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Scientific Slaughtering.

THE problem of the humane slaughtering of animals for food is one which has exercised many members of the medical and veterinary professions. It is of direct concern to men of science, first because certain relevant facts which are in dispute can only be settled by rigorously scientific experiment, and secondly, because the ethical principles involved have received a much enhanced significance from the work of Darwin and other zoologists. The discussion recently opened at King's College, London, by Profs. McCunn and Smythe, of the Royal Veterinary College, under the chairmanship of Prof. Julian Huxley, affords an occasion for putting before the readers of NATURE the more important of the facts relating to the slaughterhouse.

In all matters which involve a conflict between ethical principles and economic interests the relevant facts are apt to become entangled in a good deal of special pleading, and in the present case there are certain points upon which even scientific authorities are not in agreement; but although the necessity for further inquiry of a rigorously scientific character is generally recognised, a number of important facts may be regarded as definitely established. The most recent authoritative documents for these are the reports issued by the London County Council on Feb. 15, 1923, and by the Public Health Department of the Corporation of London on April 2, 1925. Considerable importance attaches also to a paper read by Prof. G. H. Wooldridge before a meeting of the National Veterinary Medical Association and published, together with the discussion which followed it, in the *Veterinary Record* of Mar. 4, 1922; and to a report on the Jewish method of slaughtering by Prof. E. H. Starling and Sir Michael Foster, published by the Admiralty in 1904. The views of the meat traders were defended by Prof. Leonard Hill in the *Lancet* of Dec. 22, 1923, but the results of the demonstration arranged by them at Birmingham in November 1923 should be accepted with considerable reserve, so far, at all events, as the question of bleeding is concerned, since (according to Dr. W. J. Howarth, Medical Officer of Health to the Corporation of London) animals were "left on the floor for different intervals before the blood was allowed to be extracted." This incident emphasises the necessity for ensuring that such trials be controlled in every detail (including, by the way, the selection of the animals) by men trained in the rigour of scientific method.

The old-fashioned methods of slaughtering which are employed in the case of about fourteen million animals yearly in Great Britain are broadly as follows: Large animals before being killed are stunned with a poll-axe; pigs are hoisted with a chain attached to one hind leg and stuck, commonly without previous stunning; many calves and some pigs are first stunned with a hammer; occasionally sheep and lambs are similarly stunned, but usually they are lifted on to a 'crutch' or trestle and stuck with a knife while conscious, after which their necks are broken by pressing back the head, the spinal cord being sometimes cut with the knife; Jewish slaughterers, for reasons of ritual, first throw the animal and then cut its throat in every case. The modern method, which is at present used for about one million animals yearly in Great Britain, consists in preliminary stunning with a specially designed pistol, after which the animal must be immediately bled.

From the humane point of view the superiority of the pistol over the poll-axe has been placed beyond serious question by the experiments conducted on behalf of the Corporation of London by the Medical Officer of Health (Dr. W. J. Howarth), the Superintendent of the Metropolitan Cattle Market (Mr. J. R. Hayhurst), and the Veterinary Surgeon at the Central Meat Market (Lieut.-Col. T. Dunlop Young). These officers found, in a number of trials with careful and experienced slaughtermen, that it took on the average 2·49 blows with the poll-axe to stun a bull, 1·23 blows to stun a steer, 1·27 to stun a cow, and 1·55 to stun a large sow or boar. With careless or less experienced slaughtermen the results would have been still less favourable. On the other hand, with a particular captive-bolt pistol, 542 bovines were stunned with 543 shots and 712 swine were stunned with 715 shots. Starling and Foster found that when the throat is cut with exceptional skill (in the Jewish method) the duration of consciousness, as tested by corneal reflex and by purposiveness of movement, varies from 5 to 40 seconds, with an average in the neighbourhood of 20 seconds. The qualitative superiority of the pistol over the knife, from the humane point of view, may be regarded as established, though there is some difference of opinion as to the quantitative aspect of the matter. However, Sir Arthur Mayo-Robson has described an important post-mortem test which does not appear to have been applied in the investigations under consideration: it consists in examining the meninges. Dr. Pfister, Director of the Zurich Abattoir, has found that when animals have been stunned before killing their meninges are normal, whereas in animals killed without stunning, as many millions are in Great Britain, the meninges are intensely congested, a fact which proves that suffering has occurred. Finally, the use of the knife has to be learned by practising upon living animals.

The captive-bolt pistol does not involve danger to the slaughterman or to bystanders, and its use calls for only such reasonable care as may fairly be demanded from a tradesman. The meat traders' federation collected for the London County Council inquiry 15 examples of alleged accidents occurring with 'humane killers' between 1913 and 1920, but of these 5 turned out to be cases of suicide and 4 to be otherwise irrelevant. Of 5 genuine and 1 suspectedly genuine accidents, 5 occurred with pistols of the free-bullet as distinct from the captive-bolt type, and in the remaining case the type of pistol was not specified.

There are, however, other considerations which cannot be quite so easily dismissed. The most difficult of these is the allegation that pigs do not bleed so freely when shot as when killed by the old-fashioned methods, and that shot pigs are therefore less valuable for the manufacture of export bacon. It is also alleged that the flesh of shot pigs is more liable to be disfigured by 'blood splash.' The Corporation of London's research negatives the second of these allegations but leaves the first undecided: not only scientific authorities but also those engaged in the trade are divided on the subject, and further trials are called for. Doubtless a great deal depends on the precautions taken to promote bleeding immediately after shooting. In any case, it should be borne in mind that in large factories the pigs, when hoisted, are attached to a travelling conveyer, and owing to the weight of the animal the pressure of the chain on the leg will cause suffering, apart from the use of the knife.

In the case of sheep the difficulty is somewhat different. If a sheep be lifted on to the crutch and then shot, its struggles are said to make manipulation of the pistol more difficult than that of the knife. If, on the other hand, it be shot on the ground, the labour of lifting it on to the crutch afterwards is increased. Thus a 7-handed gang slaughtering 100 sheep a day might need an extra hand, whose wages would possibly amount to 12*s.* 6*d.* a day. The increased cost of production would therefore be about 1½*d.* per sheep, or 0·025 pence per lb. of mutton. Such a small expense should not be allowed to obstruct the

doing of what is clearly just and right; Switzerland, Holland, Germany, Sweden, and Denmark have set an example which Great Britain could follow.

In the Jewish method of slaughter, which is governed by a traditional ritual, the animal is first cast, after which its throat is cut with exceptional skill and elaborate precautions. From the humane point of view throat-cutting is not so satisfactory as stunning, but the most serious objection to this method is the preliminary casting, which in the opinion of Starling and Foster involves definite cruelty, sometimes of a serious character. The Jews are by nature and tradition a humane race, and it should not be impossible for their experts to devise some modification of the procedure which will satisfy all the requirements of the situation. Indeed, so recently as Mar. 17 an important test was held at Brixton of a new apparatus designed by Mr. H. Weinberg to obviate the cruelty involved in casting. It is understood that a number of veterinary surgeons who were present were satisfied that a great advance has been made, and it is to be hoped that mercenary interests will not prevent Mr. Weinberg's apparatus from receiving a more extensive trial.

The compulsory training and licensing of slaughtermen is a pressing requirement, for while most slaughtermen are fully trained before they use the poll-axe, there is no adequate provision for the enforcement of this elementary precaution against the infliction of unnecessary suffering. But perhaps the most serious defect of our slaughtering system, both on humane and on hygienic grounds, is the lack of adequate control and inspection of slaughterhouses. In the more advanced of the Continental countries, private slaughterhouses have been extensively replaced by public abattoirs, but unfortunately in Great Britain private slaughterhouses still exist, and their licences have a capital value which opposes a strong vested interest to the movement for reform. The financial cost of doing what is right in this case is by no means an inconsiderable one. Obviously, however, the element of fear can be much diminished in a properly designed public abattoir, which also facilitates supervision for humane and hygienic ends. Hence public abattoirs alone are tolerable in towns, while in country districts a rigorous system of inspection and control by public officers is called for. The hardship which would be inflicted on the "slink" trade in meat from tuberculous animals could be softened by a good system of insurance.

It will be seen that while a very substantial body of facts may be regarded as established in connexion with humane slaughtering, there are other facts—and particularly as regards the effect on the quality of bacon and the psychological element in the suffering of the animals—which call for authoritative investigation. It is essential that the experimental work involved should be carried out by disinterested scientific men, adequately familiar with the canons of scientific method. However, apart from prejudice and conservatism and the professional pride taken by slaughtermen in a highly skilled trade, which they have learned by long apprenticeship, the opposition to reform is based on mercenary considerations. Even if the shot pig should prove to be somewhat less valuable for export bacon than the pig which has been more painfully killed, the question will arise whether the economic motive should prevail over the ethical.

The Ministry of Health proposes two alternative by-laws for adoption by local authorities, but does not enforce their acceptance. By-law 9a requires that all slaughterers except Jews shall stun the animal before killing it, except in the case of sheep. By-law 9b is similar, but it applies also to sheep and specifies the use of a mechanically operated instrument—that is, in practice, a pistol. Out of some 2000 local authorities only 226 (including the London County Council) have hitherto adopted the stricter by-law, though the number is growing in response to propaganda by the Royal Society for the Prevention of Cruelty to Animals, the Humane Slaughter of Animals Association, and other humanitarian bodies. The adoption of the by-law may put a district at an economic disadvantage in its competition with neighbouring districts for the patronage of butchers, many of whom are prejudiced against the pistol. The Sanitary Committee of the Corporation of London has therefore passed a resolution to the effect that the time is now opportune for the issue of definite regulations which should be of general application throughout Great Britain, and that "in order to secure uniformity such regulations should be issued as compulsory regulations by the Ministry of Health." Presumably the Government will hesitate to take the necessary action until it feels itself supported by a well-informed public opinion, but the subject is an unpleasant one, and the public naturally prefers to know as little of it as possible. In the face of this situation, no apology is needed for having brought it to the attention of scientific men, who are *ex hypothesi* opposed to obscurantism.

C. W. HUME.

Science and Psychic Behaviour.

The British Journal of Psychical Research. Vol. I. No. 5. Jan.-Feb. (London: National Laboratory of Psychical Research, 1927.) 1*s*.

THE accusation is frequently levelled at scientific workers that they will give no thought or credence to the very real phenomena of the supernormal, and that this attitude of aloofness sits ill on those who profess the true scientific spirit. That there is truth in the charge can scarcely be gainsaid. When Sir Oliver Lodge pronounces on a modern development or even a modern speculation of molecular physics, the auditorium is filled with craning necks and assenting minds, but let him turn to the subject of materialisations or the after-life, the scientific necks are relaxed and the minds closed. It is worth while inquiring why this conspiracy of hostile silence is maintained.

It is a truism that trustworthy scientific work can be accomplished only by trained minds after elaborate preparation for a line of attack based on a close study of the problem. For in all circumstances the question at stake is the question of what is and what is not admissible evidence. The scientific process is the method of collecting and assembling that evidence, and no deduction will stand that allows of possible ambiguity or for which the evidence is not both necessary and sufficient. Even legal standards are not permissible. The final conclusion cannot be based on circumstantial evidence, nor does one give an electron the benefit of the doubt. The logic of the law court is not necessarily the logic of the laboratory.

In these circumstances it is permissible to doubt that any individual, no matter how well intentioned, could sail into a notoriously difficult region of inquiry and produce almost immediately astounding results of full evidential value. Even were the individual a trained scientific investigator, there is a natural hesitancy in acceptance, for independent verification by other workers is a necessary and legitimate demand. The difficulty is accentuated when the scientist who undertakes or is present at the inquiry is constrained to work under conditions and limitations the full implications of which cannot be precisely appreciated. The phenomenon, he may be told, will take place only in darkness, or in dull red light, or in the presence of a particular individual or a group of individuals, or when a gramophone plays in the subdued light of a vacuum tube discharge, and so on. If, moreover, the events described as occurring, when accepted, would involve a complete reconsideration of the structure of mechanical processes, reluctance to admit that the evidence is above criticism is naturally intensified.

These are the difficulties one encounters with most of the material in the publication before us. If the merest fraction of the evidence adduced in this small volume were to be admitted it would cause a revolution in scientific thought. In a lecture delivered at the National Laboratory of Psychical Research, Countess Wassilko-Serecki describes the history—one is almost tempted to write the hysteria—and phenomenon of Eleonore Zügun, a Rumanian peasant girl. In the presence of this girl inanimate objects become endowed with a will of their own, bricks fly about, dishes dash themselves to pieces, a stone jumps out of the river, is replaced and jumps out again, scratches and bites appear on her arm, cups are snatched from her hand by invisible powers, and so on. A great deal of the evidence for this is not direct but produced by the Countess from depositions of individuals abroad. Dr. R. J. Tillyard contributes a record of two séances conducted by a medium in Boston, Mass. Here darkness appears to be essential, and the medium goes into a trance. This is verified at intervals by red light. It would be interesting to have details of the verification of this trance condition conducted in such difficult circumstances, but they are not provided. A gramophone plays a negro melody and a voice—immediately referred to as 'Walter's' voice—talks "freely and wittily" apparently from inside a cabinet. The humour does not, however, appear to be very deep. A flower basket—rendered luminous—moves about high up in the room, rocked by 'Walter,' we are told, but no evidence is adduced about 'Walter' beyond the voice, or as to whether the basket was actually rocked by him.

Much could be said about this kind of science, but restraint is desirable. Numerous questions naturally suggest themselves. If a brick can fling itself through a window, what reliance can be placed on the prediction of the total eclipse in June? What reliance can be placed on the performance of *any* machine? Alternatively, if, as experience shows, full reliance can be placed on a multitude of such predictions, what reliance can be placed on the evidence about the brick? Scepticism becomes charity indeed. There is here a frank conflict of evidence, and until it is resolved the scientist's natural inclination is to turn back to the restful haven of verified knowledge. If there are inconsistencies in his own field, if for the moment he cannot reconcile solar mechanics with

the mechanics of the electron, his past experience has at least taught him that with patience these troubles will be smoothed. Consistency of behaviour of his material, however, is implicit in his method of approach. Such an assumption may possibly prove to be ill-founded, and the self-propulsion of the brick through the window, referred to above, may ultimately prove to be the actual disturber of his mental peace. But his *malaise* in the presence of such a phenomenon—if true—goes deeper than this. "If the material with which I have to deal," he says, "is not consistent in its behaviour, how can I study the question at all?"

It seems to be inevitable in experiments in this field of inquiry—if they can be called experiments—that a great deal must depend on the good faith of the medium. There is always the lurking suspicion that, consciously or unconsciously, the observers are being deluded—a factor utterly foreign to any class of physical experiment. This suspicion is traceable not so much to the fact that, in the past, trickery has been exposed in the performances of such individuals, as to the fact that results are claimed of a nature antagonistic to the tacit philosophy of the physicist. To meet this difficulty, one of the first tests that ought to be performed should be to determine the precise conditions under which a medium can be dispensed with. Quite obviously, the smaller the number of persons actually essential to an experiment, the greater the confidence in the result. Is it not possible for the National Laboratory of Psychical Research to produce the details of a single and convincing experiment that could be performed by any competent scientific worker in his own laboratory, as simple, say, as measuring the period of a pendulum? If 'levitations' are as frequent as they are claimed, this should not be impossible. The writer has frequently tried such experiments alone, but always in vain. What are the conditions that will ensure success? Surely, after so many years' experimentation by devotees of the cult, including many eminent men, this must be known very accurately. All the tests described in the publication under review are so complex that instead of carrying conviction they arouse suspicion. It is the simple test that is required.

There is, however, another—and possibly more important—factor that repels the scientist: it is the implications and assumptions inherent in the descriptions of these uncanny doings. If a voice is heard speaking from a box, is it necessary to assume it has an owner, 'Walter'? In a court of law it might be a legitimate assumption to make, and it might in conceivable circumstances be sufficient to hang a man, but in the description of a scientific experiment, why imply the existence of an 'owner' to the voice and by identifying it with 'Walter'? Even assuming the accuracy of the phenomenon, which in the circumstances one would be far from doing, there are numerous possible working hypotheses of a more normal type than that of 'spirits.' When Sir Richard Paget makes his hands speak, one does not assume that the voice belongs to a spirit, even if it does call itself 'Walter.' Men of science have learnt that words are treacherous things, that false ideas of an ignorant past are dragged in at each turn, so they have learned to talk in symbols, with a clear-cut (1, 1) correspondence between idea and symbol. But the language of supernormal behaviour—and the very phrase itself is dangerous—is not yet sufficiently divorced from mystery and superstition, not yet sufficiently definite and precise, to ensure that the pet theories and vague beliefs of its devotees are not foisted on the unwary inquirer as he receives his description of the phenomena.

If the National Laboratory of Psychical Research can produce a simple laboratory experiment, capable of being performed by a careful and trained scientist under conditions that he himself can guarantee and control, it would go further towards producing the revolution in thought which the Council so earnestly desires than volumes of 'evidence' of the type given in the present issue of its Journal.

H. Levy.

Dynamics and Ballistics.

(1) *Lezioni di meccanica razionale.* Per Tullio Levi-Cività e Ugo Amaldi. Volume secondo: *Dinamica dei sistemi con un numero finito di gradi di libertà.* Parte prima. Pp. x+527. (Bologna: Nicola Zanichelli, 1926.) 65 lire.

(2) *New Methods in Exterior Ballistics.* By Prof. Forest Ray Moulton. Pp. vi+258. (Chicago: University of Chicago Press; London: Cambridge University Press, 1926.) 20*s*. net.

(1) THE monumental treatise which Profs. Levi-Cività and Amaldi are engaged in writing on rational mechanics (to use the comprehensive title established on the Continent) is divided into three volumes, which deal respectively with kinematics and statics, dynamics of systems possessing a finite number of degrees of freedom, and dynamics of continuous systems. The second volume is divided into two parts, to the second of

which are reserved the general questions properly belonging to rigid dynamics and the subjects of canonical equations of motion and the principle of Hamilton and Jacobi.

The plan of the first part of the second volume is as follows: The first two chapters discuss the motion of a particle constrained to move on a given curve and on a given surface. The third chapter deals with problems of gravitational attraction. General theorems on momentum, energy, and work are treated in Chapter iv. D'Alembert's principle and Lagrange's equations occupy Chapter v., and the volume closes with a chapter on stability of motion and small oscillations.

