperature work is more closely associated with atomic than with macroscopic physics. The phenomenon of superconductivity is the example, *par excellence*, of the unexpected results attained in this field. It is now familiar knowledge that at sufficiently low temperatures, most metals lose their electrical resistance, but lately the subject has been pursued in more detail, and it has been found that the resistance is restored if a sufficient magnetic field is applied to the sample. The field necessary for the restoration increases as the temperature is lowered. This effect has, as a matter of fact, received no satisfactory explanation yet. Another case in which low temperature studies led to an advance in pure science was the discovery of krypton and xenon. This was described by Prof. M. W. Travers, who was present when Ramsay first fractionated liquid air and discovered them in it.

Prof. F. A. Lindemann, whose lecture dealt in the main with the theoretical aspects of low temperature research, pointed out that "low temperature" simply means "a temperature at

which the atoms on the average contain very few quanta". It is thus in a sense accidental that the temperatures which we ordinarily think of as very low are so classified. For material in which the natural forces were of a different order, the sizes of the quanta would be different, and so the low temperature region might have been much higher or lower.

Prof. Lindemann also emphasized another important use of low temperature research. Nernst's theorem, or the third law of thermodynamics, states that entropy (that is, disorderliness, or probability of a state) decreases to zero as the temperature approaches the absolute zero of temperature. This gives us, what classical thermodynamics regarded as impossible, an absolute measure of entropy, as opposed to the measurement merely of entropy differences. Now to measure absolute entropy (from which reaction constants in chemical reactions occurring at ordinary or high temperatures can be calculated), we require measurements of the specific heats of materials right down to the point where these vanish, and hence must be able to carry out measurements at extremely low temperatures.

Since these results can be applied to such reactions as the synthetic production of ammonia and the hydrogenation of coal, they clearly impinge on the third heading under which the subject falls to be considered, namely, the practical or technological applications of low temperature research. Thus, the gases in the familiar street signs owe their commercial production to low temperature studies, and even the relatively common gas oxygen is now more frequently obtained by the fractional distillation of liquid air than by any chemical process.

The history of the commercial production of this gas, as outlined in the lecture by Mr. C. G. Bainbridge, makes a fascinating story. The barium oxide process only dates from about 1885, and, seen in the perspective of history, its duty appears to have been to build up a demand for the gas, and to stimulate the development of the associated needs, such as cylinders for its storage. It is interesting to note that the production in 1887 was about 150,000 cubic feet, and that it had risen in four years to 2 million cubic feet per annum. It is now about 8-10 million cubic feet per week. Its uses, too, have changed in the short period concerned. At first, it was required mainly for the lime-light, which essentially was a blow-pipe, and for medical purposes. Now, the blow-pipe, without the lime-light, provides one of the biggest markets, and is used in a vast variety of different industrial processes. With its aid, divers can cut steel as easily under water as it can be cut in the open air. Again, the medical or semi-

medical purposes have themselves increased in number; in mine rescue work, in high altitude flying, and still more in stratosphere flights, the gas is essential, as it is in mountain climbing. (It is to be noted that all the Everest expeditions have been equipped with oxygen apparatus.) For all these purposes, the oxygen now manufactured by the liquid air process provides a cheap and easy source, and moreover, the gas so produced is actually purer than that obtained by the earlier methods. It is perhaps worthy of mention that in the factories of large users, it has now become possible to dispense with the need for transporting cylinders, which owing to their bulk and weight add appreciably to the cost of the gas. The oxygen is now distributed by pipe lines, only being evaporated at the point where it is to be utilized.

Turning from the familiar gas oxygen, we find that the fractional distillation of air yields also the so-called 'rare gases', argon, neon, helium, krypton and xenon. The last two are not in industrial use on any appreciable scale, but they have an interest here on account of the fact that they were first discovered, as Prof. Travers mentioned in his lecture, by the examination of the residues of liquid air, most of which had been allowed to evaporate. The other three rare gases were the subject of a lecture by Mr. J. T. Randall. He pointed out that helium has already been used for filling two large airships, and that it has been proposed to use the gas instead of nitrogen in the air supplied to divers. This would have the very great advantage of minimizing the danger of bubbles of gas forming in the blood when the pressure is released, since helium, unlike nitrogen, is not appreciably soluble in the blood. The most widely used gas of this group, however, is argon. Its chief use is in the gas-filled tungsten filament lamp, of which more than 1,000,000,000 are made annually. Its value here is that it lowers the tendency of the filament to evaporate, and so enables it to be run at a much higher temperature. This causes the lamp to require far less "watts per candle" than the older vacuum lamp, despite the conduction of heat through the gas to the glass envelope. The other type of lamp, the gas discharge, also relies on argon to start the discharge, although in many the vapour of mercury is the main agent for carrying the current after the discharge is started. The colours are, of course, dependent on the gas in the tube, and may be modified by the addition of luminescent solids in powder form.

All the industrial applications dealt with so far are indirect, in that the purchaser, though he may benefit from the low-temperature work, does not receive anything cold. The last example, the subject of the lecture by Dr. I. J. Faulkner, is

direct. We have now become accustomed to the use of solid carbon dioxide for the refrigeration on the tricycles in which ice-cream is transported in the big towns. It has, however, many other industrial uses, and as many as 60,000-70,000 tons are now produced per annum in the United States. A surprising fact is that its loss by evaporation is quite moderate, being about 1-2 per cent by weight in 24 hours, on blocks of the ordinary size. It is also interesting to note that the gas itself, which surrounds the solid block, is a poor thermal conductor. This atmosphere of carbon dioxide is very useful when the solid material—'dry ice'—is used for the preservation of meat and fruit, since it prolongs the life of the latter, and tends to inhibit the growth of moulds and bacteria in the former case.

A growing, but less-known, use of 'dry ice' is in the machine shop, where it can be used for shrinking one part on to another, so that after the inner one warms up and expands, the joint is of enormous strength.

Solid carbon dioxide, like liquid oxygen, has

removed the necessity for transporting heavy empty cylinders when supplies of the gas are required at a distance. By purchasing a block of 'dry ice', a customer with a suitable pressure vessel can obtain a supply of carbon dioxide gas from a cylinder which need never leave his premises. He simply inserts the block, closes the vessel and allows the carbon dioxide to evaporate. The gas so obtained is much purer than that from which the 'dry ice' was originally made, since the process has many of the features of the chemist's purification process of recrystallization.

Taken together, the seven lectures illustrate in a forceful manner the strides which have been made in the science and art of low temperature production and utilization, and also the interdependence of pure and applied science. The authorities of the Science Museum are to be congratulated on the provision of the course, which must have added very considerably to the interest of the Very Low Temperatures Exhibition itself, valuable though it would have been without them.

J. H. A.

Obituary

Sir William Hamer

BY the death on July 7 of Sir William Heaton Hamer, at the age of seventy-four years, epidemiology has been deprived of one of its most zealous students.

William Hamer (he was knighted in 1923) was a scholar of Christ's College, Cambridge, and graduated twelfth wrangler in 1882. After graduating in medicine, he entered the Medical Department of the London County Council and rose to be Medical Officer in 1911, retiring in 1925.

Hamer's mathematical training showed itself in some of his earlier researches, particularly his elucidation of the periodicity of measles in London, which he attributed to rhythmic variation in the number of susceptibles in the population. His work on these lines was afterwards extended by the late H. E. Soper and, although it is now held that the phenomenon is not quite so simple as Hamer suggested, there is little doubt that changes in the proportion of susceptibles form an important element of the general problem.

Hamer was an acute critic of popular epidemiological theories, particularly those based upon bacteriological findings, and a sturdy champion of the doctrine of epidemic constitutions, to which he devoted years of study. The "English Hippocrates", Thomas Sydenham, propounded the general doctrine that all forms of acute diseases prevailing at the same time were linked together by common features in consequence of some general, possibly cosmic,

influence which he was unable to define. Hamer attempted to bring this rather vague hypothesis into conformity with modern scientific results. It is generally agreed that, in pointing out the chronological relation of prevalences of obscure nervous diseases to pandemics of influenza, and in explaining the nature of such mysterious epidemics as the 'sweats' of the sixteenth century, Hamer made important contributions to knowledge. To most students, however, his later writings were difficult to follow, and he seemed to exaggerate the importance of Sydenham's views. At his best, he was a most stimulating writer, and he continued the scholarly tradition of Charles Creighton, linking modern science to the philosophical outlook of the ancient masters.

Mr. W. Newbold

THE death, on June 24, of William Newbold, classical scholar, self-taught mathematician, statistician and biologist, at the age of fifty-eight years, just as he was within sight of retirement from his duties as an inspector of secondary schools under the Board of Education, and was wishing for leisure to extend his biological investigations, was a great shock to the large circle of friends to whom he had endeared himself by his ever-ready help and wise and kindly counsel.

Though Newbold never lost his delight in classical and archaeological studies, his latent first-rate mathe-

mathematical ability was, in his early manhood, stimulated by his desire to study astronomy; this led to the mastering of relativity and its application to cosmic theories; statistics next engaged his attention; and his work in this direction was invaluable to his colleagues. His eager avidity for knowledge of all kinds later drew him towards biology: here his love of observation and experimentation found its best outlet, and his work ranged over a wide field of natural history. Drawn by his combined interest in statistics and biology, he bred stick insects, to investigate their rate of increase, over a long period, keeping them in muslin meat safes, until they overflowed his study, his bedroom and his laboratory (a disused windmill). He was particularly interested in small insect parasites, especially those of birds.

The most modest and retiring of men, it never occurred to Newbold to publish any of the curious and interesting observations he made, though they were shared from time to time with his more intimate friends. A man of unusually powerful intellect, of the widest interests and sympathies, there can be no doubt that, with release from routine duties, he would have made valuable contributions to science. He met his end, which he knew for some months to be near at hand, with the utmost calm and fortitude. It is not so much as a potential man of science, but as one of far-seeing and disinterested judgment, whose wisdom in affairs was always freely at the disposal of his friends, that he will be missed.

Dr. H. J. Hansen

DR. HANS JACOB HANSEN, who died on June 26 at Gjentofte, near Copenhagen, in his eighty-first year, was one of the most distinguished of the long line of descriptive zoologists who have placed the Zoological Museum of Copenhagen in the very front rank of the museums of the world.

Hansen was born at Bellinge in the district of Odense on August 10, 1855, and studied at the University of Copenhagen, where he took the degree of Dr. phil. in 1883 with a thesis on the mouth-parts of Diptera ("Fabrica oris Dipterorum"). While still a student he worked at the Museum under J. M. C. Schiodte and in 1885 he was appointed an assistant in the entomological department, a position which he held until 1910, when in consequence of some changes in the staff he felt compelled to resign. At this time, when the continuance of his scientific work seemed to be in danger, a letter was addressed to him by a large number of zoologists in Great Britain expressing their high appreciation of his researches and their hope that he would be placed in a position to continue them. This letter was published in NATURE on March 10, 1910. Together with the efforts of his scientific friends in Denmark, this led to his being allowed to retire on full pay (although this was small enough, even by Danish standards) "for free scientific activity". He continued to work unremittingly, and letters received from him in the last year of his life were full of work in hand and plans for the future.

Except for an early contribution to the account of Danish fishes in Schiodte's "Zoologica Danica", all Hansen's published works deal with Arthropoda. Within the limits of that vast phylum, however, their range is wider than that attempted by any other zoologist of our time. Insects, Myriopoda, Crustacea, and Arachnida formed the subjects of numerous memoirs and monographs that for fullness and accuracy of detail and for exquisite illustration have never been surpassed.

Hansen's attention was especially attracted by those groups that by reason of their annectant affinities are of crucial importance to the morphologist. Thus he monographed the Arachnid Palpigrafi and Podogona (until the other day among the rarest of animals) and the Myriopod Pauropoda and Symphyla; but it was on the Crustacea that the greater part of his work was done. When taking part in the first cruise of the *Ingolf* expedition to the seas of Iceland and Greenland in 1895, he devised a method of sifting the bottom deposits that revealed an astonishing variety of minute Crustacea, and he later published memoirs on the Isopoda and Tanaidacea in which large numbers of new genera and species were established, but the material of many groups still remains undescribed. Even now, little attention has been given to this micro-fauna of the sea-bottom, although it may conceivably play an important part in marine ecology.

Perhaps the most important of Hansen's contributions to morphology was a little paper on the limbs and mouth-parts of Crustacea and insects published in the *Zoologischer Anzeiger* in 1893. This was intended as preliminary to an extensive treatise on the subject which unfortunately never appeared, for when at length he published his "Studies on Arthropoda" in 1921-30, he confined himself to elaborating the details without developing further the broader views sketched in the early paper.

Apart from zoology, Hansen's interests lay mainly in politics and in military history. On these subjects he wrote much in newspapers and magazines, and he published a number of pamphlets mostly with the object of warning his countrymen against the increasing influence of German culture and German politics. He urged Danish science students to look to England rather than to Germany as their 'spiritual home', and was a caustic critic of the "Germanising of Dansk Videnskab". Nearly all his scientific papers were published in English. In 1902 he was elected a foreign member of the Linnean Society of London.

W. T. CALMAN.

WE regret to announce the following deaths:

Sir Arnold Theiler, K.C.M.G., well known for his work in veterinary research and education in South Africa, on July 24, aged sixty-nine years.

Sir Henry Wellcome, F.R.S., governing director of the Wellcome Foundation, founder of the Wellcome Research Institution, and founder and director of the Wellcome Historical Medical Museum, on July 25, aged eighty-two years.

News and Views

Origins of Modern Races of Mankind

SIR ARTHUR KEITH's presidential address to the first Speleological Conference of the British Speleological Association held at Buxton on July 25 made a bold attempt to resolve a number of doubts and difficulties, which arise out of recent developments in the study of human palaeontology. This, Sir Arthur was careful to point out, is a matter relevant to the purpose of the Conference in that discoveries of the remains of ancient types of man in caves have provided a great part of the material, which points to the necessity of recasting the current view that modern races, black, white, brown and yellow, evolved from a common mid-Pleistocene ancestral stock. It will be remembered that it has been demonstrated recently (see NATURE, 137, 73; 1936) that certain characteristics of the modern Mongolian are to be observed in the remains of Peking man found in the cave of Chou Kou Tien. Sir Arthur would go further. Not only does he too find resemblances to the Mongolian in Peking man, but he also observes Australian and Negro characteristics in *Pithecanthropus* from Java and the Kanam skull from East Africa respectively. From this evidence, therefore, he draws, somewhat tentatively, the conclusion that at the beginning of the Pleistocene, the ancestors of the Mongol, the Australian and the Negro were already in occupation of the continental areas now inhabited by their descendants; and that after their separation each race underwent a series of parallel evolutionary changes in teeth, jaws, brain and other features showing simian affinities.

In his search for further evidence in support of his hypothesis, Sir Arthur reviewed present knowledge of early man in the areas of distribution of the main divisions of *Homo sapiens*, with the view of showing how far they exhibit traces of this parallel course of evolution. In China, unfortunately, fossil forms of man, which lead on from *Sinanthropus* towards the Chinaman of to-day, have not yet been discovered. For the evolution of the Australian type, he referred to the evidence afforded by Wadjak man from Java, with its resemblance to Talgai man, the earliest known form of Australian, and the fossil remains of Solo man, also from Java. In Africa the geological horizon of Rhodesian man is uncertain, but the Kanam fragmentary jaw from Kenya is not incompatible with the anatomy of Rhodesian man. The Kanjera skulls from deposits of mid-Pleistocene date, or earlier, are the earliest and most primitive form of Negro known to us, while in cave deposits of late Pleistocene date Dr. L. S. B. Leakey discovered fossil remains of a type still existing in north-east Africa. The gap, however, between Rhodesian man and the Kanjera negro still remains. A further problem discussed as needing solution for the acceptance of the theory was the origin of the Caucasian, who does not appear until found in late Pleistocene

times as the Cromagnon man of the caves of France and other parts of Europe. For this type, Sir Arthur suggested a possible area of origin in western Asia. It is only when we accept some such view of independent, but parallel, evolution, Sir Arthur concluded, that we can give a coherent explanation of the facts known to us; but it serves only to deepen the mystery of human evolution, for it implies that the future of each race is latent in its genetic constitution. Throughout the Pleistocene period the separated branches of the human family appear to have been unfolding a programme of latent qualities inherited from a common ancestor of an earlier period.

Historical Memorial in Hatton Garden

AN interesting memorial, the institution of which was organized by Mr. E. Kilburn Scott, was unveiled at St. Andrew's Parochial School, Hatton Garden, on July 25, by the Mayor of Holborn. Much mechanical pioneering started in the district. An early connexion with engineering was in 1804, when Richard Trevithick erected his first steam-carriage in Felton's workshop in Leather Lane. Scientific instrument making began about 1750, when the Italian, F. Pastorelli, began to make thermometers, barometers, etc., the business he founded being still carried on at No. 46. In 1850 Negretti and Zambra joined in similar work, and when the Holborn Viaduct was built, removed to the present site of the Gatehouse, in which Sir Christopher Hatton resided. In 1817, P. Norton Johnson refined platinum and other rare metals in the building No. 79, where similar work is still carried on by the firm he founded. The district has long been famous for watch- and clock-making, and the name of Lund, who made chronometers at No. 4 in 1836, is still well known. St. Geo. Lane-Fox, a pioneer in the making of electric incandescent lamps, was at No. 75 in 1881, and the lamp factory at Hammersmith, built by the Brush Electrical Company to make his lamps in 1888, was eventually taken over by the General Electric Co., Ltd.

