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Health and Safety of Industrial Workers

THE centenary of the Factory Act in 1935 led to a good deal of attention being directed to the inadequacy of the Factory and Workshops Act, 1901, which is largely obsolete, and the need for a new Act for the regulation of industry in Great Britain has been widely admitted during the last fifteen years both inside and outside Parliament. More than once, indeed, bills have been introduced ; only to be laid on one side in favour of other matters said to be more pressing.

If, however, a new factory act is essential from the point of view of industry, it is, as a recent broadsheet entitled "Industry and Health" recently issued by Political and Economic Planning (P.E.P.) emphasizes, from the point of view of health and safety in industry that it derives its greatest importance, and additional interest is attached to the new Factory Bill in view of the present concern for the physical condition of the nation. Physical culture may be invaluable as a means of maintaining or improving health. It cannot be a remedy for injuries to health which are inflicted by such conditions as bad housing, overcrowding, malnutrition or unhealthy and dangerous conditions of work. The attempt to improve the physical condition of the people means, accordingly, not merely a campaign for physical education, but also a determined and simultaneous attack on all factors undermining the health of the community whether at work or at home.

It has to be recognized in the first place that although, during the nineteenth century, broadly speaking, Great Britain led the world in imposing the observance of minimum standards of safety, health, hours and conditions of employment in factories and workshops, during the twentieth century we have permitted the country to lag behind in these vital matters. Several industrial nations in Europe and in America have surpassed us in the solicitude they show towards their workers. Accordingly, the new Bill cannot be considered only in terms of the improvements it introduces. We must also have regard to the extent to which it remedies the relatively backward state into which our labour code has fallen during the last two or three decades.

Acts of Parliament, moreover, though invaluable for establishing effective minimum standards, and for rounding up laggards, have their limitations as methods of promoting reform. It is impracticable to enforce at any time standards substantially higher than those which the majority of firms adopt or are ready to adopt. The minimum standards prescribed by law may in fact be, and often are, far below those adopted by the more progressive and enlightened industrial units : and the spread of more enlightened methods must to a large extent precede the prohibition of those that are considered unsatisfactory.

It is this fact which makes such legislation of special interest to the scientific worker. While the improvements which the Bill will effect in working conditions will depend largely on the administration, owing to the wide powers given to the Secretary of State in limiting, extending or modifying its provisions, vigilance will be demanded both during and after the passage of the measure to ensure that its intentions are implemented. A large share of responsibility for this vigilance must rest upon scientific workers. Only if they are prepared to make their contribution can we expect the full effect of the new Bill to be realized —securing a genuine advance in the conditions of health and safety not merely within industry but

also indirectly in the health of the nation as a whole.

The significance of the contribution of the scientific worker will be best appreciated if we recall first the immense superiority of labour conditions among the progressive firms over the majority, not merely the most backward; a superiority which is largely to be attributed to the more scientific outlook on the part of the managerial staff in such firms. It is further illustrated by the enormously greater incidence of industrial accidents among smaller firms where adequate scientific and technical supervision is lacking, as is shown by the annual reports of H.M. Chief Inspectors of Factories. In fact, the safety provisions of the new Bill are probably its best feature, but their efficacy will largely depend as much upon effective technical supervision and control within industry itself, particularly in the smaller firms, as upon an extension of the factory inspectorate commensurate with its greater responsibilities.

This question of health and safety in industry does not derive its whole interest from the new Factory Bill. The revival of heavy industry, and the re-employment of men who through their unemployment have lost some of their dexterity, make it probable that accident rates will rise even higher than they did last year. The tendency of armament firms under Government pressure to work night shifts and overtime will increase the danger. Moreover, the cost to industry of ill-health, whether due to unsatisfactory conditions such as long hours or poor lighting, or to the nature of the process, is already so high that little further stimulus to improvement should indeed be necessary. It was estimated by the Home Office that in 1934 industry spent nearly £11,000,000 in providing for its liabilities under the Workmen's Compensation Acts. The total number of working weeks lost annually by employees covered by National Health Insurance is estimated at thirty millions, equivalent to an entire year's work of some 600,000 persons. Moreover, any attempt to assess the burden of ill-health to industry must also allow for the losses from labour turnover through unhealthy conditions from inefficiency, due to the same cause among those actually at work.

The vital problem at the moment in industrial health is labour conditions, especially hours of work, the length of which is only restricted by law in four industries, the most important being coal-mining and road transport. In these respects, the Bill falls lamentably short of the recommendations of the report of the Departmental Committee on the Hours of Employment of Young Persons. That this position should be arising eighteen years after the work of the Health of Munition Workers Committee had demonstrated its detrimental effect on industrial output and efficiency indicates an astonishing lack of wise and scientific management. Moreover, it must be remembered that the existence of this position makes it much more difficult for the more enlightened firms to persist in their efforts to shorten the working week and to eliminate overtime. In addition, there is no adequate mechanism for ensuring that the results of research carried out by such bodies as the Industrial Health Research Board are considered and implemented.

When all due allowance is made for the natural time-lag between such research and its application in the improvement of factory conditions in respect of lighting, ventilation, humidity and air conditioning generally, there can be no doubt that the gap is excessive and very seriously detrimental to both industrial efficiency and the health of the workers. The minimum conditions laid down by the 1901 Act are antiquated and sometimes deficient, and although definite standards for different factories have sometimes been worked out, they are only enforced when the Secretary of State is satisfied that any trade is dangerous or unhealthy and where he can therefore issue special orders under the statute. The new Bill does include a clause providing that "sufficient and suitable lighting, whether natural or artificial" shall be maintained in every part of the factory. The new Bill also raises the standard of overcrowding from 250 cubic feet of space per worker to 400 cubic feet and contains general provisions regarding temperature and ventilation, although any standards are to be enforced by legislation. Specific provisions for the removal of dust and for the control of underground workrooms are included. Similarly under welfare there are general provisions regarding first-aid boxes, drinking water, and, in factories employing females, seats must be provided. Provision of washing facilities, rooms for drying clothes, and mess rooms for employees are only compulsory if special orders are made by the Secretary of State.

It is thus evident that the new Bill makes a cautious but definite advance in dealing with the environmental defects and long hours in factories

which tend to increase the incidence of diseases occurring in the rest of the community. Unfortunately, the progressive firms which have made a study of environmental conditions still cover only a small percentage of the population.

Similarly, the incidence of industrial accidents is greatest among the smaller firms, despite notable exceptions, and this problem is one that can scarcely be dealt with by legislation alone. Even a very great increase in the inspectorate would be unable by itself to cope with contravention of the law in respect of hours of work of young persons or ensure the strict observance of the new safety provisions. What is needed here is a significant increase in the extent of trained scientific supervision, competent to foresee dangers and to take the necessary precautions in advance and not merely as a sequel to some accident taking toll of life or limb. This is above all a matter for professional associations of scientific workers.

This aspect of the question becomes more important when we consider the relation of the Factory Department to the Home Office, and not to the Ministry of Health, which is concerned with most other medical services of the country. This system has been criticized as anomalous, and obviously close co-operation between the local medical officer of health and the various authorities concerned with the health and conditions of factory workers is extremely desirable. If, however, employees are to be kept in a good state of health, maximum industrial efficiency achieved, and the enormous expense caused by accidents and sickness saved, something much more than the minimum measures enforced by present legislation is required.

The most important need is in fact a considerable expansion of the medical services in industry itself which have already been introduced by a number of firms or industries, sometimes to deal with a particularly industrial hazard or high accident rate. Such services, moreover, are often organized to cover the medical examination of all employees from the point of view of their own health and, as in factories handling food, that of public health generally, and the whole tendency in industry is for this preventive medical service to increase. It is accordingly a disappointing feature of the present Bill that more is not done to make the medical examination of young persons a better protection for them.

It should not be forgotten that the medical services now developing in industry are responsible for an increasing amount of research aimed at the prevention and elimination of industrial hazards. This, of course, is not a matter for the medical officer alone. The chemist, the physicist, the engineer, the works or departmental manager have their own contributions to make, and the problem is one of organizing team work and co-operation in the most effective way. Nor should it be forgotten that questions of professional ethics and responsibility are also involved. The relationship between the general practitioner and the industrial medical officer now being worked out by a sub-committee of the Medico-Political Committee of the British Medical Association is only one aspect of the professional position of the medical officer in industry which equally applies to other types of scientific worker. The clash of loyalties which may quite easily arise is unlikely to be resolved without a definite and accepted ethical code.

The development and improvement of an industrial medical service in fact involves many extremely complex problems, including questions of co-operation between different industrial units. It is believed that unless there is a special occupational hazard, it is uneconomic to employ a full-time medical officer where less than 5,000 persons are employed. Only about one per cent of the industrial population is found in factories of this size, yet smaller factories are confronted with many of the problems which the full-time industrial medical officer has to handle in a large firm. Moreover, there are still firms with high accident rates and specific occupational hazards employing more than 10,000 persons, which have no medical officer on the premises.

The new Factories Bill has accordingly very considerable claims on the interests of scientific workers. Upon their co-operation, both in a technical capacity, and as departmental managers or as members of the inspectorate itself, apart from participation in the considerable volume of research into problems of industrial safety and health still required, the real success of its aims in no small measure depends. Further, the very extent to which they have come to share in the direction and management of industry itself stresses their responsibility for effective and informed criticism of the new Bill, particularly where, as in regard to the provisions relating to the employment of young persons and particularly overtime, it is open to grave abuse and falls lamentably short of standards of enlightened practice of proved desirability.

Malaria in Europe

Malaria in Europe:
an Ecological Study. By Dr. L. W. Hackett. (University of London Heath Clark Lectures, 1934, delivered at the London School of Hygiene and Tropical Medicine.) Pp. xvi+336+22 plates. (London: Oxford University Press, 1937.) 10*s.* 6*d.* net.

IN the Heath Clark Lectures, delivered by the author at the London School of Hygiene and Tropical Medicine in December, 1934, a semi-popular account was given of the most recent developments in malariology. The present volume, published under the terms of the bequest, gives a presentation of material gathered for these lectures. As the author points out, the book is in no sense a text-book on malaria, but a discussion of the newer findings in malaria and the way these are changing our ideas of what endemic malaria is, why it persists, and how it can be attacked. That the title should be "Malaria in Europe" is no surprise to those familiar with recent work on this disease, for there has been no more interesting chapter in the history of malaria research than that which has had to do with the recent unravelling of the malaria problems in Europe.

About ten years ago, the Rockefeller Foundation, in collaboration with the Italian Health Department, founded the Malaria Experimental Station in Rome, where Dr. Hackett and his colleague Prof. Missiroli have done such outstanding work, and soon after, similar centres for field study were created in Greece, Bulgaria and Spain, in all of which activities Dr. Hackett has played a prominent part. The co-operation of Prof. Martini of Hamburg and Prof. Swellengrebel of Amsterdam was obtained for the observation of northern European anophelism and malaria. After preparatory studies, these centres have been engaged in large-scale experiments with every fundamental measure which seems to hold out possibilities of success in combating malaria. As a result of all this work, and of investigations on European malaria by malariologists of many nationalities, there has emerged a very concrete picture of the natural history of malaria in Europe, and of the nature of control measures to be adopted on this continent. Whilst the problems dealt with have been quite special to Europe, it is remarkable that the answers to these problems have had a surprisingly important application to malaria in other parts of the world, and especially to our conceptions of what constitutes a 'carrier species' of anopheles.

The author commences with consideration of the nature of endemic malaria as now understood. The outstanding mystery of endemic malaria in Europe is the way in which it has been steadily disappearing within the last century or more, independently of any conscious effort of man to bring this about. Many reasons have been put forward to explain this, such as better housing, improved economic conditions, and other causes, but it is now realized that this slow recession of malaria from Europe has mainly depended upon causes connected with the natural history of malaria itself. The common European malaria-carrying species, *A. maculipennis*, is not, as formerly thought, a single homogenous species, but consists of some four or five or more sub-species, each of which possesses its own peculiarities in habits and behaviour, peculiarities that, though they might often seem unimportant, have nevertheless in a remarkable manner been responsible for a number of the major epidemiological features of malaria in Europe. An anopheles has the choice perpetually before it of feeding on man or on his cattle. It depends upon the conditions present and the anopheles' own predilections under these conditions how frequently it feeds upon one or the other. A single feed upon man is of no significance, since in order to transmit malaria a second feed must be taken at such time as sporozoites derived from a previous feed have matured. Hence there is a disproportionate effect as regards decrease in transmission if the number of feedings on man is lessened by 'deviation'.

The condition mainly determining the presence of endemic malaria in Europe is agriculture. Primitive agriculture is usually associated with malaria. With rotation of crops, it becomes necessary to maintain cattle to feed on the fodder, and stall-feeding replaces pasture feeding. With 'stabulation', zoophyllic sub-species tend to be deviated, and if these zoophyllic forms alone are present, as is the case over large parts of Europe, malaria disappears, though anopheles are still abundant. This is the explanation also of the 'anophelism without malaria' so constantly seen referred to in the literature on European malaria. To an unknown extent, similar influences must be operating in regard to tropical conditions, and the very numerous species and varieties there occurring.

Much is now being done in various tropical regions on the working out of the habits and relative carrier danger of different species, so-called 'species sanitation' aiming at reducing the more dangerous forms by measures directed against these species through some vulnerable feature in their habits or life-history. In all preventive action

the proper "appraisement of the malaria situation" becomes of great importance, and an excellent chapter on this aspect of the case is given. There are chapters also on the part played by the different malaria parasites themselves, and the role of immunity in man in the epidemiology of the disease, also a chapter on treatment in theory and practice, and an extremely interesting section on the strategy of malaria control and various fundamental lines of attack upon the disease.

Very seldom are the facts about disease so pleasantly and easily written about as in this volume, which is quite unique of its kind. Nowhere else will the reader obtain so easily the spirit of modern malaria research in its application to prevention. S. R. C.

The Case for Buchan

Buchan's Days:
a Modern Guide to Weather Wisdom. By E. L. Hawke. Pp. 231. (London: Lovat Dickson and Thompson, Ltd., 1937.) 5*s*. net.

ALEXANDER BUCHAN, secretary of the Scottish Meteorological Society from 1860 until his death in 1907, was esteemed in his lifetime as a worthy man, an able secretary and a tireless investigator. He wrote two excellent books on meteorology, but it is probably true to say that, until a few years ago, his name was almost unknown outside the circle of meteorological devotees. Now, strangely enough, his name is probably the first that would occur to ninety-nine out of a hundred examination candidates who were asked, in a 'general knowledge' paper, to state the name of a distinguished meteorologist, dead or alive.

Buchan's posthumous fame has been acquired as a result of his researches on the irregularities in the annual march of temperature, as revealed by daily averages of temperature at certain Scottish stations. When such daily averages are plotted, it is found that the resulting graph differs very materially from a smooth curve. The temperature does not rise steadily from a minimum in winter to a maximum in summer and then fall steadily again to the winter minimum. On the contrary, a series of humps and hollows is found, indicating that a steady rise or fall is not, on the average, maintained for more than a few days at a time. Buchan satisfied himself that certain of these humps and hollows were due to a tendency for spells of relatively warm or cold weather to recur around definite dates. Buchan's "warm periods" and "cold periods" have thus kept alive the name of the worthy Scottish meteorologist.

Since Buchan's death, there has been much controversy as to whether these "periods" are a real and permanent climatic feature of our area. Participants in the controversy have not always taken the trouble to refer to Buchan's original papers; consequently, much of what has been written is irrelevant to the issue. Mr. E. L. Hawke has done a useful service in giving a fair and clear summary of the original papers. His commentary upon the papers is not very likely, however, to win over many adherents to what we may call the 'Buchan doctrine'. He directs our attention to the resounding "successes" scored, for example, in the famous frosts of February 1917 and February 1929, and to the support given in certain cases by the Greenwich daily averages. But that sort of evidence does not really get us any further. Everyone knows that our weather tends to occur in 'spells'. The essence of the Buchan doctrine is that cold spells and warm spells tend to occur around certain specified dates rather than on other dates. Well then, let us take the best temperature record we can get, start with January 1 and see how often the temperature on that date has been, say, ten degrees or more above normal, and how often it has been ten degrees or more below normal (the 'normal' being the value indicated by an idealized smooth curve drawn through the monthly means). Do this for every day of the year. The job will take some time, but we shall be rewarded in the end with a set of figures from which we can say with reasonable certainty whether or no there is any special tendency towards abnormality during Buchan's periods or during any other periods. The adherents of Buchan seem strangely reluctant to use this very simple and obvious method of establishing their case.

Part 1 of Mr. Hawke's book is devoted to Buchan, with a very interesting, but not very relevant, chapter on "Weather Lore". Part 2, entitled "Round the Year", contains a series of chapters on the general climatic features of the months and seasons. These chapters are very good of their kind, and contain much curious information such as: "on May 18, 1891, a heavy drifting snowstorm over many hundreds of square miles in England gave holiday-makers the only recorded opportunity for tobogganning on Whit Monday". E. G. B.

The Medical Officer of Health in Present-day Germany

Der Amtsarzt:
ein Nachschlagewerk für Medizinal- und Verwaltungsbeamte. Bearbeitet von Dr. A. Gütt, Dr. L. Conti, Dr. W. Klein, Dr. O. Schwéers, Dr. Th. Sütterlin Prof. Dr. R. Thiele, Prof. Dr. F. Wiethold. Pp. xx+767. 22 gold marks. Deckblätter zu der Amtsarzt. Erste Folge. Abgeschlossen am 1.8.1936. Pp. 35. 3 gold marks. (Jena: Gustav Fischer, 1936.)

THIS book, intended as a work of reference for the use of medical officers of health and officials working in administrative capacities related to medicine in present-day Germany, is of a character entirely different from the usual medical text-book or work of reference. Although it represents a source of information on public health, hygiene, medical jurisprudence, social and State medicine and their legal aspects in particular, there can be little doubt that it is intended to convey instruction conforming to the National Socialist point of view. In this way a definite attempt is made to imbue medical activity with unilateral political ideas and force party views upon it. There are several articles exclusively devoted to political and party matters; this is not in any way concealed and cannot therefore be left out of account. There are, of course, chapters on subjects such as bacteriology, chemistry, pharmacology, pathology, psychiatry, etc., in conformity with universal scientific opinion. It need scarcely be mentioned also that in a country where social services have long been so widespread, these have been continued, varied and in some cases added to under the new regime.

The National Socialist party, through its State organs, controls every activity connected with the subject of public health, commencing with medical students and including nurses, masseurs, disinfectors, social workers, etc., by State examinations. Admission to the universities, hospitals and training schools is dependent on the so-called 'Aryan' descent, nationalist reliability and sometimes even party information. Lay treatment is permitted, except for ailments of the sexual organs and vaccination. Lay practitioners must not be called 'quacks' if they are members of the union of lay practitioners in Munich. The same snatching at popularity is shown in the endeavour to raise the standard of the midwives at the expense of the medical practitioners. A midwife is allowed to deliver even breech cases or the adherent placenta without calling in a medical man; in certain districts she is not only permitted but bound to carry out, when required, internal version of the fœtus. The two latter occurrences have to be notified to the medical officer of health. "The demand to transfer more or less all maternity cases to maternity homes is not justifiable from the point of view of social hygiene as the results of cases delivered at home are at least not bad. Moreover, the participation of the whole family in the trying hours of entrance into motherhood strengthens family feeling and family ties so much that it must on no account be forgone."

The infant welfare movement is blamed for "having in some places overstepped the limits prescribed for social welfare work and thus acting, if not rightly supervised, against natural selection". The most important and promising suggestion of the writer of this chapter is to divert child welfare endeavours from the prevention of death amongst infants, at present the predominant activity, towards creating new life by greater fertility and by fighting against a decreasing birth-rate. In another place (marriage laws) it is pointed out that diminution of unemployment cannot be expected by a married couple of which one partner is incapable of procreation. Their marriage is therefore against the interest of the community, because children, as they are only consumers and not competitors in the labour market, play a special part in political economy.

It is impossible to discuss in detail the regulations on health certificates for couples intending to marry or those dealing with the possible prohibition of marriage; or to deal with the advisory centres on questions of heredity, race and marriage. The laws for prevention of an offspring likely to be tainted with a hereditary disease are too detailed for discussion here, but we may note that compulsory sterilization is provided for this purpose, and also interruption of pregnancy up to the end of the sixth month is permitted by law. Compulsory castration can, and in the commentator's opinion, "has to be carried out unhampered by liberalistic sentimentality" in the case of second offences of most sexual crimes including homosexuality, for which the offender is sent to prison for a term of at least six months. Voluntary castration is permitted to those who without a previous trial or conviction profess to feel a propensity for one of the above-named vices. The medical officer of health has to decide whether "further lapses are to be feared".

As in the chapter on infant welfare, no mention is made of the fact that morbidity and physical weakness are not infrequently due to an avoidable or remediable neglect of acute conditions, only of a

temporary nature and easily overcome in a few years. On the subject of procreation and marriage, heredity and race, the same pessimistic and fatalistic crudity is displayed. Almost every physical, mental, psychic quality of man seems to be inherited and unalterable, practically none produced or aggravated by economic, environmental or other conditions of life. No notice is taken of the fact that not a few manifestations of neurotic persons mentioned in the list of indications for the most cruel interferences with their lives are not hereditary and are curable, or at least improvable to such an extent as to make the disability from which they are suffering negligible to the community.

The chapters dealing with eugenics, racial hygiene and measures tending to the "gradual purification and improvement of the hereditary stream of our people" abandon in many respects the scientific basis of causation and replace it by the nebulous mysticism of the Nazi creed and empty catchwords. The profession of medicine, which is justly proud of, and continually aims at, scientific fundamentals and independent objectivity, is thus degraded to a state of servitude to the views of the prevailing political party, in which the medical officer of health is the expert party representative.

The addenda are in conformity with the general trend of the book. X. Y. Z.

Agricultural Chemistry

A Practical Course in Agricultural Chemistry: for Senior Students of Agriculture, Dairying, Horticulture and Poultry Husbandry. By Frank Knowles and Dr. J. Elphin Watkin. Pp. ix+188. (London: Macmillan and Co., Ltd., 1937.) 10*s*. net.

FORMERLY agricultural chemistry was one of three main subjects in courses on agriculture, but to-day increasing specialization inside the industry itself has been accompanied by a multiplication in the courses available in the university departments and colleges engaged in agricultural education. A student may present himself for a course in horticulture, or dairying, or poultry-keeping, or in agriculture; he may be an intending producer, technician, adviser, teacher, or specialist; but in any event a goodly proportion of his time will be spent on agricultural chemistry. For most students, the materials and vital processes concerned are the same, but the emphasis on them varies according to the type of specialization desired or the nature of the qualification sought.

The authors have had this diverse field in mind, in their effort to provide what has hitherto been lacking, a laboratory text-book which would adequately serve all types of senior student. So far as methods of estimation are concerned the result is to be commended, but while laboratory estimations are a valuable help to a student, they are less effective if unaccompanied by, or based on, qualitative work, an aspect which seems to have been lost sight of in some chapters. On this account, and because of the impracticability of elaborate technique in ordinary classes, the book may prove less helpful to beginners than to advanced students.

In the field, soil is studied as a natural object, but in the laboratory it becomes and is treated as a dead material. Before it is 'prepared' for analysis, however, much can be learned by close examination, by hand and eye. The main constituents of soil are worth similar attention, but the chapter on soils neglects this aspect of the subject. The order of presentation of the determinations seems to lack purpose, such as is obvious where mechanical analysis leads up to physical properties, and chemical analysis is followed by base status and availability of nutrients.

In the chapter on fertilizers, a few exercises are introduced to illustrate manufacturing processes; but the need of the student to grasp their simple physical and chemical properties is ignored. It is to be regretted that farmyard manure is considered mainly on an N.P.K. basis.

By contrast, the chapter on biochemistry is based on qualitative work, and the whole field of materials—except flesh—is explored by informative exercises in isolating the chief constituents. The methods of analysis for feeding stuffs include some associated with special features of individual commodities, but this section is not set out in such a way as to strengthen the student's knowledge of feeding stuffs as a whole, as distinct from his ability to analyse them. The excellent chapter on dairy products includes material which has not hitherto appeared in a student's text-book.

The section on water analysis contains methods of estimation alone, but that on insecticides and fungicides, an innovation in this class of book, contains in addition informative exercises on their composition and important properties.

The book as a whole is compact, comprehensive, and clearly written, and should be found of use to all classes of agricultural students. H. H. N.

The Physics and Chemistry of Paintings

Three Lectures given before the Royal Society of Arts, March 1937. By F. Ian G. Rawlins. Pp. 52. (London: Royal Society of Arts, 1937.) 2*s*. 6*d*.

THESE three lectures by Mr. F. Ian G. Rawlins are not only of the greatest interest to those who have specialized on the materials and methods used in painting pictures in the past, but are also epoch-making in that they mark a departure in the whole conception of their duties on the part of those responsible for the preservation of the priceless works of art contained in our public galleries.