Chapter iii., which is mainly concerned with celestial mechanics, contains interesting applications to planetary orbits according to Einstein's law of gravitation and to electronic orbits according to Bohr's atomic theory. The motion of electrons in an electromagnetic field also furnishes interesting examples. It is, indeed, a refreshing change to discover so little space devoted to questions better fitted to exercise a student in integration than in dynamical principles.

Into the time-worn problems to which so large a proportion of any work on dynamics must be consecrated it would be difficult to introduce much originality of treatment. Yet throughout this work, Profs. Levi-Cività and Amaldi have succeeded in revivifying these 'dry bones' by a continual slight novelty, most stimulating to the reader. The work is planned on generous and comprehensive lines and covers ground scarcely touched in any similar treatise. It even contains a fair number of exercises for the student.

(2) Prof. Moulton's short account of some methods of external ballistics discusses the three main problems of the effects of air resistance, rotation of the projectile, and minor factors such as winds, on the projectory. The effect of air resistance is studied by the methods of finite differences, extensively used by Bashforth in England during the last century. The effect of abnormal air densities, variations in gravity, winds, etc., is studied by the method of perturbations, so widely used in astronomy. The effect of rotation is discussed by means of the classical equations of Euler. The book contains no reference to the pioneer work of Bashforth or to the work of Siacci. Few of the methods given appear to be new, and a remarkable new method due to Whitehead ("Graphical Solution from High-Angle Fire," *Proc. Roy. Soc.*, 1918) is not mentioned. It seems that the title of the book is scarcely an accurate description of its contents. Considerable interest therefore attaches to an ingenuous admission in the introduction. "In view of the complete independence of the present developments from those that have gone before, no attempt has been made to treat the question historically, nor even to connect these results with those of earlier writers." This is an explanation, if not an excuse.

Animal Nutrition in Sweden and Denmark.

Fütterung der Haustiere: ihre theoretischen Grundlagen und ihre wirtschaftliche Durchführung. Von Prof. Nils Hansson. Übersetzt von Franz von Meissner; überarbeitet und mit einem Vorwort versehen von Prof. Dr. Georg Wiegner. Pp. xii + 230. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 8 gold marks.

THE science of animal nutrition is concerned with the principles underlying the economical transformation of the produce of the soil into articles of human diet like meat and milk. The elucidation of these principles depends on a knowledge of two sets of factors: first, the nutritive requirements of the different classes of farm stock for the purposes of maintenance and of production (*e.g.* growth, fattening, and milk production); and secondly, the capacity of the various feeding stuffs for supplying these requirements.

It is instructive to note how these problems have been attacked in Germany and the United States on one hand, and in the Scandinavian countries on the other. In Germany the well-known investigations conducted by Kellner on fattening oxen in the respiration calorimeter have led to the formulation of a system of starch values, in which the productive or, more strictly speaking, the fattening value of a feeding stuff is defined in terms of pounds of starch. Kellner's system has been widely adopted in Britain, where, within limits, it has given useful results, though criticism of the method at the present time is not lacking. Armsby in the United States, also working with fattening oxen in a respiration calorimeter, has evolved a system of net energy values in which the productive value of a feeding stuff is stated in terms of therms of energy.

In northern Europe, however, where dairy cows, and not fattening oxen, have been mainly employed in feeding investigations, it has been the custom to take milk production as a measure of the productive value of a feeding stuff. Experiments on these lines were first started by Fjord at Copenhagen so long ago as 1885, and since 1898

these have been continued and expanded in a series of fundamental researches carried out by Nils Hansson at Stockholm. From the results of these feeding trials came the conception and development of the Scandinavian food unit system, which is now accepted as the basis of feeding in Sweden, Denmark, Norway, Finland, Poland, and other countries. This system, based on Hansson's data, has undoubtedly, in its application to feeding practice, achieved a larger measure of success in northern Europe than has any other system in any other country, and to its adoption must be attributed in no small degree the vast growth of the butter export trade of Denmark and the enormous increase in milk production in Sweden and other northern lands.

Prof. Hansson's main work, "Handbok i Utfodringslära," was published in three parts and contained a detailed account of the development and application of the food unit system. The present volume appeared in 1922 under the title of "Husdjurens Utfodring" and brought together all the essential features of the "Handbook" in carefully condensed form. Unfortunately, not many English workers are able to read Swedish with any degree of ease, and this fact probably explains the somewhat tardy recognition of Hansson's ideas in Britain. The translation of "Husdjurens Utfodring" into German is the direct outcome of a widespread desire among German nutritional scientific workers to know more about a feeding system which has proved so successful in other countries.

The treatment of the subject is characterised by the simplicity and logical clearness for which Hansson's publications are justly celebrated. The first section opens with an account of the composition and digestibility of feeding stuffs, the concluding chapter of this section dealing with the different methods of assessing productive values. The English reader will be particularly interested in the comparative account of the Hansson food unit, the Kellner starch value, and the Armsby net energy value. In the second section the nutritive properties of the individual feeding stuffs are dealt with, while the third and concluding section is devoted to a thorough consideration of the scientific principles underlying the nutrition of calves and other young animals, of dairy cows and fattening oxen, of sheep, pigs, goats, and horses. The tables at the end of the book constitute a praiseworthy feature. Table I. gives the average composition and digestibility of a very large number of feeding stuffs, together with their productive values in terms of food units, starch values, and milk-producing values. In Table II. the nutritive requirements of all classes of farm stock are recorded in great detail.

It is to be hoped that the translation of Hansson's treatise into English will not long be delayed. Affording as it does a fresh and hopeful outlook on the problems of the economical feeding of farm animals, especially of dairy cattle, it should prove a worthy companion volume to the well-known treatises of Kellner and Armsby and the more recently published text-book of the Cambridge worker, Prof. T. B. Wood. It should be read with interest and profit not only by the investigator in this domain of science, but also by all stock-breeders who are desirous of rearing their animals in accordance with accepted scientific principles.

H. E. Woodman.

Our Bookshelf.

Delusion and Belief. By Prof. Charles Macfie Campbell. Pp. v+79. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 6*s*. 6*d*. net.

This is an interesting study of the relation of the various beliefs which men have held at different times to their conduct of life. The method of treatment begins with the biological study of belief, pointing out how, although we cannot tamper experimentally with our fellows in regard to the main issues of human life, yet Nature does not shrink from exposing men to the most searching tests.

Various beliefs are discussed which are concerned with topics of high emotional value, such as bereavement, unsatisfied love, and ungratified ambition, and it is pointed out and examples are given of the way in which the attitudes and beliefs of the individual have a strongly subjective note. In the latter part of the book, man's general belief concerning the mechanism of Nature and the order of the cosmos is discussed. Here again the personal viewpoint is noted. The question of the mental health of the individual and the group depends largely on the underlying scheme of values.

The book concludes with a discussion of what the author terms inferior beliefs about health, such as Christian science. Although admitting the personal comfort in some cases, he maintains that any increased efficiency is largely due to adopting the healthy attitude that, even when there is some physical ailment, it is often better to ignore it and to go on playing the game of life. He also points to the danger of inferior beliefs about social problems, such as that of the optimist who talks of universal peace and often denies the existence of harsh realities and hatreds. The belief in the spiritual order of the universe is an important driving force, but it must also be associated with the workaday world. Although tolerant of

various beliefs, Prof. Campbell's conclusion is that instead of discovering something absolute in the realm of belief, one finds that beliefs are the tools of life rather than rare intellectual products to be cherished carefully for themselves. H. D. A.

Tribal Dancing and Social Development. By W. D. Hambly. Pp. 296 + 26 plates. (London: H. F. and G. Witherby, 1926.) 21*s*. net.

MR. HAMBLY has surveyed dancing and music as a communal activity and expression of emotion literally from the cradle to the grave, for he begins with the celebration of a birth and ends with the dance which follows death—often long after death, like the dance in the Nicobarese ceremony of disinterring the dead and collecting their bones. He does not concern himself with the individual or merely exhibition dancing as such, although in some of the Eastern dances it would be difficult to draw the line—for example, the whipping dance as a test of endurance as performed in the Sudan which he describes—and it would be easier to discriminate even in this case if it were possible to trace whether or not there were any possible connexion with the whipping ceremony sacred to Artemis, which was once celebrated at Sparta.

Important as it may be to consider dancing as a tribal or group activity, as an expression of an emotion, in ultimate analysis, it must be individual; and the same applies to music. In both cases, fundamentally, the appeal is to the rhythmic sense. Even in music, melody appears to be secondary. Those who have heard real savage music know what a wild appeal to the emotions can be made by the mere rhythmic beating of a drum; while the effect of modern dance music, undeniably, however much it may be disliked, lies in its beat and not in its tune. An analysis of the dance, whether individual or communal, as an effect of rhythmic appeal, has yet to be written.

Mr. Hambly's treatment is on more objective lines. His survey of the facts is a useful study of the geographical distribution and character of the dance as an element in ceremonial, which will be invaluable to the student and at the same time serve to bring home to those whose interest is least specialised, its importance as a social factor which, if not approached sympathetically in administration, might give rise to infinite difficulty.

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1927. Edited by George E. Brown. Pp. 820 + 31 plates. (London: Henry Greenwood and Co., Ltd., 1927.) Paper, 2*s*. net; cloth, 3*s*. net.

THIS is no longer an almanac, except in name, for that particular feature of the annual has been omitted since a year or two ago, presumably because it was not appreciated. We appreciated it and often turned to it. After four articles dealing with the use of reflex cameras, arranging snapshots, developing and printing amateurs' films, and the use of 'chlorobrom' papers, follows the valuable "Epitome of Progress," which is a concise and classified history of photography for last year. It includes a very brief summing up of the most striking advances, the events of the year, besides trade and legal items. The largest section of the epitome concerns apparatus, equipment, and processes, and consists of abstracts of the accounts of these that appeared during the year, with all necessary formulæ and many illustrations. After the obituary, 65 pages of formulæ and instructions for the current photographic operations, and 40 pages of tables, comes a section of miscellaneous information. This last includes an excellent "History in Brief" of photographic and photomechanical processes, and various directories. With the text are 30 photogravure reproductions of photographs by some of the most noted workers. The annual fully maintains the unique position that it has earned for itself during its sixty-seven years of issue.

Three Lectures on Atomic Physics. By Prof. Arnold Sommerfeld. Translated by Dr. Henry L. Brose. Pp. iv + 70. (London: Methuen and Co., Ltd., 1926.) 2*s*. 6*d*. net.

IT is encouraging to find that these important lectures by one of the most prominent authorities on spectroscopy, delivered under the auspices of the University of London, are now accessible to all in English. They deal with the spectra of hydrogen and helium, and then proceed to the study of complex spectra such as manganese, iron, nickel, and palladium in the light of Pauli's "Principle of Uniqueness." The third lecture gives some much-needed information concerning the structure of crystals, from the point of view of the quantum theory.

The translation is carefully done, but errs on the side of literalness. The translation of *Grundzustand* as 'ground state' is scarcely English, while *abgeschlossen* as applied to systems of elements is 'self-contained' rather than 'completed,' and 'quantize' is rather more exotic than 'quantify' would be.

New Conceptions in Colloidal Chemistry. By Prof. Herbert Freundlich. Pp. vii + 147. (London: Methuen and Co., Ltd., 1926.) 6*s*. net.

THIS volume contains eight lectures delivered by the author in America in 1925. They deal in a masterly manner with the progress made along certain lines in colloid chemistry during the last few years, and indicate that such matters as adsorption, electrolyte coagulation, and the electrical and optical properties of colloidal systems are not so simple as they were once thought to be. The ample bibliographies, although impartial, show how fundamental is the work of Prof. Freundlich himself, who is to be congratulated on the rare gift of making his discoveries intelligible in two languages, for a German version of the book has already appeared. P. C. L. T.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Constitution of Mercury Derived from Coal Tar.

IT will doubtless be a surprise to many readers of NATURE, as it was to me, to hear that the element mercury is obtained in the distillation of coal tar. This fact was recently brought to my notice by Mr. W. Kirby, of the South Metropolitan Gas Co., who kindly provided me with a sample for examination of its isotopic constitution. He informs me that the mercury appears in the lightest of the fractions distilled and occurs to the extent of about one part in seven millions of undistilled tar. Its accumulation in any reasonable quantity will, therefore, take place only in a plant arranged for continuous fractionation.

It was my first intention to compare its density with that of ordinary mercury, and if any appreciable difference was detected to submit it to analysis by the mass-spectrograph, but a favourable opportunity having occurred, I have been able to perform the latter operation under advantageous conditions. The discharge bulb was washed with carbon dioxide until all trace of the spectrum of mercury had disappeared. A portion of the sample was then introduced. This operation was more troublesome than I expected; but ultimately the bulb was flooded with the vapour and a number of mass-spectra were obtained, while the mercury spectrum was predominant in the discharge. On these the groups of isotopic lines were absolutely indistinguishable, both in position and intensity relations, from those of ordinary mercury described in NATURE, Aug. 8, 1925. F. W. ASTON.

Cavendish Laboratory,
Cambridge, Mar. 10.

The Passage of α-Rays and β-Rays through Matter.

THE loss of energy suffered by a fast-moving electrified particle passing through matter, and the ionisation produced by the moving particle, are phenomena which have, so far, not received accurate quantitative explanation. There are two main theories of the stopping-power due respectively to Bohr (*Phil. Mag.*, 25, 10; 1913; and 30, 581; 1915) and Henderson (*Phil. Mag.*, 44, 680; 1922). The theory of the primary ionisation due to a fast-moving particle is as it was left by Thomson in 1912 (*Phil. Mag.*, 23, 449). In all these theories, classical mechanics is used to calculate the possible energy transfers during encounters between the moving particle and the atomic electrons, and Fowler (*Camb. Phil. Soc.*, 21, 521; 1923) has suggested that the discrepancy which exists between theory and experiment may be due to the inaccuracy of classical mechanics in this field. *Whether this is so or not, it may be of interest that a fair proportion of the discrepancy between classical calculations and experimental results disappears when the motion of the atomic electrons is allowed for.* The effect of this motion may be considerable, though the velocity of the electron be small compared with that of the moving electrified particle.

The momentum imparted to an electron by a fast-moving electrified particle is to a first approximation independent of the initial motion of the electron, and it is the same as that communicated to an initially stationary electron provided the shortest distance between the undisturbed paths of the electron and moving particle is the same in both cases. If ϵ represent the kinetic energy of the electron in its orbit and Q_0 the energy given to an initially stationary electron, then, adding momenta, we find that the energy, Q, acquired by an electron is given by

$$Q = Q_0 + 2\sqrt{Q_0\epsilon}\cos\phi, \quad . \quad . \quad . \quad (1)$$

where ϕ is a random angle. It would appear that as the value of Q averaged for *all* ϕ is Q_0, it is unnecessary to take the second term on the right-hand side into account. However, in Henderson's theory of the stopping-power and Thomson's theory of ionisation, it is not legitimate to average for all ϕ, only those values of ϕ for which Q is greater than a certain minimum value being concerned. (In Bohr's theory there is no such minimum and it is legitimate to neglect the motion of the atomic electrons.) It follows from (1) and the classical expression for Q_0 that in an element dx of its path the average number, dA, of encounters in which the moving particle gives to the electron energy between Q and $Q+dQ$ is given by

$$dA = \frac{2\pi N' E^2 e^2}{mv^2}\frac{dQ}{Q^2}\left(1+\frac{4}{3}\frac{\epsilon}{Q}\right)dx, \quad . \quad . \quad (2)$$

usual notation being used. This expression is greater by the factor $1+\frac{4}{3}\frac{\epsilon}{Q}$ than the expression for stationary electrons. By integration we find that the primary ionisation is given by

$$I = I_P = \frac{2\pi N E^2 e^2}{mv^2}\sum_{s=1}^{n}\frac{1}{V_s}\left(1+\frac{2}{3}\frac{\bar{\epsilon}_s}{V_s}\right) = k\sum_{1}^{n}\frac{1+\frac{2}{3}\frac{\bar{\epsilon}_s}{V_s}}{V_s}, \quad (3)$$

N being the number of molecules per unit volume, n the number of electrons per molecule, V_s the binding energy of the s*th* electron, and $\bar{\epsilon}_s$ its average kinetic energy. (Quantities of the order of u^2/v^2 where u is the initial velocity of the electron and v the velocity of the moving particle are neglected, and this represents the accuracy of the results.) According to Thomson's theory

$$I = I_T = k\sum_{1}^{n}\frac{1}{V_s}. \quad . \quad . \quad . \quad (4)$$

The difference lies in the extra term $\frac{2}{3}\frac{\epsilon}{V}$ in the numerator of (3). ϵ/V is generally equal to or greater than unity, so that the new value is at least about 70 per cent. greater than the old value. C. T. R. Wilson (*Proc. Roy. Soc.*, 104, 192; 1923) found that the primary ionisation produced by β-rays in air was about double Thomson's theoretical value. The value given by (3) is thus nearer the experimental value than the value given by (4), although the uncertainty of atomic data prevents a final comparison. The data for hydrogen is more certain, and certain experimental results obtained by the writer for this case are in satisfactory agreement with the new result. The new theoretical value in fact agrees to within about 5 per cent. with the observed value of the primary ionisation in hydrogen, whilst the theoretical value according to Thomson's theory represents little more than half the observed ionisation.

If R represents the first resonance potential of an electron, then Fowler (*loc. cit.*) has shown that the stopping-power according to Henderson's theory is approximately given by

$$S_F = \frac{2\pi N E^2 e^2}{mv^2}\sum_{s=1}^{n}\log Q_m/R_s, \quad . \quad . \quad (5)$$

Q_m being the energy given to a stationary electron

in an end-on collision. According to the present calculations, in which the motion of the electron is allowed for, the stopping-power is given by

$$S_P = \frac{2\pi N E^2 e^2}{mv^2} \sum_{s=1}^{n} \{\log Q_m/R_s + 4\bar{\epsilon}_s/3R_s\}, \quad . \quad (6)$$

the correction being equivalent to decreasing R by a factor of $e^{4\bar{\epsilon}/3R}$. Fowler has shown for α-rays and Wilson for β-rays that the expression (5) is appreciably less than the observed stopping-powers. The curves in the accompanying figure show to what extent the corrected formula agrees with observations in the case of oxygen.

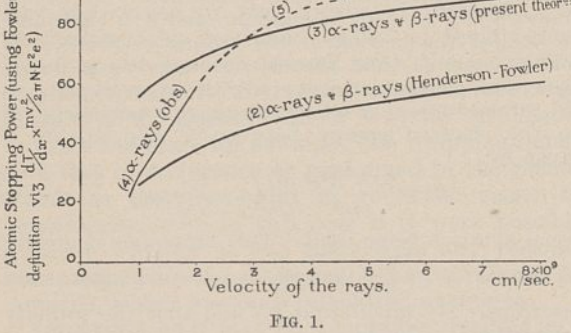

FIG. 1.