THE large building at the corner of Hatton Wall, now partly occupied by Marryat and Scott and by Raphael's, became a centre of pioneer engineering because in the basement there was a boiler and steam engine which supplied power to various tenants. One of these in 1884 was Dr. S. Z. de Ferranti, pioneer of high-tension electric transmission. Another was Sir Hiram Maxim, who developed his first automatic machine-gun in 1889, and he tried it in the basement where Hyde, the engineer, had his power plant. C. F. Cross and E. Bevan, inventors of the viscose process for making rayon fibres from sulphite wood pulp, demonstrated their process in the same building. In the early 'nineties Mr. R. W. Paul, maker of electrical instruments at No. 44, was asked to make kinoscopes like those of Edison. In 1895 he made a projector to show

the moving pictures on a screen at about the same time that Lumière was showing his in Paris. He gave his first public exhibition in the lecture room of the Finsbury Technical College, where he had formerly been a student. Hatton Garden is associated with Michael Faraday in that he had business relations with Johnson and Matthey of No. 79. Edward Barnard, of the firm occupying No. 54 (the old Court House), was father of Sarah Barnard who married Faraday. Miss Alice Faraday married Fred Barnard, grandson of Ed. Barnard, and a well-known illustrator of Dickens. For a century the district has been famous for skilled craftsmen, makers of optical apparatus, clocks and also of jewellery, etc., including pearls and diamonds. It is now the world centre for the diamond trade.

Russian Eclipse Measurements on the Ionosphere

WE have received some preliminary results from Prof. W. Kessenich, of Tomsk, U.S.S.R., of the measurements made there on the ionosphere during the total eclipse of June 19, 1936, at the suggestion of Prof. Bonch-Bruевич, and as part of the general scientific eclipse programme of the Russian Academy of Sciences. The main radio work was directed towards the solution of the problem of the source of the ionization of the F_2 -layer, since earlier eclipses have indicated that the E and F_1 layers are mainly ionized by ultra-violet light. The daily variations in the critical frequencies of the ordinary (f_o) and extraordinary (f_x) rays for the F_2 layer were measured, by the pulse method, from June 16 until June 24: in addition, qualitative measurements were made, at a constant frequency, on the absorption changes during the eclipse. The receiving apparatus was in the same room as the transmitter, and included two cathode ray oscillographs, one for visual observation and the other for recording: this arrangement enabled critical frequencies to be measured in one or two minutes with an accuracy of 1 or 2 per cent. The interpretation of the results is unfortunately somewhat limited by the fact that a world-wide magnetic disturbance set in at about three hours before optical totality: this seems in no way connected with the eclipse.

THE observations were made near Tomsk, at a place about 5 km. north of the central line of the optical eclipse, and 4° south of the centre of the corpuscular eclipse (the corpuscular track, for three corpuscular speeds, 800, 1600 and 3200 km./sec., had previously been calculated by A. Michailov). The average critical frequencies observed during the six days were much larger than those for preceding years observed elsewhere; this may be attributed to the influence of the sunspot cycle. The observations show a marked decrease in ionization of the F_2 layer during the optical eclipse, suggesting that ultra-violet light is an important part of the source of the ionization; the time of recombination seems to be of the order five minutes, agreeing with the quick appearance and disappearance of absorption at sunrise and sunset observed on preceding and following

days. The occurrence of minimum ionization somewhat before totality is regarded as clearly demonstrating the temperature effects suggested by Appleton and Naismith. As regards corpuscular influence, the results are interpreted as indicating that solar particles with velocities of the order 1000–2000 km./sec. play an important part in ionizing the F_2 layer, while corpuscles of larger speed are without influence. The stronger eclipse effects observed on June 19, as compared with those found during preceding eclipses, can be ascribed partly to the summer conditions and partly to the increased solar activity in 1936. Taking into account this increased solar activity, and the high level of critical frequencies, which decreased markedly $2\frac{1}{2}$ hours before totality, Prof. Kessenich and his collaborators Baerwald, Bulatov and Denisov are inclined to regard the corpuscular ionizing influences on the F_2 layer as established.

Sale of Newtoniana

As a result of the sale of the Newton Papers, and other articles of interest in connexion with Sir Isaac Newton, by Messrs. Sotheby and Co. on July 13–14, two gifts of scientific importance have now been made possible, and are worthy of record. That portion of the Papers which deal with Newton's work as warden, and afterwards master, of the Royal Mint, is bound in three folio volumes and contains 529 pieces. These were sold for £1,400 to Mr. Gabriel Wells who placed them at the disposal of Lord Wakefield at cost, on the understanding that they would be presented to the nation. Lord Wakefield has presented them to the Royal Mint, where they will be available for inspection. The very valuable and unique collection of Newtoniana already in the possession of the Royal Society has been enhanced by a gift from Sir Robert Hadfield which he purchased at the same sale. The gift comprises the following letters: four from Edmund Halley to Newton: four from Edmund Halley to Thomas Molyneux; two from Fontenelle to Newton; one from Philip Naudé to Newton; and one from Brook Taylor to Newton. A portrait of Sir Isaac Newton, painted in 1702 by Sir Godfrey Kneller (the most famous of the Newton portraits), has been purchased by the Trustees of the National Portrait Gallery (with a contribution of half from the National Art-Collections Fund) from Messrs. Rosenbach, of New York. The portrait was actually sold at the same sale for £800, but through the generosity of Dr. Philip Rosenbach, was re-sold to the Trustees of the Gallery at cost price. Among the many other items of interest in connexion with Newton disposed of at the sale were the following: nine letters to Newton from Edmund Halley, containing the history of the publication of the "Principia" (£310); a note-book in Newton's own handwriting, giving an interesting and amusing list of expenses, and, at the other end, various problems in geometry and conic sections (£180); an autographed draft of about 1,000 words of a very important statement on the invention of the calculus (£210).

Presentation to M. Marcellin Boule

THE forthcoming retirement of the veteran anthropologist, M. Marcellin Boule, director of the Institut de Paléontologie humaine and professor of palæontology, after fifty years' service in the National Museum of Natural History, Paris, will be marked by the presentation to him of a medal by his friends and pupils as a token of admiration, gratitude and affection. M. Boule has long been recognized not merely as the leading authority in France on early man, but also as one of the very select few among anthropologists at large whose verdict on any matter under argument in prehistoric archaeology and human palæontology comes as near finality as is possible in that ever-expanding field of science. Of his numerous contributions to the literature of his subject, "Les Hommes Fossiles" is as widely known as it is authoritative; it will always stand as a record of conclusions based upon profound knowledge and painstaking research. The arrangements for the proposed honour to this distinguished man of science have been in the hands of a committee of which the Abbé Breuil, P. Teilhard de Chardin, Prof. Verneau and other distinguished French anthropologists are members, and on which Great Britain is represented by Sir Arthur Smith Woodward and Prof. W. J. Sollas, Belgium by Prof. C. Fraipont, Holland by Dr. É. Dubois, and Switzerland by Prof. É. Pittard. A replica in bronze of the medal, which is the work of A. de Jaeger, will be presented to each subscriber to the fund, of which the secretaries are MM. J. Cottreau, J. Piveteau, H. Vallois and R. Vaufrey; treasurer, M. Georges Masson. The minimum amount of a contribution is 100 francs; and it should be addressed, 120 boulevard Saint-Germain, Paris (vi^e).

Recent Acquisitions at the British Museum (Natural History)

THE Department of Zoology has received as a permanent loan from His Majesty the King a mounted specimen of a cock scarlet-breasted parrakeet (*Neophema splendida*) which was formerly kept as a pet by His late Majesty King George V. This beautifully coloured bird, together with six other members of the same genus, is a native of Australia; it is now very rare, and the Museum possesses only a few examples. Two important collections have been acquired by the Department of Geology. One comprises a large series of Pleistocene and Quaternary mammals, chiefly from Clacton and the Lee Valley, collected over a series of many years by Mr. S. Hazzledine Warren, of Loughton, with special regard to their exact horizon and locality. The other acquisition consists of nearly two hundred type and figured specimens from the collection of Mr. J. W. Tutchet, of Bristol, of Jurassic invertebrate fossils, mostly Liassic ammonites from the Radstock district, described by the late Mr. S. S. Buckman. Mr. F. N. Ashcroft, who has long been a generous donor to the Mineral Department, has presented a further selection from his collection of Swiss minerals. The selection numbers about eighty-four specimens from twenty carefully recorded localities, and forms a

valuable addition to the now extensive series of specimens from Switzerland in the Collection. The recent cliff fall between Newton and Yarmouth brought to light the existence in the Isle of Wight of gypsum. Mr. W. White has given the Museum one of the largest crystals that has been found. The most conspicuous of the purchases are a group of well-formed crystals of the beautiful emerald-green copper mineral, diopside, from the French Congo, a magnificent group of prismatic crystals of celestine, and a large well-crystallized specimen of native copper.

Prices of Biological Books in 1935

THIS analysis of the cost of biological books in 1935 by John R. Miner (*Quart. Rev. Biol.*, Dec. 1935) is the tenth of its kind, and allows of a comparison between the current prices and those of 1926, as well as between those of 1934 and 1935. The prices are quoted in cents per page and at the current rate of exchange into United States currency. The number of pages reviewed is 143,199, an increase of 15.6 per cent over 1934 and 73.4 per cent over 1926. The cheapest of all publications are those of the U.S. Government, which are only 0.11 cents per page, a truly astounding figure which represents a reduction of 38.9 per cent on 1934 and 64.5 per cent on 1926. The next cheapest are those of the British Government at 0.50 cents per page, a decrease of 43.8 per cent from 1934. It is pointed out that there has been a reduction of 25 per cent in the export price of German publications which, as it occurred late in 1935, does not come into the calculations. Against this is to be set the fact that from 1934 to 1935 there has been an increase of 7.9 per cent. Moreover, over the ten years there has been an increase of 87.2 per cent in the price of these works, so that Germany heads the list with an absolute price of 2.04 cents per page, or nearly twenty times that of the U.S. Government or two and a half times that of British non-Governmental publications. France started the decennium with the low price of 0.35 cents per page, and in spite of a drop of 14 per cent from 1934 has a total increase over the period of 145.7 per cent. The non-Governmental publications of Britain are 0.84 cents per page, of France 0.86 cents per page and of the United States 0.90 cents per page. In considering these statistics, it is to be borne in mind that they are not based upon the whole of the biological books published by the countries chosen but upon such samples as passed through the hands of the reviewer. They are not absolute, therefore, but they may be taken as giving some approximation to the actual conditions.

National and International Health and Welfare

VOLUNTARY associations providing maternity and child welfare services, under the Local Government Act, 1929, now receive annual contributions from the county or county borough council in whose area or for whose benefit they work. The Minister of Health has accordingly issued a circular (1538) reminding county and county borough councils

outside London that they must prepare schemes in order to secure the payment of annual contributions towards the expenses of such voluntary associations within their areas, copies of model schemes for their use being enclosed with the Circular. Respecting venereal diseases, the Minister of Health has issued circulars (1536 and 1536a) to the responsible port and local authorities in England and Wales enclosing a revised list of treatment centres in the chief sea and river ports throughout the world at which seamen can obtain gratuitous treatment for these diseases, in accordance with arrangements contemplated by the international agreement signed at Brussels in 1924.

The Lister Institute of Preventive Medicine

THE Annual General Meeting of this Institute was held on June 9, and the Governing Body presented the forty-second Annual Report, in which the activities of the Institute are surveyed. Investigations have been carried out upon vaccinia, tumour-exciting, neurotropic and other virus agents by the director, Prof. J. C. G. Ledingham, and Dr. E. W. Hurst, Dr. C. R. Amies and others. Various serological studies are being continued by Dr. A. Felix and collaborators. Dr. V. Korenchevsky is continuing his work on sexual hormones, and Prof. R. Robison with others is studying phosphate metabolism and tissue calcification. Investigations on rheumatism and the possible presence of a virus agent in this disease are being pursued by Dr. Amies and colleagues in conjunction with King's College Hospital. In the Division of Nutrition, much work upon vitamins and dietary constituents has been carried out by Dr. Harriette Chick and her associates. The Svedberg ultra-centrifuge, referred to in last year's Report, with accessory equipment is now in course of installation. At the Serum Department at Elstree, under Dr. G. F. Petrie, to which the Vaccine Department has now been transferred, work on meningococcus and gas-gangrene anti-sera and on staphylococcus toxin is in progress. This brief and incomplete survey illustrates the important research work now being carried on at the Lister Institute.

Experimental Research and Disease

THE tenth Stephen Paget Memorial Lecture was delivered by Sir Malcolm Watson at the annual general meeting of the Research Defence Society, held at the London School of Hygiene and Tropical Medicine on June 9, the president, Lord Lamington, occupying the chair (*The Fight against Disease*, 24, No. 3, 1936). In order to illustrate the importance of experimental research, Sir Malcolm surveyed the work of Manson upon elephantiasis and filarial periodicity and malaria, of Ross upon malaria and its transmission by mosquitoes, and of Reed upon yellow fever. By applying the knowledge won by Walter Reed and his American colleagues, the city of Havana was within a few months freed from yellow fever for the first time in a hundred and fifty years by exterminating the mosquitoes that convey the disease. Owing to an increase in member's and life-

member's subscriptions for 1935, the Research Defence Society has commenced the current year with a small balance in hand.

A New Anthropological Publication

A NEW publication of the Section of Anthropology of the Department of the Social Sciences of Yale University, entitled "Yale University Publications in Anthropology", has appeared, which will embody the results of researches in the general field of anthropology directly conducted or otherwise sponsored by this Department of the Graduate School, the Department of Anthropology of the Peabody Museum, and the Department of Anthropology of the Institute of Human Relations (Yale University Press, New Haven, Conn.; London: Oxford University Press). The issues, which will range from brief papers to extensive monographs, will be numbered consecutively as independent contributions, and will appear at irregular intervals. The first issue (Nos. 1-7) includes a study of population changes among the northern Plains Indians by Dr. Clark Wissler, an examination of regional diversity in sorcery in Polynesia by Dr. P. H. Buck, an account of cultural relations of the Gila River and Lower Colorado tribes by Dr. Leslie Spier, with several other communications dealing with aspects of the culture of the Indians of North America. A further issue of the publication, which will comprise six communications, is in the press. In view of the widespread activities in anthropological research of the institutions interested in this publication, and more especially of Yale University, the facilities which it will afford for early publication of results will be of great advantage to anthropologists. In this connexion, it may not be out of place to refer to the announcement that Dr. David G. Mandelbaum of Yale, who has hitherto specialized in the culture of the North American tribes, will be engaged during the coming year in an investigation among the hill tribes of Southern India.

History of Fire-Fighting in America

IN a paper received from the Smithsonian Institution, a brief history is given of fire-fighting in America from colonial days to the present time. It starts with the days of the 'bucket brigades'. Many of the earliest American communities required property owners to have fire buckets in their houses, which they had to throw into the street when a fire alarm was sounded. They were then picked up by the men who raced to the fire, and when the fire was extinguished these buckets were piled up on the village common, where the owners came to claim them. In an exhibition being held in the National Museum in Washington, many of these buckets are shown. They are made of leather, and in addition to the names of the owners are decorated with family devices and scenes of the time. The first hand-pumped fire engine or tub, made in 1740, is on exhibition; but the bucket brigades were still necessary in order to fill it with water. These tubs were pulled by hand, and at night runners went before them carrying torches or lanterns

on sticks to light the way. Rival companies raced to a fire, and it was a sporting event which of them should be first there. Many incentives were offered to the companies, who sometimes did what they could to slow up their rivals. Cast iron plates were fixed to houses insured by those insurance companies paying bounties to fire-fighters who saved insured property. The fire-fighters were in great demand for parades and political rallies, and no celebration was complete without them. Next came the days of steam fire-engines pulled by horses, and then the motor fire-engine.

The Blue Water of Crater Lake

IN the Cascade Mountains, Oregon, is the remarkable Crater Lake. It is about six miles long by four miles wide and lies within a volcanic crater the cliffs of which are 500–2,000 ft. high. Its depth in places is nearly 2,000 ft. It has no visible outlet, yet its water is fresh and is said never to freeze, although the surface is about 6,000 ft. above sea-level. It was discovered by white men in 1853, and was called the Deep Blue Lake. Seen from the rim of the crater, the water shades from turquoise blue along the shallow borders to darkest prussian blue in the deeper parts. From a boat, the colour deepens to dark indigo. Cloud shadows and wind flurries produce great variety in the appearance of the surface, but the main sensation produced in the eye of the observer is one of "unbelievable blueness". Dr. Edison Pettit, working on behalf of the National Academy of Sciences and the National Park Services, has recently completed a study of the reason for this extraordinary depth of blue (*News Service Bulletin* (School Edition); Carnegie Institution of Washington, 4, No. 4). He finds that the water has no special colour of its own, but that it is exceptionally free from suspended matter; such scattering of light as occurs in its depths is mainly from the water molecules, and is therefore deep blue. The degree of clarity is almost that of specially prepared dust-free water. The scattered light from dust-free water is blue at all angles; that from Crater Lake water is white only for a comparatively narrow forward angle, and at all other angles is blue.