The first realization of the part to be played in the systematic scientific examination of works of art we owe to Prof. Forbes, of the Fogg Museum, Harvard University, who opened a laboratory for the study of these questions. This was followed by the creation of a scientific department in the Louvre, and the establishment of laboratories in the British Museum under the able guidance of Dr. A. Scott, and to-day we have the laboratories at the Courtauld Institute under Mr. Daniel Thompson, and the appointment of Mr. Rawlins on the staff of the National Gallery.

In the opening lecture, Mr. Rawlins discussed the general problems and the physical and chemical properties of the materials out of which a picture is built up. In the second lecture he discussed the 'diseases' of pictures, and the experiments undertaken at the National Gallery for the systematic collection and examination of dust, and the microscopic examination of the surface of pictures through the Ultropak microscope fitted with crossed nicols to exclude reflection, and the uses of ultra-violet light in examining pictures. The concluding lecture was devoted principally to the use of X-rays, the description of the special apparatus at the National Gallery and the methods used to systematize and control results. He also described a very interesting new feature, the use of the Lovibond tintometer to measure the colour values of the surface of pictures and record the results of cleaning.

Mr. Rawlins touched on so many problems in the course of his lectures and suggested so many possible lines of inquiry that it is impossible to deal with them in a short notice, but he may be congratulated on having given a series of lectures which will be much appreciated by all students of this subject and form a valuable contribution to our knowledge.

A. P. LAURIE.

Einführung in die Elektrizitätslehre

Von Prof. Dr. R. W. Pohl. Vierte, grossenteils neu verfasste Auflage. Pp. viii+268. (Berlin: Julius Springer, 1935.) 13.80 gold marks.

THE first German edition and the English translation of the second German edition of this book have already been noticed in this journal. The present fourth German edition, much of which has been entirely rewritten and brought up to date, will certainly not fail to have the same appeal as its predecessors.

The book makes interesting reading on account of its original method of presentation. The author starts at once with crude conceptions of 'volt' and 'ampere' in the same way as text-books on mechanics start with 'kilograms' and 'seconds'. Well selected experiments—nearly every one of which is illustrated—serve to refine gradually these conceptions. Thus the modern theory of electricity and magnetism is developed in a clear-cut way. A presentation of this type forms not only a good introduction, but also it certainly helps to clarify the ideas of students who have approached the same subject on more conservative lines.

In the new edition the addition of two very clear chapters on "Matter in the Electric Field" and "Matter in the Magnetic Field" have to be specially welcomed. To avoid enlargement of the book the author has shortened the text in some other places, not, however, always to the best advantage. These shortcomings—they are very few indeed—will not trouble the type of reader who will consult the book in Great Britain, and if we are provided with a new English translation they may be easily remedied.

A. B.

Biology in the School

By H. Alan Peacock. Pp. xvi+354. (London: William Heinemann, Ltd., 1937.) 10*s*. 6*d*. net.

AMONG the ever-growing list of books on the teaching of the biological sciences, the present work will find an honourable place. It is the result of many years of experience on the part of a public school science master. The book is intended as a volume of reference, and as such it is admirable. The spirit is eclectic, and Mr. Peacock suggests many lines along which secondary school work in biology may be undertaken and he avoids the pitfall of the rigid syllabus and method of treatment. "The ideal syllabus has not been constructed and when it has been, much of the infinite joy of learning and of teaching biology will have gone. Biology should be introduced into schools not only because of a practical value equal to, or greater than, that of the other sciences, but also because of its cultural value and the national necessity of thinking biologically."

All the book is useful, but particularly valuable are the sections on the library and the comprehensive book list both for scholars and teachers. The many external and human factors governing a choice of syllabus are dealt with admirably and there are numerous hints on the special technique of teaching the biological sciences—a technique which is still being developed. The foreword has been written by Sir John Russell.

W. L. S.

Science fights Death

By D. Stark Murray. (Changing World Library.) Pp. x+149. (London: Watts and Co., 1936.) 2*s*. 6*d*. net.

THIS book tells briefly and simply what medicine is doing to advance our knowledge of disease. It deals with macroscopic parasites, with bacteria and with viruses, with hormones, industrial diseases, cancer and anæmia. It can be recommended to the layman as a trustworthy and readable sketch.

Recent Crystallography*

By Sir William Bragg, O.M., K.B.E., P.R.S.

BENEATH the immense variety of Nature's structures lie certain remarkable simplicities. Thus the elements used in the building are surprisingly few in number. There are but ninety-two in all, of which only a few are of common occurrence, and many are used very sparingly. Indeed there are one or two of which it can only be said that they should exist, though as yet they have not been found. Oxygen constitutes half of the known world, half the remainder is silicon; aluminium comes next. In living things carbon is one of the most important elements, yet it constitutes only a fraction of one per cent of the world as a whole.

It is becoming clear that Nature is most economical in her designs also. This very remarkable phenomenon is especially evident in the structures of living matter. The proteins which play such a predominant part in the animal are all based upon a certain fundamental pattern, and so is the cellulose which plays a corresponding part in plant-life. The recent discoveries of the biochemists have revealed the existence of several classes of substances, as for example the sterols, which though minute in amount have a powerful effect on life and health. In each class a basic pattern is common to all, and the rich variety is derived from a common theme.

There is a further simplicity in the regularity of arrangement of the atoms and molecules in all substances, or at least in the effort to achieve regularity. It is naturally most in evidence in the solid body. When the solid forms from the melt, or assembles out of solution, or grows from deposited vapour, the atoms and molecules of which it is made settle themselves in orderly array. The process is often sensitive to disturbance of the surrounding conditions, but if it is allowed to go on as it begins, it ends in the production of a visible crystal. The constancy of the angles which the faces of a crystal make with one another is evidence of the regular repetition in space of some fundamental collection which is the unit of pattern of the whole. Crystallographers have long surmised that the crystal is the consequence of such a construction.

The X-ray methods of analysis have made it possible to observe and measure these regular details of the assembly. The methods have often been described; it is sufficient to say now that they depend on the reactions between the fine and regular succession of the X-ray waves and the fine regularity of the crystalline arrangement, the two degrees of fineness being fortunately of the same order. The study of crystalline matter with the help of X-rays is one of the most powerful methods of investigating natural structures. It has contributed materially to the realization of the fundamental simplicities in the choice of design.

When the X-ray methods were introduced, they were first applied to the determination of the simpler crystalline structures—rock salt, diamond and the like. Since then the improvements in technique and in theory have been so great that complicated structures have been completely worked out, such as for example the silicates and some of the less complex organic crystals; and it has been possible to go some way in the examination of the complicated and large molecules which are found in living organisms, such as the proteins to which reference has already been made.

The first of the proteins to be examined in detail was 'keratin', the important constituent of wool, hair and horn. It is a remarkable illustration of the persistent occurrence of regularity in the structures of Nature, and at the same time of the power of X-rays to discover it, that crystalline structure should have been proved to be an important feature of substances which are ordinarily supposed to be anything but crystalline.

The fundamental feature of keratin is the constant repetition in a zigzag line of the atoms carbon, carbon, nitrogen in long succession. The same repetition is found in all the proteins. These atoms carry certain attachments, some of them invariable, others not. In the protein chain when extended to its full length, each nitrogen carries a hydrogen atom, and one of the two carbons in each unit carries an oxygen to which it is joined by a double bond. The other carbon carries a hydrogen, and is also attached by a single bond to one end of a secondary or side chain, which varies from protein to protein, and generally from portion to portion of the same protein. In the accompanying diagram (Fig. 1), taken from Astbury's "Fundamentals of Fibre Structure", the side chains are denoted by R, R, . . . The difference between one protein and another, so far as constitution is concerned, is due to differences in the nature of the side chains.

By X-ray measurements it has been possible to determine the length of the repeat in various forms

* Friday evening discourse delivered at the Royal Institution on January 29.

of keratin, and to show its constancy, and its agreement with the suggested structure and with the values of interatomic distances as found in other organic crystals.

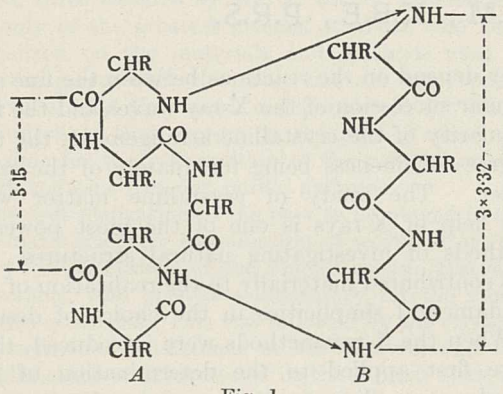

Fig. 1.

A. A KERATIN CHAIN PARTLY COILED UP. NOTICE THE APPROXIMATION AT CERTAIN POINTS OF THE NH AND THE CO. *B*. THE EXTENDED KERATIN CHAIN. (ASTBURY.)

Svedberg showed in 1929 that by means of the greatly accelerated settling of a suspension subjected to centrifugal force, it was possible to estimate the weights of various proteins. He found that nearly all those which he examined had a molecular weight of about 35,000, or a simple multiple of this number. In blood he found certain others of still greater molecular weights, to be counted in millions. The constitution of all proteins is about the same, that is to say, carbon 50–55 per cent, hydrogen about 7 per cent, nitrogen 15–19 per cent, oxygen 19–24 per cent, with traces of sulphur, phosphorus and metals. In keratin the sulphur content may amount to 2 or 3 per cent.

Proteins are assembled in the course of plant life. Animals require proteins for their nourishment, but do not themselves manufacture them to any considerable extent. They must therefore eat plants, or eat animals that eat plants. Emil Fischer showed, at the beginning of this century, that the assemblage of a protein was accomplished by the successive linking of amino-acids into a long chain, water molecules being shed in the process. The amino-acids are long-chain molecules, at one end of which (and sometimes at both ends) are found the basic group NH_2 and the acid group COOH. The linkage is effected by the interaction of the basic group of one amino-acid with the acid group of the next as illustrated in Fig. 2.

It is an accepted hypothesis that two parts of a molecule, separated from each other by a single bond, can be rotated with respect to each other about that bond. The long chain illustrated in Fig. 1*B* can therefore be crumpled up into less extended forms by successive rotations about its bonds. Astbury supposes that the keratin chains of a wool fibre in its unstretched state are shortened into the form of Fig. 1*A*. It is interesting to observe that a nitrogen is now brought near a carbon which is five links away along the chain (Fig. 1*B*). Frank has pointed out that a junction must be effected here between the N and the C; the H belonging to the N passes over to the C=O group, converting it into C—O—H. Groups of hexagonal rings are thus formed.

The side chains of one long-chain molecule can interact with the side chains of another, and it is in this way that the long molecules are tied together into a firm substance like hair or horn. When the chain is coiled up, these side chain attractions are more and more satisfied by interactions in the molecule itself. It is possible that in this way, as has been particularly emphasized by Wrinch[1], something like a ball is formed, which has relatively little attraction for other similar balls. Such may be the case in the white of an egg in its natural state; boiling the egg breaks up

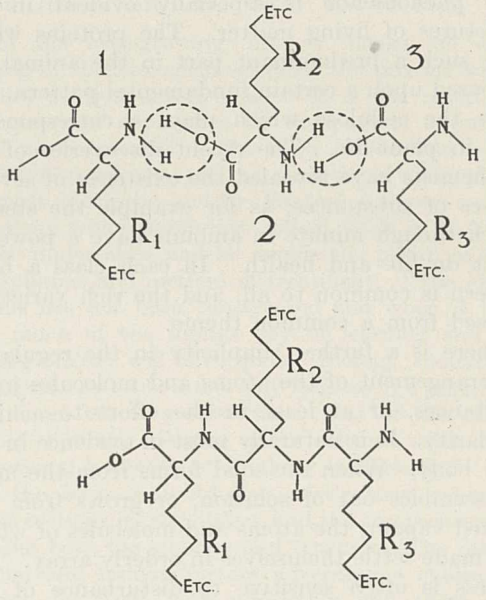

Fig. 2.

IN THE UPPER PORTION OF THIS FIGURE THREE AMINO-ACID MOLECULES ARE DRAWN SIDE BY SIDE, AS IF THEY WERE READY TO BE LINKED TOGETHER. IN THE LOWER PORTION THE JUNCTIONS HAVE BEEN MADE: WITH THE SHEDDING OF WATER MOLECULES FORMED BY THE COMBINATIONS OF THE ATOMS WITHIN THE CIRCLES OF THE UPPER PORTION. THE SIDE CHAINS R MAY VARY IN FORM. IF THEY ARE, ALTERNATELY, A SINGLE HYDROGEN ATOM AND A METHYL GROUP (CH_3), THE PARTICULAR PROTEIN IS THE CONSTITUENT OF NATURAL SILK.

the balls, and the uncoiling chains link together, forming the solid mass of the white in a boiled egg. The substance is said to be 'denatured'.

[1] NATURE, **137**, 411 (1936).

(To be continued.)

Wood-pulp and the Future

IT is safe to state that during no similar period since the first commercial production of wood-pulp in the middle of the last century has our knowledge of the subject advanced so rapidly as during the past three years. A number of entirely different influences have contributed to this activity. In the first place, one of the benefits associated with slump conditions is the time (and in the case of far-seeing concerns, the stimulation) it provides for research work; and secondly, there has been an increasing demand for rags for paper-making, which has resulted in a shortage, and consequently, rising prices in this market. To this may be added the growing use of certain classes of wood-pulp for rayon manufacture, the present position being that this industry now absorbs ten per cent of the world production of wood-pulp; in some quarters there is even a scare of a shortage of pulp for paper-making in the future.

These various influences are all apparent in the advances referred to. Prolonged research has for example resulted in the production of 'alpha-pulps', so named because they contain a high proportion (90–98 per cent) of α-cellulose; this is the name given to the constituent which is insoluble in a 17·5 per cent solution of sodium hydroxide at 20° C. under specified conditions. The method of production is usually a modified sulphite 'cook', followed by chlorination, extraction with alkali and careful washing.

In comparison with ordinary wood-pulps, alpha-pulps have some interesting properties. In the first place, highly absorbent papers may be made from them, and they are therefore very suitable for the manufacture of paper towels and handkerchiefs for facial tissues, etc., the use of which is far more common in the United States than in Great Britain. Papers made from such pulps also lend themselves readily to impregnation with rubber latex and similar materials, and as a result of subsequent processing they can then be converted into leather substitute[1]. There is already a wide market for products of this kind in the manufacture of handbags, fancy goods, bookbindings, shoe linings, etc. where effect is more important than durability. Furthermore, since alpha-cellulose represents the nearest approach to true cellulose obtainable on the manufacturing scale, it is not surprising that advantage has been taken of the inherent strength of the fibre to use it in the production of certain classes of strong papers. Special mention may be made of papers the tearing-strength of which is important, because in such cases fibre length is of special significance. The use of alpha-pulps in this connexion, however, calls for special care, because alpha-pulps do not respond in the same way as other wood-pulps to the development of strength characteristics by 'beating'. Moreover, as resistance to tear is obtained only by sacrificing other forms of strength, for example, bursting-strength, it is usual to add only a relatively small proportion of the alpha-pulp, and, so far as possible, to beat it separately.

Recent work has shown[2] that the permanence of paper, that is, its resistance to the effects of normal ageing, depends as much on the purity of the cellulose present as on the origin of the fibre, and although the traditional preference for rag is still strong, it is now recognized that a paper made from a carefully prepared wood-pulp can last longer than an inferior rag paper. The difficulty of devising a really reliable accelerated-ageing test is probably the biggest obstacle to the demonstration of the relative merits of these fibres. Apart from these questions, however, the fact that the alpha and similar pulps contain such a high proportion of α-cellulose is an obvious argument in favour of their use in 'permanent' papers. This course has so far been justified by such accelerated-ageing tests as exist; provision, however, has also been made for natural ageing tests, the conclusion of which must be left in the hands of the next generation.

Since the method of preparing alpha-pulps is similar to that employed for the determination of α-cellulose (cf. *supra*), namely, removal of other substances by selective solution in various reagents such as sodium hydroxide, it follows that the yields of pure material are necessarily low. This and the manufacturing costs arising from the use of several treatment processes have made these pulps rather expensive, and would seem to be the factor which at present places a limit to their more extended use.

The advances in the technique of bleaching wood-pulps which have been a feature of recent years have also resulted in the production of some interesting types of pulp. These are based on the treatment of the pulp with the bleaching agents in several stages instead of in one only. Chlorine, either as gas or in the form of an emulsion in water, is used in the first stage. This procedure serves to chlorinate the lignins and other undesirable substances in the raw wood, the resulting

compounds being soluble in alkali; removal of these in this way is therefore the second stage. Up to this point, there is no real improvement in the colour of the pulp, but the bleaching proper may now be carried out, hypochlorite being the reagent used. This again may be operated in one, two, or even three stages. It is interesting to note that the use of chlorination for the isolation of cellulose was proposed by Cross and Bevan[3] so long ago as 1903, but it is only within recent years that advances in chemical engineering have enabled the process to be realized in practice.

The principal advantage of this method of bleaching is that the colour may be improved without undue detriment to strength, but the elimination of a good deal of the dirt and troublesome resinous matters in wood and an economy in bleaching costs are further benefits which are not to be ignored. Pulps made by the sulphite process provide some of the best-known examples of the advantage of multi-stage bleaching, but of great interest also are bleached kraft pulps of high strength and good colour, as these have become available only relatively recently. The general principles of the preparation process are similar to those used for sulphite pulps and indicated above, but the results obtained almost justify the descriptions of a modern bleached kraft as a new raw material for paper. This is because, although the colour and cleanliness bring these pulps into favourable comparison with many grades of bleached sulphite pulp, the corresponding strength is very much greater, and the cost is not excessive. It is believed that the advent of this new type of pulp may create a demand for a paper which combines the strength of the familiar brown kraft wrapping with the æsthetic and advertizing value which result directly (and indirectly, through the printer's art) from a good colour; foodstuff wrappings suggest themselves immediately in this connexion; and substitution of certain grades of rag is another possibility.

The use of American southern pine as a source of paper-making wood-pulps other than kraft has already been referred to in NATURE[4], and the requirements of the rayon industry are now also being studied. In view of this work, there seems little doubt that it is only a matter of time before it is possible to deal with the vast supplies of southern pine by the groundwood process, and possibly even by a sulphite process. There are many who are sceptical about even the former of these possibilities; but it is less than seventy years ago that similar doubts were expressed as to the practicability of making paper from wood at all. When it is remembered that there are a hundred million acres of longleaf and loblolly pine available from the southern States of the Union alone, there is ample justification for the statement that this region may well be as important in the future as a source of newsprint as at present it is of kraft-pulp.

The exploitation of new sources of wood at once raises the general question of the conservation of timber supplies and, in particular, the matter of re-afforestation. One respect in which certain of the Scandinavian countries have set an example which might well be followed more closely elsewhere is the organization of the pulp-mill in close relationship to the saw-mill, with the object of eliminating waste. In this connexion, it was stated a few years back by the U. S. Forest Service that every year about six million cords of sound wood suitable in size for pulping processes were wasted in the course of logging operations. This statement refers to one of the richest timber regions in the world, namely, the strip of Pacific coastline between Oregon and Alaska. Here the western hemlock, which is very suitable for the production of sulphite wood-pulp, occurs in close association with an important timber tree, namely Douglas fir, and there are now possibilities that the latter might be amenable to treatment by the sulphate process.

In the case of southern pine, a relatively short time of growth—at the most eighteen years—is required in order to obtain a tree of suitable size for pulping, so that in this instance the problem of re-afforestation should be simplified, at any rate from the economic point of view.

A final word seems desirable on the subject of possible rivals to wood pulp. These are not lacking, and many indeed (such as straw) precede it historically. Each year brings a host of suggestions which the paper-maker assiduously tests, and frequently finds to be satisfactory from a purely technical point of view. The objection is nearly always the cost of transport, because the fibres usually grow in remote parts of the earth where the cost of harvesting and bringing to the nearest port is prohibitive. The rapidly advancing price of wood-pulp is, however, focusing attention on the results of trials which have been 'filed' for many years. Esparto is of course an old-established rival to wood-pulp and one which enjoys the advantage of being a printing fibre *par excellence*, although it is too soft to be used alone where strength is at all important. At the same time, any decrease in the difference in price between wood and esparto must tend to increase the demand for the latter.

Another fibre which may assume more importance in the future is bamboo. It may be safely stated that the main technical difficulties associated with this fibre have now been overcome, and it is

firmly established in India; Sabai grass, which produces a paper having similar characteristics, is also increasingly in evidence in papers from this source. Both types of paper are similar to those made from esparto, and give good printing results. To come nearer home, straw is a source of pulp which is encountered frequently in Continental papers, and particularly in those from agricultural countries such as Holland. Its use in recent years has been on the decline, but as this has been due mainly to the cheapness of wood-pulp, the removal of this competition should mark the revival of straw. Unlike esparto and bamboo, straw imparts a hardness and rattle to paper and has a good colour; it is therefore more suitable for writings than for printings. Although there is, and presumably always will be, plentiful supplies for pulping, the processing of it for use in fine papers will, however, be controlled to a great extent by the demands on the raw material made by the straw-board industry. Danubian reed (*Phragmites communis*) is also available in large quantities in the Danube valley, and a similar reed grows in the marshy districts of Norfolk. Many investigations into their paper-making properties have already been carried out both privately and in conjunction with the Ministry of Agriculture[5], and it was concluded that if it were not for the low yield the reeds might prove competitive with certain classes of wood-pulp; here again, therefore, rising prices may reverse the situation. Similar considerations apply to New Zealand flax[6] (*Phormium tenax*) and hemp stalks. The former is perhaps in a different strength category from wood-pulp, as its strength makes it more comparable with rags, but the latter is of considerable importance to countries such as Italy where some 400,000 tons of stalk are available per annum; this is sufficient to render this particular country self-supporting from the pulp point of view[7]. Here again, however, the rayon industry may claim a share of the new material.

Finally, the possibility of a paper pulp famine in the distant future is extremely remote, as even if wood-pulp supplies fail—an unlikely probability—human ingenuity will soon provide a substitute. On the other hand, the immediate future may be a period of difficulty which will last until the gap between past and future conditions is bridged, so that there is every prospect that the rapid advances in the technology of the subject will continue.

J. G.

[1] Grant, J., NATURE, **134**, 921 (1934).
[2] Grant, J., NATURE, **130**, 320 (1932); **132**, 414 (1933). Grant, J., *Discovery*, **17**, 156 (1936). Grant, J., "Books and Documents. Dating, Permanence and Preservation" (1937).
[3] NATURE, **138**, 175 (1936).
[4] Grant, J., NATURE, **136**, 1014 (1935).
[5] *Bull. Imperial Institute*, **33**, 421 (1935).
[6] Yeates, J. S., *Paper Trade J.*, Technical Section, **103**, 66 (1936).
[7] *Woch. Papierfabr.*, **67**, 75 (1936).

International Council of Scientific Unions

NINETY-EIGHT representatives of seven International Unions and twenty countries attended the third General Assembly of the International Council, held in the rooms of the Royal Society, London, under the presidency of Prof. N. E. Nörlund. At the opening meeting on April 27, the Council was first welcomed by Sir William Bragg, president of the Royal Society, and then Prof. Nörlund gave his presidential address on "The Figure of the Earth".

After the report of the Executive Committee had been read, Prof. B. Cabrera presented the report of a special committee which was appointed to consider the relations of the Council with the Committee of Intellectual Co-operation of the League of Nations. Among the recommendations of the committee, which were adopted in full, was one that the International Council should act as a consulting body on problems of a scientific nature which the Committee of Intellectual Co-operation might be called upon to solve. Questions of an international character concerning the organization of scientific work would be referred by the Council to the Committee. Prof. S. Chapman presented the report of the Committee on Solar and Terrestrial Phenomena, and the Committee was continued with an increased grant. The Committee on Instruments and Methods was discontinued.

The second session of the Council was largely devoted to the resolution from the Royal Academy of Sciences at Amsterdam asking for the appointment of a committee "which should attempt to arrive at a co-ordination of what has been proposed in respect of the social responsibilities of science and of scientific workers" (see NATURE, **139**, 697, April 24, 1937). Prof. J. M. Burgers presented the motion, which led to a lively discussion in which eighteen speakers took part. It was clear that a number of the representatives of national academies adhering to the Council were not in a position to vote for the motion as it stood without reference back to their academies. A restricted field of activity was the most that could secure general support for a committee of the type indicated. The matter was referred to a small committee representative of the different views that had been expressed.

This committee reported that the appointment of a committee with the full powers proposed by the Amsterdam Academy lay outside the objects of the International Council as laid down in the statutes, and at a subsequent meeting of the Council Prof. H. R. Kruyt formally withdrew the motion from the Amsterdam Academy in favour of one to appoint a committtee with the following terms of reference :

"The Committee, at suitable intervals, should prepare a survey of the most important results obtained and of the directions of progress that are opening and of points of view brought forward in the physical, chemical and biological sciences, with reference to :—

"(1) their interconnections and the development of the scientific picture of the world in general ;

"(2) the practical application of scientific results in the life of the community.

"The work of the Committee is limited strictly to scientific activity."

The membership of the committee was left to the Executive Council of the Union.