Curve (1) represents observed values of the atomic stopping-power for β-rays in oxygen, obtained recently by J. M. Nuttall and the writer (*Phil. Mag.*, **2**, 1109; 1926): curve (2) stopping-powers calculated by the Henderson-Fowler formula: curve (3) stopping-powers calculated by the formula proposed here. In curve (4) the observed stopping-powers for α-rays are plotted. To avoid having too many curves the value of Q_m for β-rays is taken equal to the value for α-rays having the same velocity, and a corresponding reduction of the observed values for β-rays is made (involving a change of about 15 per cent.). After making this reduction the theoretical curves for α-rays and for β-rays coincide.

Although the data used in calculating S_P and S_F is rather uncertain, there can be no doubt that the corrected formula (5) shows a better agreement with observation than formula (4).

It is to be expected that the theoretical formulæ for stopping-power should fail at small velocities because it has been assumed that the 'times of collision' for all 'effective' collisions are small compared with the period of revolution of the electron in its orbit. If this condition is not satisfied, there is an *extra restriction* imposed upon the transfer of energy to the atomic electrons, and the stopping-power represented by curve (3) is consequently too high at the lower velocities. This effect probably accounts for the fact that the observed α-ray curve is below curve (3), and also for the comparatively rapid variation of the stopping-power for α-rays with velocity. The relative effect of this new restriction would be expected to be somewhat greater for α-rays than for β-rays with the same velocity. On this view the observed α-ray curve at higher velocities should approach asymptotically the observed β-ray curve, as is indicated by the broken curve (5). It would be interesting to know the stopping-power for α-rays faster than those from radium-C to see if this is the case.

E. J. WILLIAMS.

The University,
Manchester, Feb. 24.

Coup-de-Poing.

OF that famous palæolithic implement which the French call a 'coup-de-poing,' the function is still unknown and disputed; it was once called a 'celt,' and is still regarded by some experts as the head of a once hafted ax; others, like the late M. Commont, have argued that it was used as a scraper; and still others maintain that it is an ax without a helve.

In order not to do violence to the feelings of some of our friends by forcing upon them a name which expresses a view from which they differ, I have suggested, as non-committal and non-combative, the use of a proper name; thus following the example of physicists, who speak of a watt or a volt.

The name I proposed is that of the famous Frenchman, who did such splendid service with the 'coup-de-poing' in his fight over the antiquity of man. I allude, of course, to Jacques Boucher de Crèvecœur de Perthes. From this full title I chose his family name of Boucher. This is not a Christian name, as my friend Mr. Balfour supposes, and my authority for saying this is our distinguished colleague, the Foch professor of French.

A second objection raised by Mr. Balfour in his interesting review (NATURE, Feb. 12, p. 226), is that Mr. Neville Jones has misapplied the name. I do not think he has; but this is nothing to the point, for he distinctly asserts that he uses the word 'boucher' as equivalent to the French 'coup-de-poing.'

Admiring as I do the consistent courtesy of Mr. Balfour, which is not confined to his friends, I feel sure he will not wish to introduce into our nomenclature a term like 'hand-ax,' which is eminently controversial and has not even the advantage of elegance. Who would speak of a knife-blade without a handle as a 'hand-knife'?

W. J. SOLLAS.

University College, Oxford,
Feb. 23.

I AM glad that Prof. Sollas has commented upon a remark of mine in my review of Mr. Neville Jones's book, as it gives me an opportunity of correcting an error of my own. When I referred to Prof. Sollas's "Ancient Hunters," in order to ascertain his original application of the term *boucher*, I read the passage (p. 112) as indicating that he wished to apply it to implements "made by striking off with a single blow a thick flake from a larger block of stone, and dressing the side opposite the surface of fracture by several blows directed more or less parallel to its length." I have again read the passage and realise that his intention was to suggest *boucher* as equivalent to the French *coup-de-poing*. I was misled through not having read the passage on the succeeding page, and I assumed that "it" in the sentence "In English it has no name," referred to the type described as above quoted. My reading of the paragraph was also partly influenced by the author having drawn a decided parallel between the Tasmanian implement-type, to which he had just referred, and the so-called *coup-de-poing* series. I apologise for having misinterpreted his intention.

At the same time, I cannot admit that the Tasmanian type—a typical *flake*-implement—is to be regarded as the "homologue, or rather analogue," of the *coup-de-poing*—an equally typical *core*-implement. The technique employed in making the two types is essentially different, and the resultant edges differ in character and, doubtless, in application. But, even if *boucher* is offered as a term to take the place of *coup-de-poing*, I cavil at its adoption, since it is made to cover such a variety of distinct implement-types, ranging from the Chellean pick-like tools with

rounded butts and pointed 'business' ends, to the specialised ovates of the Upper Acheulian series. It is used, in fact, to denote very dissimilar types of tools, the form and presumable function of which have but little in common. It is true that I feel equally dissatisfied with those widely-adopted terms *coup-de-poing*, *faustkeil* and *hand-axe*, all of which, as commonly used, beg a very debateable question; as I venture to doubt whether those early-palæolithic tools which were equipped with a sharp edge all round their contour, were habitually used unhafted (*vide* Sollas, p. 74). I mention this in order to emphasise how badly we are in need of a revised and reasonably descriptive terminology in prehistoric archæology. My chief reason for protesting against the adoption of the term *boucher* is its vagueness. It is used to embrace such a wide range of distinctive types that it really ceases to have a descriptive value, and is liable to cause confusion.

As to the name itself, I have been fully aware of the complete name of Jacques Boucher de Crèvecœur de Perthes, and that, strictly speaking, Boucher is not the Christian name; but the abbreviated name-formula, Boucher de Perthes, under which he is universally, and by most people exclusively, known, suggests 'Boucher' as, shall we call it, a *prénom*, and a correlation, albeit erroneous, with such names as John of Gaunt, William of Wykeham, etc., and this opens up a vista of *prénoms* adopted as generic or specific names for types of prehistoric implements. I am far from wishing to discourage homage to that great pioneer, Boucher de Perthes, but I do feel that our great debt to him could be paid more effectively than by requisitioning his name (or, rather, one of his names) for the purpose advocated; since the suggested term *boucher*, by embracing so much, signifies so little.

I greatly regret to find myself even in trivial disagreement with my good friend, Prof. Sollas, and I am merely desirous of expressing an opinion, which, if challenged and debated, may possibly be productive of good, as helping to stimulate the introduction of an adequate terminology in prehistoric archæology.

In regard to the last paragraph in Prof. Sollas's letter, I may say, though I risk his thinking me wholly unregenerate, that I feel no aversion from the use of the term 'hand-axe,' so long as it is confined to blades of axe-like form, the shape of which suggests that they were used unhafted. Nor do I see any objection to applying the term 'hand-knife' to a knife-blade which was not fitted with a handle. Such terms, where appropriately applied, have at least the utilitarian merit of being fairly descriptive, even though they may lack elegance. There is, moreover, precedent in the familiar expressions, 'hand-line,' 'hand-spike,' etc.

Henry Balfour.

Carbon Monoxide Poisoning in the Absence of Hæmoglobin.

Mr. J. B. S. Haldane's interesting letter on the above (Nature, Mar. 5) reminds me that in 1886 I made experiments on the influence of carbon monoxide, as well as of other gases (carbon dioxide, hydrogen, nitric oxide, nitrous oxide, sulphur dioxide, and hydrogen sulphide), on the vitality of three specific micro-organisms, namely, *Bacillus pyocyaneus*, Finkler's spirillum, and Koch's spirillum of Asiatic cholera. The results were published in the *Proceedings of the Royal Society* (vol. 45, pp. 292-301), but a brief reference to them may not be out of place now, inasmuch as they bear on this matter of the toxicity of gases.

The method of experiment consisted in exposing the several organisms, in the form of gelatin-peptone plate-cultures, to an atmosphere of the particular gas, a corresponding control-plate of the same culture being simultaneously incubated in atmospheric air. The behaviour of the three microbes in question in respect of carbon monoxide may be gathered from the following experimental results:

Bacillus pyocyaneus.

	Air-plates (after 4 days' incubation).	CO-plates (after 7 days' incubation).
Number of colonies developing from 1 c.c. of culture . .	113,978	0

When the above carbon monoxide plates were further incubated in air, 100,821 colonies made their appearance. Thus the carbon monoxide had had practically no *permanent* toxic effect on the bacilli distributed in the culture which had been exposed for a period of 7 days to the gas.

Koch's Spirillum choleræ asiaticæ.

	Air-plates (after 4 days' incubation).	CO-plates (after 7 days' incubation).
Number of colonies developing from 1 c.c. of culture . .	52,020	19,494

On subsequent further incubation of the carbon monoxide plates in air during 4 days, no increase in the number of colonies took place.

Finkler's Spirillum.

	Air-plates (after 3 days' incubation).	CO-plates (after 7 days' incubation).
Number of colonies developing from 1 c.c. of culture . .	4574	2

On further incubation of the carbon monoxide plates in air during 4 days, the number of colonies rose to 501.

Thus in both cases, and especially in that of the Finkler spirilla, a large proportion of the individuals had been killed or rendered incapable of multiplication into colonies by exposure to the gas.

It may be of interest to add that plates incubated in atmospheres of nitric oxide, sulphuretted hydrogen, and sulphur dioxide respectively developed no colonies, nor were any developed afterwards on placing the plates in air-chambers. These three micro-organisms are therefore rapidly and permanently poisoned by the gases in question.

Interest, again, attaches to the behaviour of the organisms exposed to nitrous oxide (N_2O). The *B. pyocyaneus* developed no colonies in this gas, but afterwards in air almost as many colonies made their appearance as on the control air-plates. Koch's spirilla, in nitrous oxide, developed nearly one-third of the number of colonies present on the air control-plates, a further but only slight increase taking place on their transference to air. In the case of Finkler's spirilla, in nitrous oxide, the number of colonies was about one-seventh of that on the air-plates, whilst the further colonies which appeared after transference to air brought the total to about one-fifth of the number on the air-control. The effect of nitrous oxide on

these three micro-organisms is thus very similar in character to that exerted by carbon monoxide.

An atmosphere of carbon dioxide, again, prevented the development of any colonies on the plate-cultures of all three organisms, and only in the case of *B. pyocyaneus* did any appear on transference to air, and then only to the extent of about one-twelfth of the number present on the control air-plates.

In reviewing the record of these experiments made forty-one years ago, it is obvious how greatly the investigation could be extended in various directions. Thus, for example, it would be particularly interesting to ascertain the deportment of sub-cultures made from the colonies appearing on plates which had been exposed to the toxic gases. By pursuing such experiments through a succession of generations it might be possible to arrive at 'strains' of the organisms endowed with the capacity to resist the inhibiting action of a particular gas. Again, differences in behaviour towards a given toxic gas might be made a means of discriminating between otherwise similar organisms, and thus adding yet one more to the already overwhelming number of tests employed in bacteriological diagnosis.

PERCY F. FRANKLAND.

Loch Awe, Argyll.

The First Public Chemical Laboratory in England.

THE statement (NATURE, Feb. 19, p. 300) that the chemical laboratory opened in 1828 in University College, London, is the oldest public chemical laboratory in Britain can scarcely be accepted without qualification, in view of the fact that the University of Oxford had built a laboratory fitted for chemical studies so early as 1683, and that this remained in use until superseded in 1848 by Dr. Daubeny's new laboratory at Magdalen College.

The use that was made of it was intermittent, and the modern practice of class teaching necessitating the multiplication of sets of apparatus had not been evolved; but still the possibility for a person to witness an experiment, even if he did not wish to make it himself, was there.

In those early days the University of Oxford appears to have done little for chemical studies beyond the initial provision of the laboratory and of "the Alkanor and Great Reverberatory" furnaces, and larger utensils such as the great alembic, barrel and worm, with which it was equipped. Smaller earthen and glass vessels and chemicals appear to have been the private property of the laboratory assistant for the time being, who was permitted to increase a very meagre salary by selling to experimenters chemical preparations "at easie rates" and by taking payment for the performance of experiments himself.

Notwithstanding the non-existence of any special university teachers of chemistry, useful practical instruction had been given in connexion with courses of public lectures in the laboratory at various times during the eighteenth century. The auditors were largely composed of medical students, with a sprinkling of the more intelligent members of the general public, who, like Princess Anne in 1683, entered the laboratory to see experiments "to their great satisfaction"; and some of the more curious-minded of these would doubtless have sought to try the experiments themselves. Dr. John Freind, described as well skilled in practical chemistry, in 1704 began courses of *Prælectiones Chymicæ* in the laboratory, which were partly based on experimental work there, and were printed and reprinted for the next twenty years. Richard Frewin was among those who acted as assistant, and it is not unlikely that there too Dr. John Wall, the inventor of Worcester china, may have learnt his chemical manipulation. George Wingfield has left a written record of the methods of analysis in vogue in 1759, and in 1781 a considerable class of divines is reported to have waded "considerably deep in chemistry." Contemporary notes taken four years later by a pupil of Dr. Martin Wall show the distinctly practical trend of the instruction given, and from 1788 until 1793 the celebrated Dr. Beddoes, later patron to young Humphry Davy, drew to the Ashmolean "the largest classes known in the University since the thirteenth century." It was the period when the work of Sadler, the aeronaut, also helped to popularise chemical experiments in Oxford.

Between 1803 and 1822 the existence of the laboratory made it possible for the first Aldrichian professor of chemistry, Dr. Kidd, to deliver courses of from twenty-six to thirty lectures on the subject of his chair during the winter terms, but owing to the lateness of the hour, 7 P.M., it was unlikely that much work was done in the laboratory by his students. One, at any rate, the poet Shelley, is known to have continued experiments in his untidy rooms in college, while the professor himself worked in the University laboratory at his own researches. Doubtless the dim light of the few candles, or oil lamps, which would have been the only source of illumination then available, as well as the grime of ages on the vaulted ceiling of the laboratory, enhanced that appearance of gloom which has been so often remembered by our visitors during the early years of the nineteenth century, and which was unsuited for the critical operations of analytical chemistry as then practised. But it was not before 1848 that the old laboratory was superseded in Oxford, and the fact remains that for over a hundred and fifty years the Ashmolean had provided England with its first public university laboratory, "the designe of this building being not onlie to advance the studies of true and real philosophy, but also to conduce to the uses of life and the improvement of medicine."

R. T. GUNTHER.

The Old Ashmolean,
Oxford.

The Spinning Electron in Wave Mechanics.

THE new wave mechanics admits the existence in physical phenomena of a variable quantity that satisfies a special differential equation. According to Schrödinger, this function ψ is such that the product $\psi\bar{\psi}$, where $\bar{\psi}$ is the conjugate complex quantity, is the electrical density. On the contrary Bateman (NATURE, 118, 839) has recently shown that, by considering two functions, each of which satisfies the wave equation, it is possible to determine the potentials $\mathbf{a}$ and ϕ of the electromagnetic field. Starting from Bateman's considerations, de Broglie (*C.R.* 184, 81) has shown that the values calculated with this theory coincide with those of Maxwell's theory if one admits that the frequency of the fundamental functions be very high and that the considered phenomenon be nearly stationary in relation to this frequency. De Broglie, however, has shown that, given the wave-equation

$$\nabla^2\psi - \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \frac{4\pi^2}{c^2}\nu_0^2\psi = 0,$$

putting in the place of the function ψ the two $\psi_1 = \frac{A}{r}\cos 2\pi\nu_0 t$, $\psi_2 = B\sin 2\pi\nu_0 t$, and introducing the potentials

$$a_x = \tfrac{1}{2}\left[\psi_1 \frac{\partial \psi_2}{\partial x} - \psi_2 \frac{\partial \psi_1}{\partial x}\right], \quad \ldots \quad \phi = -\frac{1}{2c}\left[\psi_1 \frac{\partial \psi_2}{\partial t} - \psi_2 \frac{\partial \psi_1}{\partial t}\right],$$

the results verify Lorentz's equation

$$\frac{\partial a_x}{\partial x} + \frac{\partial a_y}{\partial y} + \frac{\partial a_z}{\partial z} + \frac{1}{c}\frac{\partial \phi}{\partial t} = 0.$$

We thus obtain for the fields **E** and **H** the expressions

$$\mathbf{E} = -k \text{ grad. } \frac{1}{r}(1 + \cos 4\pi\nu_0 t), \quad \mathbf{H} = 0,$$

that is, the characteristic values of a pole of charge k.

With this new aspect of the theory, though on one hand the two functions ψ_1 and ψ_2 have no longer the properties of ψ and $\bar{\psi}$, on the other there is the advantage of correlating wave mechanics with Maxwell's theory. We may note that, using the above proceeding, it is possible to introduce the spinning electron into this theory. To do so, it should be observed that two quantities ψ_1 and ψ_2 are sufficient, according to Bateman and de Broglie, to produce the electromagnetic field; let us see if it is not better to introduce two four vectors, the components of which would be

$$\psi_{1x} = \frac{A_x}{r}\cos 2\pi\nu_0 t, \quad \ldots \quad \psi_{1l} = \frac{A_l}{r}\cos 2\pi\nu_0 t,$$

$$\psi_{2x} = B_x \sin 2\pi\nu_0 t, \quad \ldots \quad \psi_{2l} = B_l \sin 2\pi\nu_0 t \; (l = ct).$$

By this four vector we form a single four vector U such as

$$U_i = \tfrac{1}{2}\left[\psi_{1i}\frac{\partial \psi_{2i}}{\partial l} - \psi_{2i}\frac{\partial \psi_{1i}}{\partial l}\right] = \frac{\pi\nu_0}{c}\frac{A_i B_i}{r},$$

or putting

$$U_x = \frac{m_x}{r} = \frac{\pi\nu_0}{c}\frac{A_x B_x}{r}, \quad \ldots \quad U_l = \frac{q}{r} = \frac{\pi\nu_0}{c}\frac{A_l B_l}{r},$$

we find that the three special components of the four vector U form a vector $\mathbf{m}/r$, while the fourth component is q/r.