Wooden Pipe Lines

THE use of wooden pipes as a means of conveying water dates back almost to prehistoric times. They were much used in the Middle Ages. During recent years, traces of the water supply system of London (c. 1600) by means of hollow trunks of trees have often been found during excavations. In *World Power* of May, there is a paper by T. Pausert, telling how wooden pipes made of staves and bound with hoops are coming into modern practice all over the world. Generally, the staves are made of pine or larch wood, and are planed off to give a smooth finish after assembly. The contact surfaces are dove-tailed. When the pipe is filled with water, the wood swells and becomes water-tight. These wooden pipes are either placed on the ground or laid in the open on supports. Their diameters vary from 5 cm. to 6

metres. A great advantage is the immunity of the wood from the effects of water whether it is pure, acid, alkaline, saline or contains selinite. For this reason, wooden pipes are much used in the chemical industry. An important point is that salts are not deposited on the walls of the pipes, so that the latter do not become choked and their rate of flow affected. There is no risk of electrolysis from stray electric currents. If an increased pressure becomes necessary, it is easy to reinforce them by the addition of new steel hoops. If a sudden hydraulic surge occurs, the inherent elasticity acts as a safety valve; the staves being bound by hoops enable the longitudinal joints to let water escape in small jets. When the pressure comes back to normal, the staves resume their original position, and become water-tight again. Their cheapness, durability and the ease with which they can be transported in mountainous regions enable the power engineer to arrive at solutions to many of his problems by their use.

Safety on the Roads

THE National Safety Congress was held in London on May 20–22. An account of the congress is given in *Roads and Road Construction* of June 1. At the Congress dinner, Sir Herbert Blain pointed out how much the British have learnt from the Americans in connexion with improving our roads and making them safer. In particular, he mentioned the practice of coloured traffic lights and of one-way streets. Although there is a magnificent system of roadways in Great Britain, there are no roads that can compare with some of the roads now being laid in America. These national highways are very wide and have a beautiful surface, good elevation and proper lighting. The curves are properly rounded, and there is no ribbon development. Mr. A. Matheson, the assistant secretary to the Minister of Transport, read a paper on "Danger Spots". Experiments have been carried out in London, where certain roads with black records have been selected. A study of these records showed that a large fraction of the accidents occurred to pedal cyclists and pedestrians. These roads were then inspected and improvements suggested which it is hoped will diminish the number of accidents. In two of the roads where the work recommended has been completed, a record was kept for six months.

In the Chiswick High Road, the number of accidents as compared with the corresponding six months of the preceding year was reduced by 37 per cent, and in the Fulham Palace Road to Putney Bridge the reduction has been from 88 to 48, or nearly 45 per cent. The Oxford County Council, becoming alarmed at the large number of accidents on its roads, made a detailed investigation of them over two years ending July 1934. The investigation showed that nearly one half of the fatal accidents occurred on certain main roads constituting less than six per cent of the total mileage of the county. During the first seventeen weeks after making certain improvements, it was found that, compared with

the corresponding seventeen weeks of the preceding year, the fatalities were reduced 52 per cent and the number of injured 11.6 per cent. In Glasgow it was found that the installation of light signals at certain junctions reduced the number of accidents by about 75 per cent.

Farmer's Guide to Agricultural Research

FOR the past ten years, the Royal Agricultural Society of England has issued annual summaries of research work carried out in the leading branches in agriculture. The publication, known as the "Farmer's Guide to Agricultural Research", is now issued as a section of the Society's *Journal*, so that it may be automatically in the hands of all members. A few copies are published separately for private circulation, and a limited number of copies of previous issues (1925-33) are still available. The Society has now published its *Journal* for 1935 (vol. 96). The various sections of the Farmer's Guide are similar to those of the previous year, as are also the authors responsible for them. The remainder of the *Journal* consists of a number of special articles of outstanding interest, reports of the research work carried out under the aegis of the Society, together with a number of official reports. The volume may be obtained from the headquarters of the Society, 16 Bedford Square, London, W.C.1 (price 15s.).

"Index Generalis"

THE editor of the "Index Generalis", the 1936 issue of which was noticed in *NATURE* of July 18 (p. 100), asks us to state that new items for inclusion in this reference work are welcomed. They should be in the form in which they are to appear in print, and should be sent to Prof. R. de Montessus de Ballore, directeur de l'Index Generalis, Sorbonne, Paris V^e. No charge is made for insertions, and there is no obligation to purchase the volume. The only stipulations are that the information should be up to date and that it be revised annually on the request of the editor.

Announcements

MR. R. COPPOCK, general secretary of the National Federation of Building Trades Operatives, Mr. Richard K. Law, M.P., and Prof. B. A. McSwiney have been appointed members of the Industrial Health Research Board of the Medical Research Council.

PROF. A. MAIGE, professor of botany in the University of Lille, has been elected *Correspondant* of the Section of Botany of the Paris Academy of Sciences, in succession to the late Prof. H. Jumelle, professor of botany in the University of Marseilles.

THE Trustees of the Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 while flying an experimental aeroplane, have awarded the studentship for the year 1936-7 to Mr. J. W. E. Clarke, Glasgow.

PROF. PAUL UHLENHUTH, director of the Institute of Hygiene at Freiburg i.B., has been nominated a foreign member of the Royal Academy of Sciences of Stockholm in recognition of his outstanding contributions to hygiene and bacteriology.

THE twenty-eighth annual Autumn Meeting of the Institute of Metals will be held in Paris on September 14-18. The fifteenth Autumn Lecture will be delivered in the Grande Salle, Maison de la Chimie on September 14, at 8 p.m., by Prof. P. A. J. Chevenard, who will speak on "The Scientific Organization of Factories". Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

A PROVISIONAL programme has been issued of a General Discussion of the Faraday Society to be held in the Chemistry Theatre, University of Edinburgh, on September 24-26 on "Structure and Molecular Forces in (a) Pure Liquids and (b) Solutions". The scope of the meeting does not extend to kinetics, which will form the subject of a forthcoming meeting, or to subjects which have been dealt with at recent meetings, such as dipole moments and the theory of strong electrolytes. A general introduction is promised by Prof. J. Kendall. The introductory paper in Section A (Pure Liquids) will be by Prof. F. London (Oxford), and that in Section B (Solutions) by Prof. J. H. Hildebrand (Berkeley, California). As is usual in these discussions, a number of foreign guests have been invited to take part. Particulars of the meeting can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

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

An assistant for abstracting, indexing and proof-reading in the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen—The Deputy Director (August 3).

An assistant lecturer and demonstrator in physics in the University of Leeds—The Registrar (August 10).

A lecturer in physiology (Grade II) in the University of Bristol—The Registrar (August 12).

A general inspector of education and research, agricultural and horticultural division of the Ministry of Agriculture and Fisheries—The Secretary, Minister of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 12).

A professor of physics (August 31) and an assistant in bacteriology (August 20) in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2.

Structural engineering assistants for the Designs Branch of the Directorate of Fortifications and Works—The Under-Secretary of State (C. 5), The War Office, London, S.W.1.

A physicist or applied mathematician to the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He 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.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Preliminary Note on a New Fossil Human Skull from Swanscombe, Kent

IN June 1935, a fossilized human occipital bone was found *in situ* at a depth of 24 ft. below the surface, in the middle gravels of the Thames 100-ft.

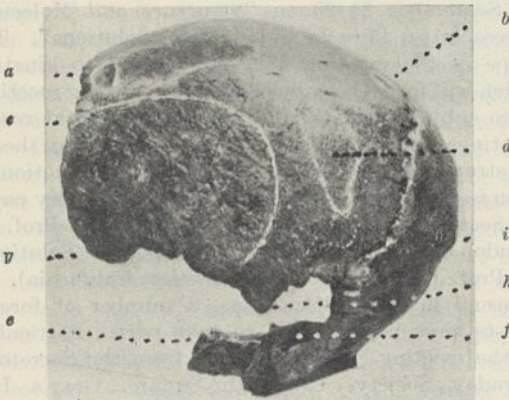


FIG. 1. Left lateral view of the Swanscombe skull.

- a, Anterior oval depression.
- b, Posterior round depression.
- c, Temporal line.
- d, Muscle attachment above and behind temporal line, perhaps for origin of functional ear muscle.
- e, Basilar process.
- f, Foramen magnum, filled with plasticene to support skull.
- g, Inverted antero-inferior angle of parietal bone.
- h, Everted postero-inferior angle.
- i, External occipital protuberance.

terrace at Swanscombe, Kent, in association with implements of the Acheulean culture phase. A note on the discovery appeared in NATURE of October 19, 1935, p. 637.

In March 1936, at the same depth, and in the same seam of gravel, the left parietal bone of the same skull was discovered, and this was witnessed and photographed while still embedded in the gravels, by an independent observer.

Both of the bones are in a remarkable state of preservation. The occipital bone is unique among the earlier specimens of fossil man in preserving the basilar process, the foramen magnum and the condyles, and both bones are complete in all their margins. They thus furnish the important positions for cranial measurements of the bregma, lambda, asterion, opisthion, inion, pterion and basion, and the completeness of the two bones permits of the most precise measurements being taken without resort to speculation.

In its relation to other fossil types, the Swanscombe skull is to be regarded definitely as a precursor of the Piltdown type. The comparison of the Swans-

combe and the Piltdown skulls may be summarized as follows.

(1) The anatomical features of the two skulls points to a definitely more primitive status for the Swanscombe skull than for Piltdown. The features of the Swanscombe are those of a specialized type less advanced than Piltdown but of the same general type, rather than a variant due to either the difference in sex or in age between two individuals of the same contemporaneous type. Both skulls are almost brachycephalic.

The main features in which the Swanscombe shows greater primitiveness are:

(a) Lower vault measured by the bregma-opisthion chord. Swanscombe is smaller than the lowest of the three British reconstructions of Piltdown (after Sir Grafton Elliot Smith).

(b) Flat ruggedness and non-filled out contours.

(c) Lower height and greater outward and downward slope of the parietal vault.

(d) The parietal eminence is not developed to the upward and backward position of Piltdown, but occupies the centre of the parietal bone.

(e) Lower frontal development at the coronal suture, with greater incurvature of the antero-inferior parietal angle.

(f) The parietal bone covers more of the frontal and the temporal regions of the brain than in Piltdown.

(g) An extensive obelion depression marks the sagittal border, and two peculiar depressions or pits, an anterior pit above the temporal line near the anterior border, and a posterior pit near the postero-superior angle are present.



FIG. 2. Left lateral view of Swanscombe endocranial cast.

(2) The comparison of the endocranial casts of the two skulls shows a definitely more primitive stage for Swanscombe than for Piltdown.

(a) The visual territories on the occipital region extend over the greater part of the cerebral hemispheres covered by the occipital bone. On the left side, the sulcus lunatus crosses the line of the lambdoid suture.

(b) In the parietal region, the orbital, frontoparietal and temporal opercula have not approximated at the anterior end of the horizontal limb of the fissure of Sylvius, and a large fossa lateralis measuring about 2.5 cm. from above downwards, and 1.0-2.0 cm. from before backwards is present.

(c) The parietal lobule, and the temporal lobe stand out in high relief as exuberant masses of neopallial growth, and the central and the intraparietal sulci occur in primitive form.

(d) The Sylvian fissure runs obliquely upwards and backwards.

(e) Low development of the parietal association area.

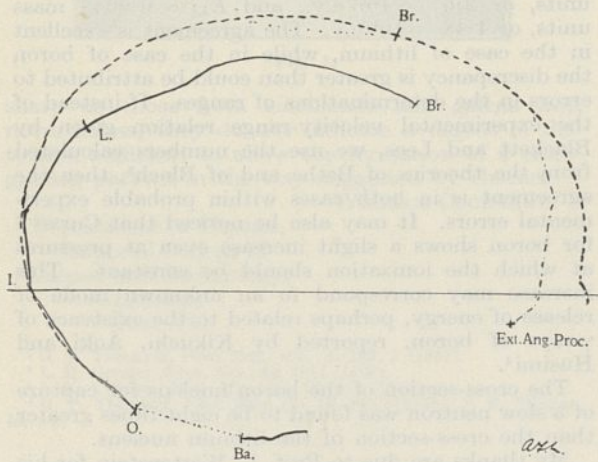


FIG. 3. Sagittal contours of Piltown (Elliot Smith) and Swanscombe superimposed so that theinion and opisthion coincide. The Piltown basion does not exist, but the opisthion is represented on the occipital fragment. The difference between the bregma-opisthion chord of the two specimens is not the result of the faulty reconstruction of the Piltown skull, for if the bones of the two skulls be examined and angulated separately apart from the skull restorations as a whole, the Piltown bones show an advanced developmental stage over the Swanscombe bones. (Swanscombe: full line. Piltown: interrupted line.)

(f) The distribution of the middle meningeal arteries on the endocranial cast is more primitive in form than Piltown.

(g) The shallow depth from above downwards of the cerebellar fossae is more primitive in form in Swanscombe.

Consideration of the above is sufficient to invite an inquiry into the status of the Piltown skull. While the geological horizon of Swanscombe as the fossil of the middle gravels of the 100-ft. terrace is authenticated and recognized by the Geological Survey, the Piltown horizon has been referred to the 80-ft. terrace, the 50-ft. terrace, and the 100-ft. terrace. The presence of the 'eoliths' or of the 'bone implement' is not reliable evidence of a Pliocene or Early Pleistocene status for Piltown. The acquisition of a brain is a process of slow growth, and the differences between the actual anatomical features of the two skulls overwhelmingly favours the view that the geological horizon of Piltown should be considered as later than that of the Swanscombe horizon in the middle gravels of the 100-ft. terrace.

The Swanscombe associated implements and flakes have been examined by the Abbé Breuil, who classes

them as belonging to the St. Acheul 1 and 3 divisions of his nomenclature. The Swanscombe skull may therefore be referred to the St. Acheul 3 culture phase of Breuil.

The Swanscombe associated fauna is being examined separately by Mr. M. A. C. Hinton.

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Mass Equivalent of the Energy in Radioactive Transformations

WITH a spark between a lead electrode and an electrode of palladium or one made of a platinum rhodium alloy, it was found that doubly-charged lead ions were formed, which in the mass-spectrograph gave close doublets with the singly-charged rhodium and palladium ions at 102, 103 and 104. The mass differences were 0.0860 ± 0.003 at 104 (Pd), and 0.0861 ± 0.003 at 103 (Rh). Although the packing fractions of palladium and rhodium have not been determined directly, they occupy a position on Dr. Aston's curve¹ where the divergence of the atomic mass from an even integer reaches its maximum value of approximately 0.085 ± 0.005 . Assuming this value as applying to palladium and rhodium, we find a value for the atomic masses of the lead isotopes of 206.00 ± 0.01 and 208.00 ± 0.01 .

It is of interest to deduce the atomic masses to be expected for the lead isotopes from the atomic masses of uranium (238.088) and thorium (232.070) given in a recent letter¹. In the uranium series of radioactive transformations, eight α -rays and six β -rays are ejected with a total energy of 52 million electron-volts (43 in the α -rays, and 9 in the β -rays). In the thorium series, six α -rays, four β -rays and an energy of 43.3×10^6 e.v. are emitted. The α -rays and total number of electrons lost by the radioactive elements are in the proper number to form neutral helium atoms² of a mass 4.0039. If we should neglect the mass equivalent of the energy, we would be led to expect mass values for the lead isotopes of $238.088 - (8 \times 4.0039) = 206.057$ and $232.070 - (6 \times 4.0039) = 208.047$. These are higher than the values deduced above by several times the possible experimental errors, and it is impossible to ascribe the discrepancy to uncertainty in the masses of palladium and rhodium, as it would be necessary to suppose that the masses of those elements diverge from integers by less than half the amount required by Dr. Aston's curve.

We have thus an example of the necessity of allowing for the mass equivalent of the energy emitted. As one million electron volts is closely equivalent to 0.001 mass units, the 52×10^6 e.v. and 43.3×10^6 e.v. would reduce the expected mass of uranium lead to 206.005 and that of thorium lead to 208.004, which agree within the experimental error with the values deduced from the observations in the first paragraph. Unfortunately, the precision of the measurements is not yet sufficient to decide whether the maximum energy of the β -rays (9×10^6 e.v. and 6.3×10^6 e.v.) or the mean energy must be considered, or even whether their energy has a definite mass equivalent.

A. J. DEMPSTER.

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June 13.

¹ NATURE, [137, 120 (1936)].

² F. W. Aston, NATURE, 137, 358 (1936).