The reports of the recent work of the various International Unions were presented by Dr. H. Spencer Jones (Astronomy), Prof. M. de Martonne (Geography), Sir William Pope (Chemistry), Prof. H. Abraham (Physics), Prof. S. Chapman and Dr. J. de Graaf Hunter (Geodesy and Geophysics), Dr. E. H. Rayner (Radio Physics) and Dr. M. J. Sirks (Biology). Prof. E. V. Appleton completed the report from the Union of Radio Physics by a lecture at the Royal Institution on "International Co-operation in Radio Research."

The social side of the meeting included a reception by the Government at Lancaster House and one by the Royal Institution, at which Sir William Bragg lectured on "Classical Experiments made at the Royal Institution". The Royal Society invited delegates to attend one of its ordinary meetings and also one of its annual soirées. Visits were also arranged for those delegates who wished to see such institutions as the Royal Observatory, the Royal Geographical Society, Kew Gardens, Rothamsted, the Zoological Gardens, the National Physical Laboratory, the B.B.C., and various institutes, museums and laboratories in or near London.

At the closing meeting of the Council, the place and time of the next meeting were fixed as Copenhagen in 1940, on the invitation of the Royal Danish Academy of Sciences. After votes of thanks for hospitality and to Prof. Nörlund and Sir Henry Lyons for their past services, new officers were appointed as follows : *President*, Prof. Charles Fabry ; *Vice-Presidents*, Il Marchese Marconi, Prof. H. R. Kruyt ; *Members of the Executive Council* (in addition to representatives of the Union), Prof. D. B. Nemeč, Dr. J. A. Fleming ; *General Secretary*, Prof. F. J. M. Stratton.

Obituary Notices

Dr. A. H. Church, F.R.S.

DR. ARTHUR HENRY CHURCH died on April 24 at the age of seventy-two years. At sixteen years of age he left his home at Plymouth, where his father was in business as a saddler, to be a pupil teacher at Ashburton Grammar School ; four years later he entered University College, Aberystwyth, and at twenty-four was elected science scholar of Jesus College, Oxford. He was a research fellow of his College from 1908 until 1912 and University reader from 1910 until 1930. One married daughter survives him.

Church was not as other men : he went his own way, indifferent, so it seemed, to the opinions of his fellows ; exceptionally able, he combined meticulous accuracy with originality and a flair for theoretical discussion. His contributions to botanical science bear the impress of a certain quality of distinction and genius. The greater part of his academic life was spent in the intensive instruction and paternal guidance of Oxford undergraduates, to whom he gave his best and earned their gratitude. To most botanists, he was known only by name and as the author of books and papers characterized by clear thinking, provocative, dogmatic statement and bold hypotheses often demanding concentrated thought on the part of readers. Well fitted by ability and breadth of knowledge to occupy the highest positions in his profession, his ambition was to advance science, not himself ; life in the laboratory and in the seclusion of home sufficed ; to the great regret of colleagues he avoided scientific meetings and social occasions.

A paper published in the *Annals of Botany* forty-two years ago on a calcareous alga, *Neomeris dumetosa*, illustrates Church's thoroughness in description, ingenuity in attacking theoretical problems, and his great skill as a draughtsman. At the beginning of the present century, Church devoted much time and thought to the mathematical laws governing the orderly disposition of leaves on stems of plants. Phyllotaxis, the arrangement of leaves on a shoot, is the expression of rhythmic production at the growing point : different plants have their own architectural plan. So much is known to students : most botanists are content to go no further. In his book, "On the Relation of Phyllotaxis to Mechanical Laws" (in three parts, 1901–4), and in a few shorter papers, Church made a comprehensive survey of the

various types of phyllotaxis, and decided that a morphological theory of spiral growth must be based on a logarithmic spiral on a plane surface. This conclusion and the mathematical reasoning, it must be admitted, did not awake an enthusiastic response on the part of the average botanist.

In 1908 the Oxford University Press published a sumptuous folio volume "Types of Floral Mechanism" in which are described twelve early spring flowers with drawings, many in colour, which have never been surpassed in accuracy. A few years later, Church gave much pleasure to me by acting upon a suggestion that he should apply methods, previously used by him in the description and delineation of Angiosperm flowers, to the elucidation of the floral morphology of the remarkable African Gymnosperm *Welwitschia mirabilis*. The results were communicated to the Royal Society in 1914. A series of "Elementary Notes" on Angiosperms, Gymnosperms and Fungi (1919–21), printed as pamphlets, that are models of concise and logical presentation of facts and theories, bear testimony to his determination to raise the standard of teaching to the highest level. Three admirable botanical memoirs on "Plant Life of the Oxford District" have much more than a local value and should be more widely known.

The best known of Church's Oxford Memoirs is "Thalassiophyta and the Subaerial Transmigration" (1919). The opening words, "The beginnings of Botany are in the sea", served as a text for a learned and exceedingly interesting thesis on the origin of terrestrial vegetation. His view was that life began in a primeval ocean covering the surface of the earth; free-swimming flagellates were succeeded by encysted organisms attached to the sea-floor, some of which in the course of ages developed into highly differentiated green algæ comparable in size and complexity to the large brown seaweeds of our rocky coasts. At a later stage, portions of the earth's crust were uplifted above the surface of the world-ocean, and some of the aquatic algæ that had reached an advanced state of differentiation were, he believed, able to grapple successfully with the serious problems presented by a changed environment and became the advanced guard of a land flora: "the origin of all the main successful adaptations of the land are to be traced down to the benthic phase of the sea". The Thalassiophyta memoir was preceded by one on "The Building of an Autotrophic Flagellate" (1919). He afterwards published several papers in the *Journal of Botany* (1924–25) and elsewhere in elaborating the main thesis.

Church's fascinating hypothesis, not perhaps wholly new, was presented by him in an original form and with a wealth of argument and fact: it has been vigorously criticized by botanists who envisage a different origin of land vegetation; but to many it makes a strong appeal as a contribution to speculative science which will endure.

Forgetting his idiosyncrasies and regrettable aloofness, we think of Church as a self-sacrificing, devoted, kind-hearted teacher, and as one of the ablest and most original botanists of our time.

A. C. SEWARD.

Diwan Bahadur L. K. Ananthakrishna Iyer

WE much regret to announce that Dr. Ananthakrishna Iyer, whose name is well known to all students of Indian sociology, died on February 25 at Palghat in the Malabar district of the Madras Presidency.

Born of a southern Indian Brahman family at Palghat in 1861, and educated at the local Government high-school, this well-known scholar graduated at the University of Madras and entered Government service, which he soon relinquished to join the staff of the Victoria College at Palghat. He then became an inspector of schools in the Cochin State, in which position his services were utilized to develop a State museum, zoological gardens and an industrial bureau. Thus he possessed suitable qualifications for taking part in the systematic ethnographical survey of India which was set on foot by the late Sir Herbert Risley as a sequel to the Census of 1901. Two volumes dealing with the tribes and castes of the Cochin State were issued by him in 1907 and 1912 respectively. The University of Calcutta then invited him to organize a Department of Anthropology, of which he became chairman in 1920.

When in 1924 the superintendent of the Mysore Ethnographic Survey, Mr. H. B. Nanjundayya, unfortunately died, leaving the Survey only partly accomplished, the Mysore State selected Ananthakrishna Iyer to succeed him. Thus commenced the most important of the latter's numerous tasks, and one which will serve as a lasting memorial to his energy and powers of research. Between 1924 and 1935, four volumes were published, giving an account of the population of Mysore on the lines laid down for the Ethnographical Survey, and containing a mass of interesting materials skilfully marshalled by the editor. The first volume, published last, contains a summary of the contents of the other three, and is enriched by contributions from such scholars as Dr. R. R. Marrett, M. Sylvain Lévi, Baron Eickstedt and Mr. C. S. Richards. The public were promised a further volume containing some additional materials, but it is feared that this may not now be available. The loss would be regrettable as it was expected to remedy an obvious defect in the first four, namely, an omission of any list of tribal and caste synonyms, an indispensable guide for scholars who are not familiar with the many names under which Indian social divisions are frequently hidden.

While preparing his final effort, in relation to Mysore, Ananthakrishna Iyer attempted a survey of the small State of Coorg on parallel lines. It is understood that this work was well advanced at the time of his death. It is therefore earnestly hoped that the completion and publication will be entrusted to some competent scholar by the Coorg State.

As a foundation member of the Indian Science Congress, Ananthakrishna Iyer endeavoured to popularize the study of anthropology. In 1934, he was invited by a number of universities in Europe to deliver lectures, and for this purpose visited Oxford, Paris, Rome, Florence, Vienna, Berlin, Königsberg, Halle, Bonn and Cologne. In July of that year, he was present at the International Anthropological Congress in London when he read a paper on the

agricultural basis of religion in southern India, and directed attention to the somewhat inadequate provision made on this occasion for the consideration of the results of Indian ethnographical research. In January last, he presided for the last time over the Anthropological Section of the Indian Science Congress Association, held at Secunderabad, when he dealt in his presidential address with his recent work in the Coorg State.

Ananthakrishna Iyer's publications are too numerous to mention here. During a period of forty years he was connected with most of the learned societies dealing with anthropology in Europe and America. He was a foundation fellow of the Indian Academy of Science, Bangalore, and of the National Institute of Science, Calcutta. In 1935 he was made officier de l'Académie Française and honorary doctor of medicine and surgery of Breslau. In the same year he was promoted from Rao Bahadur (1921) to Diwan Bahadur, by the Government of India. By his death, India loses an indefatigable and learned worker in the field of ethnographic study who cannot readily be replaced. His many friends both in that country and in England will regret the passing of an attractive and vigorous personality.

R. E. ENTHOVEN.

Dr. T. G. Macaulay Hine, O.B.E.

DR. T. G. M. HINE, who died on April 25 at the age of sixty-six years, was the son of the late Mr. George Hine, an architect in large practice. From close association with his father, Hine acquired an excellent knowledge of business, and in his youth spent a year in Germany at the practical study of engineering. Educated at Charterhouse, King's College, Cambridge, and St. Bartholomew's Hospital, Hine, after qualifying and acting as house physician, settled down to the study of bacteriology and investigated the fermentative character of organisms of the diphtheria group.

Hine's chief chance, however, came when during the first winter of the Great War cerebrospinal fever broke out among the mass of troops then in training and, as recruits are specially susceptible to the disease, a very serious outbreak was threatened. The disease was known to be due to the meningococcus and to be conveyed by droplet infection through a chain of healthy carriers who harbour the organism temporarily in their nasopharynx. The D.G. of the Army Medical Service, the late Sir Alfred Keogh, was advised as to the measures taken by Sir William Horrocks assisted by the late Dr. Richard Reece and Dr. Mervyn Gordon, whose services were supplied by the Medical Research Committee. A central laboratory was set up at Millbank (headquarters of the R.A.M.C.) with a travelling laboratory attached and Dr. Hine was put in charge. In order to check the disease, contacts were swabbed, carriers segregated, and intensive research undertaken in which Martin Flack, W. J. Tulloch, J. A. Glover, and A. G. Bell all made valuable contributions.

As each salient point came to notice it was applied by Dr. Hine. Thus (1) the first requirement was a suitable medium that could be supplied in bulk for identifying carriers of the meningococcus. When this was arrived at, Dr. Hine manufactured it on a large scale and kept more than fifty laboratories dealing with troops supplied. (2) It was soon found that the only safe way to identify the meningococcus was by serological means, and that four different types of it were operating, of which two were responsible for 80 per cent of the cases. The large-scale production of menotypical agglutinating serums for identifying these strains of the meningococcus, and homologous suspensions for checking the sera, was undertaken by Dr. Hine, who later on was succeeded in this work by Commander A. G. Bell. (3) When trial was made of monotypical therapeutic serum standardized by its antiendotoxic capacity, Dr. Hine undertook its distribution and the assessment of results. This serum was particularly successful in patients infected by Type I, the main epidemic strain of the meningococcus, in which the mortality had previously been highest, but less successful in cases infected by the other types. (4) When it was found by experiments on carriers at the central laboratory that the meningococcus can be destroyed in their nasopharynx by causing them to inhale through the nose the air of a room densely charged with a spray of droplets of 1 : 50 zinc sulphate, Hine's previous engineering experience enabled him to design a jet that was more efficient than the one previously in use.

Although the disinfection of carriers by this means was only temporary, it proved valuable for dealing with instances of mass infection, and when applied the last thing at night before going to bed, appeared to stop the incidence of the disease in some outbreaks : the disease ceasing while the spray treatment was in use and beginning again when it was stopped. The Navy adopted Hine's jet for installation in the Fleet, where it was operated by compressed air instead of by steam as in the Army.

For his services during the War, Dr. Hine received the O.B.E. and was made an honorary major in the Army. After the War, he gave assistance for a time to the administrative staff of the Medical Research Council and then retired to his house near Slapton in South Devon. Dr. Hine was a popular figure in lay as well as medical circles, and was a past Master of the Fruiterers' Company.

WE regret to announce the following deaths :

Prof. R. H. Fernald, director of the Department of Mechanical Engineering and dean of the Towne Scientific School of the University of Pennsylvania, known for his work on fuel technology, on April 24, aged sixty-six years.

Prof. A. R. Ling, emeritus professor of malting and brewing and of the biochemistry of fermentation in the University of Birmingham, on May 14, aged seventy-six years.

Prof. L. W. McCay, emeritus professor of chemistry in Princeton University, known for his work on the chemistry of arsenic, on April 13, aged seventy-nine years.

News and Views

Dr. G. F. Herbert Smith

DR. G. F. HERBERT SMITH retires from the keepership of minerals in the British Museum (Natural History) on May 26. He joined the staff of the Mineral Department under Sir Lazarus Fletcher in 1897 and devoted himself particularly to mathematical crystallography and to the development of scientific methods for the identification of gem-stones. An account of his earlier career and of his scientific work appeared in these pages in 1935 (135, p. 948). In 1921 he was appointed assistant secretary and later secretary, of the British Museum (Natural History). This was a loss to the Mineral Department, but an undoubted gain to the Museum as a whole. During his fourteen years in this office he worked for the improvement of the equipment and buildings of the Museum, and the increase of numbers and betterment of conditions of employment of its staff, and for the prestige at home and abroad of a great scientific institution. During his short period of office as keeper of minerals since 1935, he has continued the improvement in display methods initiated by his predecessor. The finely illuminated wall-cases at the entrance to the mineral gallery and the nitrogen-filled case housing the great Cranbourne meteoric iron have all been completed under his supervision. With the office of secretary to the Museum he took over the secretaryship of the Society for the Promotion of Nature Reserves and he has been chairman of the Wild Plant Conservation Board since 1931. These activities will not cease with his retirement from the Museum, and it may be hoped that time may also be found for a resumption of scientific work interrupted by many years of administrative duties. Quite apart from his scientific work, Dr. Herbert Smith has taken a very active part in Civil Service affairs. He was one of the honorary secretaries of the Society of Civil Servants in 1918–1925, vice-president in 1925–1928, and president in 1928–1932. He has been honorary secretary and treasurer of the Civil Service Arts Council since 1924.

Lieut.-Colonel W. Campbell Smith

LIEUT.-COLONEL WALTER CAMPBELL SMITH has been appointed to succeed Dr. Herbert Smith. Lieut.-Colonel Campbell Smith was born in 1887 and educated at Solihull and Corpus Christi College, Cambridge. He took a first class in both parts of the Natural Sciences Tripos (Mineralogy), and was appointed to the Museum in 1910, where his work has been confined mainly to the collection of rocks, which has been entirely rearranged in his time. He was promoted to deputy keeper in 1931. At the outbreak of the Great War he was a lance-corporal in the Artists' Rifles, was later seconded to the Special Brigade, R.E., and rose to the rank of lieutenant-colonel in 1918. He resumed his connexion with the Artists' Rifles after the War and retired in 1935 with the rank of brevet lieutenant-colonel. He was secretary of the Geological Society of London in 1921–1932, and has been secretary of the Mineralogical Society since 1927. He was a fellow of Corpus Christi College, Cambridge, in 1921–24, and is a governor of the Royal Holloway College.

Pulitzer Prize for Science Reporters

THE Pulitzer prizes in letters and journalism for the current year were announced on May 3 by Dr. Nicholas Murray Butler, president of Columbia University. Among the awards was a prize of one thousand dollars to five members of the National Association of Science Writers, all of whom have reported the meetings of the American Association for the Advancement of Science for many years. The award, "for the most distinguished example of a reporter's work", was given in recognition of their accomplishments in connexion with the tercentenary celebration of Harvard University. The criteria on which the award is made are "strict accuracy, terseness, the preference being given to stories prepared under the pressure of edition time that redound to the credit of journalism". Those sharing the reward are: Howard W. Blakeslee, Associated Press, president; William L. Laurence, *New York Times*, vice-president; David Dietz, Scripps-Howard Newspapers, past president; Gobond Behari Lal, Universal Service; and John J. O'Neill, *New York Herald-Tribune*. The work of reporting the celebration was carefully organized in advance by the Harvard authorities in co-operation with the National Association of Science Writers, the president of the University, Dr. Conant, giving personal attention to the matter. The result was eminently satisfactory, and the award of the Pulitzer prize to the five writers mentioned is an encouraging mark of appreciation of the way in which a great university function was described in the periodical press.

The Coronation Broadcast

THE modern development of radio broadcasting is among the most wonderful and at the same time the most satisfactory, of the practical applications of scientific and technical research. This was admirably demonstrated on Coronation Day, May 12, when the elaborate arrangements outlined in NATURE of May 1 were submitted to the test of practical achievement. For more than six hours, almost the entire resources of the British Broadcasting Corporation were devoted to the handling of a sound picture of the procession and coronation ceremony from start to finish. In addition, at a selected point on the route, a combined sound and vision programme was successfully broadcast from the London television station, while, later in the day, a 'round the Empire' programme concluding with an address from H.M. the King was also

provided. All those concerned must feel a deep sense of satisfaction in the successful accomplishment of this day's difficult programmes. For the first time in history, the general public in all parts of the world were enabled to participate in very intimate detail in the elaborate ceremony of the coronation of a British king. Hitherto this experience has been confined to the few who, by virtue of rank or service, have been favoured with a position inside Westminster Abbey.

CORONATION DAY, 1937, will be remembered by many millions of people who heard, either in their own homes or while they were actually in position along the processional route, a continuous broadcast commentary accompanied by a sound picture background of the pomp and majesty of the procession and ceremony. A striking illustration of the advantages which broadcasting gives over the possible scope of the ordinary sightseer, was provided by the manner in which the commentary was successively switched forward along the route, so that the listener was enabled to keep up with the progress of the procession. When, as seems undoubtedly probable in the near future, this advantage becomes available to the viewer as well as to the listener, it will be still more generally appreciated. When the picture is further provided in natural colours, the entire scope of the participation of the general public in large-scale ceremonies will have been subject to a revolutionary change.

THE evening programme comprised messages of homage to the new King, presented by speakers in various parts of the Empire in addition to the official greetings from the Prime Ministers or other representatives of the Dominions actually present in London. This expression of homage from the Empire concluded with a speech by H.M. King George VI, who himself recorded the fact that this was the first time that the King had been able to address the nation as a whole on the day of his coronation. Messages congratulating the B.B.C. on these impressive broadcasts have been received from all parts of the Empire and from many foreign lands. These marked the successful use of the two new 50 kW. transmitters at the Daventry short-wave station supplementing the older 10 kW. sets. In many cases, the resulting reception was so satisfactory as to permit the rebroadcasting of the programme through all local transmitters. For example, in Melbourne the broadcast was retransmitted from ninety-seven stations throughout Australia. The Corporation's aim to supply the whole world with an effective broadcasting service was thus realized on this occasion. Truly may it be said that radio broadcasting is a very potent factor in bringing together the peoples of the world to a closer union which should result in greater friendliness and understanding.

Natural Limits of Human Flight

IN his presidential address delivered before the Royal Aeronautical Society on April 26, Mr. H. E. Wimperis discussed the "Natural Limits of Human Flight". He showed how relatively thin is the atmospheric shell in which we live. Birds, he considers, have reached the limits of perfection in natural flight, comparatively little progress having been made in the last thirty million years, whilst the "present attainments in human flight have all grown from the endeavours of a single generation". With regard to high speed, increase in altitude of flight does not necessarily mean an increase in speed, but depends largely upon the supercharging of the engine. Increase of altitude has also other detrimental effects, for example, increase of drag coefficient due to decrease of Reynolds' number, and increase in induced drag due to the increase in incidence when flying near the 'ceiling'. Actual increase in the size of aircraft would raise the speed ; but not beyond a certain point, unless more engine power can be got from a given space, or some means found of reducing the drag by changing the turbulent flow to a laminar one. Progress along these lines will soon bring us to the most formidable obstacle of all, namely, the compressibility of the air as the speed of sound is approached ; and this Mr. Wimperis regards as being well above the limit obtainable with engines of the type in use to-day, which he placed as between 500 and 600 m.p.h.

POWER of manœuvre was the next point considered by Mr. Wimperis. Speed of dive, which also involves large changes in altitude, has apparently no harmful effects on the personnel of an aircraft. On the other hand, rapid changes in direction or speed bring into play accelerations which impose severe physiological effects on the personnel, and limit the maximum acceleration to the order of ten times gravity. Consequently, with steadily increasing speeds the rate of manœuvre must thus be correspondingly decreased. With regard to the limit of altitude, provided oxygen apparatus is used, flights at 80,000 feet are possible, but increase in altitude above the present limit of 50,000 feet will be restricted to 60,000 feet largely by supercharging difficulties alone. Speaking of the range of flight, Mr. Wimperis said that it is difficult to set a limit to it. In still air, range is independent of altitude and depends chiefly on engine fuel consumption economy, low drag, low structure weight, coupled with large fuel capacity. He also expressed the opinion that aircraft as weapons of attack in warfare will, in the future, not occupy such a favourable position as in the past.

Long Ashton Research Station

THE annual open day of the University of Bristol Research Station at Long Ashton was held on May 6, when horticulturists, cider makers and fruit growers assembled to sample the ciders and other fruit products of the current season. Prizes awarded for the production of cider fruit were presented by Lord Faversham, Parliamentary Secretary to the Minister for Agriculture, after a speech which was broadcast from the West Regional Station. The results of recent investigations in cider making were on view. These included the use of German wine yeasts such as Waldenberg, Steinberg and Zeltingen instead of

natural cider yeasts, to obtain finer flavour. Artificially and naturally sweetened ciders have been compared, and apple juice has been successfully concentrated for storage purposes. The production of non-alcoholic apple juices has received considerable attention in the past year. Various combinations of dessert, culinary and cider varieties have been used for this purpose, and the effects of aeration and pasteurization studied. Seitz-filtered still juices are considered the most attractive, pasteurization having an adverse effect on flavour. As a result of the work at Long Ashton, commercial production of syrups from pure soft-fruit juices is now in operation on a large scale, and the numerous domestic uses of these products were illustrated by an exhibit of milk shakes, jellies, cake fillings, etc.

EXPERIMENTS in progress on the extensive fruit plantations of the Station were open for inspection. These include investigations on the manuring of apples and soft fruits, pruning and shaping of fruit trees, rootstock trials with apples, pears and plums, and the influence of cultural treatment on the storage qualities of apples. Of particular interest on this occasion was the attempt to grow cider varieties of vintage quality as bush trees. If this can be accomplished, crops may be borne in a much shorter time than by the usual method of standard tree production. The propagation of basket and cricket bat willows also aroused considerable interest. Progress in methods of pest and disease control was illustrated by exhibits in the laboratories, a recent development being the use of cuprous oxide as a seed treatment for early peas and zinc oxide for ornamentals. The control of plum sawfly and red spider was demonstrated by the use of combined washes containing white oil emulsion and rotenone-containing substances. In addition to horticultural research, the extensive agricultural advisory service of the Station was evident from the exhibits on dairy bacteriology, methods of pig husbandry and the economic feeding of dairy herds.

The Patent Office Library

ON May 3 Dr. Leslie Burgin, M.P. (Parliamentary Secretary of the Board of Trade), accompanied by the Comptroller-General of Patents and other officials, received a deputation from the Parliamentary Science Committee which placed before him its report on various desired improvements in accommodation and other amenities at the Patent Office. The deputation was introduced by Lieut.-Colonel Sir Arnold Wilson, M.P. Dr. Burgin expressed himself most sympathetically towards the points raised, several of which, he stated, were already being dealt with, or were in contemplation. He was precluded at present from discussing the provision of a set of duplicate search files by the adverse findings on that subject of the Sargant Committee of 1931. If, however, the Parliamentary Science Committee presented a detailed case strong enough to justify him in re-opening that subject, he would not bar and bolt the door; but the onus of justification must rest with the Committee. Dr. Burgin stated that an extension of the Patent Office buildings was contemplated during the next few years which would allow for increased library space. On the subject of binding, he said that allocations amounting to £3,100 had been made since the Great War for the purpose of overtaking arrears, apart from substantial increases in the grant for books and binding, which had permitted of enlarged purchases of foreign publications. If the Committee would provide him with specific particulars of the foreign publications and periodicals which, in its opinion, should be added to the Library, every endeavour would be made to meet such suggestions. The deputation was satisfied that improvements in the services afforded by the Patent Office Library are in hand, and that the importance of the matters laid by them before the Board of Trade was fully appreciated by Dr. Burgin and by the officials concerned.