If we now put

$$\mathbf{a} = \text{curl}\,\frac{\mathbf{m}}{r}, \quad \phi = \frac{q}{r},$$

it follows easily that

$$\frac{\partial a_x}{\partial x} + \frac{\partial a_y}{\partial y} + \frac{\partial a_z}{\partial z} + \frac{1}{c}\frac{\partial \phi}{\partial t} = 0,$$

and the expressions of the electrical and magnetic fields are

$$\mathbf{E} = -\text{grad. } \phi = -q \text{ grad. } \frac{1}{r},$$

$$\mathbf{H} = \text{curl } \mathbf{a} = \text{curl}\left[\mathbf{m}, \text{grad. } \frac{1}{r}\right];$$

that is, the field produced by a spinning charge q which is equivalent for the magnetic field to a magnetic dipol **m**.

ANTONIO CARRELLI.
Istituto Fisico R. Università,
Napoli, Feb. 6.

Photochemical Decomposition of Hydrogen Iodide.

THE mechanism proposed by Warburg (*Sitz. der preuss. Akad. der Wiss.*, 300; 1918) for the photochemical decomposition of hydrogen iodide, namely:

(1) $HI + h\nu = H + I$
(2) $H + HI = H_2 + I$
(3) $I + I = I_2$,

has been generally accepted for a long time but has not received experimental confirmation. Warburg obtained a quantum efficiency of two and showed thermodynamically that reaction (2) was the only secondary reaction possible. Reaction chains cannot be set up in view of the non-occurrence of the highly endothermic reaction,

$$I + HI = I_2 + H,$$

which thus interrupts the chain.

Still another interpretation is possible, namely, that discussed by Stern and Volmer (*Z. Wiss. Phot.*, 19, 275; 1920), which leads to the same result of two molecules decomposing for each quantum absorbed. Here an activated molecule in colliding with a normal molecule brings about the decomposition of both.

(1) $HI + h\nu = HI'$ (2) $HI' + HI = H_2 + I_2$.

Until now no observation admits of a decision between these two possibilities, since Warburg worked at rather high pressures.

The writer purposed studying the quantum efficiencies at pressures sufficiently low so that a molecule of hydrogen iodide activated by absorbed radiation cannot make a collision with another molecule before its mean free life, namely, 10^{-7} sec. has terminated or before it decomposes of its own accord. In the former case, if reversion takes place, that is, if collisions are a necessary requisite for decomposition, one should expect the quantum efficiency to be very small, of the order 100 to 200 quanta absorbed per molecule decomposing. In the latter case, if it decomposes in a single act, the quantum efficiency should still remain two as at high pressures. The results are markedly different, and it should be easy to distinguish between these alternatives.

Using the 2080 Å.U. and 2530 Å.U. bands of the condensed zinc spark and working at pressure of hydrogen iodide of the order of 0·1 mm. mercury, well below the critical collision frequency pressure, the writer has found the quantum efficiency to be in the neighbourhood of two. The reaction was studied in its initial stages to avoid secondary absorption by iodine set free. The amount of decomposition was ascertained by freezing out all the hydrogen iodide and iodine, and measuring the hydrogen with a calibrated bifilar quartz manometer described by Coolidge (*J. Am. Chem. Soc.*, 45, 1637; 1923).

Thus Warburg's mechanism is substantiated experimentally. Further, this is the first time it has been proved that a polar molecule may dissociate in a single elementary act, thus affording a possible explanation of the continuous absorption spectrum of hydrogen iodide found recently by Tingey and Gerke (*J. Am. Chem. Soc.*, 48, 1838; 1926), and Bonhoeffer and Steiner (*Z. Phys. Chem.*, 122, 287; 1926).

The work is being continued and a more complete account will be published shortly.

BERNARD LEWIS.
(National Research Fellow.)
School of Chemistry,
University of Minnesota, Feb. 26.

The Tomb of Laplace.

To those interested in the records and memorials of men of science, Paris, no less than London, presents a most attractive field for exploration. The Sorbonne, the Natural History Museum, the Observatory, the schools, the streets, the squares, and the churches abound with statues and monuments, while here and there can be traced the footsteps of such as Pascal, Lavoisier, and Pasteur. No spot, however, recalls such a wealth of historic associations as that of the famous Père Lachaise cemetery, where, to mention only those famed in science, lie Delambre, Arago, Bichat, Cuvier, Charles, Brongniart, St. Hilaire, Comte, Chasles, and a score more. It was here also Laplace was buried, and his funeral discourses were pronounced by Daru, Biot, and Poisson. Over his

grave was erected a marble monument ornamented with a star and bearing the names of his great works.

For sixty-one years Laplace lay here, but in accordance with the express wish of his son, in September 1888 his remains were exhumed and re-interred in the grounds of the family estate at Saint Julien de Mailloc, Calvados. The removal seems to have attracted little attention even in scientific circles, and in view of the interest aroused by the centenary of the death of Laplace the following particulars are perhaps worth recording. For them I am indebted to the Comte de Colbert-Laplace, a great grandson of the famous astronomer, who also informs me that on Dec. 11, 1925, a fire completely destroyed the chateau de Mailloc, and with this were lost all the papers and personal relics of Laplace.

Saint Julien de Mailloc is a small hamlet situated between Lisieux and Orbec, Calvados; and it is on a by-road leading from the main road joining those two places that the tomb of Laplace is to be found. Erected in 1887, it is in the form of a Greek temple about fifteen metres high. The inscriptions recall the birth and death of Laplace, his "Mécanique Céleste," "Système du Monde," and "Théorie Analytique des Probabilités." In a bronze urn in the interior is the heart of Laplace, while the tomb also shelters the remains of his wife, his son, his daughter, and other descendants. Laplace's son, Charles-Emile-Pierre Joseph, Marquis de Laplace, who became a general of artillery, died at the age of eighty-four in 1874, but it was he who desired that Laplace should be brought to Calvados. At the time of the reinterment, the monument which had stood for sixty years in the Père Lachaise, was given to the commune of Beaumont-en-Auge, where Laplace was born, and was re-erected in the cemetery there.

In view of the complete destruction of the papers of Laplace in 1925, it may not be out of place to recall that in NATURE of June 8, 1871, p. 108, is a note to the effect that housebreakers raided Laplace's old chateau at Arceuil and threw the manuscript of the "Mécanique Céleste" into the River Bièvre, from which, however, it was rescued.

EDGAR C. SMITH.

Science Museum,
South Kensington, S.W.7.

Tetragonal Structure of Carbon Steel.

IT has been shown by Westgren, Vewer, and many others that the martensite of carbon steel has only the crystal structure of α iron, and sometimes has simultaneous structures of α and γ iron with carbon in the state of solid solution. Recently Fink and Campbell (*Transactions of the American Society of Steel Treating*, 9, 717; 1926) found the body-centred tetragonal structure with a ratio of axes 1·06 in carbon steel (1·5 per cent. carbon) after quenching in water from 940° C. Our investigations of carbon steel quenching in water show also the body-centred tetragonal structure. The following table gives the carbon content, the temperature of quenching T, the ratio of axes $c = a/b$, and their dimensions a and b:

Per cent.	T. °C.	c.	a. 10^8 cm.	b. 10^8 cm.
0·8	1100	1·027	2·851	2·920
1·0	1100	1·051	2·843	2·987
1·2	1000	1·058	2·848	3·010

In the samples of steel having 0·8 and 1 per cent. carbon in addition to the tetragonal structure were found γ iron (in the sample of steel which had 1 per cent. carbon there was no α iron).

From the above table we arrive at the conclusion that the observed tetragonal structure of steel is a solid solution of carbon in the body-centred tetragonal lattice of metal atoms. It is probable that the martensite has always a body-centred tetragonal structure (simultaneously there could be α and γ iron).

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J. KURDUMOFF.

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N. GOODTZOV.

The Metallurgical Laboratory of
"Krasnii Putilovetz,"
Leningrad,
Feb. 9.

Early British Patent Grants.

THE contributor of the "Calendar of Discovery and Invention" appearing in the pages of NATURE has in the issue for Feb. 26 fallen into a not uncommon error, when he records Mar. 2, 1617, as the date of the first British patent for invention. This certainly is not the case. The reasons that caused the then Commissioners of Patents to start the famous official series of English patents with the year 1617 were purely fortuitous, and in no way endow this particular patent with any special claim to immortality. The researches of Mr. Hulme and others have brought to light a large number of earlier grants, mostly by Elizabeth and James I., but including one (that to John of Utynam for the making of coloured glass) so early as 1449, and it is to this one that the distinction of priority must for the moment be given.

Moreover, the Statute of Monopolies cannot be correctly described as for the first time securing "the sole working or making of any manner of new manufacture within this realm to the true and first inventor." The Statute was passed simply to prevent the Crown making vexatious monopoly grants; it initiated nothing, and expressly exempted from its operation the use of the existing prerogative in respect of new inventions, a prerogative which, as we have seen, had been constantly exercised for many years past.

ALLAN GOMME.
(Librarian.)

The Patent Office Library,
25 Southampton Buildings,
London, W.C.2.

Prehistoric Archæology in Yorkshire.

IN NATURE of Mar. 5, p. 364, announcement is made of the proposed formation of an 'out door' museum at Easington, Yorks, by the East Riding Antiquarian Society. The exhibition of 'obsolete farming appliances' is no doubt a praiseworthy object; but one is tempted to inquire when the Mortimer collection is to become accessible for study by those interested in prehistoric archæology? This collection represents the life's work of the late J. R. Mortimer, who excavated a very large number of barrows on the Yorkshire wolds. It ranks with similar collections at Devizes and in the British Museum; but it has not even been seen by most of the present generation of archæologists, including the present writer. The collection is of national importance, and if the people of Yorkshire do not appreciate their good fortune in possessing it, they should hand it over to others who do. A collection in packing-cases is of no use to any one.

O. G. S. CRAWFORD.

Ordnance Survey Office,
Southampton, Mar. 10.

The Centenary of the Friction Match.

By Prof. WILLIAM A. BONE, F.R.S.

EXACTLY a hundred years ago next Thursday, John Walker, pharmacist of Stockton-on-Tees, recorded in his Day-Book the first credit sale of his newly-invented 'Friction Lights,' which were indisputably the first practical and useful friction matches. This historic record was as follows:

"*Die Saturni Apr. 7th* 1827
No. 30
Mr. Hixon
Sulphurata Hyperoxygenata Frict. 100
Tin Case 2*d*. 1. 2."

There are few scientific inventions which have been more saving of time and trouble to Mr. Everyman, or more generally used the world over, than that of the humble friction match. It is now so cheap and ubiquitous that to offer a light to a stranger on a railway journey is perhaps the commonest of everyday courtesies amongst all classes of society. No one feels the cost of matches; they are supplied gratis almost everywhere, and the vast number wasted passes unnoticed: truly a 'universal aid,' without which we should be thrown back to the inconveniences of the good old 'flint and tinder' days.

John Walker, to whose memory honour is due to-day, was born at Stockton-on-Tees in 1781 and died there in 1857; my grandfather (the late Thomas Hutchinson, *d*. 1893) knew him well. A memoir published by Dr. R. W. Foss ("Archæologia Æliana," vol. 7) says that as a youth he was articled to Mr. Watson Alcock, surgeon of his native town, and that, after completing his apprenticeship, he went to London (doubtless as a student) for a few years, returning to become Mr. Alcock's assistant.

It was during his apprenticeship that John Walker first began to show his scientific proclivities. He was constantly making chemical experiments, attained considerable reputation in the locality as a botanist, and later on took up the study of mineralogy, in which he became very proficient. After his invention of friction matches (or 'friction lights' as he usually called them) had brought him wider fame, as well as the prospect of a fortune, he steadily refused to patent it, being (as Dr. Foss remarked) "a studious, retiring man, caring more to pursue his scientific studies, whether botanising or experimenting in chemistry, than speculating in order to make money."

Although qualified as a surgeon, "an invincible horror to surgical operations," which he never was able to overcome, soon led Walker to abandon that profession, whereupon he spent some years in Durham and York acquiring commercial experience in the employment of wholesale druggists. Eventually, in 1819, at the age of thirty-eight years, he returned to his native town, where he established himself in business as a pharmacist, at No. 59 in the High Street (since 1896 marked by a suitably engraved brass-plate), living in a house on the Quayside, then a pleasant locality but now much dilapidated. Thirty years later he retired from business, having acquired sufficient for all his needs. He died in 1857 at Stockton-on-Tees, and was buried in the churchyard of the neighbouring parish of Norton-on-Tees, where an unpretentious stone marks his grave.

Walker was never married, but lived with a niece who survived him more than thirty years. He was described by a contemporary as "a trim, dapper, little man," of cheery disposition and ready wit; a man rather particular as to fashion in dress, well known at the time of his invention by his brown tail-coat, drab knee-breeches, grey stockings, white cravat and tall beaver hat.

For many years, how Walker came by his invention was scarcely known. According to an account published in a local newspaper in 1852, it was the result of chance. "Mr. Walker was preparing some lighting mixture for his own use when a match, after being dipped in the preparation, took fire by accidental friction on the hearth . . . and the hint was not lost." Also, Dr. Foss said, "On one occasion . . . some chemical mixture he had compounded fell upon the hearthstone and ignited . . ."; moreover, that Walker did not divulge the exact chemical composition of his matches, and that "from a careful search which has been made in his books it has not been possible to find it. . . ." Such, then, was the local tradition more than fifty years ago.

About the year 1890, however, an old Day-Book in Walker's own handwriting was found among a heap of other papers relating to his pharmaceutical business, which gave a new clue as to how he made the invention. This Day-Book covered the period from Aug. 9, 1825, to Sept. 22, 1829, inclusive, during which time the invention was made. It was handed over to me for investigation (1896) together with eight matches, which undoubtedly had been purchased of Walker himself sometime not later than November 1827. I copied all the relevant entries from the book, and made an analysis of the tip of one of the matches, which confirmed a then current belief that he had used a mixture of potassium chlorate and antimony sulphide made into a paste with gum and starch.

The Day-Book also revealed that, so early as 1825, Walker had been selling a mixture of equal parts of potassium chlorate and antimony sulphide to three different persons, but chiefly to a Mr. Vollum, Junr., of Hartlepool. Entries of such sales continued until Dec. 6, 1828, quite independently of those of his 'friction lights,' the first being as follows:

"*Die Saturni Nov.* 19 1825
Mr. Walton Jr. Norton
by Potassa Chlorat. 3 j Ant. sul. nigri 3 j
Muc. g. i. Aqua q. s. ft. pasta
N.B. Excellent. 1. 6."

The "N.B. Excellent" suggests that the com-

position in question had been made up *experimentally* for some purpose, which had been well answered. There is also strong evidence in the Day-Book that the purpose was percussion powder, because (1), there are six entries during the years 1826–8 of the Mr. Vollum in question purchasing a composition described either as "pulv. percuss." or as a mixture of equal parts of antimony sulphide and potassium chlorate, the name of Vollum not occurring in any other connexion; and (2), all these six entries, as well as the only two others relating to the purchase of such material during the years covered by the book, were in the autumn or early winter months (September to January), when game-shooting is practised, no such entry ever having been made during any other time of year.

Two entries in the book (dated July 26, 1827, and Sept. 12, 1828, respectively) refer to sales to a Mrs. Faber of "*oxygen^{d}. matches*" tipped (as is recorded) with chlorate of potash and sugar only. Undoubtedly these refer to the 'oxymuriate or dipping matches' (strips of wood tipped with a mixture of chlorate of potash, sugar and gum, and ignited by contact with strong sulphuric acid) invented by Chancel in 1805, which had been fairly widely used since 1812.

Therefore it seems reasonable to suppose (1), that Walker had occasionally made Chancel's 'oxymuriate matches' to the order of at least one of his customers; (2), that so early as 1825, if not before, he was experimenting on the production of a sporting 'percussion powder,' composed of equal parts of chlorate of potash and antimony sulphide, for certain other customers, more particularly Vollum; and (3) that, having succeeded, it occurred to him to produce a *friction* match by substituting the same composition for the mixture of potassium chlorate and sugar used for tipping the Chancel *dipping* match. It is important also to observe (4) that he never used the term 'matches' in reference to his own invention, which he usually called 'friction lights' (sometimes, however, 'attrition lights'), and (5), that in the first entry in the book of their sale (*q.v.*), there occur the words "No. 30," probably signifying (as I think) the batch-number of the friction lights in question. If this surmise be correct, he probably had been making them for some time prior to the first recorded sale, which (be it noted) was a credit, and not a cash, transaction.

Walker's 'friction lights' were thin splints of wood, three inches long, one-sixth inch broad, and one-twentieth inch thick, tipped with the aforesaid composition of equal parts of antimony sulphide and potassium chlorate, as my analysis has shown. They were sold by him at 100 for a shilling, in a cylindrical tin case, for which he charged an extra twopence (or a shilling for 84 lights *plus* case). With each case was supplied a piece of 'glass-paper,' folded in two, and a 'light' was ignited by pinching its head between the folds, and then suddenly withdrawing it.

In the Day-Book are entered 23 credit sales of friction lights during 1827, 76 during 1828, and 69 during 1829, or 168 altogether. By the year 1829 their fame had reached London; it is said that Faraday had exhibited some of them at a lecture in London "which set the scientific world thinking."

In that year, also, the following notice of them appeared in the *Quarterly Journal of Science, Literature, and Art*, under the title of "Instantaneous Light Apparatus." "Amongst the different methods invented in latter times for obtaining a light instantly ought certainly to be recorded that of Mr. Walker, chemist, Stockton-on-Tees. He supplies the purchaser with prepared matches, which are put up in tin boxes, but are not liable to change in the atmosphere, and also with a piece of fine glass-paper folded in two. Even a strong blow will not inflame the matches, because of the softness of the wood underneath, nor does rubbing upon wood or any common substance produce any effect except that of spoiling the match; but when one is pinched between the folds of the glass-paper, and suddenly drawn out, it is instantly inflamed. . . ." From 1829–30 onwards, Samuel Jones, of 201 Strand, London, made and sold imitations of them as 'lucifers' (a name which Walker always repudiated), saying that they had been "lectured on at the London and Royal Institutions." It is said that Walker, who was always very modest about his invention, even to the extent of thinking it unimportant, did not long afterwards continue to make 'friction lights.'