Ranges of Particles Emitted in the Disintegration of Boron and Lithium by Slow Neutrons

I HAVE determined the ranges of particles emitted during disintegration of ^{10}B and ^6Li by slow neutrons, using a boron or lithium-coated ionization chamber connected with a Hoffmann electrometer. The ranges were deduced from the position of angles on the curves representing the ionization as a function of the pressure. The chamber filled with air was a brass cylinder of 8 cm. inner diameter and 10 cm. height. In the case of boron, pure finely powdered boron mixed with some water was distributed over the inner walls of the chamber; the density of the layer after evaporation of water was 2×10^{-3} gm./cm.². In the case of lithium, lithium hydroxide made insoluble by heating at a high temperature was spread over the surface in an analogous manner with the same density as before. About 10 millieuries of polonium mixed with beryllium were used as source of neutrons, and the chamber was surrounded with a large cylindrical block of paraffin wax for slowing down the neutrons.

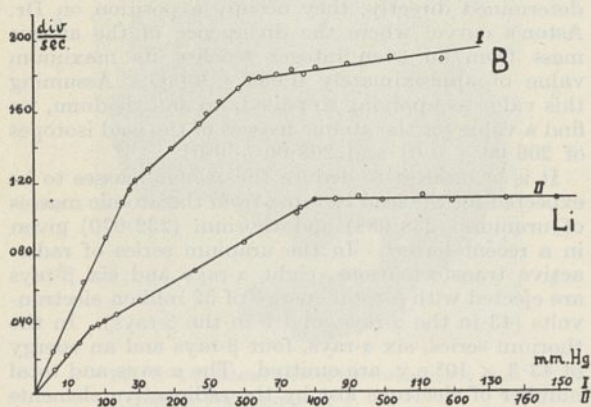


FIG. 1.

In order to evaluate the effect due to slow neutrons, measurements were made at each pressure (*a*) with neutrons filtered through a sheet of cadmium 0.5 mm. thick, (*b*) without cadmium. The difference *b* - *a* is due to slow neutrons only.

These differences are plotted against the pressure of air on Fig. 1. The angles corresponding in the case of boron (Curve I) to α -particles and ^7Li nuclei, and in the case of lithium (Curve II) to α -particles and ^3H nuclei are well apparent. They occur respectively at the following pressures:

Disintegration of boron: α , 62 mm.; ^7Li , 27.6 mm.
Disintegration of lithium: α , 82 mm.; ^3H , 408 mm.

Owing to the shape of the chamber, the paths of particles *in vacuo* were of unequal length, and it was therefore necessary to define a 'mean effective length of path'. To do this, the apparatus was calibrated in the following way. To the boron powder a few drops of an extremely weak solution of polonium were added, and the substance spread over the walls in exactly the same manner and quantity as before. The ionization pressure curve gave 293 mm. for the position of the angle, which gives 10 cm. as the 'effective mean length of the path' of the particles. Using this value, I obtained the following values for the ranges:

Disintegration of boron: α , 8.18 mm.; ^7Li , 3.64 mm.
Disintegration of lithium: α , 10.8 mm.; ^3H , 53.6 mm.

The ranges for α -particles correspond to the energy $E_{\alpha\text{B}} = 1.43 \times 10^6$ e.v. and $E_{\alpha\text{Li}} = 1.93 \times 10^6$ e.v. respectively¹.

Owing to the conservation of quantity of movement, the total kinetic energy of the emitted particles is equal to $\frac{m' + m_a}{m'} \times E_a$, E_a being the energy of the α -particles, m' the mass of the nucleus emitted simultaneously with the α -particles (namely, ^7Li in the case of boron and ^3H in the case of lithium). If the disintegration is not followed by any γ -ray emission, this kinetic energy represents the total energy, E_{B} and E_{Li} , released in the nuclear processes under examination. Assuming this to be true, I find $E_{\text{B}} = \frac{1}{2}E_{\alpha\text{B}} = 2.24 \times 10^6$ e.v., and $E_{\text{Li}} = \frac{2}{3}E_{\alpha\text{Li}} = 4.5 \times 10^6$ e.v.

Using the following atomic masses², $n = 1.0091$, $^2\text{H} = 3.0171$, $^4\text{He} = 4.0039$, $^6\text{Li} = 6.0167$, $^7\text{Li} = 7.0180$, $^{10}\text{B} = 10.0161$, I find $E_{\text{B}} = 0.0033$ mass units, or 3.07×10^6 e.v., and $E_{\text{Li}} = 0.0048$ mass units, or 4.48×10^6 e.v. The agreement is excellent in the case of lithium, while in the case of boron the discrepancy is greater than could be attributed to errors in the determinations of ranges. If instead of the experimental velocity-range relation given by Blackett and Lees, we use the numbers calculated from the theories of Bethe and of Bloch³, then the agreement is in both cases within probable experimental errors. It may also be noticed that Curve I for boron shows a slight increase even at pressures at which the ionization should be constant. This increase may correspond to an unknown mode of release of energy, perhaps related to the existence of γ -rays of boron, reported by Kikuchi, Aoki and Husimi⁴.

The cross-section of the boron nucleus for capture of a slow neutron was found to be eight times greater than the cross-section of the lithium nucleus.

My thanks are due to Prof. L. Wertenstein for his interest in this work.

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June 27.

- ¹ Blackett and Lees, **134**, 658 (1931).
² Olliphant, **NATURE**, **137**, 396 (1936).
³ M. Curie, "Radioactivité", tables (1935).
⁴ **NATURE**, **137**, 745 (1936).

Kikuchi Lines from Etched Copper Crystal

It is well known that a cross-grating pattern of spots is produced when a fast electron beam is incident, at a small angle, on the etched surface of a single crystal. Two explanations have been given of this phenomenon. Thomson¹ showed that the effect would arise if the electrons passed through small projections on the surface, while Germer² attributed it to distortion of the crystal lattice. When etched single crystals of zincblende and galena were studied by Tillman³, he found Kikuchi lines to be present in addition to the cross-grating and, as has been pointed out previously⁴, the presence and sharpness of Kikuchi lines may be taken as a criterion of the degree of perfection of the crystal lattice.

It has been found that an etched single crystal of copper gives Kikuchi lines along with a cross-grating of spots (Fig. 1). The crystal was cut from a freshly prepared single-crystal rod which had been carefully protected from any distortion. Subsequent specimens,

cut from the same rod and etched in the same way, did not give Kikuchi lines, due to the inevitable slight bending of the rod during the first sawing operation. The Kikuchi lines observed were not so

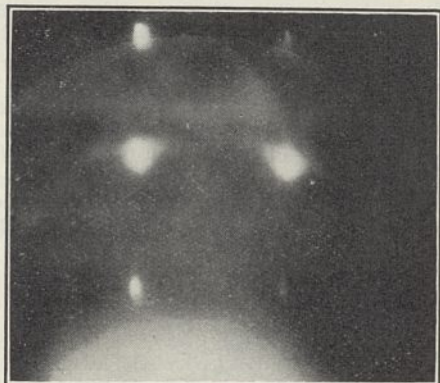


FIG. 1.

sharp as those from zinblende and galena but, nevertheless, they do not indicate a degree of distortion sufficient to allow the formation of a cross-grating pattern in the way suggested by Germer.

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June 18.

¹ G. P. Thomson, *Proc. Roy. Soc., A*, **133**, 1 (1931).² L. H. Germer, *Phys. Rev.*, **44**, 1012 (1933).³ J. R. Tillman, *Phil. Mag.* (7), **18**, 656 (1934).⁴ G. P. Thomson, *Phil. Mag.* (7), **18**, 640 (1934); J. R. Tillman, *loc. cit.*

Chemistry of Growth Substance B

SOME years ago, we found¹ that a growth substance acting upon *Aspergillus niger* and other moulds was produced when sugars (both pentoses and hexoses) were heated in a solution which also contained some organic acids or salts of these acids. This growth substance only acts when small amounts of ten different metals are added². Also the growth substance produced by moulds or the growth substance extracted from plants, urine, etc., needs these metals to be able to influence the growth of moulds. We called these metals 'co-growth substances'.

TABLE I.

Added per 50 c.c.	Dry weight in mgm.
1.0 mgm. pyruvic acid	219
0.3 mgm. glycolic acid	167
1.0 mgm. pyruvic acid + 0.3 mgm. glycolic acid	343
No addition	132

A continued investigation has shown that this growth substance is produced when sucrose is inverted by means of organic or inorganic acids. For example, a solution of 25 per cent sucrose may be inverted by hydrochloric acid at room temperature. If some of this sugar solution is added to a culture of *Aspergillus niger* after the hydrogen ion concentration has been adjusted, the growth of *Aspergillus* will increase very much. An attempt to purify the active substance is not yet finished; but it has

been shown that glycolic acid and pyruvic acid act as growth substances upon *Aspergillus niger*. Glycolic acid or pyruvic acid alone have little or no effect on the growth; but when added together they have a considerable effect.

It is seen from Table I that the growth of *Aspergillus niger* is more than doubled by the addition of glycolic acid and pyruvic acid. Some other organic acids also seem to have some influence on the growth. Thus ascorbic acid has a rather large effect when added together with glycolic acid and pyruvic acid, but not alone. Glyoxylic acid seems to have a very strong growth-accelerating influence when added alone or together with the glycolic acid and the pyruvic acid (Table II).

TABLE II.

Added per 50 c.c.	Dry weight in mgm.
1.0 mgm. pyruvic acid + 0.3 mgm. glycolic acid	451
1.0 mgm. pyruvic acid + 0.3 mgm. glyoxylic acid	551
10.0 mgm. glyoxylic acid	503
10.0 mgm. glyoxylic acid	252
No addition	252

The growth substances which act upon *Aspergillus niger* and other moulds are very resistant to oxidation. If a mixture of different plant growth substances is oxidized by means of potassium permanganate or hydrogen peroxide the growth substances which act upon yeast are destroyed, whereas the growth substances acting upon moulds are not destroyed. In this way the two groups of growth substances may be separated.

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¹ *Biochem. Z.*, **256**, 2 (1932).² *Biochem. Z.*, **259**, 340 (1933).

Relative Velocities of the Absorption of Different Sugars from the Intestine of Rat and Pigeon

THE different velocities, with which various simple sugars are absorbed from the intestine, are among the outstanding facts which demonstrate the active part played by the intestinal mucosa during absorption. Cori¹, for example, finds for the ratio of the absorption velocities of *d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose in the rat: 110 : 100 : 43 : 19 : 15 : 9; while Verzár's pupils Wilbrandt and Lasz² find 115 : 100 : 44 : 33 : 30 : 29; and McCance and Madders³ for the ratio of the last two sugars 44 : 25. According to Verzár and his collaborators, the absorption of the hexoses is inhibited by monoiodoacetic acid in contrast with that of the pentoses *l*-xylose and *l*-arabinose, which should not be affected by it. This, combined with the fact that they found equal absorption velocities for these two sugars, leads them to conclude that the absorption process in the case of the pentoses is a simple diffusion from the gut to the blood.

Now, I have shown⁴ that the absorption velocities of glucose, galactose and fructose are largely affected by the composition of the diet to which the rats are accustomed, at least when there is only a short fasting period before the beginning of the absorption experiment. There is a real adaptation of the absorption to the presence of these sugars in the diet: the

absorption of glucose is increased by the presence of glucose, fructose or galactose in the diet, compared to a carbohydrate free diet; the absorption of fructose, however, is more specifically stimulated by fructose, the absorption of galactose by galactose in the diet.

From these data several further questions arise. First, has the sequence of absorption velocities, as cited above, a general meaning, or is it more or less a casual product of dietary conditions? Secondly, what are the relative velocities of xylose, and arabinose absorption, those of Verzár and his associates, or those of Cori and those of McCance and Madders? If the latter authors be right, is there really a contrast between the hexoses and xylose as regards monoiodoacetic acid intoxication? Does the ratio of the velocities hold only for the rat, or is it general? Lastly, if it is shown to hold for other animals, at what stage of evolution does it appear first?

I have been carrying out experiments on rats and pigeons which for five days had been on a diet consisting only of fat, casein and salts (no vitamins, as I feared to introduce carbohydrate with the yeast). The rats showed the following series of absorption velocities: *d*-galactose : *d*-glucose : *d*-fructose : *d*-mannose : *l*-xylose : *l*-arabinose = 108 : 100 : 42 : 15 : 13 : 2; the pigeons gave 115 : 100 : 55 : 33 : 33 : 16. Thus there is no essential difference between my results with the rat and Cori's, and also there is no fundamental difference between the rat and the pigeon. Thus the same relationship holds for two species belonging to different, though not quite remote, classes. The smaller differences may easily be explained by differences of technique.

The pigeon showed itself much more sensitive to monoiodoacetic acid than the rat. Doses which did not kill it in two hours did not affect glucose absorption. In the case of the rat, however, not only inhibition of glucose absorption was observed, but also of xylose absorption. I believe that it is quite possible that the inhibitory effect of monoiodoacetic acid is not a direct influence on the metabolism of the intestinal mucosa, as Prof. Verzár thinks, but is a consequence of its disturbing effect on the circulation system.

A full account of my experiments will be given in *Arch. néerl. Physiol.* Experiments with lower animals have been started.

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Lab. voor Physiologische Chemie,
Universiteit van Amsterdam.
July 1.

¹ C. F. Cori, *J. biol. Chem.*, **66**, 691 (1925).

² W. Wilbrandt and L. Lasz, *Biochem. Z.*, **259**, 398 (1933).

³ R. A. McCance and K. Madders, *Biochem. J.*, **24**, 795 (1930).

⁴ H. G. K. Westenbrink, *Arch. néerl. Physiol.*, **19**, 563 (1934).

Several Spontaneous Chromosome Aberrations in *Drosophila*

THE solution of the problem of the phylogeny of the *Drosophila* species requires, in addition to a comparison of the structure of the chromosome in the salivary gland nuclei of related species, also a study of the spontaneous chromosome aberrations. Dubinin, Sokolov, Tiniakov¹ have found a large number of highly concentrated inversions in autosomes in populations of *D. melanogaster* and *D. funebris* taken from different places, but they have found no inversions in the X-chromosome, nor no translocations and no deficiencies.

Mass cultures may be compared to a certain extent with populations distributed on a small area, especially when the hatched flies are transferred on to fresh food without being selected. During six months, I studied the salivary gland chromosomes of four *Drosophila* species (*hydei*, *repleta*, *sulcata* and *lugubrina*) taken from such mass cultures. I found six spontaneous aberrations, of which only three were inversions in the autosomes (one in *D. repleta* and two in autosome II of *D. sulcata*). The other three spontaneous aberrations were chromosome rearrangements which have not been discovered in Nature by Dubinin, Sokolov and Tiniakov, namely, a deficiency in an autosome of *D. lugubrina* and two inversions in the X-chromosome of *D. sulcata*.



FIG. 1.

A heterozygous deficiency in one autosome limb of *D. lugubrina* (Fig. 1) was detected in about two-thirds of the number of larvæ in one culture; this heterozygous deficiency is retained in mass cultures throughout eight months.

The heterozygous inversions in the two limbs of the X-chromosome of *D. sulcata* (Fig. 2) belong, strictly speaking, to two different haploid chromosomes. They occurred independently of each other in two different mass cultures and were retained for several months.

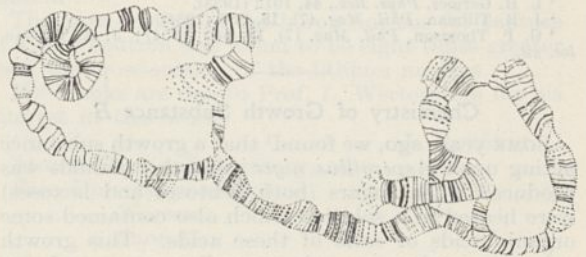


FIG. 2.

In these cultures the females heterozygous for inversions in the right or left limb of the X-chromosome were much more numerous than normal ones, and in addition to normal males there were males with an inversion in one of the limbs of the X-chromosome. Only owing to the viability of the males with an inversion in the X-chromosome could both inversions join in one individual in the case when a chance intermixture of flies from two different mass cultures occurs.

Of course, females with two inversions simultaneously may be only heterozygous. Females homozygous for inversions in one of the limbs are theoretically possible, but in fact they have not been detected either in mass nor in individual cultures. These females are apparently non-viable, this being proved by the numerical predominance of the males in individual cultures, where one of the inversions in the X-chromosome has been detected in the larvæ.

Two inversions in both limbs of the second autosome of *D. sulcata* belong to one chromosome because they are always detected simultaneously. No individuals, homozygous for these inversions, have been

found. Chromosome II, heterozygous for both inversions, was found in one of the cultures where both inversions of the X-chromosome had been detected. Consequently, in this culture a small number of larvæ with a normal chromosome set and individuals with combinations varying between normal chromosomes and inversions both in the X-chromosome and autosome II were observed; which phenomena may also take place in populations in Nature.

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June 21.

¹ NATURE, 137, 1035 (1936).

The Teaching of Science in Schools

WITH much of what Mr. H. S. Shelton says on the subject of science teaching in schools, in his letter in NATURE of July 18, every teacher will agree. For example, closer association of prominent men of science with secondary education would be welcomed and would be most desirable. It is probable, too, that if another Committee were appointed, similar in constitution to that which sat in 1916-18 under the chairmanship of Sir J. J. Thomson, it would perform valuable service.