Preservation of Monuments of Antiquity

IN a period of economic transition such as the present, the future of many monuments of antiquity, now in private ownership, even when under the protection of the Office of Works, must continue to be precarious, owing to the breaking up of large estates. Private benefaction and public response to appeal in cases of urgent necessity have been generous in recent years; but they cannot be expected to shoulder the burden indefinitely. The strongest safeguard for the less widely known, but often none the less important antiquities, which necessarily must run the greater risk, is a vigilant educated public opinion, backed by an enlightened authority. An example of the effective application of existing legislation in such conditions is afforded by the recent public inquiry at Worthing on a proposal to develop Highdown Hill between Worthing and Littledown as a building estate (*The Times*, May 13). On account of the natural, archæological and historical interest of the site, this inquiry, held by order of the Ministry of Health, is to be regarded as of considerable importance. The Hill, a southern outlier of the South Downs, rises to a height of two hundred and sixty-nine feet, and is an important feature in the maritime level tract, which is visible from far along the coast. On the summit is an earthwork, of at present uncertain age, in which was discovered in 1892 an important sixth century Anglo-Saxon cemetery. In it were eighty-six burials lying east and west in rows. The contents of the graves, of which the ornamentation suggested Frankish affinities, made this one of the most important finds of its kind in Britain. Yet the site was not scheduled under the Ancient Monuments Acts until 1930, and then only as the result of public protest, when the estate was offered for sale. The present inquiry was held on an appeal from the owner against a refusal of the Worthing Rural District Council to grant an interim development order. It was opposed by the Worthing Rural and Town Councils, the West Sussex County Council and four adjacent owners. A public-spirited offer has been made by the local authorities to accept any financial responsibility involved in the preservation of the site.

The Cerne Giant

THE 'Cerne Giant', it is announced, will come under the auctioneer's hammer on June 16 next when the Abbey estate, Cerne Abbas, near Dorchester, Dorset, is to be sold in lots. The 'Cerne Giant' is one of a small group of remarkable and curious antiquities of Britain which were described by Sir Flinders Petrie some years ago in a special publication of the Royal Anthropological Institute. They are figures of considerable size cut in the turf on the chalk in outline. They are of unknown purpose and unknown age, though almost certainly some, if not all, are prehistoric. The best known, owing in part to its appearance in popular fiction, is the Berkshire 'White horse', but the 'Wilmington giant' in Sussex and the 'Cerne Abbas giant' are almost equally famous. The 'Wilmington giant' is on a slope so steep as almost to appear to be standing upright. The 'Cerne giant' is on Trendle or Giant's Hill, and is a huge ithyphallic figure, one hundred and eighty feet high, brandishing a club, which is one hundred and twenty feet long and in breadth runs from seven to twenty-four feet. The head appears disproportionately small. The outline is cut in trenches two feet broad by one foot deep. The 'Wilmington giant' is rather larger, being approximately two hundred and forty feet high, with a head of twenty-one feet breadth. Various explanations of the giants' figures have been put forward. It has been suggested that the 'Cerne giant' is the figure of the Saxon god Heil, but in all probability it is much older, possibly Iron Age. The circle above the figure of the giant in which the Cerne maypole used to stand, together with the ithyphallic character of the figure, support the obvious attribution to a very ancient fertility cult. The remarkable character of the figure and its great interest for the light it throws on ancient British culture make it regrettable that the ground on which this figure is cut should be in private ownership and subject to such vicissitudes as that now impending.

Archæological Investigations in Cilicia

A DISCOVERY of much interest in relation to the sources of supply of material for implements in the prehistoric period of the eastern Mediterranean and western Asia was the subject of reference by Prof. John Garstang in an account of recent excavation on Hittite sites in Cilicia delivered before the Society of Antiquaries of London on May 6. Archæologists have sought for some time sources of the supply of obsidian, the rare volcanic glass from which the finer types of stone implements were fashioned in Egypt, the Aegean, Greece and western Asia, and of which for long the only source known to have been available for these areas was the island of Melos. An outcrop of this material several miles across, Prof. Garstang states, has now been discovered at the foot of Mount Argaeus in Anatolia. It shows many traces of having been worked in antiquity, and implements of this material, with others of chert, have been found in the lower levels of one of two interesting sites near Mersin. The site in question, on a small river Souk Sü (Cold Water), showed signs of a pre-Hittite occupation of possibly so much as two thousand years. In describing the results obtained by the Neilson expedition to Cilicia, Prof. Garstang said that twenty-three sites on the plain of Adana had been examined, some of which yielded superficial evidence of Hittite occupation. Four sites had been opened in co-operation with the Government Museum at Adana. These included the mound at Serkeli on the east bank of the ancient Pyramus, where the important imperial Hittite monument was studied. On the mound of Kazanli, between Tarsus and Mersin, evidence was found of Hittite occupation extending from between 2400 B.C. and 2200 B.C. down to the Assyrian invasions. Prof. Garstang believes that the fall of the Hittite capital on the plateau did not involve the destruction of the Hittite centres of Cilicia.

Electricity in the Hospital

THE Faraday Lecture of the Institution of Electrical Engineers was given on May 6 by Mr. R. S. Whipple, on the subject of "Electricity in the Hospital". Dealing separately with lighting, power, heating, medical treatment and intercommunication, Mr. Whipple could easily convince his audience of the enormous call made on the electrical engineering services of a big hospital. He gave an estimate of the X-ray photographs taken annually by the largest ten hospitals in London as a million. Electro-medicine has indeed gone a long way from the methods of the seventeenth century, when a cure for paralysis was sought by giving the patients shocks from Leyden jars. Mr. Whipple passed in review the instruments devised especially for medical use, with special reference to the electro-cardiograph and the various diathermy machines; these were also shown in action.

New Zealand Handbook

ON the occasion of the meeting of the Australasian and New Zealand Association for the Advancement of Science at Auckland on January 12–19 this year, a useful handbook to New Zealand was issued to members. The book contains some thirty short articles on various aspects of the country, but the greater part is concerned with the geology, natural history and native population. Among the most valuable chapters are those on the climate by Mr. E. Kidson, the geomorphology of Wellington by Prof. C. A. Cotton, the economic geology of New Zealand by Mr. J. Henderson, the ecology by Mr. H. H. Allan and the forests by Mr. E. P. Turner. The volume gives in a collected form a great deal of precise information which is not otherwise easily accessible. The chapter on New Zealand's economic history discusses the future development of the resources of the Dominion.

Christ's Hospital and Prof. Armstrong

THE annual report of the Headmaster of Christ's Hospital contains the following reference to Prof. H. E. Armstrong, who, as many of our readers know,

has been confined to his room for several months, though he maintains his interest in scientific and educational activities: "Illness has deprived the Committee of Education of the attendance of Prof. Armstrong, who, as a member of the committee for nearly forty years and latterly as chairman, may claim a large share in the formation and guidance of the Hospital's educational policy and ideals. It is a consolation to know that in his position as educational adviser to the council we shall still have the benefit of his wide knowledge and wise direction. We consider ourselves very fortunate to have as the new chairman of the Committee, the Rev. Prebendary A. Chilton, who brings to this work the special knowledge both of an old Blue and of a distinguished headmaster."

Announcements

AT a recent meeting of the Lawes Agricultural Trust Committee, Lord Clinton tendered his resignation as chairman owing to ill-health, and Prof. H. E. Armstrong was appointed in his place. Sir Merrik Burrell, lately president of the Royal Agricultural Society of England and chairman of its Research Committee, was appointed vice-chairman.

WE regret that the name of Sir Cuthbert Wallace, president of the Royal College of Surgeons, who has been made a baronet, was omitted from the list of Coronation honours published in NATURE of May 15.

THE eighth annual Haldane Memorial Lecture at Birkbeck College, London, will be delivered by Sir Arthur Eddington, director of the Observatory and Plumian professor of astronomy in the University of Cambridge, on May 26 at 6 p.m. The subject of the lecture will be "The Reign of Relativity 1915–1937". Admission is free, without ticket.

THE silver jubilee of the Chadwick Lectures occurs this year and the Chadwick Trustees are holding a reception for their former and recent lecturers, scholarship holders and recipients of Chadwick Medals and Prizes, to precede the lecture on May 26 by Prof. J. G. Fitzgerald, to be given at Manson House, 26 Portland Place, at 5.30 p.m. Dr. Fitzgerald is director of the School of Hygiene and the Connaught Laboratories, and professor of hygiene and preventive medicine in the University of Toronto. He is now on a year's leave of absence for the study of the teaching of preventive medicine in medical schools in the United States, Canada, the British Isles and other countries of Europe, for the Rockefeller Foundation. The title for Dr. Fitzgerald's lecture is "Preventive Medicine—an Avenue of Good Will". This will be the initial lecture of a series on public health questions by representatives of Overseas Dominions.

THE following appointments and promotions have recently been made in the Colonial Service: J. Glover, second plant physiologist, East African Research Station, Amani, Tanganyika; K. Wilkinson, European assistant, Meteorological Service, East Africa; N. S. Haig (agricultural officer), senior agricultural officer, Uganda; M. C. Abraham (assistant irrigation engineer), irrigation engineer, Ceylon; F. H. Clarke (assistant game warden), senior assistant game warden, Kenya; W. G. G. Cooper (geologist), assistant director of Geological Survey, Gold Coast; S. G. Taylor (irrigation engineer), divisional irrigation engineer, Ceylon; A. P. Weir (irrigation engineer), divisional irrigation engineer, Ceylon.

AT the forthcoming meeting of the National Peace Congress, which will be held at Friends' House, Euston Road, London, on May 28–31, a meeting of the Science Commission is to take place with Prof. S. Chapman in the chair. Prof. P. M. S. Blackett will open the discussion on "The Responsibility of the Scientist in Relation to Peace Problems". Further information concerning the National Peace Congress may be obtained from the Secretary, 39 Victoria Street, London, S.W.1.

AN informal conference on "The Conduction of Electricity in Solids" will be held at the H. H. Wills Physical Laboratory, University of Bristol, under the joint auspices of the Physical Society and the University of Bristol, on July 13–16. Several morning and afternoon discussions have been arranged. Among those who will take part in the discussions are: Prof. R. W. Pohl (Göttingen), Dr. J. H. de Boer (Eindhoven), Prof. Borelius (Stockholm), Prof. W. L. Bragg, Dr. C. H. Desch, Prof. G. I. Finch, Dr. E. T. S. Appleyard and Prof. J. E. Lennard-Jones. The conference will be open to members of the staffs of universities and research institutions. Further information can be obtained from Prof. A. M. Tyndall or Prof. N. F. Mott, H. H. Wills Physical Laboratory, The University, Royal Fort, Bristol, 8.

A CATALOGUE of rare and valuable books (No. 609) from Francis Edwards, 83 Marylebone High Street, W.1, contains some unusually interesting volumes of voyages, including Champlain's "Les Voyages de la Nouvelle France Occidentale" (1632), Hearne's "Journey from Hudson's Bay to the Northern Ocean" (1795), Linschoten's "Discours of Voyages into ye Easte and Weste Indies" (1598), Martyr's "History of Travayle" (1577) and a unique item in the form of a twelve-page print of a letter from Sir Joseph Banks describing his voyage with Captain Cook in 1768–71.

THE Oxford University Press announces that "The Science of Petroleum", edited by Dr. A. E. Dunstan, Prof. A. W. Nash, Sir Henry Tizard and Dr. A. B. T. Brooks, is approaching completion. The publishers expect to issue it in three volumes, each containing about one million words, during this summer. It contains about four hundred articles, written by three hundred contributors drawn from all parts of of the world.

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. 887.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Resistance Thermometry below 1·0° K.

DURING an investigation of the thermal coupling between the ionic magnets and the lattice vibrations of paramagnetic salts in the neighbourhood of the absolute zero, we have made some resistance measurements in the temperature range below 1° K. The resistance measured consisted of a specimen of fine phosphor-bronze wire very kindly supplied to us by Prof. Keesom of Leyden.

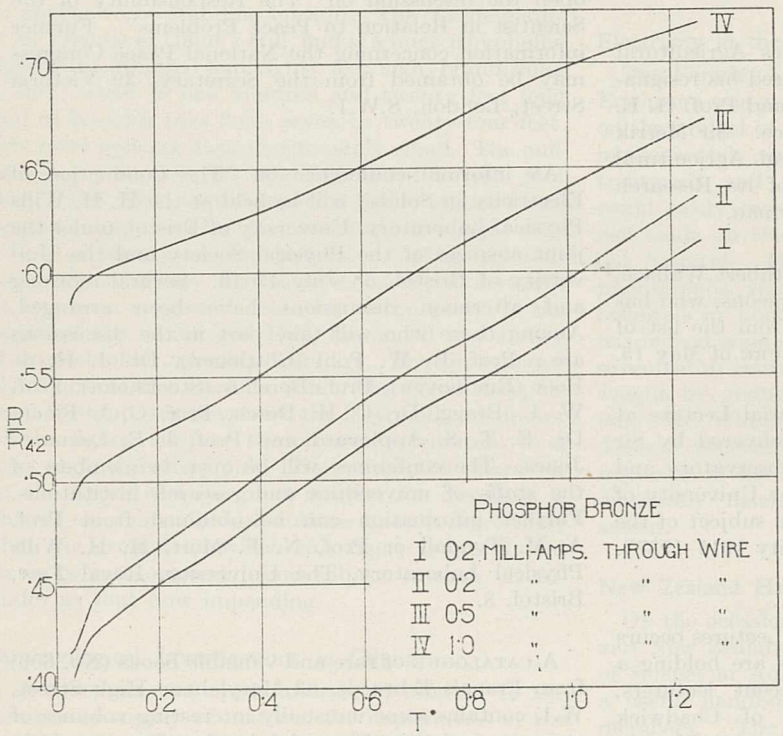

Fig. 1.

The measurements are shown graphically in the accompanying diagrams. The low-temperature unit used to obtain Curves I, III and IV was composed of a cylindrical bomb of German-silver with internal dimensions 70 mm. by 8 mm. The bomb contained grains of iron ammonium alum varying in size from 0·25 mm. to 0·5 mm., and helium at a room-temperature pressure of 120 atmospheres. At the lowest temperatures, the helium was in the liquid II phase, which has been found by Keesom[1] to have a very high thermal conductivity and therefore provided good thermal contact between the salt and the bomb casing. The phosphor-bronze thermometer was wound on the bomb and insulated from it by means of a layer of adhesive cellulose tape. For Curve II the unit was simply a cylindrical tube of German-silver into which iron ammonium alum was hydraulically compressed. From results to be published shortly, it was found for both units that thermal equilibrium between the paramagnetic temperature and the resistance thermometer was maintained down to the lowest temperature reached. By using high-resistance manganin leads, and by having thermal contact between the leads and the liquid helium bath at about 10 cm. above the bomb, warming-times were obtained between extreme low temperatures and the bath temperature which varied from more than an hour for Curves I and II to twelve minutes for Curve IV. The helium bath temperature was 1·25° K., and the demagnetizing field 20 kilogauss. The resistance measurements were made on a Tinsley thermo-electric potentiometer, and the specimen had a resistance of 2·5 ohms at 4·2° K.

In the diagrams the resistance ratios are plotted against T^*, the temperature deduced from susceptibility measurements on the assumption that Curie's law holds for iron ammonium alum throughout the range of temperature involved. Simon[2] has shown, however, that Curie's law does not hold for the salt below 0·1° K., there being a maximum departure at 0·06° K. as well as a sudden bend in the susceptibility curve at 0·034° K., which is interpreted as the Curie point of the salt. Simon's $T^* - T$ relation was determined for an ellipsoid of salt of 6 : 1 length to diameter ratio. Simon claims accuracy to within only 10 per cent in his $T^* - T$ relation, although the shape of the curve is held to be correct. Our specimens were roughly cylindrical of 8 : 1 ratio, and in the case of the bomb containing small salt particles had quite a different density factor from that of Simon's solid ellipsoid. In view of the above, and since our potentiometer measurements are correct only to the third significant figure in the ratio $R/R_{4\cdot2°}$, we decided not to attempt any reduction of our T^* values to absolute values of the temperature. The most that can be said is that our T^* is almost certainly not more than 0·02° lower than T in the neighbourhood

of 0·06° K., and differs by less than that both below and above that temperature. The size of the discrepancy near 0·034° K. can be deduced from Fig. 2. At the Curie point (0·034° K.), according to Simon, the $T^* - T$ curve becomes normal to the T ordinate; that is, the susceptibility changes without a corresponding change in the absolute temperature. The sharp bend in the resistance curve II near 0·034° shows that our T^* is quite close to Simon's value for T at that point. Below the Curie point the discrepancy increases rapidly, since T^* changes without a corresponding change in T. The lowest T^* which we observed was 0·027°. The corrected resistance curve would probably show no bend near 0·034° such as is seen in Fig. 2.

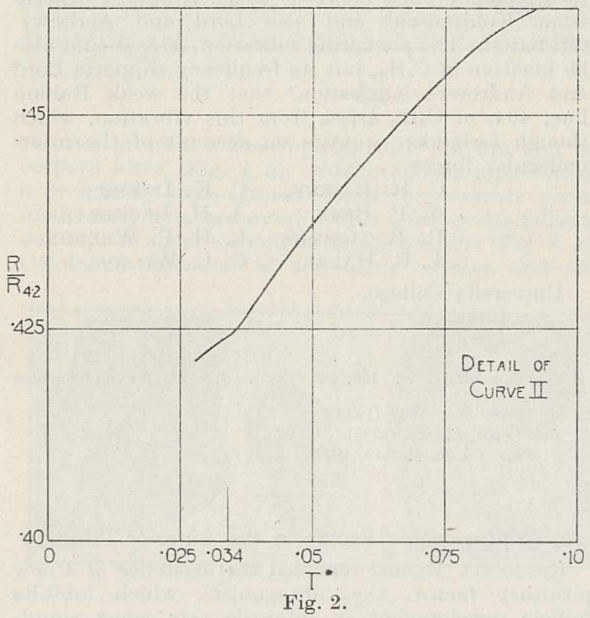

Fig. 2.

From the shape of the resistance curve it is impossible to say whether or not phosphor-bronze would become supraconducting below 0·034° K. The extreme structure sensitivity of phosphor-bronze with regard to resistance can be seen from Curves I and II, where the current densities are the same in both cases. Between taking Curves I and II the thermometer was rewound and leads were resoldered to it. Curves I, III and IV show the effect of changing the current density, and agree with results previously obtained by W. H. Keesom and van den Ende[3].

If the thermometer is left untouched, the temperature-resistance curves are reproducible to within the limits of experimental error. The thermometer may be repeatedly subjected to strong magnetic fields without affecting the calibration, provided the measurement of resistance is made in zero magnetic field. The results show that for a given specimen, a phosphor-bronze resistance thermometer can be quite conveniently used in the range of temperature below 1° K., and possesses approximately the same accuracy as does the ballistic measurement of susceptibility for the determination of T^*.

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E. S. SHIRE.

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Cambridge.

[1] Keesom, W. H., and Keesom, Mlle. A. P., *Physica*, **3**, 359 (1936).
[2] Kürti, Lainé and Simon, *C.R.*, **204**, 754 (1937).
[3] Keesom, W. H., and van den Ende, *Leyden Comm.*, 219*b* (1932).

Positrons from Radio-Scandium

ACCORDING to Fermi's theory[1] for the emission of β-particles, and its modification by Konopinski and Uhlenbeck[2], a nucleus can, instead of emitting a positron, absorb an electron from the K-shell, thus giving rise to the emission of the K-radiation from the element formed by the transformation. The ratio of the probabilities F for the emission of a positron and F_K for the absorption of a K-electron has been calculated by Møller[3] and by Mercier[4]; for scandium ($Z = 21$), the value for F_K/F varies from 0·1 to 5 according to the assumptions made in the theory.

I have carried out experiments with radio-scandium to see if the emission of positrons is accompanied by the emission of the K-radiation of calcium. Radio-scandium was obtained by bombarding lime, supported on a mica leaf, with α-particles from 300 millicuries of radon. The mica leaf with the lime was placed at the centre of an expansion chamber and the tracks photographed with air in the chamber in

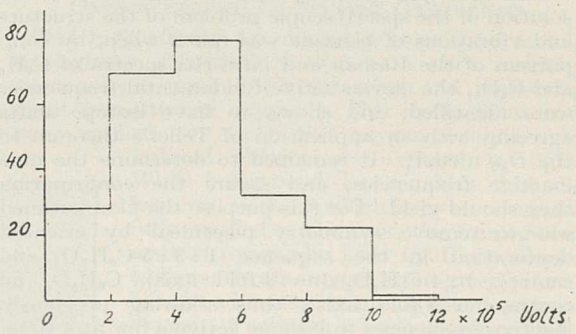

Fig. 1.

a magnetic field of 700 gauss. About 500 tracks were photographed, of which about 250 were utilized for measurements. The distribution of energy is shown in Fig. 1; the accuracy in the energy measurements is only moderate due to the use of air in the chamber, but is sufficient to give the upper limit of energy as $1·1 \pm 0·1$ MeV.

The K-radiation of calcium, when present, would by its absorption in the air of the chamber produce electrons with a range[5] of about 0·2 mm. This was checked by sending X-rays scattered from a target of calcium into the expansion chamber through a thin aluminium window. In the experiments with lime no trace of the X-radiation in question was observed; a number of short dense tracks was actually found, but these tracks were in nearly all cases secondaries from fast electrons and were further distributed uniformly throughout the chamber, whereas the X-radiation from calcium could only be found in one half of the chamber, since the mica leaf supporting the lime would absorb the X-radiation almost completely. The persistence of tracks with a high density of ions is larger than for tracks from fast electrons, so that the absence of K-radiation from calcium is fairly certain.

An estimate of the upper limit for the ratio F_K/F can be obtained from a consideration of the absorption of the K-radiation from calcium and the dimensions of the expansion chamber. In the absence of any observed effect such an estimate must necessarily be rather vague, but it appears fairly safe to assume that F_K/F is less than $\frac{1}{10}$ and is probably less than $\frac{1}{100}$. The result of the present investigation, when

compared with the calculations by Møller and by Mercier is, therefore, that Fermi's theory for β-decay is probably in accord with experiments; the modifications introduced by Konopinski and Uhlenbeck predict an emission of X-rays from elements emitting positrons, which is so intense relative to the emission of positrons, that it could scarcely have been overlooked in the experiments.

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April 6.

[1] Fermi, *Z. Phys.*, **88**, 161 (1934).
[2] Konopinski and Uhlenbeck, *Phys. Rev.*, **48**, 7 (1935).
[3] Møller, *Phys. Rev.*, **51**, 84 (1937).
[4] Mercier, *C.R. Acad. Sci.*, **207**, 1117 (1937).
[5] Williams and Nuttall, *Phil. Mag.*, **2**, 1109 (1926).

s-Trideuterobenzene and the Structure of Benzene

THE first and probably largest single step in the solution of the spectroscopic problem of the structure and vibrations of benzene was taken when, by comparison of the Raman and infra-red spectra of C_6H_6 and C_6D_6, the eleven active fundamental frequencies were identified, and shown to have isotope shifts agreeing with an application of Teller's theorem to the D_{6h} model[1]. It remained to determine the nine inactive frequencies, and secure the confirmation they should yield. For this purpose the plan outlined was to remove symmetry piecemeal by oriented deuteration in the sequence 1 : 3 : 5-$C_6H_3D_3$ (no centre), 1 : 4-$C_6H_4D_2$ (no 3-fold axis), C_6H_5D (no centre, no 3-fold axis), thus allowing previously inactive frequencies to become active a few at a time.

We have now completed the spectroscopic study of *s*-$C_6H_3D_3$, in which six additional fundamentals become allowed in either the Raman or infra-red spectrum. The centre of symmetry, which in C_6H_6 and C_6D_6 forbade coincidences, having now been destroyed, seven allowed fundamentals are common to the two spectra.

Having shown that the laws of electrophilic substitution are followed in the direct deuteration of aromatic compounds[2], we prepared the required benzene in a spectroscopically pure form by trideuterating aniline and eliminating the amino-group. Other methods had yielded spectroscopically impure material owing to partial randomization of the deuterium, a phenomenon which has been overlooked with resulting error in the published literature of partly deuterated benzenes.

We have determined the frequencies of forty lines in the Raman spectrum of the liquid, and the peak and integrated intensities and depolarization factors of eleven of them. We have measured also thirty-two infra-red absorption maxima for the vapour, and studied the contours of the twelve chief bands. The following abridged table contains the more prominent frequencies (cm.$^{-1}$).