Such, then, were the nature and circumstances of this most useful invention. Before many years had passed, other claimants to it arose. At one time the late Sir Isaac Holden thought himself to be the original inventor of 'friction matches,' but in a letter which he wrote to the late Mr. Joseph Parrott of Stockton-on-Tees on Feb. 3, 1894 (*after* hearing of the discovery of Walker's Day-Book), of which I have a photograph, he said, "My invention, if so it may be called, was introduced by me in Oct. 1829 in *entire ignorance* of Mr. Walker's." Unfortunately, the Report of Juries of the Exhibition of 1851 contained a judgment by Warren de la Rue and A. W. Hofmann that "The first friction matches or congreves made their appearance about 1832," without even mentioning Walker's prior invention. Now the 'congreves,' which were introduced into England from Germany and Austria in that year, were originally invented by a young French chemist, Charles Sauria of St. Lothair (*d.* 1895), who in January 1831 (or nearly four years after Walker's invention), whilst a student at the Collège d'Arc, Dole (Jura), made friction matches containing phosphorus, but (like Walker) he did not patent his invention, which some think was pirated in Germany. In 1884 the French Government recognised Sauria's 'l'Invention des Allumettes Chimiques' by appropriately granting him a 'bureau de tabac'; and a medal was also bestowed upon him by the Academie Nationale Agricole. Unfortunately, except that in 1913 *Punch* published some verses in his honour, so far nothing has yet been done in Great Britain to recognise or commemorate John Walker's invention; but its centenary affords the opportunity of removing this reproach.

Activities of the Medical Research Council.

PERUSAL of the report of the Medical Research Council for 1925–1926,[1] as usual, gives the reader a bird's-eye view of much of the research work which has been carried out in Great Britain on medical and allied subjects during this period. By the system of grants-in-aid to workers in university and hospital laboratories, etc., the Council is enabled to promote research on a much wider variety of subjects than would otherwise be possible; in fact, almost two-thirds of the Parliamentary grant of £135,000 was utilised in this manner, the greater part of the remainder being devoted to the expenses of the National Institute at Hampstead and of the farm laboratories at Mill Hill. Only a few of the more salient points of the report can be touched on in this short account.

Before referring to the scientific work, attention may be directed to certain events of the year which affected the Council. By an Order in Council in July the constitution of the Committee of the Privy Council for Medical Research was altered and the Committee now consists of the Lord President of the Council, the Secretaries of State for Home and Dominion Affairs, for the Colonies, and for Scotland, and the Minister of Health. A few months previously an alteration of the charter of the Medical Research Council had been approved; the amendments provided, *inter alia*, for an increase in the numbers of the Council from ten to eleven, of whom eight are appointed in respect of their scientific attainments, whilst the remaining three include a representative from each of the Houses of Parliament. Two of the former retire each year and are not eligible for immediate reappointment, whilst one of the latter group retires every two years but is eligible for immediate reappointment.

During the year also, the Committee of Civil Research was set up to provide for the discussion of problems which are common to more than one field of science, or to more than one part of the Empire. In addition, representatives of the Medical Research Council were appointed members of the Research Special Sub-Committee of the Imperial Conference and took part in the deliberations of this Committee.

Physiological and Biochemical Investigations.

Insulin.—Since the original discovery of insulin by Banting and Best, the problem of the fate of the sugar which disappears under its action from the blood has led to much speculation and stimulated numerous researches, without reaching a final solution until last year. It was known that in the diabetic organism, insulin produced a storage of glycogen in the liver, but in the normal animal the disappearance of sugar from the blood was usually accompanied also by a decrease in the glycogen of this organ; at the same time, examination of the respiratory exchange had shown that, although the metabolism became predominantly carbohydrate in type, yet the oxygen consumption was not sufficiently increased—it might even be decreased—to account for the combustion of all the sugar vanishing. A brilliant series of researches at the National Institute during the past year appears now to have solved this problem.

C. H. Best, in a preliminary investigation on artificially perfused limbs, was able to show that the skeletal muscles were the chief site of the disappearance of sugar. Working with J. P. Hoet and H. P. Marks, he then found that a large part of the glucose disappearing could be found as glycogen in the muscles; although the inorganic phosphate of the blood falls together with the sugar, no storage of phosphoric esters in the muscles was observed. Finally, Best, Dale, Hoet and Marks made a complete balance-sheet of the glucose exchange under the action of insulin. Under all conditions of glucose supply in relation to the dose of insulin, the total amount of glucose disappearing from the system—the decapitated eviscerated preparation—was equal to that burnt, as estimated from the oxygen consumption, together with that found deposited as glycogen in the muscles.

The loss of glycogen from the normal liver under the action of insulin is a secondary effect of the fall in the blood-sugar. In the diabetic with a high blood-sugar, insulin promotes glycogen deposition in the liver, but under its continued action, with a fall in the blood-sugar below a critical level, this glycogen will be transferred, as sugar, to the muscles. The liver glycogen acts as a carbohydrate reservoir, easily available if the blood-sugar falls; muscle glycogen, on the other hand, does not appear to have this function. The depression of the total metabolism under the action of insulin, mentioned above, is most easily explained on the assumption that insulin restrains the new formation of carbohydrate from protein, or fat (Burn and Marks), in the liver. It may therefore be concluded that the action of insulin is identical in both the normal and the diabetic organism.

A very interesting observation has been made by Hoet and Marks, as an incidental outcome of this work on insulin. It has been known for some time that animals dying from an overdose become rigid almost immediately. This also occurs when a rabbit dies after daily thyroid feeding for some weeks. In both cases there is almost complete exhaustion of the muscle glycogen; the *rigor mortis* sets in also whilst the muscles are still alkaline. It appears that the rigidity is due to a failure to reform the hexose-phosphate or 'lactacidogen,' from a shortage of the raw material, the glycogen. Under ordinary conditions the muscle enters into *rigor* only some time after death, and with an acid reaction; in this case the cause must be sought in the death of the synthetic mechanism.

Histamine.—Since the discovery by Dale, Laidlaw, and Richards that histamine, whilst

[1] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1925–1926. Pp. 161. (London: H.M. Stationery Office, 1926.) 3*s.* 6*d.* net.

stimulating smooth muscle, relaxes the walls of the capillaries, leading to a marked fall of blood pressure, interest in this substance has been maintained, more especially since it was probably responsible for many of the cases of 'shock' seen during the War. More recently it has been suggested that it may have therapeutic applications. It has been known for many years that extracts of most tissues cause a fall in the blood pressure; recently a liver extract has been advocated as a therapeutic measure in high blood pressure in man. Best, Dale, Dudley and Thorpe have succeeded in identifying the active principles of liver extracts and have found them to be histamine and choline. In addition, large amounts of histamine have been extracted from fresh lungs, *e.g.* 0·3 gm. from 10 kgm. of lung. It must be remembered in connexion with these quantities that 1 part in 250 million parts of water can produce contraction of the smooth muscle of the uterus.

The physiological function of histamine in the body is still a subject for research, but it may be suggested that it plays a part in the chemical control of the capillary circulation, perhaps as an antagonist to adrenaline. This suggestion is supported by the work of Sir Thomas Lewis and his colleagues; they have found that the local reaction of the skin blood-vessels to irritation or injury can be exactly imitated by the injection of minute amounts of histamine.

Bacteriological Investigations.

Cancer.—The work of Gye and Barnard on the filter-passing virus of cancer has been continued. It will be remembered that Gye, working with the Rous chicken sarcoma, found evidence which he believed could only be explained on the hypothesis that the cell-free filtrate from the tumour contained two factors, either of which alone was innocuous. One was a thermolabile substance, specific to the species from which the material was derived; the other was a filter-passing virus, which could be obtained also from mammalian tumours. Gye's recent work has confirmed his original observations; thus he has been able to destroy the virus by using antiseptics like acriflavine or cyanides, instead of chloroform, leaving the specific factor intact in the solution. Some parts of his work have been confirmed by other investigators, other parts are unconfirmed or the validity of his evidence denied. Only further experiments can settle the conflict of testimony.

Dog Distemper.—P. P. Laidlaw and G. W. Dunkin have continued their investigations into canine distemper; the work is greatly aided by the fund collected by the *Field* newspaper. It is now quite certain that the disease is caused by a filter-passing virus; unfortunately, no means have yet been discovered of cultivating it *in vitro*. It can, however, be transmitted to ferrets and back again to dogs at will. The ferret can be immunised by inoculation with formalin-treated virus and is then usually protected against what is an almost invariably fatal disease in this animal. On the other hand, attempts to immunise dogs have been less successful; but it is hoped that a primary inoculation of dead virus followed by a mild distemper infection while the animal is refractory to the disease, will develop sufficient resistance to protect the animal against chance infections.

Chemotherapeutics.—In conclusion, attention may be briefly turned to one or two chemotherapeutical investigations. S. R. Douglas has shown that sanocrysin (sodium gold thiosulphate) has not a specific action on the tubercle bacillus, but so affects the cells of the tubercular lesions as to give indirect damage to the infecting organisms; in rabbits, S. L. Cummins has found that mild infections can be eliminated by this drug, but heavy or virulent infections cannot be cured. In another direction Dobell and Laidlaw, utilising their method of cultivating entamœbæ *in vitro*, on media containing solid rice-starch, have shown that emetine and cephæline are specifically poisonous to *E. histolytica*, the causal organism of amœbic dysentery in man. Minute quantities inhibit its growth and ultimately destroy it, but relatively strong concentrations are necessary to kill it at once. The importance of this time factor in the treatment of the human disease is obvious.

Obituary.

Dr. A. W. Crossley, C.M.G., C.B.E., F.R.S.

DR. ARTHUR WILLIAM CROSSLEY, who died at his residence, Thorngrove, Alderley Edge, Cheshire, on Saturday, Mar. 5, at the relatively early age of fifty-eight years, was the son of the late Richard Crossley and was born at Accrington on Feb. 25, 1869. His early education was obtained at Mill Hill School, from whence he proceeded to the Owens College, Manchester, then part of the federated Victoria University, where he graduated in the honours school in 1890. It is evident that thus early in his career his tastes inclined towards the organic side of chemistry because, after graduating, he went to Würzburg to work under Emil Fischer, then well on the way towards the zenith of his fame, and from there published his first paper, a short note on the optical behaviour of dulcitol, in 1892. He graduated Ph.D. at Würzburg in 1892 and then followed Fischer to Berlin, from which University he published his second paper, on the oxidation of mucic acid, in 1894.

In the autumn of 1894, Crossley returned to Manchester to work with the younger Perkin, who had two years previously succeeded Schorlemmer in the chair of organic chemistry and had started the Manchester school of organic research, which was afterwards to become world famous. He was awarded a Bishop Berkeley fellowship, which, however, he relinquished in the following year on his appointment as lecturer in chemistry at St. Thomas's Hospital; nevertheless, during his short stay in Manchester, he completed an important paper on the substituted pimelic acids, which he published

conjointly with Prof. Perkin in 1895. During the time he remained at St. Thomas's Hospital, that is, until 1904, when he was appointed professor of chemistry to the Pharmaceutical Society of Great Britain, he published several papers on the malonic ester condensation, mainly in connexion with the formation of hydro-aromatic compounds. This work was evidently the outcome of that which he had started earlier with Perkin on the constitution of camphor—a problem at that time occupying the full attention of Perkin's school at Manchester. It appears that Crossley completed this camphor work at St. Thomas's, for it is embodied in a paper on dihydrocamphoric acid published with Perkin in 1898, and that, moreover, the peculiar properties of dihydrocamphoric acid decided him to subject a whole series of hydro-aromatic substances to special investigation.

In this way Crossley's life work, so far as organic chemistry is concerned, was determined, and we find a number of papers from his pen appearing at regular intervals from 1896 until 1914, in which year he was appointed Daniell professor of chemistry at King's College (University of London). The insight and manipulative skill shown by these researches place Crossley in the front rank of modern organic chemists and would have enabled him to accomplish far greater achievements had not fate determined otherwise, for the advent of the War directed his energies into other channels of wider and more urgent importance. During his stay at St. Thomas's Hospital he was associated in his research work with Henry Rondel Le Sueur, and while at the Pharmaceutical Society, with Charles Gilling and Nora Renouf, with whom he published many important papers. He was awarded the D.Sc. of the Victoria University in 1899, and was elected fellow of the Royal Society in 1907. He received the Longstaff medal of the Chemical Society in 1918.

Shortly after the outbreak of War, the Royal Society formed a committee to render the Government any assistance that might be necessary on the scientific side, but after the first definite use of gas in April 1915, it was evident that special measures would have to be taken to meet the new menace. On the formation of the Trench Warfare Department under Colonel (now General Sir Louis) Jackson, Crossley was nominated by the Royal Society as a member of the Advisory Committee of the Department and became its first secretary. Early in 1916 it was realised that the trench warfare experimental grounds at Clapham Common and Wembley were too small for the purposes of large-scale experiments, and were, moreover, situated in areas too congested to warrant the use of materials likely to be dangerous to health. Search led to the discovery of a tract of land of poor agricultural value situated between the London Road and the railway about two miles from Porton in Wiltshire, and here, in the spring of 1916, it was decided to establish an experimental station for investigations in connexion with chemical warfare.

The problems requiring solution were urgent and complex, the power and safety of our armies in the field depending upon the provision of offensive and defensive appliances in the shortest possible time. Nothing existed on the ground but a few farm buildings and out-houses, and everything from a gun range to a drainage system had to be provided as quickly as possible. Crossley undertook to put things in order, and for this purpose he was given the rank of Lieutenant-Colonel R.E. Here, then, with a band of devoted helpers, he started to carry through what was in all probability the most difficult task of his life, requiring as it did the exercise of infinite tact and a power of control over men such as few, especially those trained in academic surroundings, possess. It was, indeed, a prospect which the boldest might have hesitated to face. Nevertheless, Crossley played his part as a soldier with all the energy and force with which he did everything else, and brought to bear a personal charm of manner which enabled him, although a strict disciplinarian, to endear himself to all the officers and civilians serving under him. It was due to him and those with him that within a comparatively short space of time the experimental station at Porton became a real factor in the War, and that it was established on a basis which not only caused it to be the centre of chemical warfare research in Great Britain, but also enabled it to serve as a model on which similar organisations have been built in other countries.

It was the present writer's lot to form one of the group of five who walked from the London Road into that peaceful valley one Sunday in February 1916, and also to be one of those who was present when His Majesty the King visited the station in 1918. No one who has not undergone these two experiences can realise the change Crossley had wrought in the time. For some considerable period he acted as liaison officer with the French and he visited the front on many occasions. His work also necessitated frequent consultations with the chemical advisers to the armies, and for this purpose he made many visits to St. Omer and Paris Plage. Later, the increase of work at Porton required his full attention and he delegated his French work to others. For his services to the French Government he was created an Officier de la Légion d'Honneur on the occasion of the visit of the Chemical Warfare Advisory Committee, which had now become part of the Ministry of Munitions, to Paris. He was created C.M.G. in 1917, and C.B.E. in 1919.

During the War the Department of Scientific and Industrial Research, which had been established as a Committee of the Privy Council in 1915, decided to form industrial research associations in order that, after the War, there might be an organised effort, backed by the latest scientific methods, to meet the competition which would then arise. Among these, one of the latest to be formed was that constituted in 1919, dealing with the cotton industry, for which, in the following year, the house at Didsbury, Manchester, afterwards known as the Shirley Institute, was acquired. Crossley was appointed first Director of

the Association, and here, as at Porton, he was faced with the problem of creating an organisation from the beginning. The Shirley Institute comprised a large private house situated in its own grounds but bearing no semblance to a scientific institution. He had to undertake the difficult task of installing laboratories and equipment which could deal effectively with the problems arising in this basic industry. Such problems would necessarily cover a wide field, including many branches of science, and would, therefore, entail the initiation and control of researches in subjects other than chemistry. He had not only to help the industry by research on scientific lines, but also had to accomplish the still more delicate task of appealing by the work of the Institute to those who were anxious for immediate practical results and were not always cognisant of the essential need for fundamental research as a foundation for industrial progress. It is a remarkable fact that in two years, that is to say, in approximately the same time as was taken to organise Porton, the Shirley Institute was established as a fully equipped research unit and was formally opened by the Duke of York in 1922. Since then the volume of research work from the Institute has not only made it a model research association, but has also, by reason of the practical application of its work, convinced many who were previously sceptical of the value of fundamental research in relation to the industry.

Despite his many other activities, Crossley found time to devote himself to other public work, and was from 1903 until 1913 secretary of the Chemical Society and from 1913 until 1925 its foreign secretary. In the latter year he was president of the Society, but had to relinquish the office after one year owing to failing health. He was a man, therefore, who gave great and useful service to his country, and received the recognition of his King, his University, and his fellow scientific workers. Had he lived he would have attained to greater honours, for the full power of his work will not be realised until the lapse of time has proved its value. Without question his life was shortened by his devotion to public duty and by the strain imposed on his constitution by the high sense of responsibility he felt in all the work he undertook. The War years imposed a heavy burden, which, although cheerfully borne, nevertheless left its mark on a not too robust constitution, and he never seemed quite the same man afterwards. He was essentially a pioneer, for his great activity of mind led him to seek new problems as soon as he had settled the one in hand to his own satisfaction and had brought it to a stage at which he felt he could safely hand it over to others. He was denied, therefore, the complacent rest which ought to follow the contemplation of smoothly running administrative machinery well and truly constructed. J. F. T.

M. F. E. Turpin.

M. François Eugène Turpin, well known as the inventor of melinite, one of the high explosives used in shell-filling, died on Jan. 24 at Pontoise. We are indebted to a recent issue of *La Nature* for the following particulars of his life. After his birth at Rosendael in 1849 his parents moved to Paris, where, on leaving school, he began to study medicine. But he became interested in chemical research, and it was not long before his natural skill in experimental work was publicly recognised by the bestowal upon him by the Paris Academy of Sciences of the Montyon prize for his invention of harmless colouring matters for children's toys. This invention presently involved him in some litigation, but, nothing daunted, he applied himself with energy to the study of explosives. Those were the days of black gunpowder, dynamite, and gun-cotton. The instability of nitrated organic compounds had rendered them unfit for use by the artillery and even unsafe to store in magazines. With the object of overcoming these difficulties Turpin decided to abandon the search for suitable material among aliphatic compounds and turned his attention to those of the aromatic series. After seven years of ceaseless toil he perfected a process for preparing a suitable high explosive from picric acid by the simple device of melting it in an oil-bath and running it into moulds. When, shortly afterwards, a suitable detonator had been devised for use with the new explosive, the French Government purchased the new process from him; but the secret appears to have been treacherously revealed to a British firm by an artillery officer, whom Turpin vigorously denounced in a volume entitled "Comment on a vendu la mélinite." For this indiscretion Turpin was prosecuted, and eventually condemned to prison on the charge of having revealed in his book secrets of importance to the national defence. After spending nearly two years in prison he was pardoned in 1893, and in 1901 he was completely restored to favour by being elected to serve as a technical adviser to the artillery. In this capacity he rendered invaluable service to France until after the War, when the State awarded him an annuity.