Unfortunately, however, Mr. Shelton includes in his letter a number of statements which may mislead those not closely in touch with what is happening. In the first place, it is inaccurate to say that the recent conference on general science represented a belated attempt to implement the (Thomson Committee) recommendation "That the science work . . . should include . . . some study of plant and animal life". The title given to the conference meant what it said and, as a matter of fact, far more schools include biology in their curriculum than Mr. Shelton probably recognizes. Before long, there will be few which do not.

Nor does the sub-committee appointed by the Science Masters' Association to consider the teaching of general science propose (as Mr. Shelton hints) to recommend a time-allowance of three hours per week. On the contrary, its members heartily endorse the original Thomson Committee recommendation that "the time given to science should be *not less* . . . than 6 periods". They would, indeed, prefer a more generous allowance than this.

Facts must, however, be faced: in many schools the recommendation has not been implemented. So that the report might prove useful to teachers in such schools, and so that it might not be merely an academic curiosity, the sub-committee has decided to work out two distinct syllabuses, of which the one to which Mr. Shelton refers is the less important.

When Mr. Shelton writes "If this proposal comes into being, we shall be back again in pre-scientific times", he seems to me guilty of pessimistic exaggeration. By "proposal", I suppose he means the publication of a syllabus, since no one proposes to recommend diminishing the time allowance given to science. It is very unlikely, after all, that the publication of a syllabus—explicitly stated as intended for schools giving a meagre time allowance to science—will encourage the more enlightened headmasters to curtail the time given to the subject in their own schools.

Lastly, I cannot subscribe to Mr. Shelton's statement that "The whole problem of the school time-table

is now in hopeless confusion. No attempt is being made, for example, to correlate the mathematics and the science . . ." Confusion is, on the whole, less than it was and in many of the best schools a genuine attempt is being made to achieve some degree of correlation and to act on the recommendations of the various committees which have already considered the matter.

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Dissociation Energy of Diatomic Sulphur, Selenium and Tellurium Vapours

ON the basis of the spectroscopic data of Naudé and Christy¹, Montgomery and Kassel² have recently calculated F^0 values for S_2 and the dissociation constant for the equilibrium $S_2 = 2S$. Their log K values are smaller by nearly 3 units than the experimental data of Nernst and v. Wartenberg³ at 2290° and 2350° K. Although these latter values may be somewhat erroneous, it seems highly probable that they give the right order of magnitude. The necessary corrections to Montgomery and Kassel's calculations according to the data on vibrational and rotational levels⁴ cannot explain this difference.

However, if we assume that the products of pre-dissociation of S_2 at $4.41 + 0.02$ v.⁵ (Montgomery and Kassel have used the value 4.45 v.) are $S(^3P) + S(^1D)$ instead of two normal 3P atoms, we get $D_{S_2} = 3.28$ v. and the dissociation constant falls within the limit of error of Nernst and v. Wartenberg's measurements.

The dissociation measurements of Nernst and v. Wartenberg allow also of the calculation of the dissociation energy of Se_2 and Te_2 , although the necessary spectroscopic data are not yet sufficient for a high degree of accuracy. The accompanying table summarizes the thermochemical and spectroscopic values of the dissociation energies. In the case of sulphur, the normal state of the molecule is a $^3\Sigma$ state⁴, whereas in the case of Se_2 and Te_2 it is not certain whether it is a $^3\Sigma$ or a $^1\Sigma$ state. In the table, the first value corresponds to the former, the second value to the latter case.

Dissociation energy in electron-volt

	from spectroscopic data	from equilibrium data at 2350° K.
S_2	4.41 ± 0.02 or 3.28 ± 0.02	3.2
Se_2	3.1 ± 0.2^6	2.7 or 3.1
Te_2	2.3 ± 0.2^7	2.0 or 2.4

With the value $D_{S_2} = 3.28$ v., the equilibrium measurements for the three equilibria would be in good agreement; they would also be consistent with the spectroscopic data. If $D_{S_2} = 4.41$ v. is correct, however, we would have to assume a very considerable error in Nernst and v. Wartenberg's measurements in the case of S_2 , although the agreement is satisfactory for Se_2 and Te_2 .

On the other hand, the value $D_{S_2} = 3.28$ v. would mean that the dissociation products in the upper level of the main S_2 -band system are not $^3P + ^1D$ as in the analogous levels of O_2 , Se_2 and Te_2 , but probably $^3P + ^1S$. Although there is spectroscopic

evidence in favour of this solution⁶, it is not quite satisfactory.

The two possibilities could be tested by measuring the energy of combustion of the SO molecule, which has been recently isolated by Schenk⁸. For this molecule as well as for S₂, two values are possible, $D_{SO} = 5.05$ v. and $D_{SO} = 3.92$ v., corresponding to the two possible interpretations of the predissociation at 5.05 v. A thermochemical cycle gives for the heat of combustion of SO, for the possible values of D_{S_2} and D_{SO} , the values 63, 77, 90 or 104 kcal., so that a measurement of that heat of combustion would give D_{SO} as well as D_{S_2} .

Note added in proof: In a recent paper⁹, Olsson suggests the value 3.6 v. for D_{S_2} on the basis of his experiment on the induced predissociation. His interpretation of the process of induced predissociation is, however, not necessarily correct⁶ and the value 3.6 v. does not agree with the attractive character of the S₂-level producing predissociation at 4.41 v.

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- ¹ *Phys. Rev.*, **37**, 490 (1931).
² *J. Chem. Phys.*, **2**, 417 (1934).
³ *Z. Elektrochem.*, **9**, 626 (1903); *Z. anorg. Chemie*, **56**, 320 (1908).
⁴ Olsson, *NATURE*, **137**, 745 (1936); *Z. Phys.*, **99**, 114 (1936).
⁵ Rosen, Désirant et Duchesne, *Phys. Rev.*, **48**, 916 (1935).
⁶ Rosen, *C.R. du Congrès de photoluminescence*, Varsovie 1936. In the press.
⁷ Désirant et Minne, *Bull. acad. Roy. Belg.*, **22**, 646 (1936).
⁸ Schenk, *Z. anorg. Chem.*, **211**, 150 (1935).
⁹ *Z. Phys.*, **100**, 656 (1936).

Scattering of Light by Light

IN a recent paper¹ Euler and Kockel have calculated the effective cross-section for the scattering of light by light. The calculation was carried out for the case of small frequencies ($\hbar\omega \ll mc^2$), the frequencies being taken in a frame of reference, where the total momentum of the colliding quanta vanishes.

We have calculated the cross-section for the opposite case of large frequencies ($\hbar\omega \gg mc^2$). For the integral cross-section we get an expression of the form:

$$\sigma = a \alpha^4 \left(\frac{c}{\omega}\right)^2,$$

where $\alpha = \frac{c^2}{\hbar c}$ with a constant a , which is difficult to

compute. According to Euler and Kockel, for small frequencies σ is proportional to ω^6 . Consequently σ has a maximum value in a region $\hbar\omega \sim mc^2$.

It is also difficult to compute the dependence of the differential cross-section on the angle of scattering. We find that for the small angles the polarization of the light quanta is not altered. The differential cross-section for small angles is

$$d\sigma = 8\pi \alpha^4 \left(\frac{c}{\omega}\right)^2 \log^4 \Theta d\theta,$$

Θ being the angle of scattering and $d\theta$ the solid angle. This formula is valid for small angles, but not essentially small compared with $mc^2/\hbar\omega$. In the latter case it is necessary to insert into the logarithm $mc^2/\hbar\omega$ in place of Θ .

The formula has a relative accurateness of $1/\log\Theta$. The cross-section increases with decreasing angles,

but not very rapidly, and it is impossible to affirm that this region plays the main role in the integral cross-section.

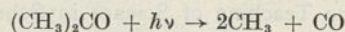
The detailed calculations will appear elsewhere.

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Khar'kov, U.S.S.R.
I. POMERANCHOOK.

¹ *Naturwiss.*, **23**, 246 (1935).

Mechanism of the Photo-Decomposition of Acetone

IN continuation of an investigation which has been reported elsewhere¹, an attempt was made to produce free methyl radicals by the photo-decomposition of acetone. According to Norrish, Crone and Saltmarsh², the radicals are produced by the following mechanism:



which is based on the latter authors' observation that at 60° the main products are equal volumes of carbon monoxide and ethane.

At room temperature, however, we were unable to obtain this equivalence, the volume of ethane being always 1.5 times that of the carbon monoxide. Furthermore, we were able to isolate diacetyl from the liquid products in considerable quantity, determine its boiling point and prepare several derivatives. Diacetyl has previously been detected in the products of photo-decomposition of aldehydes and ketones by Barak and Style³.

Further experiments with filtered light of different intensities and with different concentrations of acetone suggest that the primary photo-chemical process is:



However, when the photolysis is carried out at 60°, approximately equal amounts of carbon monoxide and ethane are formed together with some methane, the acetyl radical evidently being extremely short-lived at this temperature.

A detailed account of the experiments will be given in a forthcoming publication.

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W. WILD.

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Leeds.
June 16.

- ¹ *Proc. Leeds Phil. Soc.*, **3**, 141 (1936).
² *J. Chem. Soc.*, 1456 (1934).
³ *NATURE*, **135**, 307 (1935).

Proposed Suspension of Rules of Nomenclature in the Case of Bohadsch 1761

THE undersigned invites the attention of the zoological profession to the fact that application has been made to the International Commission on Nomenclature to suspend the Rules in Bohadsch 1761, "De Quibusdam Animalibus Marinis" and its translation 1776, on the ground that the application of the rules in these cases will produce greater confusion than uniformity.

Zoologists interested in this case, for or against suspension, are invited to present their views to the Commission.

C. W. STILES.
(Acting Secretary.)

U.S. National Museum,
Washington, D.C.

Measurement of River Bores

WITH reference to the note in NATURE of April 25, p. 711, concerning the observations of the bore in the River Trent, may I direct attention to the observations made by the surveyors of Whangpoo Conservancy Board in February 1920 on the famous bore of the Ch'ien Tang River? Apart from general tide readings, special water-levels were observed every ten minutes during the day and every minute for one hour before and after the passing of the bore, at six stations covering a reach of $18\frac{1}{2}$ miles, for two weeks. The maximum height of the vertical face of the bore was $4\frac{1}{2}$ feet, the total rise in that tide being about 16 feet.

Representative figures, diagrams and photographs are given in the publication entitled "Report on the Hydrology of the Hangchow Bay and the Ch'ien Tang Estuary". This is now out of print, but a copy was deposited in the Science Library at South Kensington.

HERBERT CHATLEY,
(Engineer-in-Chief.)

Whangpoo Conservancy Board,
Shanghai.
May 29.

The Beams Ultracentrifuge

AN ultracentrifuge designed by Beams has been in operation in this laboratory for the past year. From information published^{1,2,3,4}, we assumed the forces to be of the order of 5×10^5 times gravity when driven by air at about 80 lb. pressure. On subsequent measurement we find that the maximum force developed is 4×10^6 times gravity. This is obtained at a speed of 10,000 r.p.s., which is considerably in excess of that obtained by Beams⁴ with a similar rotor under the same conditions.

The figures given in cytological papers from this Department therefore require correction.

A paper on the apparatus and methods of measurement is in course of preparation.

W. CUSACK FAHIE.

University College,
Dublin.

RALPH H. J. BROWN.

Trinity College,
Dublin.

¹ Beams, *Rev. Sci. Inst.*, **1**, 667 (1930).

² Beams and Weed, *Science*, **74**, 44 (1931).

³ Beams, Weed, and Pickels, *Science*, **78**, 333 (1933).

⁴ Beams and Pickels, *Rev. Sci. Inst.*, **6**, 229 (1935).

Points from Foregoing Letters

A DESCRIPTION of a new fossil human skull from the middle gravels of the Thames 100 ft. terrace at Swanscombe, Kent, is given by A. T. Marston. Its features are those of a specialized type less advanced than the well-known Piltdown skull. The author considers that the Piltdown skull must be assumed to come from a later geological horizon than the Swanscombe skull.

Values of 206.00 and 208.00 for the mass of lead isotopes are calculated by Prof. A. J. Dempster, by comparison with palladium and rhodium, by means of the mass spectrograph. This is in agreement with the atomic masses to be expected for lead isotopes derived from the radioactive transformation of uranium (238.088) and thorium (232.070), allowing for the loss of mass due to the emission of alpha-rays (helium) and beta-rays (electrons), and also for the mass equivalent of the energy of the emitted particles.

Graphs showing the ranges of particles emitted by boron and lithium (due to the capture of slow neutrons only) at different air pressures are submitted by J. Rotblat. Taking into account the most probable values of the masses of the particles involved in the transformation, the author finds in the case of lithium good agreement with the total energy calculated (4.5×10^6 e.v.). In the case of boron good agreement is obtained if the velocity-range calculated from the theories of Bethe and of Bloch is substituted for the experimental velocity-range relation given by Blackett and Lees. The boron curve indicates that there is an additional release of energy from boron, probably in the form of gamma-rays.

When a fast electron beam is diffracted by an etched surface of a single crystal of copper, Dr. W. Cochrane finds, in addition to the cross-grating pattern, also the 'Kikuchi' light and dark line

pattern, which indicates a high degree of perfection in the crystal.

Data indicating the growth-promoting action of glycolic, pyruvic and glyoxylic acids upon the mould, *Aspergillus niger*, are given by N. Nielsen and V. Hartelius, in continuation of their investigation on the nature of the growth substance produced when cane sugar is inverted by means of acids.

Dr. H. G. K. Westenbrink shows that fundamentally the same ratio holds for the velocities of intestinal absorption of certain sugars (*d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose) with the rat and the pigeon. With both rat and pigeon there is a distinct difference between the velocities of absorption of *l*-xylose and *l*-arabinose.

Dr. S. L. Frolova describes and illustrates spontaneous aberrations of the chromosomes in mass cultures of several species of the fruit-fly, *Drosophila*. Of six changes observed, three were inversions in the autosomes of *Drosophila repleta* and *D. sulcata* and the other three consisted of a deficiency in an autosome of *D. lugubrina* and two inversions in the X-chromosome of *D. sulcata*.

A table summarizing the values of the dissociation energies of the sulphur, selenium and tellurium molecules, as deduced from both spectroscopic and thermochemical observations, is given by P. Goldfinger, W. Jeunehomme and B. Rosen. The authors state that a determination of the heat of combustion of the recently isolated sulphur monoxide would enable a choice to be made between the alternate values deduced from spectroscopic data.

A. Akhieser, L. Landau and I. Pomeranchuk have calculated the cross-section for the scattering of light quanta by light quanta for the case of large frequencies.

Research Items

Early Man in New Mexico

IN view of the discovery by Mr. E. B. Howard of stone artefacts attributed to Folsom man in association with the fossil remains of extinct mammals in what he termed "blow-outs" near Clovis, New Mexico, it is essential for chronological purposes that the geological character of these formations and the conditions in which the remains and artefacts were deposited should be clearly understood. This question was investigated by Messrs. Chester D. Stock and Frances D. Bode of the California Institute of Technology (*Proc. Acad. Nat. Sciences, Philadelphia*, 88, 1936). The "basins"—a term preferable to either "blow-out" or "lake", which are misleading—are depressions, usually several hundred feet in diameter and two to ten feet in depth, in a long shallow trough, the Black Water Draw, from five to ten miles wide, which originates some thirty miles south-west of Clovis. The basins have been formed by wind-action, which has scoured the soil and underlying sediments of the centre, piling it up as sand dunes on the periphery, down to the Blue Sand (a blue-grey sandstone), which forms a smooth flat unbroken floor. As the Blue Sand is cut away—in the centre to a depth of four or five feet—flat benches with steep vertical banks develop. Residual areas capped by Blue Sand are left standing on the floor like islands. Erosion does not proceed beyond the Blue Sand. Probably the Blue Sand underlies the entire floor of Black Water Draw near Clovis. Masses of broken bones are found weathering out of the Blue Sand. These include bison, horse, elephant and camel. Flint chips are abundant on the floor of every basin, and several types of artefacts are associated with them. Artefacts of the Folsom or Yuma type occur only where the Blue Sand has been dissected. Convincing association with fossil mammal material was demonstrated in at least two basins, the Gravel Pit and Anderson Lake. Charcoal suggests a fire, but not necessarily of human origin, as it may be due to spontaneous combustion. The stratigraphic and physiographic relations of the Blue Sand to the present landscape suggest that it is possible to assign a very recent age to the deposit. It dates back to a pluvial period when the rainfall was greater than it is to-day; but this period does not necessarily fall into Pleistocene times.