Raman		Infra-red	Raman		Infra-red
E''	375	‖ 533 A_2''	E'	1407	1407 E'
E'	590·0	591 E'	E'	1572·2	1573 E'
E''	707·5 D	691 —	—	2239·3	1631 —
E'	830·8	833 E'	A_1'	2279·0 P	1749 —
A_1'	953·5 P	‖ 914 A_2''	E'	Obscured	1835 —
A_1'	1000·9 P	1065 —	—	2975·7	2292 E'
—	1064	1095 E'	A_1'	3053·8 P	2362 —
E'	1102·6	1226 —	E'	3094	3087

The fundamentals are indicated by assignment symbols: A means totally symmetric, E degenerate, $'$ and $''$ symmetric and antisymmetric to the ring-plane, and $_1$ and $_2$ symmetric and antisymmetric to a 2-fold para-axis. The tie-lines show the allowed coincidences of fundamentals: in these the Raman lines are depolarized and the absorption bands perpendicular. The optical properties of the other fundamentals are shown by the symbols P = polarized, D = depolarized, ‖ = parallel. The assignments agree with these properties, and the frequencies satisfy Teller's theorem applied to the D_{6h} model.

The frequency, 1000·9, in which alternate ring-atoms move radially towards and from the centre, is inactive in C_6H_6, but we can now calculate that its frequency must be 1007, which is almost exactly what Kohlrausch[3] and also Lord and Andrews[4] estimated. The puckering vibration, 375, should also be inactive in C_6H_6, but its frequency supports Lord and Andrews's suggestion[4] that the weak Raman line, 404, of C_6H_6 arises from this vibration, which though forbidden appears on account of the intermolecular forces.

C. R. BAILEY. C. K. INGOLD.
A. P. BEST. A. H. LECKIE.
R. R. GORDON. L. H. P. WELDON.
J. B. HALE. C. L. WILSON.

University College,
London.
April 27.

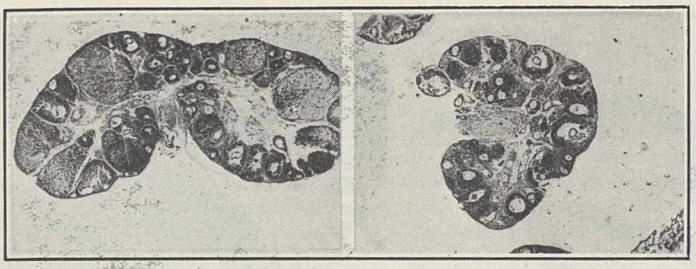
[1] NATURE, **135**, 1033; **136**, 680 (1935). *J. Chem. Soc.* (1936), nine papers.
[2] *J. Chem. Soc.*, 1637 (1936).
[3] *Naturwiss.*, **23**, 624 (1935).
[4] *J. Phys. Chem.*, **41**, 149 (1937).

An Antiluteogenic Factor in the Anterior Pituitary

RECENTLY Evans[1] reported the existence of a new pituitary factor, the 'antagonist', which inhibits follicle development in infantile rats when simultaneously injected with follicle-stimulating extracts from various sources. To avoid misunderstanding, it is proposed to call this factor 'antifolliculogenic', in contrast with 'antiluteogenic'. At about the same time, Bunde and Greep[2] described a regression of persistent corpora lutea in the ovaries of hypophysectomized rats by the luteinizing fraction of pituitary extracts.

The failure of regression of corpora lutea in a few thousand hypophysectomized rats has been very consistently proved in this laboratory. However, quite exceptionally in adult animals, no corpora lutea were found, when between hypophysectomy and autopsy they were used for testing 'growth hormone'. Another observation with importance in this connexion is, that very often after the twelfth day following insemination the complete removal of the pituitary in rats does not interfere with pregnancy, otherwise than that delivery is delayed 2–3 days beyond term. The responsibility for this was ascribed to the persistence of corpora lutea and confirmed by the histological appearance of the ovaries and by death, maceration and compression of the fœtus or abortion when the ovaries or only the corpora lutea alone were removed even a few days before expected delivery. An antiluteogenic function of the pituitary was suspected on these grounds and further experimental evidence in favour of this view was obtained as follows.

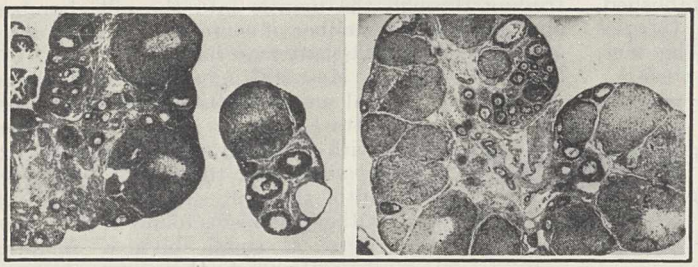
An alkaline extract from an acetone dry powder of beef anterior pituitaries after subcutaneous injection in infantile (about 20–28 days old) rats weighing 25–35 gm. produces enlarged ovaries with four to eight corpora lutea each (Fig. 1, *a*). The same extract when given intraperitoneally produces little



(*a*) (*b*)

Fig. 1.

ovarian growth, a few follicles with antrum and no corpora lutea (Fig. 1, *b*). Subcutaneous injection of a pregnancy urine gonad-stimulating extract yields moderately enlarged ovaries with a few cystic follicles and four to eight corpora lutea on each side (Fig. 2, *a*). Combined injection of the urine extract and the



(*a*) (*b*)

Fig. 2.

pituitary extract both subcutaneously, yield much enlarged ovaries with twelve to twenty corpora lutea each (Fig. 2, *b*), while after simultaneous injection of the urine extract subcutaneously and the pituitary extract intraperitoneally small ovaries are found with a few (cystic) follicles but no corpora lutea (Fig. 3).

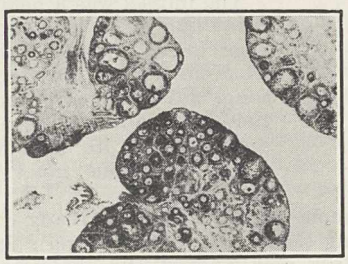


Fig. 3.

The dose of the urine extract was 10 R. œstr. U., of the pituitary extract 160 mgm. acetone dry powder extracted at *p*H 10·5. Six injections were given in 36 hours, the ovaries were removed for histological examination (hæmatoxylin-eosin staining) on the fifth day after the beginning of the experiment; four or five rats were used for every group and littermates were uniformly distributed. The experiments were repeated three times.

Confirmatory evidence was found by the interruption of two early (twelve day) pregnancies after eight intraperitoneal injections in five days. At autopsy no fœtuses were found. They probably were resorbed, because the placentæ were recovered in macerated condition from the uterine horns.

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March 23.

[1] *Univ. Californ. Publ. Anat.*, **1**, No. 8, 237 (1936).
[2] *Proc. Soc. Exp. Biol. and Med.*, **35**, No. 2, 235 (1936).

Oxygen Evolved by Isolated Chloroplasts

THE high affinity for oxygen possessed by muscle hæmoglobin suggested its use as a very sensitive spectroscopic method for detecting and measuring small quantities of oxygen[1]. This method has now been applied to study the oxygen evolution of isolated chloroplasts exposed to light. While being much less sensitive than the bacterial methods which have been successfully applied in the past, the hæmoglobin method (originally used by Hoppe-Seyler to demonstrate oxygen from green plants) has the advantage of giving the measure of oxygen. A solution of hæmoglobin containing $0{\cdot}45 \times 10^{-4}$ gm. atoms of iron per litre, is equivalent to 1 c.mm. of oxygen per c.c.; the degree of saturation can be determined spectroscopically with an accuracy of 5 per cent.

Fresh suspensions of chloroplasts obtained from various angiosperms with sucrose solutions do not evolve measurable amounts of oxygen in the light, even in presence of carbon dioxide. If, however, chloroplasts were suspended in an aqueous extract made from an acetone-leaf preparation, oxygen in measurable amounts was evolved in light. Extracts of acetone yeast or boiled yeast would produce the same effect as the leaf extract. The activity of these preparations depended on their ferric iron content, and they could be replaced by ferric potassium oxalate. Molecular oxygen is evolved, while ferric iron is reduced to ferrous.

At the beginning of the experiment oxygen is rapidly evolved, but as the partial pressure of oxygen rises the oxygen is absorbed and its evolution comes to a stop. This shows certain advantages of the hæmoglobin method over a manometric method, which could not be applied in the present case. A strong illumination of approximately 40,000 lux was used. The chloroplasts were present in an amount equivalent to $0{\cdot}2 \times 10^{-4}$ molar chlorophyll. The vessel was an evacuated Thunberg tube, 1·5 cm. diameter and containing 5 c.c. of fluid. Oxygen output curves in terms of percentage saturation of the hæmoglobin with oxygen are shown in Fig. 1 for (*A*) chloroplasts in leaf extract, (*B*) chloroplasts in an extract of boiled yeast, (*C*) and (*D*) chloroplasts in ferric potassium oxalate, all at 20° C. The

evolution of oxygen in presence of ferric salts was not influenced by concentrations of sodium azide and hydroxylamine which markedly inhibit catalase.

The iron-oxygen reaction of chloroplasts may indicate a mechanism connected with carbon assimilation. The appearance of molecular oxygen in light from a biological system apart from the whole cell or from hydrogen peroxide and catalase is unique. There is no evidence, however, that this particular reaction takes place in the living cell, neither is it proved that carbon dioxide takes part in the reaction. Carbon dioxide is the only known reagent which will cause oxygen evolution by the living plant; ferric iron at present seems to be the only reagent which will cause measurable oxygen evolutions by free chloroplasts. This may be connected with the very interesting specific *in vitro* reaction found by Rabinowitch and Weiss[2] with ethyl chlorophyllide and ferric chloride, where the chlorophyll derivative appears to be reversibly oxidized in light while the iron is reduced.

Until other facts have been definitely established, it might be misleading to discuss the different theories of photosynthesis involving iron salts. The fact, however, that molecular oxygen in measurable quantities can be evolved by a biological system, less organized than the whole cell, gives new possibilities for applying biochemical methods to the green plant.

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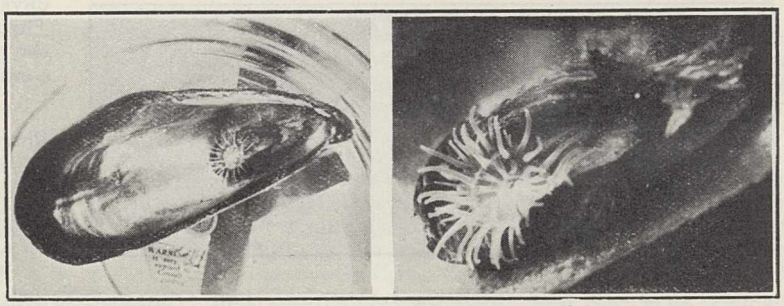
Biochemical Laboratory,
Cambridge.
April 10.

[1] Hill, R., *Proc. Roy. Soc.*, B, **120**, 472 (1936).
[2] Rabinowitch, E., and Weiss, J., NATURE, **138**, 1098 (1936).

Commensalism between a Marine Mussel, an Anemone and several other Organisms

ON February 4, 1937, Mr. A. R. Holland, assisting us in biochemical investigations on the California mussel, *Mytilus californianus*, brought to our attention one individual which showed a fair-sized cup or raised crater, built of the same calcareous material as constitutes the shell, attached at its base to the anterior region of the inside of the left valve, protruding through the mantle into the gill chamber, and containing a number of commensal invertebrates and some attached plant material.



a *b*

Fig. 1.

LEFT VALVE OF MUSSEL WITH FLESH REMOVED. (*a*) WHOLE VALVE; (*b*) ENLARGED VIEW OF CRATER CONTAINING ANEMONE.

Most striking among the commensal animals was a small anemone, attached to the inside of the crater, with disk and spread tentacles extending over the rim of the crater into the gill chamber (Fig. 1). Other organisms found in the crater were a small bivalve mollusc, several polychæte worms, numerous Protozoa, a large siphonaceous alga apparently of the genus *Derbesia* and some small filaments of Myxophyceæ, along with much detritus. For the information regarding the algal organisms we are indebted to Prof. N. L. Gardner, of the Department of Botany at the University of California, to whom we submitted the plant material.

The mussel was a healthy female containing masses of orange-coloured eggs in its mantle; the shell is 11·5 cm. long; the crater 3·5 cm. long, 1·7 cm. wide (outside diameter at widest portion), and 1·2 cm. in depth, its bottom being the bright, nacreous inner surface of the valve.

The anemone was also healthy, ready to feed, and is still living (March 18) in the crater; it showed a pale greenish ring around the oral aperture, the tentacles being only very faintly greenish in tint. Zoochlorellæ were not observed. The animal is almost certainly a young specimen of our common anemone *Cribrina* (= *Bunodactis*) *xanthogrammica*. It showed, at the time of discovery, a tentacle spread of 2 cm., the diameter of the oral disk being 0·8–0·9 cm.

Where the mantle surrounded the outer wall of the crater's short column, it was attached thereto,

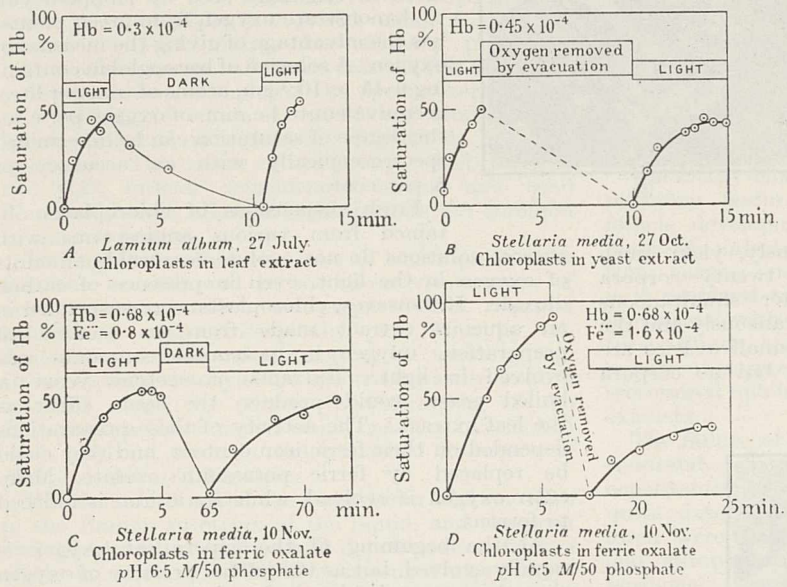


Fig. 1.

and had formed a dark out-curling lip around the edge of the crater's opening; this lip was composed of a chitinous material similar to that which is laid down by the mantle at the inner rim of each valve.

Prof. G. E. MacGinitie, at the Kerckhoff Marine Biological Laboratories of the California Institute of Technology, writes (personal communication) that he has encountered such craters as described above in certain other lamellibranchs, notably *Schizothœrus*, but that the condition is rather rare. He states that such pockets, built up by the animals in response to the presence of insoluble detritus which may lodge between the mantle and the shell, will soon become inhabited by other forms which invade it in larval stages, and that it is a matter of relative chance what forms adapted to such a locality first secure residence. The laws governing survival then determine which members of such a group may retain their places and which must be crowded out or devoured.

The subject of commensal organisms encountered within lamellibranch shells is rather extensive, and has no place in this note. It seemed of interest, however, to report this particular case, since a fair search through the literature and discussions with various ecologists failed to reveal previous reports of commensalism between a normal anemone and a healthy, plankton-feeding lamellibranch.

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Water and Fat Content of Tsetse Flies

IN recent letters Mr. R. W. Jack[1] and Dr. C. H. N. Jackson[2] state that, when considering the effects of climate on tsetse metabolism, it is valuable to express the percentage of water present in the insects at different times as a function of the "fat-free" dry weight. This is because the amounts of this food-reserve vary greatly; it occurs concentrated in the fat-body and not in large amounts in the individual cells of the vital tissues. Jack and Jackson imply that their methods show the conditions in the tissues of the tsetse more accurately than do gross percentages of water and dry matter present in the bodies of the insects.

I am doubtful whether this manipulation of the results is really useful. If we wish to know what conditions obtain in the tissues, it will be necessary to study individual tissues by microanalytical methods. There are many constituents of an insect's body which vary greatly, such as skeletal structures, gut-contents or fæcal materials, and they, as well as fat, should be subtracted to obtain the sort of results which Jack and Jackson desire. There is one other substance which they do not consider, but which should be studied in investigations of the water-balance of insects, and that is the circulating fluid or hæmolymph. Dissections of bedbugs, *Rhodnius*, tsetse flies and other insects show that sometimes the tissues are amply bathed with fluid, while at other times they appear almost dry. The hæmolymph acts as a sort of 'buffer' against desiccation. The tissues themselves do not usually appear to vary greatly in water-content, for so long as there is a sufficient supply of hæmolymph to circulate, the cells of the various organs reached by it are not themselves desiccated unduly. This has been shown experimentally by analyses, by microscopic examination of the living tissues themselves, and the same conclusion is supported by Wigglesworth's observations[4] on the extent of the fluid in the tracheoles of desiccated insects. These changes in volume of the circulating fluid will affect the gross analyses enormously, whether or not the fat is subtracted.

These comments are made because I feel that if other workers adopt Jack's and Jackson's suggestions, they may be diverted from more significant studies of the effects of climatic conditions on vital structures. Laboratory studies[3] show that the gross percentage of water in a tsetse fly may vary more widely than Jack's and Jackson's field observations indicate, without the insect being harmed or its metabolic rate being affected. The insects have to lose a great deal of water, probably equivalent to the whole of their hæmolymph, before they suffer from desiccation. Normally, even under dry conditions, they appear to exhaust their reserves of fat before this happens; or they obtain a meal of blood which contains sufficient excess of water to allow the body to return to normal.

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[1] Jack, R. W., NATURE, **139**, 31 (1937).
[2] Jackson, C. H. N., NATURE **139**, 674–5 (1937).
[3] Mellanby, K., *Bull. Ent. Res.*, **27**, 611–32 (1936).
[4] Wigglesworth, V. B., *Proc. Roy. Soc.*, B, **109**, 354-59 (1931).

Histology of *Derris* Roots

WE have recently investigated the histology of *Derris elliptica* roots, with respect to their contents of rotenone and related toxic substances. Cells which apparently contain resins are distinguishable in unstained sections. We have applied Durham's test to sections, and have shown that the resin cells, and these only, respond to the test.

Rotenone cells first appear in young roots just as suberization is beginning, but never before, as isolated groups in the secondary cortex. These are invariably arranged opposite to the protoxylem elements, and correspond in number to them. Rotenone afterwards appears in cells scattered through the xylem parenchyma and the cortex. These increase in number with the age of the root, and are especially numerous in the medullary rays. They appear to be structurally non-specialized, and are indistinguishable from normal xylem parenchyma.

Starch also occurs in *Derris* roots. It is mainly confined to the semi-lignified cells forming a sheath to the vessels, but it also occurs in scattered irregular groups in the non-lignified xylem parenchyma and in the cortex. We have never observed starch and rotenone in the same cell: in fact, we are satisfied that, in the xylem parenchyma, starch cells and rotenone cells form mutually exclusive groups.

A paper giving the full results of this investigation is being prepared for publication.

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Tanganyika Territory.
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Estimation of Ammonia Volatilized from Soils

ALTHOUGH it has been recognized that a part of the nitrogen in the soil system may be lost in the form of ammonia, the extent of such loss—especially under field conditions—has not yet been satisfactorily determined, largely owing to want of suitable technique. Estimates based on difference in total nitrogen are not sufficiently accurate. Aeration methods are tedious and time consuming : they also disturb the biological conditions in the medium. Extraction and distillation methods are unsuitable, as the estimates thus obtained may not be entirely due to free ammonia. The following method was therefore developed, and was found to work quite satisfactorily.

The procedure consists in pasting a piece of filter paper (previously acid treated, for example, Whatman No. 30 or 41) moistened with standard acid on the inside of a glass or enamelled dish which just covers the beaker or other vessel containing the soil. The ammonia evolved from the medium is absorbed by the acid. At convenient intervals the dish can be removed and the unused acid in the paper estimated by back titration against standard alkali with methyl red as indicator and boiling to drive off carbon dioxide.

The above procedure is very simple and rapid. By suitably altering the strength of acid, varying quantities of ammonia can be estimated. The method can be applied to time studies, the paper being changed periodically. The temperature can also be varied according to requirements. The studies can be carried out under both laboratory and field conditions.

Applying the above method, it has been found that practically all soils treated with ammoniacal fertilizers—especially under tropical conditions—lose ammonia by volatilization. In some cases, all the added nitrogen is lost in the course of ten days. Soil treated with organic manures with narrow C—N ratios also lose large quantities of nitrogen as ammonia.

The mechanism of the related processes has been studied and will be reported elsewhere.

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April 7.

The So-called 'Transition Temperature' of Metallic Films

THE relation of the electric resistance to temperature of metallic films of zinc, cadmium, magnesium and antimony, condensed from vapours on a cold surface of glass, was investigated employing an apparatus similar to that described in a previous paper[1]. A double-walled copper cylinder was inserted in the inner vessel in order to cool pentane contained in the latter indirectly with liquid nitrogen, and a stirrer was used to ensure uniformity of temperature distribution. The bath temperature was read with a copper-constantan thermo-junction and a millivoltmeter, and the thicknesses of the metallic films were estimated by weighing with a microbalance having an accuracy of 1×10^{-5} gm. The metallic specimens were from Kahlbaum.

Zinc, cadmium and magnesium were condensed on glass at $-150°$ C. and antimony at $-75°$ C., and the heating rates were kept between $1{\cdot}0° \sim 1{\cdot}2°$ C. per minute. An example of the changes of resistance for various thicknesses of films is shown in Fig. 1. The so-called 'transition temperature'[2], which is the crystallizing temperature, is indicated by arrows, and becomes less distinct when the thicknesses of the

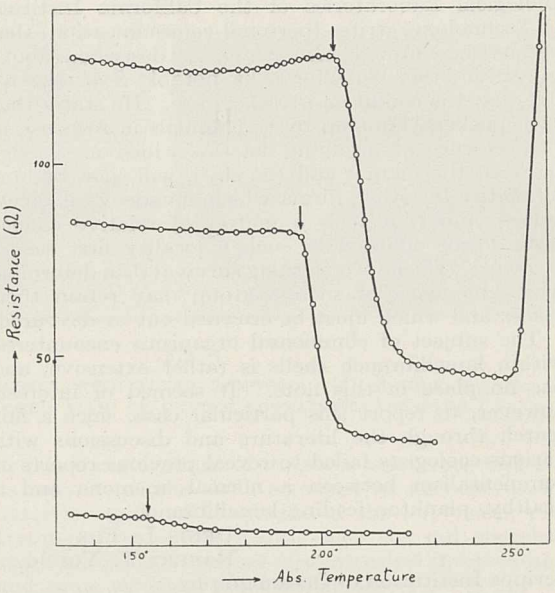

Fig. 1.

RESISTANCE OF CADMIUM FILMS.

films reach several hundreds millimicrons. Abrupt increases of resistance in zinc, cadmium and magnesium are caused from the crack-formation in the films.

If the films are not too thin, linear relations exist between the thicknesses and the logarithm of the transition temperatures. The gradients of these straight lines are exactly the same for zinc and cadmium, and almost the same for antimony and magnesium. When this straight line relation is extrapolated to zero thickness, the ratio of transition temperature (Tu) to melting point (Ts) of the respective metals ranges from 0·36 to 0·41, which coincides with that for the bulk metals[3] as shown in the following table :

	Zinc	Cadmium	Magnesium	Antimony
$\log_e tu$	5·625	5·485	5·8	5·82
tu	277°	241°	330°	337°
ts	692°	594°	906°	903°
tu/Ts	0·40	0·41	0·36	0·37

The present investigation is being extended to other metals.

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Steel and Other Metals,
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March 1.

[1] T. Fukuroi, *Sci. Rep. Tôhoku Imp. Univ.*, Prof. Honda Anniversary Volume, 80 (1936).

[2] Kramer, J., *Ann. Phys.*, (5), **19**, 37 (1934); *Naturwiss.*, **20**, 792, etc. (1932).

[3] Tammann, G., *Z. anorg. Chem.*, **157**, 325 (1926) or Jefferies and Archer, "The Science of Metals" (1924), p. 86. The ratios of the recrystallization temperature and the melting point are given as $TR/T^s = 0{\cdot}32 \sim 0{\cdot}43$ for ordinary metals.

Dispersion of Sound Velocity in Liquids

As is now well known[1], the spectral character of monochromatic light scattered by many liquids exhibits an observable change as the result of such scattering; an instrument of sufficiently high resolving power, for example, a Fabry-Perot étalon[2], indicates the presence of Doppler-shifted components on either side of the main radiation. From this we are able to infer that sound waves of very high frequency represent a considerable part of the energy of thermal agitation in such liquids. The frequency of the sound-waves actually revealed by this method depends on the wave-length of the incident light, the angle of scattering and the liquid employed; in most actual cases, it lies within the frequency range 1,000–10,000 megacycles per second.