Prof. Carl Graebe, who died after a long illness on Jan. 19 in his native town, Frankfort, within a few weeks of completing his eighty-sixth year, had for many years occupied with distinction the chair of chemistry at Geneva. Graebe's reputation was made by his brilliant researches on the constitution of aromatic and heterocyclic compounds, particularly on quinones, phthalic acid, alizarin, and acridine. He also succeeded in demonstrating the constitution of anthracene, phenanthrene, fluorene, carbazol, etc., and was a pioneer in the investigation of the relationship between colour and chemical constitution. Having shown that alizarin was derived not from naphthalene but from anthracene, the synthesis of that important dyestuff could not be long delayed, and the solution of this problem in 1868 by Graebe and Liebermann marks an important stage in the development of the dyestuff industry. Graebe was also the author of a work on the history of organic chemistry.

News and Views.

There is now real ground for hope that a new measure for the protection of wild birds in Great Britain may reach the Statute Book within the next few months and so come into force on Jan. 1, 1928. The Wild Birds Protection Bill received a second reading in the House of Commons on Mar. 25, and is referred to a standing committee. Ever since the Departmental Committee on the subject reported in 1919, legislation on these lines has been pending. Several bills, not greatly differing from the present one, have been introduced, and have made progress in varying degree: they have eventually failed not through opposition but merely on account of the exigencies of parliamentary time. On this occasion the crucial stage has been survived, and if the Bill is given sympathetic treatment in committee, there should be no difficulty in its receiving a third reading and then passing through the House of Lords.

We published a full account of an earlier form of the measure two years ago (Nature, June 20, 1925, p. 934), and a brief indication of the scope of the present Bill will here suffice. Some general protection is given to all birds by the prohibition of destruction and capture by certain methods and at certain times and places. Special protection, further, is given to different species according to the categories in which they are classified for the purpose. Birds in Category I. and their nests and eggs are protected at all times. Birds in Category II, with their nests and eggs, are protected during the close season, normally Mar. 1–July 31. Birds in Category III., but not their nests or eggs, are protected during the close season except against the owner or occupier of the land or his agents. Named as coming within the first category are the greater rarities, some much persecuted species, and a few others: in the second are birds which especially need protection in the breeding season. The third category comprises all birds not scheduled as belonging to the first or second. The Bill will supersede the existing legislation on the subject. Its great merits are its simplicity, the uniformity which it will introduce, and the better powers given for enforcement. These should lead to a much greater effectiveness in practice.

It is noteworthy, from the report of the debate on the second reading of the Protection of Wild Birds Bill, that such opposition as there was, apart from points of detail which will be raised again in committee, mainly arose not from objection to the proposed provisions but from a desire for a still wider measure. The protection of all birds at all times, apart from such few species as might have to be blacklisted, was indeed suggested. The Bill as it stands, however, seems to achieve a wise moderation. It gives absolute protection where it is most needed, and some measure of protection to all birds: it avoids the unnecessary creation of new offences, and the imposition of excessive restrictions which would tend to alienate that public opinion upon which the successful working of a law of this kind must largely depend.

Among the great City Companies of London there is none more closely associated with pure and applied science than the Goldsmith's Company, which this week is celebrating the six-hundredth anniversary of its foundation. By a happy coincidence, the Prime Warden of the Company this year is Sir Dugald Clerk, who presided at the banquet held on Monday, and one of the Wardens is Sir William Pope, who will become Prime Warden the year after next. Other fellows of the Royal Society who have been Prime Wardens of the Company are Mr. George Matthey, Sir Frederick Bramwell, Sir Frederick Abel, Sir J. Wolfe Barry, and Mr. C. T. Heycock. In October last we described an extension of the City and Guilds (Engineering) College at South Kensington, provided by the munificence of the Company at a capital cost for building of £87,000. The Company also heads the list of grants made by city companies to the City and Guilds Institute with total grants amounting to £204,500, and these represent only part of the generous provision made by the Company for progressive education and science. We have often expressed appreciation of the encouraging attitude constantly displayed by the Company towards scientific activities, and we are glad to offer it our most cordial congratulations upon the wise purposes for which it employs its funds and upon the strength of its present position in national life.

The interesting collection of prehistoric stone implements from Suffolk, the South Downs, and other British localities formed by Mr. S. G. Hewlett during twenty-five years of personal collecting, has recently been sold at Stevens's auction rooms. Although dispersals are especially to be regretted when objects of local importance are thereby removed from their proper homes, they afford an excellent opportunity for appraising the value which the public sets upon the specialised collections and researches of others. Truth to tell, this sale has shown that these stony and enduring records of early but barbaric man are very far behind the ephemeral postage stamps of his civilised successors in the public estimation. No single implement fetched more than £3. Close on two hundred and fifty lots, comprising 6000 'flints,' passed under the hammer for a total of £293 : 9*s*. In detail, 287 palæoliths brought £25 : 4*s*., and 1076 neoliths, mostly from the eastern counties of England and the Thames Valley, brought £103 : 17*s*., an average of ten to a £1. Those from the South Downs, with others, were sold at about thirty to a £1, and some 300 from abroad only fetched £15 : 1*s*. For years we have been stimulated by the sight of long series of such specimens beautifully set out in museums in expensive cases, to wander across ploughed fields and gravel heaps looking in vain for flints that never turned up, but which we had come to regard as of great value. Can it be that the reward for finding them is so small as the Hewlett sale would lead us to suppose? If so, flint-collecting is certainly an appropriate hobby for a poor man of science.

FOLLOWING closely on the announcement of the purchase by the Zoological Society of London of part of the Ashridge Estate as the site for a new Zoological Park, comes the news that Mr. G. B. Chapman, the well-known animal dealer, has purchased the "Withdean Hall" estate, on the London-Brighton Road, which he intends to form into a public zoological gardens. Considering the enormous interest which is taken in animals of all kinds in Great Britain, there is a notable lack of zoological gardens as compared with many other countries, there being only five in Great Britain, while in Germany there are more than twenty, and as many as ninety-two in the United States. Mr. Chapman's new gardens will be laid out on modern lines and the animals will be exhibited under the most natural conditions possible. Cages and bars will be to a great extent eliminated, and their place will be taken by wide ditches over which the animals cannot pass. Mr. Chapman is to be congratulated on his enterprise in providing for the public what will not only be a place of enjoyment and recreation, but also one of the highest educational value.

PROF. E. T. WHITTAKER delivered a lecture on "Present Conceptions of the Cosmos" at Bedford College for Women (University of London) on Mar. 22. Cosmology was founded, he said, in the fifth century B.C. by the Pythagoreans, who first put forward the idea that the earth was spherical; the difficulties they experienced in proving this statement are analogous to our difficulties in establishing present-day hypotheses concerning the size and nature of the whole universe of stars and space. Since the days of the Pythagoreans we have been convinced by experimental evidence that the earth is round and finite, so that there cannot be more than a maximum distance between two points on its surface. The methods of investigation, with the exception of the geodetic, depend on observations made outside the earth, but in considering the whole universe we have no external system of reference. We are apt to be misled by early education, which often implants *a priori* notions concerning space, and obscures the fact that the axioms on which Euclidean geometry is based are not necessarily true from all points of view. Systems of non-Euclidean geometry also have practical applications, and it is possible that on one of these systems as a basis, space may be found to be finite. The distinction between being finite and being unbounded must be clearly made. Space may very well be finite, yet with no boundaries; the traveller through space, unconscious that he is not moving in a straight line, may yet return eventually to his starting-point.

SINCE the Victorian age, Prof. Whittaker continued, the theory of relativity has produced a definite advance in the interpretation of the cosmos in terms of a non-Euclidean system. This theory helps to elucidate observations made on the astronomical universe. The number of stars, though immense, is not infinite, and their distance from the earth can be measured. The earth is situated in the Milky Way or galactic system, and the nearest star is at a distance of about four light years. The spiral nebulæ, first discovered by Lord Ross in 1845, are the most distant objects yet observed and are right outside the galactic system; the latter has a diameter of roughly three-quarters of a million light years, while the spiral nebulæ are at a distance of from one to ten million light years. It has long been known that the motion of stars towards or away from the earth can be deduced from the shift of the spectral lines; a shift towards the red has been observed in the spectra of the spiral nebulæ, and it is therefore concluded that they are moving away from the earth. Einstein's theory of relativity, based on a non-Euclidean system, brings into account the possible curvature of the universe and predicts that a shift of the spectral lines towards the red will be observed for all bodies at a great distance. The diameter of the universe has been estimated from the spectral observations, and is found to be of the order of one hundred million light years. From this point of view, therefore, the universe, though remaining unbounded, may be said to be of a finite nature.

IN his Friday evening discourse delivered at the Royal Institution on Mar. 25, Prof. C. T. R. Wilson stated that much may be learnt about the processes which are going on in a thundercloud by observing the sign and magnitude of the electric field which it produces at the surface of the earth and the sudden changes which lightning discharges cause in this field. These changes are generally of the order of 10,000 volts per metre below the central portion of the thundercloud, of the order of 1000 volts per metre at a distance of 10 kilometres, and they become comparable with the fine weather field of 100 volts per metre at about 20 kilometres. The fields destroyed by lightning discharges are most frequently negative below the thundercloud and positive at great distances. Thunderclouds seem to be essentially bipolar, with the positive charge above the negative. Discharge may occur between the upper and lower poles, between the ground and the lower or more rarely the upper pole, or between the upper pole and the upper atmosphere; combinations of these, either simultaneous or in rapid succession, also occur. From the magnitude of the sudden changes produced in the field by lightning discharges at known distances, the electric moments of the discharges (depending on the quantities discharged and their heights) may be determined. These generally exceed 30 coulomb-kilometres. The quantity discharged in a lightning flash is of the order of 20 coulombs. The potential difference developed in the cloud before discharge is of the order of one million kilovolts, and the energy spent in a lightning discharge is about 10^{17} ergs or 10^{10} joules. Nearly 2000 thunderstorms are on an average in action at a given time, and they may, perhaps, be the main sources of the downward current and positive potential gradient of fine weather regions. In a thundercloud, on account of the great distance through which the intense electric fields extend, effects may be possible which

we cannot hope to produce in the laboratory. It may, for example, be possible for electrons to be accelerated until their energy is some hundreds of times as great as that of any known β-particle.

BY electing Dr. H. H. Woollard, at present assistant professor of anatomy and sub-dean of the Faculty of Medical Sciences at University College, London, to the chair of anatomy just vacated by Prof. Wood Jones, the University of Adelaide has once more deprived England of one of her best anatomists, who can ill be spared. Dr. Woollard obtained his M.D. in the University of Melbourne and served throughout the War in the Australian Medical Corps at Gallipoli and in France, eventually attaining the rank of Lieut.-Colonel and being awarded the Croix de Guerre avec Pâlme. After the War he joined the postgraduate class of anatomy at University College, London, and was invited to join the staff of the Department. He spent the academic year 1921–22 at Johns Hopkins University as a Rockefeller Foundation Fellow, and on his return to University College was made assistant professor. In addition to a monograph on the anatomy of Tarsius, in the main corroborating and extending the pioneer work of Burmeister, he has made exact histological surveys of the cerebral cortex of Tarsius and Orycteropus, and a detailed comparative study of the visual apparatus (retinal and cerebral) in the primates, yielding results of far-reaching value and importance for the student of human evolution. But perhaps his most distinctive achievements are his researches (in particular his application of the methylene-blue technique) on the double innervation of the heart, blood vessels, and striated muscles.

THE Prime Minister's appeal, issued by the Royal Society of Arts, for funds to ensure the preservation of ancient cottages throughout Great Britain, is one which should secure the hearty support of all lovers of beauty, as well as of those who appreciate the fact that these fast-vanishing relics of a bygone day have a value greater than the mere charm of their antiquity to those who seek to interpret the social and economic history of England in the past. Scarcely any material evidence which has survived from those earlier days can serve equally to throw light upon the conditions of agriculture, of rural industry, and of the labourer during the last two to three hundred years or more. Mr. Baldwin's appeal is supported by Mr. Thomas Hardy whose long and intimate acquaintance with rural conditions lends weight to his contention that the ancient type of mud-built cottage is superior to the modern brick structure, not merely on the ground of æsthetic considerations, but also in comfort. The appeal briefly outlines a scheme whereby the fund will endeavour to assist owners financially in securing fitting attention for these ancient cottages and the machinery by which an advisory council will work under the council of the Royal Society of Arts. Donations should be sent to the Secretary, Royal Society of Arts, John St., Adelphi, W.C.2.

THE centenary of the death of Ernst Florens Friedrich Chladni, who has often been called the father of modern acoustics, occurs on April 3. Chladni was born in Wittemberg on Nov. 30, 1756, and died at Breslau on April 3, 1827. His father was professor of law at Wittemberg, and it was in accordance with his wishes that Chladni also studied law. His natural inclination, however, was towards science, and he once wrote: "As an admirer of music, the elements of which I had begun to learn rather late, that is, in my nineteenth year, I noticed that the science of acoustics was more neglected than most other portions of physics. This excited in me the desire to make good the defect, and by new discovery to render some service to this part of science." He then goes on to show how he initiated the experiments on plates set in vibration in various ways. Taking a hint from the work of Lichtenberg of Göttingen, who had sprinkled fine powders on electrified planes, Chladni obtained those beautiful patterns which are given in most text-books. He next invented two new instruments, the euphone and the clavicylinder, and he spent a good deal of his time travelling and explaining his discoveries. Some of the experiments of Chladni were made known in a book published at Leipzig in 1787, but his fame is mainly due to his "Die Akustik" of 1802. When he visited Paris in 1808, Chladni had an opportunity of explaining his discoveries to Napoleon, who asked the Institute to report on them, and allocated 6000 francs for the translation of the work of Chladni into French. Chladni is also remembered for his views on meteors. His portrait forms the frontispiece of Tyndall's book on "Sound."

AMONG the most active of the scientific bodies of the south-west of England is the Royal Cornwall Polytechnic Society, which has recently issued its ninety-third annual report. Though like similar societies it has its lectures and papers, the Polytechnic Society also maintains a Meteorological Observatory and encourages both art and science in the county by holding exhibitions and awarding prizes, medals, and certificates. The exhibition is held at the same time as the summer meeting, and is supported by the Education Committee of the County Council. The present president of the Society is Viscount Falmouth, and the report contains his address in 1925 on the "Development of Physical Science," in which he traced the work of Röntgen, von Laue, Bragg, Rutherford, and others. Two papers reported in full are those on "The Mining Coinage of Cornwall," by Mr. Newton, and "Boulton and Watt in Cornwall," by Mr. Hamilton Jenkin. Towards the end of the eighteenth century there were more than 400 mines in Cornwall, and from these, practically all the copper used in England was obtained. It was the shortage of government coinage which led to the use of local coins and tokens, and it is of interest to note that many of these coins were made in Birmingham by Boulton and Watt, who were then busily engaged installing their engines in the mines. The Polytechnic Society possesses a large number of letters of Boulton and Watt, and Mr. Jenkin's paper was based on these. Boulton and Watt met with great

opposition in Cornwall, and the troubles drove Watt to distraction. Boulton's instructions to their representatives in Cornwall when carrying out a steam trial are probably unique, for they begin: "Give a drink to all necessary persons and knock any man down that touches the coal or the fire during the whole trial," and ends with "We pray God send you a good deliverance."

HIS MAJESTY THE KING has approved the award of the Royal Medals of the Royal Geographical Society for 1927 as follows: *Founder's Medal*: to Major Kenneth Mason (Survey of India) for his connexion between the surveys of India and Russian Turkestan through the Pamirs in 1913 and his organisation and conduct of the Shaksgam Expedition of 1926; *Patron's Medal*: to Dr. Lauge Koch (Copenhagen) for his remarkable six years' exploration of northern Greenland. The Council has made the following awards: *Victoria Medal*: to Col. Sir Charles Close for his distinguished contributions to the advancement of the science of geography; *Murchison Grant*: to Mr. John Mathieson for his surveys of Spitsbergen and for his special studies during his long service with the Ordnance Survey in Scotland; *Back Grant*: to Capt. A. H. MacCarthy for his preparation and leadership of the ascent of Mount Logan, 1925; *Cuthbert Peek Grant*: to Mr. Francis Rodd to assist him in further exploration of the Sahara; *Gill Memorial*: to Mr. A. E. Young for his development of the mathematical theory of map projections.

AT the annual general meeting of the Chemical Society held on Mar. 24, Prof. H. B. Dixon, Prof. G. G. Henderson, and Prof. A. Smithells were elected new vice-presidents, and Mr. M. P. Applebey, Mr. E. R. Bolton, Prof. J. E. Coates, Prof. J. C. Drummond, Dr. E. K. Rideal, and Prof. J. F. Spencer as new ordinary members of council. Prof. H. B. Baker delivered his presidential address entitled "Experiments on Molecular Complexity," which will appear in the *Journal of the Chemical Society* for April. The anniversary dinner took place the same evening at the Hotel Victoria. The toast of the Society was proposed by Viscount Sumner, while the toast of the guests, proposed by Sir William Pope, was responded to by Sir Ernest Rutherford, Prof. C. Matignon, representing the Société Chimique de France, and Prof. Wilhelm Schlenk, president of the Deutsche Chemische Gesellschaft.

THE next meeting of the International Astronomical Union will be held at Leyden, Holland, commencing on July 5, 1928.

THE council of the Geological Society of London has this year awarded the proceeds of the Daniel-Pidgeon Trust Fund to Mr. William Elgin Swinton, who proposes to undertake the comparison of British Mesozoic Reptilia with those from similar deposits on the continent of Europe.

ON Feb. 24 a dinner was given in honour of Dr. A. P. Coleman, professor emeritus of geology, University of Toronto. It was arranged by some of his colleagues, former students, and other friends, and it was the occasion of the presentation to the University of Toronto of a portrait of Prof. Coleman, and also of a fund for the maintenance of a gold medal to be known as the Coleman Medal. This medal is to be awarded annually to the student who has obtained, at the time of graduation, the highest standing in his class in geology and mineralogy.

MR. HENRY THOMAS TIZARD, Principal Assistant Secretary, Department of Scientific and Industrial Research, has been appointed by His Majesty the King in Council to be Secretary to the Committee of the Privy Council for Scientific and Industrial Research on the retirement of Sir H. Frank Heath from that office on June 1 next.