Apparent Transformation of one Virus into Another

THERE are two inoculable tumour-diseases of rabbits, somewhat similar in appearance, and both caused by ultra-microscopic filterable viruses. One, rabbit myxoma, is malignant and always fatal; the other, rabbit fibroma, is never fatal and ultimately ends in recovery. A curious fact recently observed is that animals that have recovered from an attack of fibroma are unsusceptible to myxoma, and cannot be inoculated with it. According to Science Service, Dr. George Berry has reported at the meeting of the American Association for the Advancement of Science at Rochester, N.Y., that when active fibroma virus is mixed with myxoma virus killed by heating and the mixture injected into rabbits, the animals develop the deadly myxoma and die. That is to say, the benign fibroma virus by admixture with dead

myxoma virus is apparently transformed into the myxoma virus. Controls with the dead myxoma virus alone had no effect. Further details respecting this important observation, which has been repeated many times, will be awaited with interest.

Microbiology of Australian Soils

THE results of a study, at different ranges of temperature, of the rate of decomposition of organic matter in soil in relation to the numbers of micro-organisms present are detailed in a recent paper by Mr. H. L. Jensen (*Proc. Linn. Soc. N.S.W.*, 61, 27-55; 1936). The decomposition rate was measured by the carbon dioxide production. In soils to which there had been no addition of organic matter, the carbon dioxide production was generally 100 per cent stronger at 28° than at 15° C., and some 50 per cent stronger at 37° C. than at 28° C. At each temperature, there was a significant correlation between daily yields of carbon dioxide and direct counts of bacteria. Growth of fungi was more extensive in sand soils than in loam soils, but no correlation was found between density of mycelium and yield of carbon dioxide. Decomposition of the soil's own 'humus' seems to be carried out almost entirely by bacteria, the accelerating influence of increasing temperature being due to stimulation of the metabolic activity of the bacteria. In soils to which various undecomposed plant materials (straw, hay, fungal mycelium) had been added, the rate of carbon dioxide production increased steeply with rise of temperature from 5° C. to 37° C. Significant correlations appeared between daily yields of carbon dioxide and densities of mycelium, and also between yields of carbon dioxide and direct counts of bacteria, but not between carbon dioxide yields and plant counts. The efficiency of the organisms decreased rapidly with advancing time. The fungi appeared to be important agents of decomposition during the earlier stages when the most intensive destruction of organic matter takes place. It is suggested that, especially at 28° C., their carbon dioxide production may considerably exceed that of the bacteria; with advancing degree of decomposition they cease to be of importance. The decreasing rate of decomposition of added organic materials, together with the increasing accumulation of microbial substance, seems to offer an explanation for the increasing accumulation of 'humus' with decreasing soil temperature.

Californian Shrimps of Commerce

MR. HUGH R. ISRAEL'S researches on the commercial shrimps of California are interesting and instructive ("A Contribution Towards the Life Histories of Two Californian Shrimps, *Crango franciscorum* (Stimpson) and *Crango nigricauda* (Stimpson)". Division of Fish and Game of California. Bureau of Commercial Fisheries. Fish Bull., No. 46, 1936). Both species move towards the ocean as the spawning season approaches, and the eggs hatch in water of high salinity, the young shrimps migrating farther inshore into less saline water, and as they grow larger gradually moving into deeper water. Both species breed at the end of their first year, and soon afterwards disappear from the commercial catch, the main

breeding season being December–May or June for *Crago franciscorum* and April–September for *C. nigricauda*. A very large catch of *C. franciscorum* in 1932 was made after the breeding season had ended, and one of *C. nigricauda* corresponded exactly with the breeding season. It is suggested that as in May and June 1933 the expected increase of this species did not occur, the heavy inroads made during the spawning season of the year before may be responsible. Very little is known about the planktonic larval stages of their shrimps, although it is presumed that they are similar to those of *C. vulgaris*. The latter species, however, may breed close inshore, and it would be useful to make a careful survey of the larvæ of these two Californian shrimps. The post-larval stages are taken at a considerable distance from the ocean in the shallow water of tidal flats and shoals.

Cercospora Leaf-Spot of Tobacco

A DISEASE of tobacco caused by the fungus *Cercospora nicotianæ* has attained severe proportions in the tropical areas of Queensland, Australia, the Dutch East Indies, Rhodesia and Nyasaland. The organism may produce spots upon leaves of the host at any stage of growth, and if it occurs in epidemic form shortly before the harvest, it results in a very destructive 'barn spot' during the process of curing. Mr. A. V. Hill has made a thorough study of the disease (*Bull.* 98, Coun. Sci. and Ind. Res., Australia, Melbourne, 1936), and shows that it can attack twelve species of *Nicotiana*, in addition to the thorn apple and *Nicandra physaloides*. The optimum temperature for growth of the fungus is 26° C., and outdoor temperatures of this order, combined with rainy periods, greatly aggravate the effects of the malady. Seed from infected capsules is capable of transmitting the disease to a subsequent crop grown from it, and the main control measure lies in the use of healthy seed. Many other aspects of the problem are discussed in the paper, which has also seven excellent plates illustrating symptoms and the causal organism.

The Angiospermic Carpel

DR. I. V. NEWMAN has published (*Proc. Linn. Soc. N.S.W.*, 61, 56–88; 1936) details of his studies of the floral apex of *Acacia longifolia* and *A. suaveolens*, which have induced him to champion the old theory of the origin of the carpel, and to criticize theories advanced in recent years by a number of investigators. After discussion of the evidence he concludes that (i) the legume is a lateral structure, (ii) the legume is a single, folded structure, (iii) the legume is not a foliar structure; and considers that in the two species dealt with there is no reason for doubting that the legume is of foliar nature and that it is reasonable to interpret the flowers of these species as modified leafy shoots. The subject has recently been under notice in the columns of NATURE (137, Jan. 11; March 14, 1936).

Lunar Periodicity of Earthquakes

OF the three laws that Perrey stated as governing the lunar frequency of earthquakes, the third, according to which earthquakes are more frequent when the moon is near the meridian than when it is at a distance of 90° from it, has suffered most from recent criticism. Mr. M. W. Allen (*Bull. Amer. Seis. Soc.*, 26, 147–157; 1936) urges, however, that this criticism depends on statistics obtained from large areas, and takes no

account of the strike or hade of the faults concerned. He has, therefore, considered the earthquakes during about forty-five years that originated within five or ten miles from three great faults in California. The earthquakes were grouped in different intervals of time, and harmonic analysis was applied to the numbers of shocks within lunar hour angles of 30°. Mr. Allen shows that, for the second harmonic alone, that associated with the semi-diurnal lunar effect, does the epoch incline towards constancy. Moreover, the amplitudes of this harmonic are more prominent than the others, ranging about 0.25 and being in some intervals nearly four times as great as that required by Schuster's test. It is thus difficult to escape the conclusion that "the semi-diurnal lunar tidal forces have in some manner acted to determine the moment of occurrence of a significant number of the shocks of the region of the San Jacinto, Agua Caliente, and Elsinore faults".

Cosmic Rays

THE July issue of the *Journal of the Franklin Institute* devotes 81 pages to the report of the work of the Bartol Research Foundation 1934–35, made to the members of the Institute by Dr. W. F. G. Swann, the director of the Foundation. Almost the whole of the work during that period has centred around cosmic rays which have been investigated at ground-level, and at various altitudes up to 4,300 metres in Peru, Panama, Mexico and at stations in the United States up to 45° N. latitude. The 45 figures given enable the general reader to follow with ease the descriptions of the apparatus used and the results obtained. So far as they relate to the variation of the radiation with the latitude of the place of observation and angular distance from the zenith of the point from which they emanate they confirm the results of other observers, and they supply new facts as to the efficiencies of radiations from different directions in producing the secondary effects known as cosmic ray bursts. Dr. Swann concludes that the primary cause of the rays as measured is in the main an electrically charged particle of which the energy and the energy of the radiation measured is absorbed more rapidly when it is small than when it is large by its passage through the atmosphere.

The Compton Effect

IN the June issue of the *Review of Scientific Instruments*, Prof. E. L. Hill, of the University of Minnesota, reviews the recent work on this effect, and shows that the simple quantum theory of it, hitherto thought adequate, requires revision. That theory gives when a photon impinges on an electron: (1) the angle of deviation of the photon and its change of frequency, (2) the angle of recoil of the electron and its recoil energy, (3) that the three momenta concerned are coplanar and that the angles of deviation and recoil are related in a certain way. While conclusions (1) and (2) have been verified experimentally, the recent work of Dr. R. S. Shankland in Prof. Compton's laboratory has cast doubts on the simultaneous production of a photon deviation and an electron recoil which (3) assumes, and a revision of our corpuscular theories of radiation will be necessary. Dirac (NATURE, 137, 298; 1936) has expressed the opinion that most of the present quantum mechanics may be retained, but that the quantum theory of the electro-magnetic field will probably have to be sacrificed.

Flagella Movement

By A. G. Lowndes, Marlborough College

ALTHOUGH flagella movement or propulsion by means of a single flagellum is probably one of the first types of movement which came into existence, the fact remains that comparatively little is known

the amplitude of the waves decreases while the frequency increases and thus a series of small waves is produced. This is illustrated to perfection in *Peranema*, in which the waves pass along the flagellum

sufficiently rapidly to cause the tip to rotate rapidly while the proximal part appears to be rather stiffly extended.

The actual tip of the flagellum is bent round so that the impulses passing from base to tip actually produce a forward component, and it is only when the flagellum is extended in this manner that the organism swims forward with its maximum velocity (Fig. 3). The organism itself does not

rotate as it progresses, nor does the base of the flagellum.

In *Euglena viridis* the waves of distortion pass along the flagellum as in *Peranema*, but the flagellum is bent right back from the actual base. The waves passing along the flagellum produce both a lateral and a forward component, thus causing the organism to rotate as it moves forward (Fig. 4). The net result is that, as the organism swims forward, its anterior end traverses a circular path at right angles to the long axis of the animal, while the whole of the animal rotates.

Now *Euglena* is highly metabolic, or in other words, it changes its shape rapidly. If the organism approaches or meets anything which normally would compel a reversal or change of direction, the organism immediately swells out at its posterior end and thus

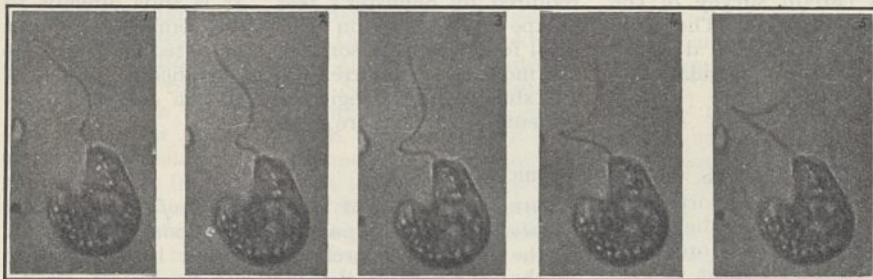


FIG. 1. *Peranema trichophorum*. Five consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/30 sec. approx. The wave is clearly passing up the flagellum. The dark spot in the flagellum shows where a slight twisting occurs. This results in the extremity of the flagellum rotating. Measurement shows that the wave passes up the flagellum with an increase in velocity.

for certainty about its actual mechanics. For example, it has always been a debatable point whether the flagellum is a passive unit mechanically operated by the cell, or an active structure developing partly or wholly its own energy. It is true that Gray¹ has given much evidence in favour of the latter view, but quantitative data are lacking. It has also been maintained in practically all standard text-books, that in all tractella or cases in which the flagellum is attached to the anterior end of the cell or organism, the waves of distortion pass from the tip of the flagellum to its base.

By the application of ultra-rapid cinema photomicrography² it has been possible to settle the one point and disprove the other. The flagellum is an active unit and generates its own mechanical energy. In the tractella of five species investigated, the waves of distortion start at the base of the flagellum and travel towards the tip.

Fig. 1 shows five consecutive exposures of the flagellum of *Peranema*, which is a very common monoflagellate with a so-called tractellum. The exact interval between the exposures is known, and so is the magnification. The distance from the base of the flagellum to the crest of the wave is easily measured, and on plotting this against the interval, it is established that the wave is passing along the flagellum with a definite increase in velocity.

Fig. 2 shows four consecutive exposures of the flagellum of the same species, but the flagellum is behaving rather differently. Both figures show, however, that a wave passes along the flagellum with an increase in velocity and also an increase in amplitude.

Reference to Fig. 1 also shows that as the wave of distortion passes along a flagellum, a certain amount of rotation of the distal end is caused, and if the energy output of such a flagellum is increased,

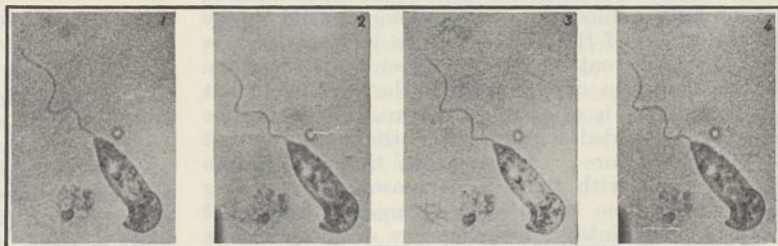


FIG. 2. *Peranema trichophorum*. Four consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/60 sec. approx. The wave is passing up the flagellum. The amplitude is increasing as the wave progresses, but it is smaller than in Fig. 1. Two complete waves in the flagellum indicate an increase in frequency.

causes the anterior end to retract. This causes the flagellum to be swung forward, and the waves passing along it now constitute a powerful backward component, with the result that the organism either swings round with its hinder end acting as a pivot or it may actually swim backwards. When *Euglena* is swimming normally and is rotating, the flagellum appears first on one side and then on the other, and it is, of course, obscured in the intermediate positions.

The rotation may be in a clockwise or anti-clockwise direction.

Altogether five species of monoflagellates have been investigated, and three of them filmed at considerable length. The action of the flagellum in all five species appears to be identical in outline, though quite different in detail.

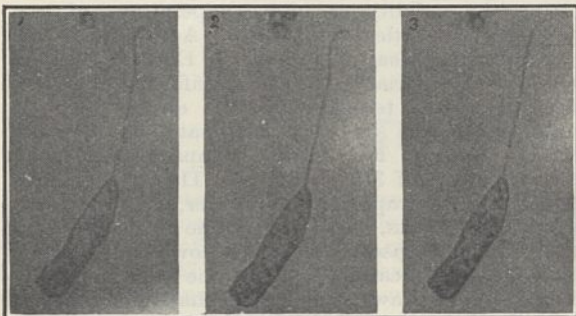


FIG. 3. *Peranema trichophorum*. Three consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/30 sec. approx. The waves are confined to the tip of the flagellum. In this case, the organism is swimming forwards with its maximum speed. The extreme tip of the flagellum is not seen since it lies beyond the penetration of the objective.

To sum up: (1) The flagellum generates its own energy, at any rate in part, if not completely. (2) The waves of distortion pass from base to tip of the flagellum and not in the reverse direction. (3) The actual position taken up by the flagellum at any instant will determine whether these waves of distortion constitute a forward or backward com-

ponent. (4) They may also cause the organism to rotate in a clockwise or anti-clockwise direction. (5) They constitute an important escape movement by causing the organism to reverse its direction

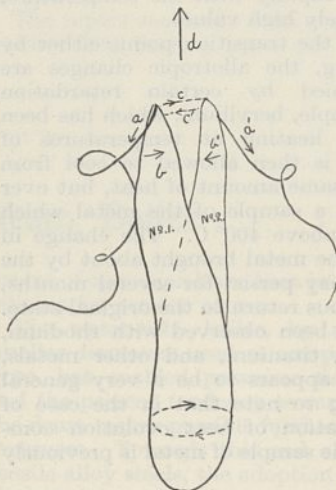


FIG. 4. Diagrammatic representation of *Euglena viridis*.

No. 1. A wave is passing along the flagellum in a direction *a*. This causes the organism to rotate in a clockwise direction *b*. It also causes lateral displacement of the front end of the animal *c*.

No. 2. The flagellum is now on the right of the organism. Either the same wave or another passes along the flagellum. Lateral displacement is in the direction *c'*. The organism is propelled in the direction *d*, and rotates in a clockwise direction. The anterior end moves in a circular path at right angles to the mean direction.

rapidly without necessitating a reversal in either the direction of propagation of the waves themselves or the direction of rotation of the organism.

¹ J. Gray, "A Text-Book of Experimental Cytology". Cambridge University Press, 1931.

² A. G. Lowndes, "The Twin Polygraph and Strobograph", NATURE, 135, 1006 (June 15, 1935).

Specific Heats of Metals and Alloys at High Temperatures*

AFTER some ten years of experience in the investigation of various physical properties of metals at high temperatures, Prof. F. M. Jaeger and his collaborators at Groningen commenced, about fifteen years ago, the much more difficult investigation of the changes which the specific heats of metallic substances undergo at temperatures up to 1,600° C. At that time there were considerable differences in the data published by various experimenters regarding the specific heats of metals and their temperature coefficients at those high temperatures—differences which could not be accounted for entirely by variations in experimental technique, but which seemed to be due, in part at least, to unknown peculiarities of the metals themselves. As a result of the work of Prof. Jaeger, many of these discrepancies have been removed and much valuable information has been obtained concerning the nature of thermal and molecular transformations in the metallic state.