It is a question of considerable importance, whether these spontaneously existing sound-waves of thermal origin of very high frequencies ('hyper-sonic waves'), have velocities of propagation differing appreciably from those of lower frequencies (audio-waves and ultra-sonic waves) capable of being produced artificially by mechanical or electro-acoustic methods. The sound velocities within the ultra-sonic range (< 100 mega-cycles) can be measured with high precision (Hiedemann[3] and Parthasarathy[4], etc.). For the determination of the hypersonic velocity, we have to depend on the magnitude of the Doppler-shifts as observed interferometrically, the measurements of which are, however, liable to serious errors owing to (*a*) the angular width of the scattered beam, (*b*) the intrinsic breadth of the Doppler component, and (*c*) the imperfect monochromatism of the incident radiation, including especially the hyperfine structure satellites. The third source of error is particularly serious, as the satellites are intense and by their superposition shift the apparent position of the Doppler components. An examination of the published literature shows that none of the measurements reported so far has taken account of the sources of error sufficiently to enable any definite conclusions to be drawn from them.

TABLE 1.

Liquid	Observed Doppler shift (cm.$^{-1}$)	Velocity in metres/second	
		'Hyper-sonic' frequency $5{\cdot}0 \times 10^9$	'Ultra-sonic' frequency $7{\cdot}32 \times 10^6$
Carbon tetrachloride	0·261	1070 ± 25	928 ± 1
Acetone	0·221	978 ± 25	1205 ± 1

The subject has been taken up afresh by me, at the suggestion of Sir C. V. Raman, and systematic efforts have been made to eliminate the sources of error mentioned above by choosing the experimental conditions suitably. By using a low-density and cathode-cooled mercury arc lamp, and by a proper selection of the radiation used and of the invar distance piece separating the plates of the étalon employed, with reference to the sound velocity in the liquid under investigation, it has been found possible to eliminate the errors and obtain dependable results.

The programme now on hand includes numerous liquids; it will be sufficient here to report the results for carbon tetrachloride and acetone, which have stood the test of careful repetition and scrutiny.

It is interesting to note that in carbon tetrachloride the hyper-sonic velocity is definitely greater than the ultra-sonic velocity, while in acetone the reverse is the case.

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April 10.

[1] Brillouin, L., *Ann. Phys.*, **17**, 88 (1922). Gross, E., NATURE, **126**, 201, 400, 603 (1930).
[2] Raghavendra Rao, B. V., *Proc. Ind. Acad. Sci.*, A, **1**, 261, 473, 765 (1934); **2**, 236 (1935); **3**, 607 (1936).
[3] Hiedemann, E., and Bachem, *Z. Phys.*, **94**, 68 (1935).
[4] Parthasarathy, S., *Proc. Ind. Acad. Sci.*, A, **2**, 497 (1935).

An Effect of Rectified Current from a Tunger Valve upon the Electrolytic Separation of Heavy Water

A RATHER low yield of the heavy water obtained with the usual method of electrolysis, using the single-phase full-wave Tunger valve rectifier, led us to investigate the cause of loss of the heavy water. Besides a good deal of loss through evaporation and spraying, and possibly a loss arising from an exchange reaction occurring at the electrode, the rectified current employed may have been also a contributing factor to the loss.

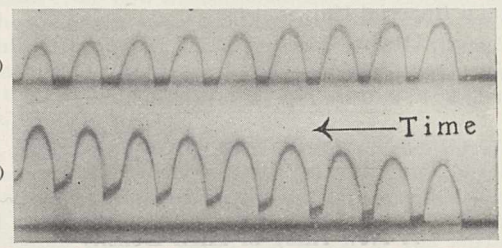

Fig. 1.

With this latter view in mind, the following experiments were performed. Two identical cells in a closed form with nickel electrodes, which were so constructed as to make a loss from evaporation and spraying entirely negligible, were employed. In each of these two cells was placed an equal amount of the electrolytes (40 c.c.) with 1 per cent D_2O content. To one cell was supplied the direct current, to the other the rectified current. The two cells were independently connected with a Wood discharge tube. The intensity of the Dγ line in the Balmer series was observed from the water remaining in the cell, simultaneously with the decrease of the volume of the electrolyte. The result after the exposure of one minute showed that on the D.C. side the Dγ line appeared at one ninth the initial volume, whereas on the rectified current side the same intensity of Dγ line appeared at one twenty-seventh the initial volume.

The effect was also investigated with the oscillograph, using this time fifteen cells actually employed for the production of the heavy water. The result showing the variation of current and voltage with the time immediately after the rectified current was supplied are shown in Fig. 1, where *a* shows that the current passing through the cell becomes smaller with the period of the pause becoming greater; and *b* shows that the back E.M.F. reaches the half-value

of saturation in 10/120 sec., during which a H atom may be able to stay on the electrode.

The action at the cathode may be as follows: first, neutralization of the hydrogen ion or its hydrated ion with an electron from the cathode metal, and secondly, recombination of H atoms to form a molecule. Both H and D atoms accumulated at the cathode tend to diffuse back into the solution during the pauses of a, but their respective rates will be different. According to the theories of W. R. Gurney[1] and R. P. Bell[2], the rate of diffusion of an atom into the solution depends on the force constant of the link between the ion and the water molecule. With the increase of atomic weights, the force constant of the link or the heat of hydration becomes smaller, that is, the rate of the diffusion becomes smaller; thus, for example, the heat of hydration of H ion is 200 kcal. per gm.mol., while that of Li ion 15 kcal. per gm.mol. Therefore, the rate of back diffusion of the H atom will be higher than that of the D atom. Consequently, D may remain on the electrode sufficiently long for another D or H atom to approach it, with the formation of D_2 or HD, which will escape as a gas molecule. This process may perhaps account for a loss of D content during the electrolysis, in our case.

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[1] Gurney, W. R., *Proc. Roy. Soc.*, A, **134**, 137 (1932).
[2] Bell, R. P., *J. Chem. Phys.*, **2**, 104 (1934).

A New Alloy of High Density

IN an article in NATURE of March 20[1], Dr. C. J. Smithells describes a very interesting method of producing alloys of tungsten without melting the tungsten itself. He mixes tungsten powder together with copper and nickel powder and then heats them to 1,450° C., at which temperature the mixture sinters, the tungsten becoming embedded in a tungsten-copper-nickel eutectic. He thus avoids the technically extremely difficult, if not impossible, task of heating large masses of tungsten to melting point.

This metallurgical process is of particular historical interest, as it makes use of the principle employed by the Pre-columbian Indians of the Esmeraldas coast in South America. As I have shown[2,3], these Indians used the above method to produce coherent platinum; the platinum was heated together with a small quantity of gold until the melting point of the latter was reached. The platinum thus became embedded in a platinum-gold eutectic. Subsequent alternate heating and hammering produced a homogeneous alloy so resembling ordinary platinum that superficial examination will deceive even a modern metallurgist.

Copenhagen.
April 12.

PAUL BERGSØE.

[1] NATURE, **139**, 490 (1937).
[2] NATURE, **137**, 29 (1936).
[3] Ingeniørvidenskabelige Skrifter A 44. Copenhagen.

Effect of the Penetration of X-Rays on the Resolving Power

FROM the generality of the principle of uncertainty $\Delta E.\Delta t = h$, it follows that the equation for the resolving power of a grating $\lambda/d\lambda = m.n$ (where λ is wave-length, m is number of rulings, n is order of the spectrum) is valid not only for the ruled grating,

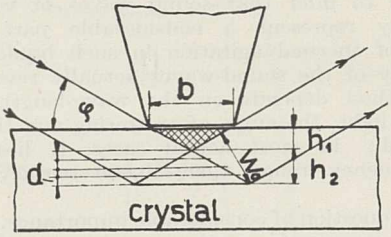

Fig. 1.

but also for space-lattices. On the other hand, for example, for the ruled plane gratings used for X-rays, the resolving power is limited by the fact that it is not possible to collimate the reflected beam of X-rays. It can be shown that for the space lattices also the resolving power is limited, owing to the widening of the lines caused by the penetration of X-rays into the crystal, since the reflected beam of width w_0 is not collimated (see Fig. 1), so that the resolving power, corresponding to the number m of reflecting planes, cannot be attained.

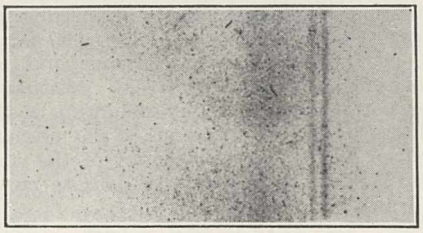

Fig. 2.

We attempted to find the effective depth of penetration of the radiation into the crystal using the Seemann 'edge' method, only instead of sharp edges we used blunt edges of various thicknesses b, placed against the surface of the crystal. Thus, as shown in Fig. 1, we screened from the incident X-rays of glancing angle $\dot{\varphi}$ a surface portion (though mostly effective) of the crystal to the depth $h_1 = \tan \dot{\varphi}.b$.

We used the $K\alpha$ lines of silver. By using an edge of thickness $b = 0{\cdot}3$ mm. pressed against the surface of the crystal, we have screened (for silver $K\alpha$, calcite crystal $\dot{\varphi} = 5° 20'$), a depth $h_1 = 1{\cdot}5 \times 10^{-2}$ mm. With this arrangement we obtained the photograph shown in Fig. 2. Comparing this result with those obtained by means of sharp edges for this region of shorter wave-lengths[1], it can be seen that by screening a definite depth of the crystal, and thus diminishing the number of reflecting planes, the resolving power has been considerably increased (about five times).

From the width of the silver $K\alpha$ lines on plates taken at varying distances from the crystal, and by measuring the divergence of the beam $\Delta\dot{\varphi} = 11''$, we have calculated the width w_0. This width corresponds

to the depth h_2, which remains effective for interference in the crystal after screening $h_2 = 2 \times 10^{-2}$ mm.

The decreased number of reflecting planes corresponding to this depth h_2 is thus still of a greater order than that corresponding to the resolving power $\lambda/d\lambda = m.n$ actually obtained, so that the resolving power is still not limited by the time uncertainty $\triangle t$ between rays reflected from the first and m-th planes. On the other hand, it can be shown from the results of Allison and Parratt[2], that the limiting of $\lambda/\triangle\lambda$ by $\triangle t$ occurs for long wave-lengths, for example, for Si $K\alpha$.

By using the screening method described above also for the $K\alpha$ lines of copper, we found that the resolving power for these lines was increased, if compared with that obtained by us without screening, but was not greater than that obtainable from a vacuum spectrograph using the Bragg method.

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J. KLEIN.

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March 31.

[1] See, for example, M. Siegbahn, "Spektroskopie der Roentgenstrahlen", 1931, p. 105, Fig. 92.

[2] Allison, S. K., *Phys. Rev.*, **38**, 203 (1931); Parratt, L. J., *Rev. Sci. Inst.*, **6**, 113 (1935).

Points from Foregoing Letters

RESISTANCE-TEMPERATURE curves have been obtained by Dr. J. F. Allen and E. S. Shire for a phosphor-bronze resistance thermometer down to a susceptibility temperature of 0·027°. The results show that a phosphor-bronze resistance thermometer can be conveniently used in the range of temperature below 1° K. From Simon's relation the probable difference between susceptibility temperature and the absolute temperature at such very low temperatures is not greater than 0·02°.

The energy distribution of positrons emitted by radio-scandium, produced by irradiating lime with alpha particles from radon, has been determined by Dr. J. C. Jacobsen. He finds that there is no emission of X-rays corresponding to the K-radiation of calcium, as would be expected from the hypothesis of Konopinski and Uhlenbeck.

As a further step in the spectroscopic investigation of the structure and vibrations of the benzene molecule, a table giving the more prominent frequencies in the Raman spectrum of s-trideuterobenzene (s-$C_6H_3D_3$) is submitted by a group of investigators from University College, London.

When the pituitary glands are removed from rats, the corpora lutea do not regress in the usual way, but persist. This, J. Freud points out, suggests the presence of an antiluteogenic factor in the pituitary, and he finds further support for this view in the fact that when an extract of the anterior pituitary is injected intraperitoneally in infantile rats, the formation of corpora lutea is inhibited. Subcutaneous injections, on the other hand, do not prevent the formation of corpora lutea.

The evolution of oxygen from illuminated chloroplasts isolated from the cell has been measured spectroscopically by the use of hæmoglobin by R. Hill, who finds that the evolution of oxygen is caused not by carbon dioxide, as in the intact cell, but by ferric salts which become reduced to ferrous salts while molecular oxygen is liberated.

Dr. K. Mellanby does not consider that expressing the content of water in tsetse flies as a function of the fat-free dry weight gives an accurate picture of conditions in the tissues, as is suggested in recent letters by R. W. Jack and C. H. N. Jackson. Gross changes in the volume of circulating hæmolymph occur, considerably altering the dry-matter water ratio. The tissues themselves are not desiccated so long as any circulating fluid remains.

Prof. V. Subrahmanyan directs attention to loss of soil nitrogen by volatilization of ammonia and describes a method for estimating it. The ammonia is absorbed in filter paper previously moistened with known quantities of standard acid. Applications of the method are indicated.

A table giving a comparison of the velocity of ultra-sonic waves (of frequency 7×10^6) in carbon tetrachloride, and also in acetone, with the velocity of 'hyper-sonic' waves (of frequency 5×10^9) as deduced from new measurements of the Doppler shift in the monochromatic light scattered by those liquids, is submitted by B. V. Raghavendra Rao. In carbon tetrachloride, the hyper-sonic velocity is greater than the ultra-sonic while in acetone the opposite is the case.

A comparison of the increase in the concentration of heavy water by electrolysis, (*a*) with direct current, (*b*) with current rectified with a 'Tunger' valve, shows that the direct current is more efficient for separating the heavy water. From the shape of the current-voltage curves of the rectified current (analysed by means of the oscillograph), T. Asada and E. Honde infer that the loss in the heavy component produced by the rectified current may be due to the fact that the rate of diffusion of the heavy hydrogen (deuterium) being slower than that of the light hydrogen, a deuterium atom may remain on the electrode sufficiently long for another atom to approach it, with the resultant formation of D_2 or HD molecules, which then escape as gas.

Curves giving the electrical resistance at different temperatures of very thin metallic (cadmium) films condensed on glass are submitted by T. Fukuroi. The curves show a fall in resistance at the 'transition temperature'—which itself depends on the thickness of the film. The author gives a table indicating that in the case of films of zinc, cadmium, magnesium and antimony, the transition temperature is a constant fraction of their melting point.

By screening a calcite crystal to a definite depth by means of a blunt 'Seemann edge', Prof. V. Dolejšek and J. Klein find that the resolving power for the K-α lines of silver is increased about five times. From the generality of the principle of uncertainty they deduce that, as in the case of the ruled gratings, the resolving power of the space lattice of crystals is limited owing to the widening of the lines caused by the penetration of the X-rays into the crystal.

Research Items

Military Organization in Swaziland

IN a study of the military organization of the Swazi (*Africa*, **10**, 1, 2), Hilda Beemer points out that the one service which the military organization is no longer allowed to perform is the key to its former importance and present impotence. Inter-tribal warfare has been suppressed, and for the purpose of war against the European its weapons are out of date. Wars were waged to extend the boundaries, to retain tribal independence, and to secure internal solidarity. At times it was a competition instituted by the warriors to show their courage, loyalty and strength. The prize was glory and booty, more especially cattle. The young bloods would boast to the king, asking to be allowed to show that they were better than such and such a regiment, who would then ask permission of the king to be allowed to show their prowess against an outside enemy. An enemy rich in cattle would be chosen, and the tribal war-doctor would doctor the regiments to bring them home alive and 'wipe out' the terror of taking life. This was a national and not a personal rite ; and the individual soldier would often arm himself with powerful medicine purchased from private doctors. The king himself never went to war but while the regiments were away he, with the national war doctor, worked out destructive magic against the enemy, and in this way also fortified his own subjects. The old war magic was in the hands of a special clan who were forbidden to use it for private individuals or for civil strife between two sections of the Swazi. The tribal ancestors were always considered to be present in spirit, giving courage to the men and ennobling their aim. Spoil brought back was distributed by the king according to group and individual achievement. A certain number of cattle was always set aside for national use in the cattle posts of the king, while every man who killed an enemy was entitled to a decoration for bravery.

Clowns in Hopi Ceremonial Dances

DR. ELSIE CLEWS PARSON has edited the voluminous journals kept by Alexander M. Stephen, who from 1881 until the early 'nineties, when he died, was in touch with the Hopi of Arizona, and assisted J. W. Fewkes by his intimate knowledge of Hopi ceremonial and custom in the studies which the latter published with the Bureau of Ethnology (*Columbia Univ. Contrib. Anthrop.*, **23**, Pts. 1–2). Stephen was admitted to three societies, the Flute, the Lalakon and the Snake, and he lived in several households, both Hopi and Tewa, on the Mesa top. His journals contain much detail unpublished even in the parts incorporated by Fewkes. Little attention is given to material culture (though an exception is his account of pigments, and their relation to sexual attribution and the cardinal points), and his observations deal mainly with the seasonal festivals, of which he took detailed notes while they were being performed. Owing to the changes which have since taken place and the reticence of the Hopi, which even Stephen found a hindrance, the material is especially valuable. One of the remarkable features which Stephen observed is the puzzling ceremonial of the clowns. Of this he gives a graphic description. On First Mesa there are four clown types, of which the Ta'chukti, like the Koye'mshi, wear masks with knobs and carry a fawn skin bag. They wear the black dress of a woman as breech-clout, and mask and body are painted with pinkish clay. They sing Zuñi songs, pretend to talk Zuñi and even make Zuñi prayer sticks. Their origin myth is a Koye'mshi brother-sister incest story, their play obscene or phallic, and their games are those of the Koye'mshi. They are sprinkled with meal as sacred figures and rain-making is an attribute of their eponymous spirit. They have no fixed chieftainship or organization. The Chü'rkü'-wimkya wear a wig and are painted yellow with red stripes across their faces. They initiate in an ash house, an outline in ash made in the dance court. The initiation is for temporary membership only, and seems to be part of their play. The ash house appears in the clown ritual elsewhere.

Nemertea and Crinoidea of the John Murray Expedition

NUMBERS 3 and 4 of the "Scientific Reports of the John Murray Expedition 1933–34" (British Museum (Natural History), **4** ; 1936) contain the Nemertea by J. F. G. Wheeler and the Crinoidea by Austin H. Clark. Only two specimens of nemerteans were collected by the Expedition, a littoral form taken with the dredge in shallow water off the Arabian coast which proved to be *Amphiporus reticulatus* Bürger, previously only known from the Bay of Naples ; and a pelagic form sorted from the plankton taken in the Indian Ocean, representing a new genus and species which is described in the report under the name of *Nannonemertes indica*. This new nemertean is referred to the family Pelagonemertidæ, Mosley. The crinoids form an important addition to our knowledge of the fauna of the Indian Ocean, as they were very imperfectly known in this region, the sixteen species recorded enabling the author to supplement the information already available and to describe one new genus and five new species. An annotated list of all crinoids at present known from the seas west of Ceylon and the west coast of India is given and the crinoid fauna of the Indian Ocean and the Red and Arabian Seas is discussed. Many interesting points arise and for the first time it has been possible to describe, "with the probability of a reasonable degree of accuracy", the faunal relationships of the different portions of the Indian Ocean.

The Asteroid Nervous System

TO Johannes Müller (1850) we owe the first recognition of the asteroid nervous system. As a result of subsequent work, it is widely taught that it is composed of three parts, a sensory ectoneural system, a hyponeural system (Lange's nerve) and an apical system, the two latter being motor in function and of mesodermal origin. The whole problem of this system has been re-investigated by J. E. Smith (*Phil. Trans. Roy. Soc.*, B, **227**, 1937). The work was mainly based on *Marthasterias glacialis*, but six other species were also studied. It is suggested that a more useful division would be into sensory and motor systems. There is a general ectodermal sensory system with concentrations in the radial nerves and the circumoral ring found in all classes. The ring,

however, is absent in Crinoids, which have a well-developed apical sensory system not homologous with the apical nerve of Asteroids, which is motor. The ectodermal system communicates with the motor system through the interspaces of the boundary zone of connective tissue. The hyponeural (motor) system is also a constant feature but the extent and position of its development are related to the type of motor activity of the animal. Thus in Echinoids, where a test prevents movement of the body wall, the radial hyponeural nerve is absent.

Fowl-Pox and its Transmission

FOWL-POX is a virus disease which attacks chicken, pigeons, geese, turkeys and other birds, and causes considerable loss to the poultry farmer. It appears as cheesy diphtheritic membranes in the mouth, and as warty growths on the comb, wattles and mucous membrane of the mouth and eyelid. In the past, it was supposed that these various lesions were caused by different agents, but R. L. Kaura and S. G. Iyer confirm the present view that all are due to a single filter-passing virus (*Indian J. Vet. Sci. and Animal Husbandry*, 6, Pt. iv, 313 ; 1936). They find that diphtheritic lesions from the mouth produce the fowl-pox lesions on the skin, and that the Indian strain of virus is immunologically indistinguishable from the English Weybridge strain. A. L. Brody has studied the transmission of the disease (Cornell Univ. Agric. Expt. Station, Memoir 195. Ithaca, N.Y., 1936). Direct contact is one certain method by which fowl-pox is spread within a flock, and contaminated inanimate objects may possibly do so as the virus on them remains alive for at least six weeks. Mosquitoes, such as *Aedes ægypti*, may also transmit the contagion by intermittent feeding. Inoculation of the bodies of mites (*L. sylviarum*) four days after their last association with diseased birds produced pox, but mites after feeding on diseased, and then on healthy, birds did not cause pox.

Pruning the Tea Plant

J. R. TUBBS (*J. Pom. and Hort. Sci.*, 14 (4), 317 ; 1937) has estimated that the young shoots of the tea plant (*Camellia Thea*), of which the majority of leaves are normally harvested almost as fast as they grow, have produced at the time of harvesting only half the amount of carbohydrate used up in their development. The consequent continual depletion of the reserves of the bush frequently causes die-back of branches, followed by fungal attack and the death of the whole bush. An investigation on plantations at 200 ft., 1,500 ft. and 4,600 ft. above sea-level showed that die-back was more common at the lower elevations, and smaller amounts of reserve carbohydrate were found in the roots. Several methods of pruning were tried, and it was found that by allowing a number of branches to retain their foliage, a method designated 'lung-pruning', the drain on carbohydrate was checked and the incidence of die-back reduced.

Euchromocentre Type of Nucleus and Feulgen's Stain

IT is now commonly recognized that plant nuclei are usually either of the large chromosome type giving a chromatin 'reticulum' in the resting stage or of the small chromosome type in which, in the resting stage, the small amount of chromatin is present in the form of euchromocentres lying peripherally to a large central region containing the single large nucleolus. G. Yamaha and S. Suematsu (*Sci. Rep. Tokyo Bunrika Daigaku*, **3**, Section B ; 1936) have examined many species of Cucurbitaceous plants, which with *Impatiens* and *Ricinus* have the latter type of nucleus, and have followed the behaviour of the constituent parts of the nucleus to Feulgen's stain through the nuclear cycle. During prophase, in addition to the euchromocentres, the nucleolus and nuclear sap also stain faintly with Feulgen. At metaphase-anaphase the chromosomes are fully chromatic, but the nucleolus, which persists to this time, and the nuclear sap no longer stain. After the formation of the nuclear membrane at the completion of telophase, a clump of irregular granules, often in connexion with the disappearing chromosomes, appears and afterwards this clump rounds off to form the typical nucleolus of the resting stage. There seems strong evidence in this case that material responsible for the Feulgen reaction is, at least in part, transferred from nucleolus and sap to chromosomes during prophase and from chromosomes to the sap and a new nucleolus at telophase.

Air-Mass Analysis

AT a meeting of the Royal Meteorological Society held on April 21 a paper was read by E. W. Hewson on the application of wet-bulb potential temperature to air-mass analysis, particularly in regard to the rainfall that is to be expected to result ultimately from the ascent of air in the warm sectors of depressions with various vertical distributions of wet-bulb potential temperature. Wet-bulb potential temperature was introduced sixteen years ago by Normand as a simple function of the temperature and humidity that will remain constant during any adiabatic or pseudo-adiabatic process, the name being derived by analogy with ordinary potential temperature—the temperature that any sample of air will take up when its pressure is brought adiabatically at a standard pressure. It was shown that the potential instability in a column of air is determined by the vertical distribution of potential wet-bulb temperature, and that a mass of damp air may become unstable merely by being lifted to a greater height above the ground, the condition for this being that the wet-bulb potential temperature shall decrease with height. Evidence in support of the ideas put forward is furnished by a table of data referring to a number of depressions with warm-sectors for which aerological soundings are available, and by a diagram in which the maximum rainfall in 12 hours is plotted in each case against the sum of all the decreases of wet-bulb potential temperature in the different layers through which this quantity showed a steady decrease with height. The two quantities were seen to be highly correlated, but the author emphasized that the diagram is not suitable for forecasting rainfall for the whole of a depression, but only for regions bordering the trajectory followed by the air during the 24 hours immediately after the aerological sounding which furnished the computed rainfall.