MRS. BATESON, widow of the late Dr. W. Bateson, Director of the John Innes Horticultural Institution, Merton, would be glad of the loan of letters written by Dr. Bateson to any readers of NATURE. The letters would be copied and returned without delay unless copies themselves are sent. We are sure that any readers who possess such letters will be glad to assist Mrs. Bateson to bring together correspondence of personal or scientific interest carried on with Dr. Bateson. Communications should be addressed to her at 25 Bolton Gardens, London, S.W. 5.

THE National Research Council of the United States recently granted authority for the establishment of a general committee on the physics of the earth. A number of subsidiary committees have already been elected to deal with such topics as the figure of the earth; seismology; terrestrial magnetism; the age of the earth; the internal constitution of the earth; meteorology; oceanography; and volcanology. The committees are largely American in constitution, but several British scientific workers have been included. Dr. Alfred Harker (Cambridge) has been invited to join the sub-committee on volcanology; Prof. Arthur Holmes (Durham) that on the age of the earth; and Dr. Harold Jeffreys (Cambridge) that on the internal constitution of the earth. The results of the work of the various committees will be published in the Bulletins of the National Research Council.

EXETER has been chosen this year as the centre for the meeting at Easter for regional survey study usually organised by Leplay House. The choice has been determined by the fact that Leplay House and the University College of the South-West at Exeter are co-operating in a regional survey of the south-west of England which, it is hoped, may have a considerable practical effect on the future development of this part of the country. An attractive scheme of study has been planned to cover the period April 14-23, which will include, in addition to the usual lectures and opportunities for individual study, visits to Dartmoor, Crediton, Topsham, and possibly Teignmouth, Dartmouth, and Brixham, thus covering a variety of types of geographical, economic, and industrial conditions in the area. Arrangements are also being made for a summer meeting at Warwick

on Sept. 7-17. Particulars of membership, etc., may be obtained from the Secretary, Leplay House, 65 Belgrave Rd., S.W.1.

THE council of the Institution of Mining and Metallurgy has made the following awards: The Gold Medal of the Institution to Prof. William Frecheville, in recognition of his services to the mining industry during a long and distinguished professional career, and to mining engineering education; The Consolidated Gold Fields of South Africa, Ltd., Gold Medal and Premium to Dr. Sydney W. Smith, for his paper, embodying much original research, on "Liquation in Molten Alloys and its possible Geological Significance"; and the Arthur Claudet Students' Prize to Mr. Robert A. Mackay for a paper on "The Influence of Superimposed Strata on the Deposition of Certain Lead-Zinc Ores."

THE Report of the Secretary of the Smithsonian Institution, submitted on Dec. 9 last, records the acquisition of the Dognin collection of Lepidoptera, by means of gifts from friends amounting to 50,000 dollars. The collection contains 82,000 specimens, of which 3000 are types mostly from the New World, and will thus, it is claimed, give the United States National Museum a better representation of American species in this group than exists in any other museum. In the same report Dr. Walcott states that during the year the Smithsonian Institution directed or took part in forty scientific expeditions to various parts of the world. Most of these expeditions were for the collection of natural history specimens, and the report emphasises the urgent need for making such collections before more species of animals and plants are extinguished by the rapid encroachments of civilised man. This great activity was rendered possible by the generosity of other organisations and of many private citizens.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A male assistant horticultural instructor at the Hertfordshire Agricultural Institute, Oaklands, St. Albans—The Clerk of the County Council, 28 Castle Street, Hertford (April 14). A head of the department of pharmacy of the Bradford Technical College—The Principal, Technical College, Bradford (April 23). A lecturer in geography (man or woman) at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (May 14). A teacher of woodwork and metal work at St. Olave's School, Tower Bridge, S.E.1—The Head Master. A sanitary inspector in connexion with the Sudan Medical Service—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1. Civilian education officers of the Royal Air Force—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

Our Astronomical Column.

COMETS.—A later orbit of Stearns's comet, including observations up to Mar. 18, has been computed by Messrs. J. P. Möller and Bengt Strömgren (*Copenhagen Circ.* 144).

$$\left.\begin{array}{ll} T = 1927 \text{ Mar. } 1{\cdot}5645 \text{ U.T.} & \\ \omega = 6^\circ\ 57'{\cdot}64 & \\ \Omega = 214\ \ 31{\cdot}64 & \\ i = 87\ \ 8{\cdot}15 & \end{array}\right\} 1927{\cdot}0$$

$$\log q = 0{\cdot}56575$$

The plane of the orbit agrees well with that found by Mr. L. E. Cunningham, but the date of perihelion is six months earlier, so that no increase in light is to be expected. The comet is, however, an easy telescopic object, and should be followed for several months. The following observation was obtained by Dr. A. C. D. Crommelin:

	R.A. 1927·0	S. Decl.
Mar. $27^d\ 0^h\ 48^m\ 39^s$ U.T.	$15^h\ 9^m\ 22^s{\cdot}40$	$1^\circ\ 43'\ 33''{\cdot}2$

The comet was about 1′ in diameter, with distinct central condensation; the position is in good agreement with that calculated from the above orbit, which is probably near the truth. The following are the positions for 0^h calculated from it:

April 5, R.A. $15^h\ 3^m\ 32^s$; N. Decl. 1° 36′; April 13, R.A. $14^h\ 57^m\ 12^s$; N. Decl. 4° 38′.

Mr. G. Merton has found an image of Pons-Winnecke's comet on a plate taken Feb. 25·06804 U.T. R.A. 1927·0, $14^h\ 4^m\ 25^s{\cdot}54$; N. Decl. 23° 49′ 13″·6; magnitude, 15; diameter, 15″. He has also measured a photograph of comet Comas Sola taken by Mr. F. J. Hargreaves and gives the following position:

Mar. 23·8729 U.T.; R.A. 1927·0, $4^h\ 36^m\ 26^s{\cdot}67$; N. Decl. 30° 27′ 43″·5; magnitude, 12·6.

MERCURY AS AN EVENING STAR.—Herr C. Schoch writes to say that he had many replies to his request for observations of Mercury as an evening star in February (NATURE, Feb. 12, p. 252). At Arosa, in Switzerland, it was visible for the first time on Feb. 13, the *arcus visionis* being 10°·2, the same as the value indicated by the old Babylonian observations. The duration of visibility was 62 minutes at Arosa, 66 minutes at Steglitz, the longest duration recorded at Babylon being 72 minutes. He noted the colour of Mercury, seen from Steglitz, as yellow, without admixture of red. Only three reports were received from England, the weather being generally cloudy.

Herr Schoch's latest value of the solar acceleration in a century is 2″·98 if measured by the increase of speed, but 1″·49 if measured by the distance gained, which is the more usual method. He ascribes the acceleration to the lengthening of the day by tidal friction, and gives the formula, length of day = 24^h (reckoned as in 1900) + $0^s{\cdot}00194T$, so that 52,000 years from 1900 will be required to make the day 1 second longer. T denotes the centuries after 1900.

SOUTHERN DOUBLE STARS.—Mr. W. H. van den Bos, who is observing southern double stars, gives a third list in *Bull. Astron. Instit. Netherlands*, 3, 114, containing 423 new pairs and bringing his total discoveries to 634, of which 50 are nearer than 0·24″, 104 between 0·25″ and 0·54″, and 87 between 0·55″ and 1·04″. Very few are of types *B* and *M*. More than one-third are of type *G*, the order then being *A*, *K*, *F*. ψ Sagittarii is an interesting star. The magnitudes are 5·5, 6·0, separation 0·2″, spectrum *F*5. This has also been observed as a spectroscopic double at the Lick Observatory station at Santiago; both spectra visible, relative velocity 130 km./sec. Mr. van den Bos says "This can hardly relate to the visual pair, unless the eccentricity and inclination are large, the period short, and the spectrograms taken near the node."

Research Items.

ORIENTATION OF CHURCHES.—In a lecture on "The Orientation of Churches," recently delivered to the members of the Sidmouth Literary Society, the Rev. John Griffith paid a whole-hearted tribute to the work of Sir Norman Lockyer in the study of stone circles from the astronomical point of view. His attention was first directed to the subject by an article by Sir Norman on "The Agricultural Divisions of the Year" in NATURE, in which it was pointed out that the orientations of stone circles grouped themselves around February, May, August, and November. This 'farmer's year' was based upon a division of the year with which he himself had been familiar from boyhood and, as he had at once pointed out to Sir Norman, coincided with the Celtic divisions of the year of tradition and folklore; while English fairs, as dated at the beginning of the last century, clustered around these four points. These facts indicate a continuous calendrical usage from the present day back to the stone age, over a period of 4000 years. Stimulated by this result of the application of astronomical methods to the study of ancient monuments, Mr. Griffith has devoted himself to investigating the orientation of the older churches of Great Britain and has obtained similar results. He finds that, allowing for a difference of five days in the calendar between the twelfth century, when most of those churches were built, and the present day, there appears to be evidence of dedication to a popular saint, who often differs from the official patron saint. In Wales the choice is generally limited to four saints, Mary, Michael, Peter, and John the Baptist, while everywhere the feast of St. James with St. Philip on Mayday is popular as occupying a seat which, since the dawn of traditional history, has been held by one pagan deity or another.

REST PERIODS IN NEW GUINEA.—In *Man* for March, Prof. C. G. Seligman describes the alternation of rest and work periods among the Sinaugolo of Rigo District, New Guinea. Among this people the *dubu* could be built and the great feast, the *tabu*, be celebrated only during the *kaba* period; while in the period known as *dauka*, intervening between two *tabu* feasts, the drum was not sounded or the customary small feasts held, while only those known as *dauka*, feasts accompanying payment for a wife, and death and mourning feasts, could take place, dancing being to the accompaniment of bamboo dancing sticks and not the drum. Food was not piled on the *dubu* but on temporary platforms. Otherwise life proceeded as usual, and the customary hunting, fishing, planting, and sexual taboos were observed. A *dauka* period recurred every second or third year. According to the explanation of a Sinaugolo headman, these periods were instituted to secure the proper observation of these ceremonies, and a relaxation from the toil of ordinary life represented by the *dauka* period. In the *tabu* feast itself all neighbouring and friendly villages take part, but it is given by one portion of a village or by a clan, though sometimes two clans united for the purpose. The preparations involved the collection of stores of food under a taboo. Food for the first ceremony, the *kidua*, is collected from neighbouring villages, this virtually constituting an invitation and acceptance of an invitation to the feast. This food was distributed to the visitors from neighbouring villages in the *kidua* ceremony. On the next day the pigs given at the *baiseno*, a dance preceding the *tabu* feast by about a month, were hung to the *dubu*. Then follows the giving away of the *tabu*, an essential feature of which was the boasting of the men with the object of instigating visitors to undertake the next *tabu*. For the next two or three days feasting follows, in which the pigs given at the *baiseno* are killed and eaten.

EARLY CHINESE CARTOGRAPHY.—The oldest two maps of China known to exist were found some years ago at Hsianfu, the capital of the Shensi province, and were described by Prof. E. Chavannes in 1903. These maps formed the subject of a lecture by Prof. W. E. Soothill to the Royal Geographical Society on Mar. 14. They are engraved on stone, and preserved among other stone tablets. Chavannes dated the earlier of these maps 1043, but it is less easy to decide the date of the map from which much of it was copied. Prof. Soothill's conclusion is that the larger map is part of Chia Tan's map completed in A.D. 801, and that it may have been based on P'ei Hsiu's maps of the third century, not directly, but rather on copies elaborated by local cartographers. He believes that, with some change in names, it may be taken to represent China as it was known in the eighth century. The second map would appear to be more recent. It lacks the marginal notes of the other, and is covered by a grid of 100 li squares. Prof. Soothill thinks that it was drawn by an unknown cartographer some time during the three centuries preceding A.D. 1100, that is, after the time of Chia Tan. It suggests an endeavour to reconstruct P'ei Hsiu's lost map, using his net system, but it shows an advance in accuracy from Chia Tan's time.

ESKIMO IN EAST GREENLAND.—In a lecture to the Royal Geographical Society on Mar. 21 on the Cambridge expedition which he led to East Greenland last summer, Mr. J. M. Wordie referred to the traces of former Eskimo habitation which occur on that coast. A search of the coast region between Sabine Island and Scoresby Sound revealed a number of tent rings, groups of winter huts, and a few graves. Clavering Island is rich in remains: some regions, on the other hand, showed no traces. The conclusion is that the Eskimo can never have been very numerous on the east coast, and Mr. Wordie believes that the evidence points to only one period of immigration during which the Eskimo arrived by the north of Greenland. This is a reversion to the earlier views of H. P. Steensby, who held that the Eskimo followed the musk-ox by that route. Recent examination of the north coast of Greenland by K. Rasmussen renders that route unlikely, not merely in the lack of Eskimo remains but in the absence of game or possible hunting grounds and the bad travelling conditions. Mr. Wordie visited the new Eskimo settlements formed by the Danish Government on Scoresby Sound, which are composed of Eskimo of pure stock from Angmagsalik, the one surviving Eskimo settlement from the original colonisation of that coast. If game resources last, the prospects of these new colonies are good, but it must be remembered that the disappearance of the majority of the east-coast Eskimo during the nineteenth century was probably due to the exhaustion of resources. The same might occur again.

FISHERY INVESTIGATIONS AT CULLERCOATS.—The results of the investigations carried out at the Dove Marine Laboratory, Cullercoats, during the year ending June 30, 1926, are given in Report 15 (N.S.), which has recently been issued by the Laboratory. Mr. Storrow and Mrs. Cowan deal with their observations of the length, age, growth, and sexual condition of some 4600 herrings from commercial landings from the Shetlands, Firth of Forth, East Anglia, north-west and south of Ireland, Irish Sea, and Clyde. Mr. Gill, biochemist at the laboratory, gives a preliminary

description of some investigations regarding the characterisation of the flesh protein of the herring, the subject being attacked from the point of view of the amino-acids present. Mr. Gill also reports on his estimations of the quantity of dissolved oxygen in the waters of the River Tyne. The percentage in the tidal region follows very closely the amount of fresh water coming down the river, both being at a maximum in the winter and at a minimum in the summer. Heavy rains, however, even for a few days, can raise the oxygen content of the estuary from its low summer values to the high winter values. Mrs. Cowan describes the growth under aquarium conditions of the lumpsucker (*Cyclopterus lumpus*) reared from the egg. Prof. Meek deals with some interesting replies to a letter circulated among fishermen and fishery officers requesting their opinions on the currents along the east coast of Great Britain.

VARIATION IN EARWIGS.—The bimodality of the curve for forceps-length in male earwigs (Forficula) has been well known since the original observations of Bateson and Brindley in 1892. Diakonov in 1925 published further evidence, from material collected in Russia, that the forceps are dimorphic and that the difference is probably not a genetic one but represents two independent positions of equilibrium for forceps development. He also showed various relationships between forceps-length and body-size, but the data were not fully analysed. Prof. J. S. Huxley (*Jour. of Genetics*, vol. 17, No. 3) has now published the original measurements and added a further analysis of this apparently unique type of dimorphism. He finds that plotting the logarithm of forceps-length against the logarithm of body-length gives a straight line, indicating that this organ has the same growth-mechanism as other organs showing heterogonic growth. With increasing body-size there is a tendency for the forceps to shift from short to long, the forceps of the largest animals always coming in the long group. In a colony under unfavourable conditions there was a decrease of mean body-size, but the means of forceps-length were scarcely affected. Nevertheless, the percentage of individuals in the population with short forceps was considerably increased. Similarly, more favourable conditions shift the forceps-length of some individuals during their development from the short to the long type. But there is still no evidence as to why there should be two positions of stability in forceps-length with a gap between them. This can probably only be determined by experiment.

MICRO-ORGANISMS IN TICKS.—Part I. of the 11th and 12th Reports of the Director (Sir Arnold Theiler) of Veterinary Education and Research of the Union of South Africa (Pretoria, Sept. 1926, 817 pp.) contains twenty-six papers ranging over the varied work of this active Department—serological investigations and other studies on blood and on inoculation, protozoology, helminthology, entomology, and studies on grasses and other plants. Attention may be directed to the account, by Dr. E. V. Cowdry, of a group of micro-organisms transmitted hereditarily in ticks and apparently unassociated with disease. These organisms are pleomorphic, bacterium-like, and intracellular, and they stain much less intensely with ordinary methods than most bacteria. They were found in fifteen different species of ticks, including representatives of the Argasidæ as well as the Ixodidæ. No evidence could be found of injury to the tissues of the ticks other than physical distention of the cells to accommodate large numbers of the organsims. They were found in every tick examined, not only from South Africa but also from Jamaica, Trinidad, Honolulu, and several parts of the United States; and as they were present in the eggs of ten species and in the unfed larvæ of seven species, it was concluded that transmission was hereditary. The organisms in several respects resembled Rickettsia, but were of larger size. They also resembled the symbionts of certain lice and blood-feeding flies, but they never gave rise to definite organ-like structures comparable with the mycetomes, and they were restricted to the Malpighian tubes and the eggs, whereas the symbionts referred to are confined to the digestive tract.

THE UTILISATION OF POLLEN BY THE HONEYBEE.—In a paper entitled "The Collection and Utilisation of Pollen by the Honeybee," published as Memoir 98 (June 1926) of the Cornell University Agricultural Experiment Station, Mr. Ralph L. Parker contributes observations of considerable interest. Pollen is known to be the chief source of protein in the food of bees, and a lack of it reacts deleteriously upon the developing brood. The adult bees use the nitrogenous material of pollen in the elaboration of the brood food that is fed to the larvæ for the first two days after eclosion from the egg. This predigested food is fed to the queen all through her larval life. The worker and drone larvæ, on the other hand, are fed afterwards with a mixture of honey and undigested pollen. Substitutes for pollen such as rye, oats, corn, pea-meal, etc., were not found to be beneficial. The feeding with such substitutes is a failure, since, although it may stimulate egg-laying by the queen and brood-care by the workers, larval development is not completed. Some of the simple sugars and proteins of pollen are available to the bee, but most of the other contents are not available. Proteolytic enzymes have been shown to be present in the bee's alimentary canal, but the actual proteins of pollen utilised by that insect have not, so far, been identified. Bee-keepers in regions which at times experience a shortage of pollen during the beginning of the season, are advised to preserve combs of pollen for use during such an eventuality, since no efficient substitutes can be recommended.

ORE DRESSING IN CANADA.—The Annual Report of Investigations in Ore Dressing and Metallurgy for 1925 by the Mines Branch of the Canadian Department of Mines has just been published and shows evidence of very active work. A number of complex ores, *e.g.* silver-lead-zinc, gold-copper, copper-lead-zinc, etc., have been investigated, and satisfactory methods for the treatment of the ores have in most cases been devised. A new process is outlined for the treatment of ilmenite, producing a titanium oxide concentrate capable of being used for the production of pigment and other purposes. Detailed reports upon the concentration by flotation of Canadian molybdenite and graphite ores are also included. It is evident that this section of the Department of Mines is doing excellent service in the development of the Canadian mining industry.