The direct specific heat measurements were carried out by means of a high-precision metal-block calorimeter in which temperature differences of a few millionths of 1° C. could be measured with certainty. The results obtained by the calorimetric technique were checked and confirmed by independent methods, for example, by measurements of the variation with temperature of the electrical resistance and of the

thermo-electric behaviour of the metals. In studying the variation of any such property as a function of temperature, use was also made of two optically coupled galvanometers combined with a photographic recording device in order to obtain continuous curves, which immediately reveal any sudden discontinuity of the variable property at a particular temperature.

As regards the discrepancies in the results of previous workers, Prof. Jaeger's investigations show that these can be largely attributed to the measurements having been made with samples of metal which had undergone different preliminary thermal or mechanical treatment and which, therefore, were physically non-homogeneous due to the presence of inner stresses. Metals which have been suitably tempered by prolonged heating *in vacuo* at a constant high temperature as near to the melting point as possible, followed by slow cooling *in vacuo*, give values of the specific heat which, even at lower temperatures, are quite reproducible. This is especially striking in the case of silver, for which Prof. Jaeger has obtained a C_p -temperature curve which is concave to the temperature axis and not convex, as indicated by the best previously recorded data.

In many cases, the behaviour of metals at high temperatures is complicated by the occurrence of allotropy, and the calorimetric method is particularly suited to the detection of such changes. The trans-

* Substance of a lecture by Prof. F. M. Jaeger, University of Groningen, delivered at University College, London, on May 11.

formation to a new allotropic form usually commences at a much lower temperature than the thermodynamically defined transition point, and in this 'transition interval' the specific heat of the metal increases very rapidly with the temperature, often reaching extremely high values.

In passing through the transition point, either by heating or by cooling, the allotropic changes are frequently accompanied by certain retardation phenomena. For example, beryllium, which has been given a preliminary heating at temperatures of 450° C. or more and is then allowed to cool from 400° C., gives off the same amount of heat, but over a longer period, than a sample of the metal which has not been heated above 400° C. The change in the internal state of the metal brought about by the preliminary heating may persist for several months, but there is a continuous return to the original state. Similar changes have been observed with rhodium, zirconium, chromium, titanium, and other metals, and the phenomenon appears to be a very general one. It is interesting to note that in the case of beryllium, the retardation of heat evolution completely disappears if the sample of metal is previously finely powdered.

Another factor of importance is the remarkable influence which may be exerted by almost imperceptible traces of gases—chiefly of oxygen, but occasionally also of nitrogen and of hydrogen—on the phase changes which occur in metals. In the

α -titanium \rightleftharpoons β -titanium transition, for example, there is at the transition temperature of 882° an additional hysteresis effect, which disappears with a sample of metal prepared *in vacuo*, but returns on the addition of traces of oxygen and nitrogen.

Prof. Jaeger's experimental study of the specific heats of metals at different temperatures has provided more accurate data which can be applied to testing the validity at high temperatures of two important theoretical deductions. According to the quantum-theoretical treatment by Einstein and by Debye of the variation of the specific heat of solid substances with temperature, the atomic heat at constant volume of solid mono-atomic elements should, even at the highest temperatures, never exceed a value of $3R=5.955$ cal. The experimental results make it improbable, however, that any such upper limit exists, since this value is already exceeded in most cases at relatively low temperatures. The second application concerns the validity of the Neumann-Kopp law, which states that the molecular heat of a compound is an additive property of the atomic heats. Prof. Jaeger's measurements show that, in the case of alloys, the law is obeyed only when true solid solutions are formed between the component metals. With intermetallic compounds, the deviations from additivity, which are sometimes very considerable, may be either positive or negative, and in all cases rapidly increase with the temperature of observation.

O. J. WALKER.

Insect Pests of Crops in England*

THE Ministry of Agriculture and Fisheries' report for 1932-34 on insects affecting crops has been drawn up by Mr. J. C. F. Fryer, in collaboration with his colleagues at the Plant Pathological Laboratory, Harpenden. In dealing with advances in the application of insecticidal measures, the subject of pyrethrum is again considered in this report. Methods for the evaluation of the toxic principles of pyrethrum, elaborated by Dr. F. Tattersfield at the Rothamsted Station, have proved valuable, and it has been further shown that the incorporation of certain anti-oxidants greatly retards the deterioration of pyrethrum dust when exposed to the air. The plant has been shown to grow, and to yield satisfactorily, under English conditions; but the available methods of harvesting entail too heavy labour costs to warrant cultivation as a paying proposition. This aspect, therefore, remains in abeyance, at any rate for the time being, but in view of the valuable properties of pyrethrum, and the safety attending its application as a spray fluid, we may hope that cultural difficulties will eventually be overcome.

The hot-water treatment of daffodil bulbs as a measure against the Merodon fly and nematode pests is now an established procedure, and the same method has now become applicable in respect to the *Tarsonemus* mite of the strawberry. The treatment has been further developed with reference to strawberries, chrysanthemums and violets.

Among introduced pests, the Colorado potato

beetle is of great importance: the recent eradication of a slight infestation in the Tilbury-Gravesend area is a matter for congratulation to all concerned. But for the prompt measures put in force by the Ministry, this insect might have gained a foothold, and led to a veritable campaign for its eradication. The extent of its adopted area in France, and its continued spread in that country, will serve as a justification for the close scrutiny that is being maintained at likely English ports of ingress.

Among other foreign pests that have found entry into Great Britain, reports on the eradication of the chrysanthemum midge and fluted scale are satisfactory, and measures to preclude the introduction of the apple maggot and cherry fruit fly have given the effective results anticipated. During the period under review, many indigenous crop pests are mentioned. There were no very outstanding attacks on cereals but with regard to potatoes, the *Heterodera* eelworm was a serious menace and appeared to be spreading. Larvæ of chafer beetles were specially in evidence as pests of grassland, while in connexion with sugar beet cultivation, the discovery of the *Heterodera* potato eelworm in that crop has complicated the situation. Proper rotation and clean cultivation may avert the severe losses which this creature has brought about on the continent of Europe. *Brassica* crops came in for heavy infestation by the aphid *Brevicoryne*, flea beetles and the cabbage white fly—dry weather conditions seemingly having favoured such attacks.

Fruit pests are always numerous: the apple sawfly attracted most attention, but the application of

* Ministry of Agriculture and Fisheries. Bulletin No. 99: Report on Insect Pests of Crops in England and Wales, 1932-1934. Pp. vi+50. (London: H.M. Stationery Office, 1936.) 1s. net.

proper measures, when carefully timed, reduced the menace to manageable proportions. The deterioration of strawberries has greatly concerned growers, and the discovery that the disease known as 'yellow edge' is carried by a prevalent species of aphid has added to the importance of the latter as a pest. Among glass-house troubles, the record of damage to tomato seedlings by a species of the order Symphyla during

the three successive years under review is of interest. Much damage has been claimed as being due to such creatures in America in recent years, but the status of this species as a pest is not as yet universally accepted.

The report concludes with a useful bibliography of publications bearing upon the subjects dealt with.
A. D. I.

The Marine Steam Boiler

IN a recent note on "The Future of Steam Propulsion", reference was made to a paper on the relative merits of steam and oil engines for ships (NATURE, 137, 267; 1936). The subject is one of considerable importance at the present time, when a period of increased ship construction is imminent, and a new and different 'battle of the boilers' such as occurred at the time of the introduction of the water-tube boiler into H.M. Navy may be anticipated. Two papers dealing with the matter were read before the spring meeting of the Institution of Naval Architects in April last. In one of these, a "Review of the Present Position of Marine Steam Boilers", Eng.-Rear-Admiral W. M. Whayman dealt with large high-speed ocean-going mail steamers and passenger liners; he holds that these services constitute practically an exclusive field for steam machinery. Asserting that oil is, at present, the only suitable fuel for such installations, he points to the fact that, where speed and passenger comfort are the main considerations, oil-fired water-tube boilers have been adopted for ocean liners in all countries, and he gives details of the boiler equipment of many well-known ships. Whereas pressures on shore approach 1,500 lb. per sq. inch at 900° F. the tabulated figures show that 400-450 lb. per sq. in. and 650°-740° F. constitute the generally accepted limits for high-class sea installations at present. It is suggested that by reason of the more severe conditions of sea service, these pressures and temperatures may be expected to remain fairly steady. It should, however, be recognized that since these special sea conditions must always exist, marine practice, while necessarily following land practice at a safe distance, will steadily advance as quickly as new methods, machinery and

means of operation have been proved to be sufficiently reliable for service at sea.

The water-tube boiler, by reason of the much smaller diameters used as compared with the Scotch type, has enabled pressures to be nearly doubled, and the present tendency towards the elimination of the drum makes possible further advances in working pressures. Towards this end also the use of higher tensile alloy steels, the adoption of welding processes, the provision of air heaters, and the introduction of forced circulation, of pure feed supply and of methods of treating the steam between the turbines either by re-heating or by extraction of moisture, indicate the lines on which improvements may be anticipated.

In "Naval Water-tube Boilers", Eng.-Capt. S. R. Dight gave particulars of tests and experiments which have been carried out at the Admiralty Fuel Experimental Station, Haslar, with the object of obtaining more intimate information regarding the internal working conditions, and so enabling further improvements in efficiency and reliability to be made. Circulation was tested by means of Pitot tubes, and marked variations were noted between differently placed tubes, with occasional reversals occurring in fire-row tubes when sudden changes took place in the feed supply.

A device described as a circulation augments was introduced to enable the feed supply to assist circulation, and proved advantageous. The overheating of fire-row tubes, the use of air pre-heaters and of automatic feed regulators were among the subjects of test, and the general conclusion was that increase of output for the same space and weight was possible. The application of forced circulation is stated to be under consideration.

Breeding of Arctic Marine Prosobranchs*

DR. GUNNAR THORSON accompanied the Danish Three-Year Expedition to East Greenland in 1931-34 under the leadership of Dr. Lange Koch, and made extensive and regular collections of plankton from the southern main station of Ella Island during the period from January until September 1932. Later, these samples were supplemented by others collected by a Greenlander, Benjamin Samuelson; thus giving a whole annual cycle of East

Greenland plankton. In none of these samples and in none previously examined from these regions were there any prosobranchiate gastropods. This remarkable fact was partially explained by the large number of different prosobranchiate egg capsules with big embryos in the bottom samples and dredged material.

In order to investigate further, Dr. Thorson continued the collecting of gastropod egg-masses in 1932 and during the cruise of the *Godthaab* in the summer of 1933, and in addition examined material from other expeditions. By carefully studying the species in their various habitats and their distribution, and

* "Studies of the Egg-Capsules and Development of Arctic Marine Prosobranchs" by Gunnar Thorson. *Treaarspeiditionen til Christian den X's Land 1931-1934 under Ledelse af Lange Koch. Medd. om Gronland*, 100, No. 5 (1935).

by comparing the embryos with the adults a good knowledge of the prosobranchiate fauna was obtained, with their breeding, resulting in the discovery that not one species has a pelagic larva, but all pass directly into the free bottom stage after they have reached a considerable size in their capsules. Alone of the twenty-eight Greenland molluscs noted (in twenty of which the breeding is described for the first time) *Acmaea rubella* was found to be viviparous and hermaphrodite.

The present paper deals with the egg capsules and enclosed embryos, their breeding seasons and habitats (very characteristic in most cases). The young in the capsules were identified by comparing the shell with the apex of the adult, which is very different from the rest of the shell and gives a perfectly good clue to the embryonic period. Whenever possible the size and shape of the capsules, description of embryos, duration of embryonic state and number of embryos in each capsule are given. In many cases, especially in the large species, there are nurse eggs. In *Siphocurtus* about eight hundred eggs are laid in each capsule, of which usually only two develop into

shelled embryos which devour the others. It is found that the number of embryonic whorls in a species is not always constant, but depends upon the conditions of nourishment in the capsules, and the time of escape of the embryos depends on the amount of nourishment.

The fact that these arctic species have no pelagic larvæ is very important, especially when we compare closely related species from Britain and elsewhere, and find that many of these have distinct veliger larvæ which often stay in the plankton until several whorls are attained. With the larger forms such as *Buccinum* and *Neptunea*, the young emerge in the crawling stage in both Arctic and British waters, but the British turrids and the species of *Natica* and *Velutina* whose larvæ are known all have well-developed veligers which remain in the plankton for a considerable time.

The author does not in this paper make any suggestions as to the special conditions in these Arctic waters which apparently prevent any pelagic prosobranch larvæ from living. One anticipates with interest a discussion on these general problems.

Radio Research in Australia

IT is with considerable satisfaction that those responsible for the organization of radio research in Great Britain will note the continued activity of the Australian Radio Research Board as shown by the seventh Annual Report for the year ended June 30, 1935, recently issued by the Commonwealth Council for Scientific and Industrial Research¹. Some of the papers published during the year under review have already been noticed (*NATURE*, 136, 650; 1935) and further papers have just been issued in Report No. 9.

Investigations connected with the fading of radio signals and the transmission of waves through the ionosphere have been continued with the aid of fresh modes of attack and advances in technique. A new method of carrying out frequency-change emissions for the recording of interference fringes at the receiving station has been developed, involving the production and separation of modulation sidebands at the transmitter. It is pointed out that one of the methods of controlling the wireless signal variations, commonly known as fading, is to emit signals simultaneously on a number of adjacent carrier frequencies; and some preliminary experiments have been carried out to ascertain the possibilities of this technique as applied to radiotelephony circuits. In the field of atmospherics, observations of direction, wave form and intensity are being continued as a long-term investigation. Most of the evidence supports the now generally accepted view that every atmospheric originates in a storm centre and probably in an actual lightning flash. From the study of intensities of atmospherics from lightning at known distances, it has been estimated that the equivalent power of a lightning flash is about 2 kw. for a receiver tuned to 1,000 kc./sec. and with a band-width of 20 kc./sec.; the total peak radiated power is probably of the order of 100,000 kw. The application of the knowledge obtained in this work to interference with broadcast reception, to meteorology and particularly in

reference to aircraft navigation at night, receives continuous consideration in Australia.

The Annual Report acknowledges the co-operation which the Radio Research Board has received from such institutions as the Postmaster General's Department, the Universities of Melbourne and Sydney, the Department of Defence, and the Commonwealth Solar Observatory and Meteorological Bureau. The Board also welcomes the indication of the way its staff is regarded by industry, given by the fact that two of its members have recently resigned to take up industrial appointments.

The other publication recently issued, No. 9 in the series of Reports of the Australian Radio Research Board², contains seven papers. The first two papers deal with the study of the magneto-ionic theory of wave-propagation. A graphical method to facilitate this study, worked out by Prof. V. A. Bailey, has been applied by Dr. D. F. Martyn to the calculation of dispersion, absorption and polarisation curves for five typical wave-lengths between 100 m. and 20,000 m.

In the third paper, Mr. J. H. Piddington describes an investigation of the causes of frequency variation of a dynatron valve oscillator, and indicates the manner in which such variations may be reduced. Two of the papers by Dr. G. Builder deal with certain aspects of circuit technique as applied to radio reception, while a third describes a useful and robust thermionic voltmeter having four ranges between 0.5 and 0.500 volts. The last paper in the Report is by Mr. Piddington, and this describes the principles and design of a novel form of harmonic analyser, which operates by suppressing the fundamental frequency and measuring the harmonics with a cathode ray tube outfit or a thermionic voltmeter.

¹ Reprinted from the *Journal of the Council for Scientific and Industrial Research*, Vol. 8, No. 4, November, 1935. (Melbourne: Government Printer.)

² Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 95: Radio Research Board, Report No. 9. Pp. 71. (Melbourne: Government Printer, 1936.)

Educational Topics and Events

BIRMINGHAM.—Mr. C. G. Parsons has been awarded a Walter Myers travelling studentship to be used in research in the United States on anaemia.

The following appointments have been announced: Dr. M. Stacey to be lecturer and Mr. F. Smith assistant lecturer in chemistry; Dr. A. Lamont to be assistant lecturer in geology; Mr. J. W. Drinkwater to be lecturer in mechanical engineering.

CAMBRIDGE.—Mr. A. L. Hodgkin, of Trinity College, has been elected to the Michael Foster studentship in physiology, which is offered annually for the encouragement of research. The value of the studentship is £105.

At King's College, O. L. Zangwill and J. W. S. Pringle have been elected to Martin Thackeray studentships.

LEEDS.—The Lord Mayor of Leeds has given a capital sum to provide an annual prize in clinical dental surgery, to be known as the Percy Leigh Prize.

The following appointments have recently been made: J. C. Gregory, to be honorary lecturer in the history of science; Dr. Frank C. Happold, at present lecturer in pathology and bacteriology, to be lecturer in biochemistry; H. R. Noltie, to be lecturer in physiology; W. Hobson, to be part-time lecturer in physiology and hygiene; G. D. A. MacDougall, to be assistant lecturer in economics.

WALES.—At the University Congregation held on July 22 at Bangor the honorary degree of D.Sc. was conferred on Prof. A. A. Read, emeritus professor of metallurgy in University College, Cardiff.