Radio Fading and Solar Eruptions

THE relation observed between the fading of high-frequency radio signals and solar eruptions is the subject of a News Service Bulletin by Dr. R. S. Richardson issued by the Carnegie Institution of Washington. The work is connected with the observations of Dr. J. H. Dellinger of the National Bureau

of Standards that, between July 1934 and June 1936, thirty-nine fade-outs of radio transmissions have coincided so closely with observations of bright solar eruptions as to suggest the probability of a relationship between the two phenomena. Fifteen eruptions were photographed at the Mount Wilson Observatory of the Carnegie Institution and are described in the bulletin, which is illustrated by reproductions of spectroheliograms of the sun. From his earlier observations, Dr. Dellinger noted that the complete fading of the high-frequency radio signals occurred at intervals of 54 days, but this simple law does not appear to have been maintained since about July 1936. In co-operation with Dr. Dellinger, special hydrogen spectroheliograms have been taken at Mount Wilson with automatic apparatus, and these have been studied in conjunction with the radio records. In five cases, the time when the eruption was first seen agrees to a minute or less with the time at which the fade-out began. In six cases, the eruption preceded the fade-out by from two to twelve minutes; while in no case is a fade-out known definitely to have preceded an eruption. If continued observation confirms the relationship between eruptions and fade-outs, it would appear that the cause of the fading travels from the sun to the earth with the velocity of light; but further investigation is required to explain why some eruptions produce fading while others do not.

Deterioration of Paper

Technical Bulletin No. 541, November 1936, of the United States Department of Agriculture, Washington, D.C., deals with the "Deterioration of Book and Record Papers" and is written by T. O. Jarrell, J. M. Hawkins and F. P. Veitch. It appears to be the general opinion of librarians that much of the paper of books and records on their shelves, especially that made since about 1860, is not sufficiently durable. This conclusion applies especially in the case of books and papers subject to frequent handling. Thirty-eight samples of paper taken from old books, magazines and court records, ranging in age from 19 to 169 years, were examined. The results seem to indicate that paper actually absorbs from the air harmful quantities of acidic sulphur compounds with which the air is generally polluted. The absorption is greater in the portions of the leaves more fully exposed to the atmosphere, and this is one reason why the leaves of old books become more brittle near the outside edges. Seven samples of commercial bond and ledger papers, made in 1914 and 1915, were tested after storing under normal conditions for eighteen years. They were examined after five years and again after eighteen years storage. After eighteen years, the folding endurance of these papers had decreased 23–93 per cent and the bursting strength 0–18 per cent. In general, papers with the higher acidity, as indicated by the *p*H of their water extract, suffered the greatest deterioration. The results are indicative that a water extract with a *p*H of less than 5 is a major factor in the deterioration of even the best classes of paper.

Integrating Electricity Meters

THERE is now a great demand for prepayment meters for use among consumers who do not wish to pay a quarterly account. In a progress report on integrating electricity meters by Mr. G. F. Shotter, which is published in the February number of the *Journal of the Institution of Electrical Engineers*, various novel types of prepayment meters are described. One of these makes provision for arrears of payment which mount up owing to the consumer not inserting sufficient coins to cover the continuous collection of a fixed charge. The meter has a dial which when the consumer has inserted sufficient coins indicates by black figures the amount the consumer has overpaid, the word 'credit' in black appearing on the dial. When he has underpaid, 'credit' in black changes to 'arrears' in red, the figures automatically changing to their opposite sequence and appearing in red. Another possible difficulty due to his supply being cut off owing to arrears mounting up in his absence or for other reasons is overcome by a special device giving a limited supply for a short time upon the insertion of a coin. The current must be used immediately, as the mechanism allocates a larger proportion of the value of the coin inserted to the repayment of arrears. If the current is not so used, the balance of the value of the coin is transferred by the operation of a small motor to the paying off of further arrears. Manufacturers are also supplying prepayment meters which may be changed from D.C. meters to A.C. meters by merely changing the meter element. This type of meter would be useful and advantageous to undertakings which are supplying at present on D.C. but look forward later on to supplying some or all of their consumers with A.C. from the Grid.

Theory of Age-Hardening

RESEARCHES on the copper-aluminium alloys have resulted in the view being put forward that two kinds of hardening occur during their ageing, one of which relates to those changes which take place prior to precipitation, whilst the other is connected with the precipitation of the $CuAl_2$ itself. It has also been suggested that a concentration of copper atoms occurs at certain definite positions in the aluminium lattice prior to a copper-rich phase being thrown out of solution. It is not easy, however, to explain all the facts on the basis of existing theories, and Dr. M. L. V. Gaylor (Institute of Metals, March 1937) now proposes a modification which is believed to cover the known facts more adequately. Briefly, the new hypothesis suggests that age-hardening takes place in two stages, of which the second overlaps the first. In the initial stage, ageing is considered to be due to the diffusion of the solute atoms to the planes about which precipitation will ultimately take place. This view is in agreement with that of Desch. The next stage, which follows the first directly and takes place nearly simultaneously with it, results in some of the atoms forming molecules with neighbouring atoms of the solvent metal. As these molecular groups increase in size, local stress is set up. When the solid solution can no longer withstand these stresses their release is effected by the rejection of the compound from solid solution, and precipitation proper has taken place. It is believed that precipitation of molecular groupings intermediate between that of the solute and the solvent metal may conceivably take place, and in support of this view intermediate structures between that of $CuAl_2$ and the aluminium or solid solution have been observed. It follows that age-hardening is now considered as being due not so much to the precipitation itself but rather to the mechanism by which the alloy passes through the metastable to the stable state.

Monaco Conference on Corrosion

A VERY successful conference on corrosion was held at Monaco on March 25–27 under the direction of the Académie Méditérranéenne. It was attended by most of the French authorities on corrosion and by a number of delegates from other countries; the latter included Sir Robert Hadfield and Prof. S. M. Dixon, representing the Institution of Civil Engineers, Dr. J. C. Hudson, representing the Corrosion Committee of the Iron and Steel Institute, Prof. J. Timmermans, of Brussels, and Prof. T. O. Rotini, of Milan. Although, apart from one or two original contributions, most of the papers presented dealt with investigations already undertaken or completed by the various authors, they may be taken as representing the general trend of thought as regards corrosion problems in French circles. It may, therefore, be of interest to communicate some of their most interesting features.

The inaugural session was opened by a communication from General C. Grard, who is the chairman of the Corrosion Committee of the French Air Ministry. This Committee is primarily concerned with the corrosion of such metals and alloys as are, or may be, used in aircraft. Thus, for some time after its formation in 1926, its work was confined to a study of the corrosion of light alloys, but its field of research was extended in 1929 to include such ferrous metals as are of interest in aircraft construction. This Committee has a central organization of its own[1] and is also responsible for sponsoring research work in the laboratories of French universities, for example, at Lille, where Prof. Chaudron and his pupils have been conducting fundamental and practical work of great importance for a number of years. In addition, researches are undertaken in industrial laboratories, but it would appear, from conversation with several French workers in this field, that industrial collaboration in this respect is not yet quite so advanced as in Great Britain, where as a result of the influence of the Department of Scientific and Industrial Research and the formation of research associations, there is a very real and effective co-operation between individual firms in many industries.

The necessity for much closer co-operation in industrial research is generally recognized in France, and was alluded to on at least two occasions in the course of the conference. For example, *M.* Michel, of Messrs. Jacob Holtzer, raised the question at the conclusion of his communication on the properties of certain stainless steels, and his appeal for closer collaboration in research on corrosion work was warmly received by the other delegates. It may be added that organized researches on corrosion in France are also being fostered by the Office Technique pour l'Utilisation de l'Acier, although little information about this work has yet been published.

General Grard was followed by Sir Robert Hadfield, who commenced by paying a warm tribute to the memory of his old friend, Prof. Henry le Chatelier. Sir Robert then referred to the researches on corrosion fostered by the Institution of Civil Engineers, in which he has been actively interested since their inception in 1916, and to his investigations of wrought iron samples taken from the Delhi pillar. British field tests on corrosion were also described by Dr. J. C. Hudson, who dealt more particularly with atmospheric corrosion and the work of the Iron and Steel Institute Corrosion Committee.

The biological and particularly the bacteriological aspects of corrosion were prominent features of the conference. This subject was discussed during the opening session in a paper presented by *M.* R. Legendre, the director of the Laboratoire Maritime du College de France at Concarneau, who has been interested in corrosion research for some fifteen years[2] and in particular has been responsible for numerous field tests on marine corrosion conducted at Concarneau. In the course of some experiments on painted steel specimens exposed to complete immersion in a tidal basin at this port, a peculiar type of corrosion was observed underneath the paint. Local deposits of black mud were found between the paint and the steel, below which the steel was brilliantly etched, as if by acid. Samples of this mud were subjected to a bacteriological examination in the Pasteur Institute by *M.* Veillon, who was able to isolate from it a number of distinct types of aerobic and anaerobic bacteria. Laboratory experiments, in which samples of bare or of painted steel were exposed to corrosion in a suitable medium inoculated with various cultures of these bacteria, showed conclusively that the anaerobic bacteria or the anaerobic bacteria acting in symbiosis with the aerobic bacteria promoted corrosion of the steel, as compared with the behaviour of blank specimens exposed in the sterile medium; the aerobic bacteria alone had no effect. A black corrosion product was formed which had a characteristic smell similar to that of the original mud and was considered to be iron sulphide, since analysis showed that it contained both iron and sulphur[3].

References were also made to interesting researches on protective paints conducted in the laboratories of the Office National des Recherches et Inventions at Bellevue by *M.* A. Vila and his colleagues. These have resulted in the development of an accelerated weathering test for paints and of coal tar paints pigmented with flake aluminium. The accelerated test[4] is peculiar in that the French workers have been led by their experience to abandon exposure to ultra-violet light, which is so prominent a feature of most types of accelerated testing apparatus for paints, and to rely on a wide variation in the range of temperature and of the corrosive media to which the specimens are exposed. The aluminium tar paints[5], which are not unknown in Great Britain, consist essentially of a tar medium to which suitable thinners and about fifteen per cent of aluminium pigment have been added, although, according to *M.* Coret, of the Paris Gas Company, twelve per cent of pigment should suffice. *M.* Coret also stressed the fact that the choice of a suitable tar is of great importance and that the presence of compounds that are capable of being readily nitrated is injurious, whilst Dr. J. Roux claimed, probably with justice, that these paints have inhibitive properties.

Another interesting paper was presented by *M.* F. Canac, the scientific director of the Laboratoire du Centre d'études de la Marine at Toulon, who summarized and extended the results of his work on the

topography of corrosion[6]. *M.* Canac has utilized an optical method to investigate the character of the attack on a corroded surface; briefly, the method consists in studying the distribution in space of the light diffused from a corroded surface, the angle of incidence being varied. He has shown by mathematical analysis that the diffusion/time curves at different angles of incidence should be characteristic for different types of attack, for example, for uniform corrosion spreading outwards at a constant rate from a regularly distributed number of centres, for intercrystalline corrosion, etc., and he has observed close approximations to the theoretical curves in actual corrosion experiments. This method and also one described by *M.* Nicolau for studying the roughness of a surface, depending on observations of the rate of escape of compressed air from a standard orifice brought into close proximity with it, should prove of value in the study of certain types of corrosion problems.

Prof. A. M. Portevin and Dr. E. Herzog communicated the results of some tests on the corrosion of a low alloy chromium-aluminium steel exposed to sea air and to immersion in sea-water at five different ports in France and Algeria[7]. It is encouraging to note that the results showed a marked superiority in the behaviour of the low alloy steel as compared with ordinary steels, not only in the atmospheric but also in the immersion tests. This observation may be of considerable practical importance, since the improvements effected so far in the corrosion resistance of steel by the addition of small amounts of alloying elements, without markedly increasing its cost, have not proved nearly so pronounced in the case of exposure to immersion in sea-water as in that of exposure to atmospheric corrosion.

Prof. G. Chaudron gave a general survey of his researches at Lille, which deal both with ferrous and with light alloys, and stressed the fact that studies of dissolution potential should include the behaviour not only of the bare metal but also of the metal covered with its oxide film. Prof. A. Travers of Nancy communicated the results of an examination of a cast iron pipe that had suffered severe graphitization whilst lying in the soil, and concluded, as is also the view of Dutch experts who have studied the problem, that bacteriological action plays an important part in this phenomenon; the reduction of calcium sulphate in the soil as a result of bacteriological action also formed the subject of a paper by Prof. R. O. Rotini, of Milan. It is also possible that an electrolytic method of polishing metals, devised by *M.* P. A. Jacquet[8] which, the author states, does not result in the formation of a Beilby layer or mechanical disturbance of the metal, may have other interesting applications besides its effect on the structure of electro-deposits, which he discussed.

It remains to add that the arrangements of the Conference were in the capable hands of *M.* J. Desthieux, the secretary of the Académie Méditérranéenne, that thirty papers were read or presented and that at the end of the Conference the proceedings were very ably summarized by *M.* Canac, who acted as *rapporteur*.

[1] Grard, C., *Métaux*, **9**, 291 (1934).
[2] Legendre, R., *Recherches et Inventions*, **17**, 29 (1937).
[3] Veillon, R., *Annales de l'Institut Technique du Bâtiment et des Travaux Publics*, 1, 19 (1936).
[4] Vila, A., *Recherches et Inventions*, **17**, 79 (1936).
[5] Roux, J. *Métaux*, **10**, 509 (1935).
[6] Canac, F., *C.R.*, Jan. 3, 1933; Nov. 19, 1934; July 29, 1935.
[7] Portevin, A. M., and Herzog, E., *C.R.*, Dec. 14, 1936.
[8] cf. NATURE, **135**, 1076 (1935).

The Post Office Speaking Clock in Great Britain

UP to the beginning of the nineteenth century the time in most towns was taken from public clocks of various kinds, which occasionally varied appreciably from one another. This was a serious obstacle to the postal services, and led to the practice on mail coaches and trains of carrying chronometers to synchronize local post office clocks with a standard clock in London. Shortly after the introduction of the electric telegraph, electro-mechanical devices of various kinds were controlled by telegraphed signals. But it was not until 1874, a few years after the Government acquired the telegraph system, that successful distribution of the 10.00 a.m. Greenwich time signal was accomplished over sixty different lines. The development of this service into the very accurate International Time Signal transmitted from Rugby radio station at 10.00 and 18.00 G.M.T. daily was made in 1927. This service has the disadvantage of not always being available in the home. The well known six 'pips' of the B.B.C. have the disadvantage of being only available at certain times. Then came the synchronous motor-clocks running on frequency-controlled mains, but at present these clocks are far from being in universal use.

The success of 'speaking clocks' abroad, especially in Paris, encouraged the General Post Office to design a speaking clock service which would be of use to every house or shop connected with the P.O. telephones. It was decided that the inaccuracy of the clock should not exceed a tenth of a second, fast or slow, and that the time should be announced six times a minute, each announcement being followed by three audio-frequency pips, the last of which gives the exact time spoken. To hear the time a subscriber connected to an automatic exchange dials the code TIM, and one connected to a manual exchange asks for 'Time'.

A technical paper on this novel service was read to the Institution of Electrical Engineers on December 3 by Dr. E. A. Speight and O. W. Gill. They pointed out that when the exchange is called at, say, 10.25, a voice is heard saying, "At the third stroke it will be ten twenty-five and ten seconds". The third of the three pip sounds gives this time precisely. The next announcement will be ". . . . ten twenty-five and twenty seconds", and so on. Most recording systems may be classified as mechanical, magnetic or photographic in principle. The gramophone is typical of the instruments which give a mechanical record. It is compact and cheap to produce, but it has a fairly high noise level which increases steadily with the fairly rapid wear occurring in reproduction. Experiments on gramophone records made in India showed that it was necessary to replace them in one or two days time. Magnetic sound recording is done by means of a steel tape, but owing to its high velocity a considerable length of tape is required. In this case the initial quality

of the reproduced sound is good, but it deteriorates rapidly. The system used by the Post Office is the photographic system, and photocells are used. The technique is complicated, but the record is not subjected to any mechanical wear and is therefore, for all practical purposes, permanent.

During the first week of the public operation of the service, nearly 400,000 calls were made, and during each subsequent week the number has remained practically constant at about 200,000. The relay sets at present permanently installed can each supply 100 simultaneous calls.

Noise on the Road

THE Departmental Committee on "Noise in the Operation of Mechanically Propelled Vehicles" has published its third interim report (H.M. Stationery Office, 1*s*. net). The Committee, of which Dr. G. W. C. Kaye is chairman, was set up by the Minister of Transport in 1934. The present report is based on loudness tests carried out for the Committee by the National Physical Laboratory on some 600 'used' motor-vehicles representative of all the main types on the roads to-day, and of various ages up to thirteen years. A comparison of the results with those from the earlier tests on new vehicles, shows that on the average the used vehicles were the louder by some 4–5 phons. In the range of noise met with on the road (about 70–105 phons) ordinary motor-cars were much the quietest vehicles, while amongst the loudest were certain motor-cycles and sports cars, particularly at high speeds.

The noise from the engines of ordinary cars and commercial vehicles is louder than the exhaust noise, but with motor-cycles and sports cars the position is reversed. This fact lends support to the Committee's earlier criticism of the unsatisfactory nature of the silencing of many motor-cycles and sports cars, and the investigation generally indicates that greater progress has been made in the silencing of sports cars than of motor-cycles.

In its previous reports the Committee made the recommendation that new motor-vehicles should not be offered for sale if the loudness under prescribed conditions of test exceeded 90 phons, adding that motor-cycles should be allowed a latitude of 5 phons for two years. The Committee now proposes for vehicles actually in use on the road a limit of 95 phons (that is, about the noise in a tube train). No vehicles would be allowed on the highway if the loudness, when measured at a point 18 ft. laterally from the middle of the vehicle or 25 ft. behind the open end of the exhaust pipe, exceeded this limit in a normal running test and in a racing engine test conducted in the same way as for newly manufactured vehicles. The Committee also recommends that this limitation of loudness should be applied at first only to vehicles first registered after an appointed day, but that two years thereafter it should apply to vehicles of any age.

It will be appreciated that the noise limit proposed, while making very modest demands on the majority of manufacturers and owners of motor-vehicles, would, by ruling out the arch offenders, form a substantial contribution to the amenities of the road. It is to be hoped, moreover, in the public interest that future developments will enable the limit to be lowered as time goes on. At the Minister's request, the Committee is now investigating the noise caused by motor horns with the view of advising him whether action might usefully be taken to abolish the more strident noises of this kind. The question of the noise arising from trams and trolley buses is under examination by the Ministry in conjunction with the associations concerned.

Hirosima Wave Geometry and Field Theory

REFERENCE has already been made in this journal (Dec. 21, 1935) to the vigorous school of mathematical physics now flourishing in the Hirosima University, Japan. These investigations are continuing (*J. Sci. Hirosima Univ.*, A, 7; 1937), bringing the number of memoirs on the subject up to fifteen. A good summary of the whole series is contained in the paper "Geometrization of the Law of Physics" (*ibid.*, p. 81) by Y. Mimura.

It is claimed that the new theory bears a relation to Einstein's theory similar to that which Einstein's bears to Newton's, or to that which modern quantum mechanics bears to the old quantum theory. Einstein's theory is described as semi-geometrical, and the same term is applied to all existing unified field theories, as they are all built by a mixture of two procedures, namely, the finding of an appropriate geometry, and the finding of an appropriate invariant density to be used with a generalized Hamilton's principle, which is assumed to be the fundamental law of physics.

The Hirosima school considers that the generalized Hamilton's principle should be dispensed with, and they replace it by the condition of the complete integrability of the fundamental differential equation, which is obtained by purely geometrical means. In the hope that 'wave geometry' is identical with physics, extensive investigations of possible varieties have been carried out, including those corresponding to four-dimensional ordinary metrical geometry, to projective geometry, and to conformal geometry.

It is acknowledged that the question as to which wave geometry is to be identified with physics can only be judged by its results. The new field theory has already succeeded in deducing some important physical results, such as a gravitional wave in Maxwellian form, a line element of de Sitter's form, and one equivalent to Schwarzschild's. Perhaps it is not unfair to say that, in these days of competing unified field theories, the ordinary physicist must be allowed to suspend judgment until the physical consequences of the theories have been worked out very much more fully than has been done at present.

Astronomical Determination of Longitudes and Azimuths

HISTORICALLY the relations between geodesy and astronomy have always been of the most intimate character, and the contributions of Bessel, Struve and Gill, famous as astronomers, to measured arcs and the adjustment of observations still play a fundamental part in the determination of the figure of the earth. It was therefore appropriate, the more so since astronomy is becoming increasingly concerned in its objects and methods with physics, that the Royal Astronomical Society should have recalled its association with geodesy by inviting Prof. N. E. Nörlund, president at the recent London meeting of the International Council of Scientific Unions, to deliver the annual George Darwin Lecture before the Royal Astronomical Society on May 14.

Prof. Nörlund took as his subject the astronomical determination of longitudes and azimuths. He derived a general expression for the error in a longitude determination as a function of the zenith distances of the two groups of stars observed with the transit, and showed that a corresponding expression held for the azimuth determination provided the polar distances of the groups were substituted for the zenith distances. Graphical representation of this expression showed that for the maximum attainable accuracy a considerable freedom in the choice of stars was permissible, and Prof. Nörlund showed how this freedom might be utilized to minimize the unavoidable systematic errors due to level, the positions of the stars and personal equation. This discussion in its turn naturally led to a discussion of the separation of the 'Laplace points', where the geodetic triangulation is adjusted by such astronomical observations.

Prof. Nörland concluded that with stars chosen in accordance with the foregoing considerations and with the methods of observation used in Denmark, a separation of as much as 250 km. was allowable. This separation is determined by the necessity of keeping the labour of observation and adjustment to a minimum and if the occasion had permitted, many fellows of the Society would have been interested in hearing Prof. Nörlund's reactions to the alternative procedure of occupying more 'Laplace points' with the simpler observational procedure made possible by the prismatic astrolabe, or an astrolable attachment to a theodolite.

The lecture was characterized by a number of asides on the technique of observation, and some of the results thereof. None excited greater interest than the concluding remarks on the longitude of western Greenland. An important piece of evidence for Wegener's hypothesis of continental drift has been the fact that longitude determinations in Greenland between 1823 and 1870, and between 1870 and 1907 showed evidence of a westerly movement of the area amounting to 9 metres per annum in the first period and 32 metres per annum in the second. Under Prof. Nörlund's direction, the Danish Geodetic Survey has occupied stations in western Greenland at two epochs separated by seven years, and in that period there has been no change of longitude. There can therefore be little doubt that Wegener's suspected movement is simply the result of errors in the early determinations of longitude.

Nitrogen Transformations in the Soil

IN his presidential address to the National Academy of Sciences, India, on January 15, Prof. N. R. Dhar gave a very comprehensive account of his work on nitrogen transformations in the soil, various aspects of which have recently been described in NATURE (**137**, 462, 629, 1000; **138**, 648, 1060; 1936). Further evidence was provided of increases both in soil nitrogen content and in crop yield following the application of molasses, and striking results were reported in the reclamation of alkali land by molasses on the practical scale. Other carbohydrate-rich materials, and the sodium salts of fatty acids, were also shown to promote nitrogen fixation. Cow dung had a double action, not only supplying extra nitrogen but also leading to nitrogen fixation as well. With more highly nitrogenous materials, however, such as oil cake or sulphate of ammonia, a loss of nitrogen from the soil took place, especially if it was exposed to sunlight. This loss was reduced when leaves or cow-dung were also added, while molasses converted the loss into a gain, nitrogen fixation occurring in spite of the presence of much available nitrogen.

Many experiments were described on the influence of sunlight on ammonification, nitrification, nitrogen fixation and the loss of nitrogen from soils. Prof. Dhar has shown both in the laboratory and in the field that exposure to sunlight accelerates these processes, but it is necessary to point out that the heating effect of the long wave-lengths was present as well as the possibly photochemical effect of the short wave-lengths. Soils exposed to full sunlight were compared with soils that were either shaded or kept in a dark room. The higher temperature of the exposed soils would be expected to cause, on the average, greater microbiological activity, and although the author observed that the temperatures were often above the optima for bacteria in pure culture, it is unsafe to argue from this to mixed soil flora which were subject to the fluctuations between day and night temperature.

This point is raised because, while Prof. Dhar's results are undoubtedly of great interest, the *a priori* objection to the occurrence of an important amount of photochemical activity in soils in the field, based on their opacity to light, is such a real one that experiments on the subject require especially stringent examination.

Science News a Century Ago

Warwickshire Natural History and Archæological Society

THE first anniversary meeting of the above Society was held on May 23, 1837, when the Council's report was read. Though some interesting addresses had been delivered, the Council regretted not having been favoured with communications so much desired by them and so easily furnished by observant naturalists, relating to the different branches of natural history. The collections in geology and mineralogy had been greater than had been anticipated. Most of the objects had come from the cabinets of members. The sole purchase was that of a series of mountain rocks from the British Isles collected by the late Dr. Rowley, late master of University College, Oxford. The zoological collection was daily increasing. It contained about 300 birds. The curators were extremely anxious to complete and classify the collection of British birds and quadrupeds. (*Analyst*, 7, 92).

Carl Ernst Adolf von Hoff (1771–1837)

ON May 24, the eminent German geologist, Carl Ernst Adolf von Hoff, died at the age of sixty-five years. Born on November 1, 1771, von Hoff was educated at Jena and Göttingen, and at twenty years of age became a secretary in the diplomatic service of the Government of Gotha, and during the Napoleonic era held various posts. In spite of the unrest of the times, he pursued the study of geology with great zest, in 1801 founded a geological journal and became acquainted with Werner, Goethe and Humboldt. In 1818, the Royal Society of Sciences in Göttingen, acting on a suggestion of the physiologist Blummbach, offered a prize for the best "investigation of the changes that have taken place in the earth's surface conformation since historic times, and the application which can be made of such knowledge in investigating earth revolutions beyond the domain of history". This led to the writing by von Hoff of his "History of the Changes in the Surface of the Earth", published during 1822–41, which placed him in the front rank as an original thinker. Carl von Zittel, speaking of this work, said : "The fact that von Hoff's meritorious work was not properly valued, and was put in the shade by Lyell's epoch making book, which appeared almost simultaneously, is easily explained by the circumstance that the modest German man of science derived his material mainly from books, that his position did not allow him to examine in the field the questions which he discussed, and that he enriched science by no new facts ; he faced the problem as an historian, and not as an observer" (see NATURE, 72, 123, June 8, 1905).

The Royal Society

AT a meeting of the Royal Society on May 25, 1837, the concluding portion of Sir David Brewster's paper on the "Absorption of Light" was read, after which Thomas Andrew Knight (1759–1838) read a paper "On the Hereditary Instinctive Propensities of Animals", in which he referred to his observations on terriers, spaniels and retrievers ; and Captain Beaufort communicated a paper entitled "On Meteorological Deductions from Observations made at the Observatory at Port Louis in the Mauritius, during the years 1833–34–35 by John Augustus Lloyd, Esq., Surveyor-General of that Island, F.R.S." The observations, from which the results recorded in the paper were made, were nearly 50,000 in number, and were taken four times each day at the hours of 8 a.m., noon, 4 p.m. and 8 p.m. The observations were those of the barometer, hygrometer, rain gauge and the appearance of the atmosphere.

End of the Euphrates Expedition

ACCORDING to the *Annual Register* for 1837, "On May 28 the *Pembroke*, 74, arrived at Plymouth with the surviving officers and men of the Euphrates expedition. There appears no doubt, notwithstanding the disasters which have attended this preparatory expedition, that with steamers adapted for the purpose and when the navigation of the river is a little better known, that the passage from Bussorah to Beles may be made in twenty days ; and when the river becomes known in fifteen days. Beles is about 100 miles from the Bay of Antioch over which distance the mail bags might be rapidly conveyed to a steamer. The passage from Bussorah to Bombay would take a good steamer 10 days. When the whole scheme was brought into existence, communication between Bombay and England might be fairly calculated at not exceeding fifty days."

John Ericsson's Screw Propeller

ON May 28, 1837, the packet sailing ship *Toronto* of 630 tons burthen and drawing 14 ft. 6 in. of water was towed down the River Thames by the experimental steamboat *Francis B. Ogden* fitted with Ericsson's screw propeller. The *Francis B. Ogden*, the largest boat built so far for trial with a screw propeller, was named after the United States Consul at Liverpool, and was 45 ft. long, 8 ft. beam and drew 2 ft. 3 in. It was fitted with an engine having two cylinders 14 in. diameter, 12 in. stroke working with steam at 50 lb. per sq. in. She had been built at Wapping. "The new propelling apparatus", said the *Mechanics' Magazine*, "consists of two short cylinders made of wrought iron, and supported by arms of a peculiar form, which are placed entirely under water at the stern ; and made to revolve in contrary directions about a common axis. To the outer periphery of each cylinder, there is attached a series of spiral planes or plates, which may, we understand, be placed at any desired angle, according to the effect sought to be obtained, whether it be great speed or great propelling power."

Fires in London

ACCORDING to *The Gentleman's Magazine* of May 1837, of 564 fires which occurred in and around London in the previous year, the following were the causes so far as could be ascertained. Accidents of various kinds, scarcely avoidable, 11 ; apparel taking fire on the person, 2 ; bed curtains set on fire by accident, 71 ; accidents with candles, 57 ; cases of palpable carelessness, 18 ; charcoal fires, portable, 2 ; children playing with fire, 6 ; fires kindled on hearths, 5 ; defective or foul flues and chimneys, 72 ; fumigation, 9 ; sundry gas accidents, for the most part occurring from gas-fitters, during the progress of repairs, 38 ; gunpowder, 1 ; heating of hay, lime, etc., 7 ; sparks from lamps, 2 ; linen incautiously hung before fires, 31 ; ovens overheated, 6 ; loose shavings ignited, 13 ; sparks from fire, 7 ; defective setting of stoves, etc, 28 ; application of fire heat to various purposes of trades and manufactures, 34 ; tobacco smoking, 1 ; unknown, 95 ; wilful, 8 ; window curtains catching fire, 35.

University Events

CAMBRIDGE.—The Gordon Wigan Prize in Chemistry for 1936 is divided equally between A. E. Alexander, of King's College, and T. P. Hughes, of Gonville and Caius College.

LONDON.—Prof. A. M. Carr-Saunders, Charles Booth professor of social science in the University of Liverpool, has been appointed director of the London School of Economics and Political Science as from October 1, in succession to Sir William Beveridge.

OXFORD.—E. J. Bowen, University College, and J. W. Wolfenden, Exeter College, have been appointed University demonstrators in chemistry for four years as from October 1. Dr. B. G. Maegraith, Exeter College, has been appointed University demonstrator in pathology for four years from May 1.

M. A. Jennings, Lady Margaret Hall, has been elected to the Schorstein research fellowship in medicine for 1937.

H. Field, New College, has been granted the degree of D.Sc. for his work in anthropology. Prof. J. C. Moir, Oriel College, has been given the degree of M.A. by decree.

The amount subscribed in the first three months to the University appeal for approximately a million pounds is £355,845.

Societies and Academies

Paris

Academy of Sciences, April 12 (*C.R.*, 204, 1093–1144).

LUCIEN CAYEUX : Signification of the disturbances recorded by the phosphates of Hodna (Algeria) during and after their deposit.

CHARLES MAURAIN : Possible influence of mechanical actions (vibrations) and magnetic disturbances on the earth's magnetic field, and its anomalies.

EMILE MATHIAS : Curvature of the diameter of densities.

JULIUS WOLFF : Invariant domains in conformal representation.

JOSEF L. KRAMES : A remarkable class of space movements. Symmetrical viration.

RENÉ DUGAS : Dirac's mechanics and the last multiplier in the sense of Jacobi.

ARCADIUS PIEKARA : The phenomenon of positive electrical saturation.

JULES FARINEAU : Spectrographic study of the conductivity electrons of magnesium and silicon.

MAURICE PARODI : Study of some borates and some oxides in the extreme infra-red.

JULES DUCHESNE : Calculation of the vibration frequencies of the molecule N_2O_4.

ANDRÉ GUINIER : An arrangement for obtaining very intense diffraction diagrams of crystalline powders with a monochromatic radiation.

ANDRÉ MERCIER : The theory of β-radioactivity.

JULES GUÉRON : The general trend of the evolution of aqueous solutions of ferric chloride.

MLLE. MARGUERITE FROLLO : The petrographical study of the radiolarian complex of the Mesozoic formations of the Eastern Carpathians.

GABRIEL LUCAS : The Palæozoic of the Ghar Rouban region (Algero-Moroccan frontier).

EUGÈNE WEGMAN : Genesis of the alkaline rocks of Julianehaab (Greenland).

WILLIAM HENRI SCHOPFER : The nitrogen metabolism of a micro-organism, considered from the point of view of allometry.

ROBERT ECHEVIN : The influence of calcium carbonate on the growth of the radish.

MLLE. MARIE THÉRÈSE GERTRUDE : The determinism of the morphogenic action exercised by the aquatic medium in plants.

HENRI GAUSSEN : The evolutionary equilibrium and the germinal influence in the Abietineae.

ANDRÉ TOURNADE and MARC CHEVILLOT : Concerning the Philippeaux-Vulpian experiment.

MAX LAFON : The biometrical study of cystine deficiency in the rat.

R. HERPIN : The periods of fixation of the animal organisms determining the fouling of ships' hulls.

Rome

Royal National Academy of the Lincei (*Atti*, 24, 99–171 ; 1936).

E. SOLER : Geophysical work carried out by the Institute of Geodesy of the Royal University of Padua in the Vesuvian region in 1934–35.

A. RUSSO : Chondriome increment and activation of metabolism.

C. PAUC : Curvature in metrical spaces.

C. MINELLI : Continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span.

E. GUGINO : Trajectories of variational problems.

G. BERNARDINI and D. BOCCIARELLI : Energy and intensity of groups of neutrons emitted by Po + Be (2).

G. TEDESCHI : Causes of the evolution of oxygen from lead accumulators at rest.

L. MONTI : Oxidizing action of selenium dioxide (2).

G. CENTOLA : Researches on the process of stabilization of nitrocellulose.

R. SAVELLI : Some manifestations of the reducing power of vegetable tissues (1). Development and adaptation of some plastids (2).

G. CASALAINA : An eleochloroplast with a positive Ciaccio secretion.

A. AGOSTINI : Statistical studies on the variability of the goatsucker (*Caprimulgus e. europæus* L).

T. PERRI : Correlative processes of determination and of growth of the lens-forming rudiment in Amphibia (3). Experiments on *Bufo viridis*, *Bufo vulgaris*, *Rana agilis*, and *Rana esculenta*.

(*Atti*, 24, 175–238 ; 1936).

U. CISOTTI : Behaviour at the boundary of well-known analytical integrals.

L. TONELLI : Equations in the problems of Mayer.

U. MORIN : Ensemble of linear spaces contained in an algebraic hypersurface (1). Unirationality of the algebraic hypersurfaces of the fourth order (2).

B. SEGRE : Topological invariants relative to the united points of the regular transformations between

superposed varieties (1). A complement to the correspondence principle, for correspondences with zero valence on the algebraic curves (2).

R. L. GOMES : A correction of the note on the operator *S*—Schrödinger's operator.

G. B. BONINO and R. MANZONI-ANSIDEI : Raman spectrum of thiophene.

G. PICCARDI : Presence of molecular hydrogen in sunspots (1).

G. SCAGLIARINI and G. AVONI : Colour reaction between nitroprusside and glutathione.

M. FENOGLIO : Natural neutral and basic hydrated carbonates of magnesium.

C. LENTI : Osmotic pressure of the colloids of vitreous humour.

L. SANZO : Rearing of a pelagic larva of *Cerianthus* up to the stage of acquiring definite characteristics.

C. KOCH, B. SCHREIBER and G. SCHREIBER : Attempts to graft tissues in the vitreous humour of the guineapig's eye.

S. MINZ and E. SERIANNI : The action of adrenaline and of atropine on experimental alcoholæmia.

(*Atti*, 24, 239–313 ; 1936).

L. TONELLI : Equations in the problems of Lagrange.

G. A. MAGGI : Notable complement of Love's conditions (at the wave-front of a succession of electro-magnetic waves) and its applications.

B. SEGRE : A complement to the correspondence principle, for valency correspondences with united points of any multiplicity (2).

R. CACCIOPPOLI : Inverted functional correspondences : general theory and applications to some non-linear functional equations and to Plateau's problem.

G. ARRIGHI : Dynamics of the deformable body with variable mass (1). Motion of a compressible fluid of variable mass with forces derived from a potential (2).

L. CESARI and F. CONFORTO : The equation of the three moments for a continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span.

M. MAGGINI: Attempts at photo-electric photometry of planetary surfaces.

E. SEGRÈ : Selector of velocity of slow neutrons.

G. PICCARDI : Presence of molecular hydrogen in sunspots (2).

G. B. BONINO : Molecular symmetry of thiophene (1).

G. SCAGLIARINI : Action of nitroprusside on pyrroles.

G. REVERBERI : 'Total' segmentation in the fragments of the fertilized egg of Ascidians.

C. JUCCI : Rearing of *Reticulitermes lucifugus* in sample tubes.

A. CAPPELLETTO : Development of the embryo in rarified air (1). Growth of tadpoles.

C. LENTI : Modifications of basal exchange in high mountainous regions.

Washington, D.C.

National Academy of Sciences, *Proc.*, 23, 133–187, March 15.

D. F. POULSON : Chromosomal deficiencies and the embryonic development of *Drosophila melanogaster*. By observation of living eggs, and by means of sectioned material, it is concluded that sections of the *X*-chromosome are essential for certain specific processes in embryonic development. The larger the section missing, the earlier and more general are the effects.

C. W. METZ : Deficiencies and structural variations within the giant chromosomes in relation to the problem of gene structure. A review of recent investigations.

K. V. THIMANN and G. W. BEADLE : Development of eye colours in *Drosophila* : extraction of the diffusible substances concerned. Water extracts of wild-type larvæ, made in a nitrogen atmosphere, contain substances which, when injected into test larvæ, are capable of changing vermilion and cinnabar eye colour towards wild type. The substances are probably neither protein nor enzyme in nature.

G. W. BEADLE : Development of eye colours in *Drosophila* : fat bodies and Malpighian tubes as sources of diffusible substances. Extract of fat bodies is capable of affecting the eye colour of genetically vermilion flies ; extract of Malpighian tubes has a similar effect on genetically cinnabar flies.

B. R. COONFIELD : The regeneration of plate rows in *Mnemiopsis leidyi* Agassiz. There are eight such rows in the body of this ctenophore, and rapid regeneration following natural or experimental injury takes place in the sequence healing, stretching of remaining parts of canal and concentration of mesogleal cells in the wound area, fusion of parts of canal and formation of plates above the new canal.

E. U. CONDON : Immersion of the Fourier transform in a continuous group of functional transformations.

H. WALLMAN : Lattices and bicompact spaces.

J. L. WALSH : Curvature of orthogonal trajectories of level curves of Green's function.

W. A. SETCHELL and N. L. GARDNER : *Iridophycus* in the northern hemisphere. Brief descriptions and a key are given.

H. C. YIN : Effect of auxin on *Chlorella vulgaris*. Measurement of individual cells after experiments lasting 2, 3 or 10 weeks showed that pure heteroauxin (β-indole-acetic acid) promotes cell enlargement in this alga as it does in higher plants. No conclusive effect on total growth was observed in cultures containing 0·001–0·01 mgm./c.c. of heteroauxin, and higher concentrations had injurious effects.

F. L. WHIPPLE and J. L. GREENSTEIN : Origin of interstellar radio disturbances. Jansky has observed continuous electromagnetic disturbances of wavelength 14·6 metres which appear to come from an extra-terrestrial source approximately coinciding with the galactic centre in Sagittarius. A theoretical investigation indicates that this radiation is unlikely to be caused by thermal agitation of charged particles in interstellar space.

I. ROUSE : New evidence pertaining to Puerto Rican prehistory. Three expeditions from the Peabody Museum have investigated Puerto Rica, the last in the summer of 1936. Evidence has been obtained of an early period when no pottery was used. The succeeding pottery period can be divided into three periods, Crab (painted), Intermediate (undecorated) and Shell (incised). A single people probably inhabited the region, gradually changing their pottery and food habits under the influence of neighbouring peoples.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 24

ROYAL SOCIETY OF ARTS, at 5.15.—Sir Gwilym Gibbon: "The Public Social Services".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. D. McKie: "Development of Theories regarding Combustion and Respiration in the 18th Century".*

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. I. M. Heilbron, F.R.S.: "The Chemistry of the Carotenoids and Vitamin A" (succeeding lectures on May 25 and 26).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—L. Wager: "The Kangerdlugssuak Region of East Greenland".

Tuesday, May 25

EUGENICS SOCIETY, at 5.15—(at the Royal Society, Burlington House, Piccadilly, W.1).—Dr. R. R. Kuczynski: "Future Trends in Population".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. F. G. Young: "The Development of certain Aspects of Metabolism during the 19th Century".*

Wednesday, May 26

WARBURG INSTITUTE, at 5.30.—Dr. R. Klibansky: "Religion and Science in the Twelfth Century".*

BIRKBECK COLLEGE, LONDON, at 6.—Sir Arthur Eddington, F.R.S.: "The Reign of Relativity 1915–1937" (Haldane Memorial Lecture).*

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. H. D. Kay: "The Biochemistry of Milk Secretion".

Thursday, May 27

ROYAL ASIATIC SOCIETY, at 4.30.—Sir Arnold Wilson: Burton Memorial Lecture.

UNIVERSITY OF OXFORD, at 5 (in the Examination Schools).—Dr. Joseph Needham: "Integrative Levels, a Revaluation of the Idea of Progress" (Herbert Spencer Lecture).

ROYAL AERONAUTICAL SOCIETY, at 6.30.—Dr. Theodor von Kármán: "Turbulence" (Wilbur Wright Lecture).

Friday, May 28

UNIVERSITY OF OXFORD, at 5—(in the University Museum).—Dr. B. F. J. Schonland: "The Lightning Discharge" (Halley Lecture).

Appointments Vacant

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

ASSISTANT in H.M. Nautical Almanac Office—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (quote C.E. 3157/37) (May 29).

PRINCIPAL of the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 29).

PRINCIPAL of the Croydon Polytechnic and Evening Institutes—The Education Officer, Education Office, Katharine Street, Croydon (May 29).

LECTURER IN BOTANY, UNIVERSITY DEMONSTRATOR IN BOTANY and UNIVERSITY DEMONSTRATOR IN PLANT PHYSIOLOGY in the University of Cambridge—Dr. A. D. Imms, Department of Zoology, Downing Street, Cambridge (May 31).

LECTURER IN MECHANICAL ENGINEERING in the Technical Institute, Gainsborough, Lincs.—The Principal (May 31).

ASSISTANT LECTURER IN MATHEMATICS in King's College, London—The Secretary (June 1).

ASSISTANT LECTURER IN PHYSICS in the University of Manchester—The Registrar (June 12).

LECTURER IN BOTANY in the University of Reading—The Registrar.

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1710 (2342): Tests on Two Streamline Bodies in the Compressed Air Tunnel. By Dr. R. Jones, D. H. Williams and A. F. Brown. Pp. 6. 1*s*. net. No. 1715: A New Form of Biplane. By H. B. Irving and A. S. Batson. Pp. 44+4 plates. 7*s*. net. No. 1720 (2218): Preliminary Calibration of the 24-foot Wind Tunnel, R.A.E., with a Short Description of the Tunnel. By W. G. Jennings, A. Terry and P. J. Pearsall. Pp. 9+4 plates. 2*s*. 6*d*. net. No. 1721 (1247): The Pressure Distribution and Forces on Thin Aerofoil Sections having Sharp Leading and Trailing Edges, and moving with Speeds greater than that of Sound. By Dr. S. G. Hooker. Pp. 18. 2*s*. 6*d*. net. No. 1723 (1375b): The Influence of Differential Aileron Control on Wing Flutter. By R. A. Frazer. Pp. 20. 3*s*. net. No. 1724 (1944): Full Scale and Model Resistances of a Southampton II Hull. By E. T. Jones, L. Johnston and J. Hanson. Pp. 26+1 plate. 4*s*. net. No. 1725 (2323): Turbulence Measurements in Flight. By J. E. Serby and M. B. Morgan. Pp. 7+1 plate. 1*s*. 6*d*. net. No. 1726 (2302): An Analytical Comparison of Model and Full Scale Spinning Experiments on a Bristol Fighter. By R. P. Alston and J. Cohen. Pp. 14. 2*s*. net. No. 1727 (2337): The Effect of Blade Twist on the Characteristics of the C. 30 Autogiro. By J. A. Beaven and C. N. H. Lock. Pp. 28. 4*s*. net. No. 1728 (2397): Note on Wind Tunnel Tests on a Parasol Monoplane with Zap and Split Flaps. By J. H. Hartley and W. H. Curtis. Pp. 14. 2*s*. net. No. 1729 (2062): Wind Tunnel Tests of High Pitch Airscrews. Part 2: Variations of Blade Width and Blade Section. By C. N. H. Lock and H. Bateman. Pp. 40. 5*s*. 6*d*. net. No. 1730 (2122): The Flight of a Helicopter. By H. B. Squire. Pp. 24. 3*s*. 6*d*. net. No. 1732 (1809): Note on Effects of Landing Flaps on Stability and Control. By S. B. Gates. Pp. 6. 1*s*. net. No. 1733 (2610): A New Form of Dash Pot with a Large Range of Damping. By Dr. A. S. Halliday. Pp. 2+1 plate. 9*d*. net. No. 1737 (2338): Abstract—Notes on the Optimum Stiffness of Thin Shells. By Dr. H. Roxbee Cox. Pp. 2. 6*d*. net. No. 1738 (2041): Abstract—Boundary Layer Growth. By Dr. S. Goldstein and Dr. L. Rosenhead. Pp. 2. 6*d*. net. No. 1739 (2139): Abstract—Note on the Velocity Distribution in the Wake behind a Flat Plate placed along the Stream. By Dr. L. Rosenhead and J. H. Simpson. Pp. 2. 6*d*. net. No. 1743 (2418): Rolling Experiments on a "Puss Moth" Model. By A. S. Batson, J. H. Warsap and H. J. Gummer. Pp. 5. 1*s*. net. No. 1745 (2165): Abstract—On the Static Pressure in Fully-developed Turbulent Flow. By A. Fage. Pp. 4. 9*d*. net. No. 1747 (2104): Further Measurements of Ground Interference on the Lift of a Southampton Flying Boat. By J. L. Hutchinson. Pp. 6. 1*s*. net. No. 1750: Reports and Memoranda published between 1st April 1935 and 30th November 1936. Pp. 8. 1*s*. 3*d*. net. (London: H.M. Stationery Office.) [264

Other Countries

University of Illinois: Engineering Experiment Station. Bulletin No. 288: An Investigation of Relative Stresses in Solid Spur Gears by the Photoelastic Method. By Paul H. Black. Pp. 32. 40 cents. Bulletin No. 289: The Use of an Elbow in a Pipe Line for determining the Rate of Flow in the Pipe. By Wallace M. Lansford. Pp. 36. 40 cents. Bulletin No. 290: Investigation of Summer Cooling in the Warm-Air Heating Research Residence. By Prof. Alonzo P. Kratz, Prof. Maurice K. Fahnestock and Seichi Konzo. Pp. 140. 1 dollar. Bulletin No. 291: Flexural Vibrations of Piezoelectric Quartz Bars and Plates. By Prof. J. Tykocinski Tykociner and Marion W. Woodruff. Pp. 36. 40 cents. (Urbana, Ill.: University of Illinois.) [264

Field Museum of Natural History. Anthropology, Memoirs, Vol. 2, No. 3: Archæological Explorations in Peru. Part 3: Textiles of the Early Nazca Period. By Prof. Lila M. O'Neale. (Second Marshall Field Archæological Expedition to Peru.) Pp. 117–218+plates 32–68. 3.50 dollars. Anthropology, Memoirs, Vol. 2, No. 4: Archæological Explorations in Peru. Part 4: Canete Valley. By Prof. A. L. Kroeber. (First Marshall Field Archæological Expedition to Peru.) Pp. 219–274+plates 69–90. 1.50 dollars. Anthropology Series, Vol. 25, No. 1: Skeletal Material from San José Ruin, British Honduras. By Wilfrid D. Hambly. (Field Museum—Carnegie Institution Expeditions to British Honduras.) (Publication 380.) Pp. 20. 30 cents. (Chicago: Field Museum of Natural History.) [294

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 72, Abh. 1: Geologische Probleme um die Gebirge zwischen Engadin und Ortler. Von Rudolf Staub. Pp. iv+115+3 plates. (Zürich: Gebrüder Fretz A.-G.) [294

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 47: Interseasonal and Intraseasonal Changes in Size of the California Sardine (*Sardinops cærulea*). By Frances N. Clark. Pp. 28. Fish Bulletin No. 48: Fishing Localities for the California Sardine, *Sardinops cærulea*, 1928–1936. By Frances N. Clark. Pp. 11. (Terminal Island, Calif.: California State Fisheries Laboratory.) [294

U.S. Department of the Interior: Geological Survey. Bulletin 860-C: Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico. Part 3: The La Ventana–Chacra Mesa Coal Field. By Carle H. Dane. Pp. v+81–166+plates 39–55. 40 cents. Bulletin 880-B: Recent Mineral Developments in the Copper River Region, Alaska. By Fred H. Moffit. (Mineral Resources of Alaska, 1935.) Pp. ii+97–109. 5 cents. Professional Paper 186-H: Inferences about the Origin of Oil as indicated by the Composition of the Organic Constituents of Sediments. By Parker D. Trask. (Shorter Contributions to General Geology, 1936.) Pp. ii+147–157. 10 cents. Water-Supply Paper 789: Surface Water Supply of the United States, 1935. Part 9: Colorado River Basin. Pp. 174. 25 cents. (Washington, D.C.: Government Printing Office.) [294

Bulletin of the American Museum of Natural History. Vol. 69: Horned Ruminants of North America. By Childs Frick. Pp. xxviii+669. (New York: American Museum of Natural History.) [294