ADULT education in the United States has in the past been academic in scope and method, depending in the main for its inspiration and agencies on the universities through their 'university extension' departments. With the inauguration in a number of States of large-scale projects on the lines of the Des Moines "Public Affairs Forums", it has entered upon a new phase in which it finds inspiration and objectives that are frankly political. In his bulletin "Education for Democracy: Public Affairs Forums" (Superintendent of Documents, Washington, price 10 cents), the United States Commissioner of Education attempts a partial answer to the question "How can we make democracy work?" The success of American democracy depends very largely, he holds, upon how much understanding of our common problems can be diffused among the people, and he suggests that such understanding can be most rapidly and effectively promoted through the instrumentality of public forums to be established throughout the country and conducted on the lines of those which have been for the past four years in successful operation in Des Moines. In this city of 140,000 inhabitants some twenty-five 'small-neighbourhood' forums, five large-district forums and one city-wide forum were attended in 1934 by 70,000 adults. Distinctive features of the system are: it is administered as a fundamental part of the public school system under the control of the local education authority; the forum meetings are conducted by expert leaders; corresponding with the varying size and composition of the membership various techniques are used.

Science News a Century Ago

Suspended Animation

THE *Indian Journal of Medical and Physical Science* of August 1, 1836, gives the following account of a man who submitted to be buried alive for a month and was dug out alive at the end of that period: "He is a youngish man, about 30 years of age . . . he generally travels about the country, and allows himself to be buried for weeks or months by any person who will pay him handsomely for the same. The man is said by long practice to have acquired the art of holding his breath by shutting the mouth and stopping the interior opening of the nostrils with his tongue; he also abstains from solid food for some days previous to his internment, so that he may not be inconvenienced by the contents of his stomach, while put up in his narrow grave; and, moreover, he is sewn up in a bag of cloth, and the cell is lined with masonry, and floored with cloth so that the white ants and other insects may not easily be able to molest him. The place in which he was buried at Jaisalmer is a small building about 12 ft. by 6 ft., built of stone, and in the floor was a hole about 3 ft. long, 2½ ft. wide, and the same depth, in which he was placed in a sitting posture, sewed up in his shroud, with his feet turned inwards towards the stomach, and his hands also pointed inwards towards the chest. Two heavy slabs of stone, 5 or 6 ft. long, several in. thick and broad enough to cover the mouth of the grave, so that he could not escape, were then placed over him. The door of the house was also built up, and people placed outside that no trick might be played. At the expiration of a full month the walling up of the door was broken and the buried man dug out of his grave. . . . He was taken out in a perfectly senseless state, his eyes closed, his hands cramped and powerless, his stomach shrunk very much, and his teeth jammed so fast together that they were forced to open his mouth with an iron instrument to force a little water down his throat. He gradually recovered his senses and the use of his limbs".

Disease in Elm Trees

At a meeting of the Entomological Society held on August 4, 1836, a letter was read from Mr. Spence giving an account of the destruction of elm trees in the promenades of Dunkirk, Boulogne and Calais, by *Scolytus destructor*. The decay of the trees had there, as in many other cases, been attributed to wind, soil and various other causes; but the writer was convinced it was owing to the one he had assigned, regarding which he had gained much information. Mr. Westwood added some observations on the extensive injury sustained by the elm trees in Kensington Gardens, London, the majority of those on the south side being dead. He considered that the Society, having accumulated a large mass of information on the subject, should hold an official communication with the commissioner of Woods and Forests for the purpose of suggesting some means by which the ravages might be restrained, as they had already extended to the trees in Lord Holland's park and along the Western Road past Hammersmith. Some attempts at remedying the evil had recently been made with the young elms, by plastering them over with cow dung, which was, however, quite ineffectual, as the beetles might be

seen in thousands running over the covered surface. The neglect of the authorities was a matter of regret, as there could be no doubt that entomological science would cure the evil.

Giraffes at the Zoological Gardens, London

A CORRESPONDENT writing to *The Times* said that the Zoological Society, "which is now extended to about 3000 members held their monthly meeting for the first time on Thursday last [Aug. 4, 1836] in the room which has been fitted up for that purpose, as also for the scientific meetings which are held every fortnight, at the new museum in Leicester-square, the collection of preserved specimens having been removed from Bruton-street". In the report of the council read at the meeting it was stated that M. Thibaut, who had secured the giraffes for the Society, had now left England. The total cost and expenses connected with the four giraffes had been about £2,340. A building for their accommodation would be ready by October, and it was proposed to heat this by air which had passed through pipes surrounded by hot water, a plan suggested by Mr. Sylvester.

Terrestrial Magnetism in Chile

In its columns of *Miscellanea*, the *Athenæum* of August 6, 1836, said: "M. Gay, residing in Chile, has communicated to the French Academy of Sciences that at the time of the great earthquake in that country in February 1835, he observed great variations in the diurnal movements of the needle; but in the lesser shocks the variations were feeble. His observations amount to more than two thousand, all of which have proved to him, that magnetic phenomena are much more complete in that part of the world than in Europe; for instead of two daily movements he obtained three: one in the morning in the East, another in the middle of the day in the West, and a third in the evening to the East again. This triple movement he considers as permanent, and suggests the great chain of the Cordilleras as one of the influential causes."

Education of French Pharmacists

In the *Records of General Science* of August 1836 is a note on the French School of Pharmacy. The object of this School, it said, is to teach all the sciences connected with pharmacy, and to receive such apothecaries as in four trials prove they possess the requisite knowledge for exercising this profession. Every candidate must produce certificates of his having studied for eight years—of his having attained his twenty-fifth year, and—his place in the hands of the treasurer the sum of 1,300 francs. The School consists of a director, a joint-director, ten professors, of which four are joint-professors, and a treasurer. The necessary examinations are two upon theory, one of which is upon the principles of the art, the other upon the botany and natural history of simple drugs, and a third and fourth on the practice of the art which last for four days and consist of at least ten chemical or pharmaceutical operations, which the candidate must perform himself, describing the process, materials and results. The existence of this establishment thus enables every apothecary in France to be a chemist; while in England, whoever heard of an apothecary being a chemist or of doing anything for the improvement of pharmacy?

Societies and Academies

Paris

Academy of Sciences, June 22 (*C.R.*, 202, 2021–2108).

ERNEST ESCLANGON: Observations of the eclipse of the sun of June 19, 1936. Observations of Nova Cephei and Peltier's comet. The partial eclipse in France was observed under excellent conditions at Paris, Meudon, Besançon and Bourges.

VITO VOLTERRA: The canonical equations of biological fluctuations.

W. DOEBLIN and PAUL LÉVY: The sums of contingent independent variables with lower restricted dispersions.

B. HOSTINSKY: Movements depending on chance.

OCTAV ONICESCU and G. MIHOC: Statistical chains.

CHARLES EHRESMANN: The notion of complete space in differential geometry.

DAVID WOLKOWITSCH: A family of surfaces of the fourth order.

VICTOR LALAN: Two groups of transformations defined by geodesy.

ARMAND RAUCH: Integral algebroids.

HENRI PONCIN: The search for the conditions of stability of a limiting surface of cavitation.

LÉOPOLD ESCANDE and GEORGES SABATHE: Experiments on the piers of bridges or of mobile dams with aerodynamic profile.

CHARLES BERTAUD: The star stream of Scorpio-Centaurus.

ROGER MÉRIGOUX: The movement of contaminated liquid surfaces.

PIERRE JOLIVET: A cause of the small power of electrostatic machines and a means of remedying this. The yield is increased by enclosing the electrostatic machine in a vessel containing air under pressure.

ALEXANDRE MARCEL MONNIER and JOSEPH BAZIN: A continuous voltage amplifier.

PIERRE GIRARD and PAUL ABADIE: Molecular interactions and chemical affinity.

LADISLAS GOLDSTEIN: Collisions of the second kind and electronic affinity.

ROBERT FORRER: Electrons, carriers in supra-conduction.

LÉON CAPDECOMME: The substitution of surfaces in comparisons of reflective powers by means of the microscope. Discussions of the magnitude of the errors and precautions to be taken for reducing them.

LEWI HERMAN and MME. RENÉE HERMAN-MONTAGNE: The absorption coefficients of the bands 4774, 5770 and 6290 Å. of oxygen. As found by Janssen, the absorption varies proportionally to the square of the pressure. A table is given for calculating the optical densities of atmospheric oxygen for different zenithal distances, neglecting the influence of temperature.

MAURICE ROULLEAU: The spectral transmission of developed photographic emulsions.

Mlle. YVETTE CAUCHOIS: Observation and measurement of the $L\alpha$ satellites for the elements 72, 73, 75, 83, 90 and 92. The presence of satellites has been definitely proved and this suggests the necessity of modifying or completing certain recent theoretical conceptions.

AURELIO MARQUES DA SILVA: The materialization of the energy of the β -rays of radium C.

ALBERT PORTEVIN and PAUL BASTIEN: The mechanical study of the malleability of various types of light and ultra-light alloys. A study of the best conditions for hot working of aluminium and its alloys with copper and magnesium.

ERNEST TOPORESCU: The transformation of urea into ammonium carbonate. Some ammonia is produced by dialysing a solution of urea containing sodium chloride.

RENÉ PARIS and P. MONDAIN MONVAL: The crystallization of zinc borate. A contribution to the study of the conditions of the devitrification of glass.

Mlle. SUZANNE VEIL: The Liesegang periodicity and the concentration of the reagent drop.

RAYMOND ZOUCKERMANN and RENÉ FREYMANN: The high-frequency absorption of various alcohols. For a given wave-length, going up a homologous series, the conductivity rapidly increases, tending to become constant starting with the term C_5 . This fact does not follow from Debye's theory, nor from the experiments of Malsch.

GUY GIRE and FERNAND RIVENQ: The hydrolysis of solutions of pentavalent vanadium.

ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT: The Raman spectra of some substituted epoxyhexanes.

ANDRÉ DUPIRE: Contribution to the study of the borates of the polyalcohols. Pure boric esters can be obtained by azeotropic distillation with toluene.

MARCEL PATRY: Esters of polymetalluric acid.

PIERRE LEGOUX: The relations between the granitogneiss and the schists and quartzites in western Africa.

MARCEL GAUTIER: The tectonic of the Nemours region.

MARCEL MASCRÉ: The action of acrolein on the structure of the plant cell.

ROBERT QUETEL: The variations in the proportion of nitrogen in the lily-of-the-valley during forcing.

EMILE MIÈGE: Experimental cultures of the potato in Morocco in 1935 in the mountains and on the plain. Whatever the origin and mode of preservation of the tubers sown, the yields are always greater in the mountains.

ROGER HELM: The relationship between *Lactarius* and certain *Gasteromycetes*.

PIERRE DRACH: The cycle traversed between two moults and the principal stages in *Cancer pagurus*.

GABRIEL GUIGNON: The study of the blood circulation of the wings in Coleoptera and Orthoptera by means of nicotine.

RAOUL MICHEL MAY and Mlle. ALICE FRANK: The replacement of an anterior foot by a grafted bulb, in the embryo of *Discoglossus*, and its relations with the law of bilateral symmetry of the neurones.

Amsterdam

Royal Academy (*Proc.*, 39, No. 5, 1936).

L. S. ORNSTEIN, C. JANSSEN, D. T. J. TER HORST, C. KRIJGSMAN and G. H. FREDERIK: Investigation of transformer oil. Physical studies of ageing.

W. H. KEESOM and P. H. VAN LAER: Measurements of the latent heat of tin in passing from the supraconductive to the non-supraconductive state.

W. H. KEESOM and A. BIJL: Comparison of platinum resistance thermometers with the helium thermometer from -190°C . to -258°C .

R. WEITZENBÖCK: The theory of semi-invariants.

J. G. VAN DER CORPUT: (1) Distribution functions (8). (2) On some Vinogradoff methods (3).

E. COHEN and A. K. W. A. VAN LIESHOUT: An electrical pressure dilatometer. Apparatus for the study of polymorphic transformations at pressures up to 200 atm.

A. H. BLAAUW, IDA LUYTEN and ANNIE M. HARTSEMA: Accelerated flowering of Dutch irises (1).

J. J. VAN LAAR: Variation of some thermal and calorimetric quantities along the two melting curves of helium.

A. G. BOER, E. H. REERINK, A. VAN WIJK and J. VAN NIEKERK: A naturally occurring chicken provitamin D. The isolation and chemical nature of a provitamin D from cholesterol.

K. MAHLER: An analogue to a theorem of Schneider.

H. FREUDENTHAL: Partially ordered moduli.

J. BEINTEMA: Crystal structure of barium antimonate. X-ray and crystallographic examination of $\text{Ba}\{\text{Sb}(\text{OH})_6\}_2 \cdot 2\text{H}_2\text{O}$.

D. TAPPENBECK: Tertiary Foraminiferan rocks of Sipoera (Mentawai Islands).

W. VAN TONGEREN: Mineralogical and chemical composition of the syenite-granite from Boekit Batoe near Palembang, Sumatra, Dutch East Indies.

H. A. BARKER: Fermentation of some diabolic C_4 acids by *Aerobacter aerogenes*. The process involves an initial oxidation-reduction between two molecules of the substrate and a subsequent decomposition of the oxidized molecule.

B. VAN DER EYKEN: Dentition and teeth development in the irisforelle (*Salmo irideus*) (5). Palate and pharynx.

D. WIERSMA: Imagination and attention during childhood.

A. GEESINK, H. DE JONG and F. J. NIEUWENHUYZEN: Experimental catatonia produced by auto-intoxication. (2) Experimental catatonia after ligation of the arteria hepatica propria.

H. A. MEYLING: The glomus caroticum and the sinus caroticus of the horse.

Cape Town

Royal Society, May 20.

MRS. M. R. LEVYNS: Notes on the genus *Stoebe*. *Stoebe* falls into two well-marked sections based on distinct types of floral structure. One type is widespread in Africa and extends to Madagascar and Reunion. Distribution of species of this type is predominantly discontinuous. The other type (comprising most of the species) is almost confined to the south-west Cape and the species have, with few exceptions, a restricted and continuous distributional range. The distribution supports the view that the south-western flora at one time occupied a much larger area than it does to-day.

J. L. B. SMITH: Fishes new to South Africa.

Vienna

Academy of Sciences, May 7.

LEOPOLD SCHMID, SIEGMUND MARGULIES and SIDONIE LENZER: Chemical investigation of amber.

LEOPOLD SCHMID and HUGO KÖRPERTH: (1) The colouring matter of the poppy (*Papaver rhoeas*, L.). (2) Examination of extracts of petals. The chemical nature of the colouring matter of ten flowers is given.

GEORG KOLLER and HERMANN HAMBURG: Rhodocladonic acid.

PHILIPP GROSS and HANS SUESS: Thermal decomposition of dioxane.

H. DOSTAL and R. RAFF: The mechanism of thermal polycondensation reactions.

B. ORMONT and B. A. PETROW: Thermal decomposition of simple and complex cyanides with formation of alkali metals, with special reference to potassium.

W. J. MÜLLER, H. FREISSLER and E. PLETTINGER: Anodic behaviour of gold-copper alloys in 5N hydrochloric acid and N sulphuric acid. The relative quantities of gold and copper dissolved out of alloys of various compositions are measured when these are made the anode in acid solutions.

W. J. MÜLLER and E. LÖW: (1) The influence of the purity of aluminium upon corrosion in hydrochloric acid of varying concentration. (2) Theory of corrosion phenomena. Part 4. Application of the theory of local elements to the problem of corrosion.

ALFRED LICHTENFELD and KARL SCHWARZ: The theory of Kikuchi lines studied by means of models. Light is transmitted through a 3-dimensional grating having a spacing of about 1000 λ and bright lines are formed on a screen behind the grating.

F. SEIDL: (1) Electrical conductivity of solidified melts of Rochelle salt. Conduction in Rochelle salt is found to be ionic in nature. (2) Electrical behaviour of single crystals of Rochelle salt crystallized from saturated solutions in an electric field.

HERBERT HABERLANDT: Radioactive haloes in fluorite from Striegau.

MAX TOPERCZER: Contribution of the data of the magnetic survey of Austria in 1930.0 to the study of the earth's magnetic field. (2) Improvement of some values of the vertical intensity.

WILHELM SCHMIDT: Vertical motion in clouds studied by cinematograph pictures. Vertical motion of any part of a cloud is detected by placing two successive photographs of the cloud in a stereocomparator.

NORBERT LICHTENECKER: Glacier research in the Sonnblick in 1930-34.

F. STEINHAUSER: Probability of precipitation in the eastern Alps.

H. TOLLNER: Glacier winds on the Pasterze glacier.

ERHARD BRAUMÜLLER: The north boundary of the Tauern between the Fusch and Rauris valleys.

SEGMUND PREY: The possibility of the emergence of the Dent Blanche nappe in the Sonnblick.

GABRIELE ROGENHOFER: Action of growth-promoting substances on bark formation in woody shoots.

HELMUTH ZAPPE: The possibility of aragonite surviving the fossilization process investigated by means of the Feigl-Leitmeier reagent.

EMIL ABEL and A. BILDERMANN: Kinetics of the oxidation of formic acid by iodine acid.

WALTER KOSMATH, VOLKMAR HARTMAIR and OTTO GERKE: Contribution of plant physiology towards the assessment of the biological or balneological importance of the radioactivity of the treatment at Bad-Gastein.

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