THE PALAGONITE FORMATION OF ICELAND.—The first of a series of papers describing a comprehensive study of the Icelandic eruptives (based on a collection made in 1924 by Dr. G. W. Tyrrell and Dr. M. A. Peacock) appears in the *Trans. Roy. Soc. Edin.*, vol. 55, Pt. 1, No. 3, 1926. It consists of a preface to the series, followed by an account of the basic tuffs by Dr. Peacock. These are either sideromelan-tuffs or palagonite-tuffs. The former consist of basalt glass which has been drastically chilled and fragmented owing to the sub-glacial extrusion of basalt magma. The palagonite-tuffs are the older sideromelan-tuffs which have been hydrated, usually by submersion beneath the sea or by hot springs. It is shown that palagonite is essentially the hydrogel of sideromelan, the hydration being accompanied by a partial loss of

lime and soda and an almost complete oxidation of iron. The palagonite due to submersion is an isotropic yellow gel, but in that due to the action of hot springs there is an obscurely birefringent fibrous structure. Both types are unstable and tend to crystallise with loss of part of the water into chlorites and zeolites. It is suggested that Fermor's proposal to use the term *palagonite* for chlorophæite and other late-magmatic hydrous residual materials in basaltic rocks should be discontinued, since the latter, though of somewhat similar composition to that of the Iceland palagonite, have originated by an entirely different process.

THE COMPOSITION OF METEORITES.—In the *Proc. Amer. Phil. Soc.*, vol. 65, No. 2, p. 119, G. P. Merrill summarises recent work on the chemical and mineral composition of meteorites. The chief point of interest is the result of a series of carefully conducted analyses of representative masses. Twenty-eight terrestrial elements have so far been detected, among those not found being antimony, arsenic, barium, strontium, fluorine, lithium, tin, lead, zinc, and gold. This is a particularly significant list, for it includes many of the common ore- and gangue-making elements that are associated with the continental rocks of the earth. The characteristic ore-making elements of norites and peridotites, such as copper, cobalt, nickel, and the platinum group, are all present, as would be expected. The minerals of meteorites are in many cases of a type that can be accounted for, provided that oxygen was relatively deficient in the medium from which they crystallised. It is pointed out that nothing akin to rocks of the granite family has been found in meteorites; and further, that meteorites have never been found in terrestrial beds of any geological horizon but the most recent. Merrill regards the possible meteoric origin of tektites as still unproved.

COAL CARBONISATION.—On Feb. 8, 1927, Dr. C. H. Lander, Director of the Fuel Research Board, read a paper before the Institution of Petroleum Technologists on "The Production of Oil from Coal." The history and work of the Fuel Research Department, which set out to study this problem in particular, was surveyed. The most interesting part was a disclosure of recent experience with vertical retorts of cast iron. Coal has been carbonised at 625° continuously in this retort setting, from March to December 1926, when it was let down for inspection. These retorts, which are again in use, are stated to have been easy to operate, and the coke product has given satisfaction to consumers. Yields of tar reaching 18 gal./ton were obtained, and it is believed that the retorts approach technical success. More experience of protracted working is necessary before commercial success can be assessed.

IRREGULAR EMISSION OF X-RAYS.—Any experimental work with X-rays in which unusual discontinuities are recorded is now of particular interest, in view of its possible bearing on the *J*-phenomena which are being investigated by Prof. Barkla and his school. It has already been shown that in certain circumstances the relation between the intensity of a number of characteristic rays and the voltage on the bulb changes abruptly at about 4·5 times the minimum potential required for the excitation of each. D. Nasledow and P. Scharawsky, working in the X-ray Institute at Kiew, now report similar changes when a Müller tube of the hot filament type is run at constant voltage and with a variable current (*Zeit. für Phys.*, 41, p. 155, 1927). The $K\alpha$ and $K\beta$ lines from a copper target were separated by reflection from calcite, and their intensities were measured by an ionisation method. When less than 4 milliamperes were passing through the bulb, the intensity of either line was closely proportional to the current; for greater currents the rate of increase was linear, but less rapid than before. A break still took place at 4 milliamp., when the exciting peak voltage was raised from 30 kilovolts to 45 kilovolts. No explanation is offered of these results—which the authors propose to extend—but the apparatus appears to be described in sufficient detail to permit of comparison with the experience of other workers in this field.

FORMS OF SULPHUR TRIOXIDE.—The *Gazzetta Chimica Italiana* for Jan. 1927 contains a series of memoirs by G. Oddo and A. Casalino on the different forms of sulphur trioxide, which were studied some years ago by Oddo. The vapour density of the liquid form at 25° is only slightly above the value for SO_3, although slight association may be present. The amorphous and fibrous solid varieties gave molecular weights about 83·77 as a mean. The solutions of the trioxide in phosphoryl chloride were found to give solid solutions in all proportions, and the results of the depression of freezing-point were therefore irregular and unsuitable for the determination of the molecular weight. In anhydrous sulphuric acid the molecular weight of the liquid form was 80, of the fibrous form 88. The papers contain a detailed description of the preparation of the different forms of sulphur trioxide and of the transformation of one form into another.

MAGNETIC OBSERVATIONS IN AUSTRALIA.—Magnetic observatories in the southern hemisphere are so few that it is an event of some importance when a new one is instituted. For many years, only one magnetic observatory was in operation in Australia, at Melbourne, and even this was of limited service to magnetic science owing to the non-publication of its observations. Gradually this observatory became disturbed by electric tramways, and in 1919 a new observatory, 34 miles away, was built. The magnetograph house is above ground, and consists of a chamber within a chamber, the walls being well lagged to reduce temperature changes. No attempt is made to control the temperature of the inner room by artificial heating. There is no resident observer, the records being changed by a local resident, who also registers a time-break at the beginning and end of each record. The records are posted weekly to Melbourne for development and computation; an observatory official visits the station monthly to make absolute observations for base-line values, and to execute any necessary adjustments. The magnetographs are of the Eschenhagen type; the absolute instruments include a Kew magnetometer and a Schultz earth inductor. During 1924, which appears to be the first year for which hourly observations are published, the vertical force instrument gave considerable trouble, there being large changes in scale value and base line; the horizontal force magnetograph had a nearly constant scale value. The results are given in an (undated) publication, "Melbourne Observatory: Hourly values of the magnetic elements at Toolangi in 1924." It is very satisfactory that the Director, Dr. J. M. Baldwin, has been able both to institute this new observatory and also to obtain publication of hourly values of the elements, a course which places the observations so fully at the disposal of investigators of terrestrial magnetism. It is to be hoped that in time the Government of Victoria may provide the funds necessary for a resident observer, without which it is impossible to maintain a magnetic observatory with full efficiency. The only other magnetic observatory in Australia is the one recently instituted by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington; it is situated near Perth, Western Australia.

The Botany School of the University of Sydney.

THE opening of the new Botany School in the University of Sydney is an event not only important for the British Empire, but also for the world at large. The building is in modernised perpendicular Gothic and harmonises with the main structure of the University of Sydney, which presents some interesting resemblances both in its architecture and its origin to the well-known main building of the University of Toronto. The construction is in stone, and the building is so arranged that it will be an ornament to the University for many years. Although architecturally attractive, it does not represent the petrification of the science in the Pierian springs of architecture rightly dreaded by Thomas Huxley, for it is thoroughly well lighted, spacious, and in every way practical. The entrance is adorned by representations of some of the great masters in the science. The idea of commemorating the great, however, is not confined to the exterior of the building, for the laboratories and other work-rooms are named after distinguished botanists. The botanical museum bears the names of Bentham and Hooker, and its windows show the portraits of such outstanding botanists as Hofmeister, Grew, Sachs, Nageli, Hooker, Bentham, and others. The herbarium, which is spacious and well equipped, is named after John Ray, and in its windows appear effigies of Morrison, Ray, Tournefort, De Jussieu, Linnæus, Robert Brown, etc. The advanced laboratory is named after Charles Darwin. The research laboratory bears the name of Robert Brown, while the first-year laboratory is named after Sir Joseph Banks, two names so signally connected with the beginnings of Australian botany.

The library and reading-rooms provide abundance of space, but the shelves are as yet meagrely lined with books. It is hoped that this shortcoming may, before long, be remedied in view of the great interest which the public in Sydney has begun to take in botanical science.

A physiological laboratory is also among the rooms in the Botany School, and it supplies excellent facilities for the prosecution of that important side of the science. Numerous research rooms for the staff and advanced students are included in the plan of the building, and last, but not least, the lecture theatre is capable of seating two hundred students.

The building was formally opened on Nov. 6, 1926, in the presence of the Governor of New South Wales, the Vice-Chancellor of the University, and Prof. Anstruther Lawson, the head of the school. Prof. E. C. Jeffrey, of Harvard University, was present as guest of honour to deliver an address and also the formal felicitations of this University.

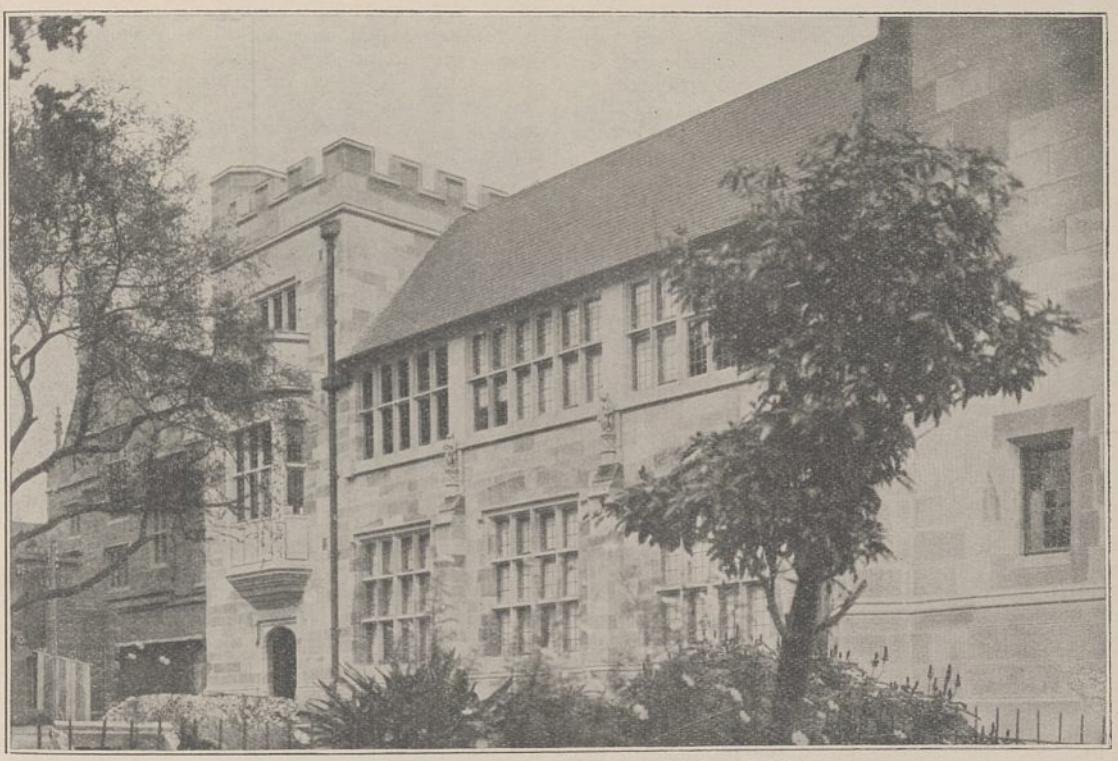

Fig. 1.—Botany School of the University of Sydney, N.S.W.

The opening of the new Botany School in Sydney University is a scientific event of the first magnitude, because it supplies an equipment in the southern hemisphere in every way adequate for the carrying on of botanical investigation. The facilities provided by the Botany School, in fact, compare most favourably with those which are offered by the larger universities in the northern hemisphere. In his remarks Prof. Jeffrey referred to the great advantages which Australasia presents to the students of plants, combining as it does a great variety of environment with healthful conditions of existence and a stable and well-organised government. Australasia, in fact, unites to a large extent the advantages of the tropics with the comfort and salubrity of temperate regions. The flora of Australia is quite as interesting as its fauna, but not nearly so well known. It was suggested, further, that it would be a great advantage if every student of botany in

the northern hemisphere could some time or other visit Australasia. Prof. Lawson, in the name of the University, offered the full hospitality of the botanical laboratory to visiting botanists.

The Botany School of the University of Sydney is a monument to the zeal, capacity, and artistic sense of Prof. Anstruther Lawson. The school has already a large and growing body of students and a highly creditable list of published researches.

E. C. J.

Animal Breeding Research Department, University of Edinburgh.

WE have received from the Director, Dr. F. A. E. Crew, the sixth annual report of the Animal Breeding Research Department of the University of Edinburgh. This department has recently received two large benefactions, namely, £10,000 from Lord Woolavington toward a fund for converting the directorship into a University chair, and £30,000 for general purposes from the Rockefeller Fund, so that the Department has the happy prospect of enlarging the scope of its work.

The report before us contains the list of a large number of problems of inheritance which are being attacked, but the progress made with the solution of any of them seems to be but moderate. All of them will require a long stretch of years before any considerable advance is made towards their solution, and in the case of domestic animals, the numbers with which it is possible to deal are too small to justify a successful analysis into Mendelian 'factors.'

More striking results are obtained from the investigation of endocrine reactions. We may direct attention to some extremely interesting results of extirpation of gonads in the mouse obtained by Mr. Kasur. The weight of the male remains unchanged, that of the female increases, but the kidney of the normal male is much heavier than that of the normal female, whereas the thymus and spleen of the former are considerably lighter than those of the latter. After castration the kidney of the male decreases whilst the thymus and spleen increase in weight, so that in all these respects the animal approaches the female type.

Another thought-provoking result was obtained by Mr. A. W. Greenwood acting in collaboration with the Director. He grafted into the body of a female chick four days old, after removing her ovaries, the testes of her brother. The bird assumed the plumage of the cock. This is in accordance with Zawadovsky's interesting results, in which he converted a cock into a hen and vice versa by the transposition of the gonads. But in the case under consideration the bird, after a subsequent moult, reverted to the plumage of the hen. A post-mortem examination revealed the fact that a small fragment of the functional left ovary had been left in the body by the operation, but that this remnant had degenerated. Not only, however, had the testis grafts survived and produced an abundance of testicular tissue, but ovariotomy had stimulated the vestigial right ovary to activity and it had also produced testicular tissue, so that the bird was in fact over-masculinised. Messrs. Greenwood and Crew advance the hypothesis that the ovary exercises a heavier drain on metabolism than the testis, and that the distinction between male and female secondary sexual characters is due to the degree of strain exercised on the organisation by the respective gonad in each case. If the testis is artificially increased in bulk beyond the normal, it exercises a strain equal to that of the ovary, and hence the secondary sexual characters of the female are produced. E. W. M.

Experiments on Molecular Complexity.

PROF. H. BRERETON BAKER, for his presidential address at the annual general meeting of the Chemical Society on Mar. 24, chose as his theme "Experiments on Molecular Complexity." He had claimed that, like Sir Isaac Newton, "hypotheses non fingo," but, speaking later at the anniversary dinner, admitted that he was an inveterate maker of hypotheses, which, however, he forbore to publish.

The investigations described in the address arose out of the observation, some five years ago, that if liquids of very varying types were subjected to prolonged drying, the boiling points were raised to a very considerable extent. This rise, ascribed to an increase in the complexity of the molecules, takes place with typically unassociated liquids; hence it may be that all liquids are capable of association. Since water can also promote dissociation, it is conceivable that its absence might influence the molecular complexity in opposite directions; so far, however, dry liquids boiling at subnormal temperatures have not been obtained, although dry benzene has been separated into fractions boiling at 80° and 118° respectively. Further researches were carried out to see if catalysts other than water are effective, the experimental methods involving measurements of vapour density and surface tension.

Preliminary experiments in barometer tubes with very pure sugar charcoal gave definitely positive, although not quantitatively reproducible, results. For example, the vapour pressure of ethyl ether at 16° was raised by 25 mm., of methyl alcohol at 35° by 12 mm., and of benzene at 23° or 37° by 2 mm. Prolonged experiments with Smith and Menzies' methods still gave variable results—a circumstance which has led Prof. Baker to two somewhat important deductions. First, a catalyst evidently acts very slowly, and sometimes in a direction contrary to that shown in the final equilibrium; secondly, a pure liquid appears to have no constancy of composition, but possesses a vapour pressure which depends on the history of the specimen. It therefore became necessary to employ a method by which the vapour pressure of the liquid could be balanced against that of the liquid with the catalyst.

Such a method made use of a U-tube containing mercury, the horizontal upper ends each carrying a pair of bulbs, and being connected by a capillary tube. The liquid could thus be distilled on to a catalyst, the capillary junction closed, and the difference arising between the vapour pressure of the pure liquid and that in contact with the catalyst could be directly measured. Acetic acid, benzene, methyl alcohol, ether, and bromine were examined, the catalysts being charcoal, platinum black, or thoria. In every case the catalyst caused an increase in the vapour pressure of the liquid; such a difference was, indeed, clearly apparent in a sample tube exhibited. An even more striking exhibit was a two-limbed tube in which, three weeks previously, accurately measured equal volumes of bromine had been placed, one of the limbs also containing charcoal. After evacuation, the tube had been sealed; so much bromine had afterwards distilled from the limb containing the catalyst that the charcoal was left almost dry. A refinement of the barometer tube method showed that the difference was increased by heating and diminished by cooling; heating and afterwards cooling to 20° always caused an increase in vapour pressure, and cooling the reverse, the original value for a particular catalyst being restored only after some weeks.

For the surface tension measurements Ramsay and Shields' method was employed, the diameters of the

specially resistant capillary tubes being determined directly to one-thousandth part of a millimetre. Comparison tubes were, of course, always used. It was noteworthy that the pure liquid, for example, acetic acid, does not reach its normal value until three weeks after filling the tube, the process of boiling to remove air clearly causing dissociation. Thus, after 2 days the molecular weight was $1{\cdot}568 \times 60$, and after 3 weeks or 9 months, $2{\cdot}097 \times 60$. Heating for a short period in most cases increased the molecular complexity, whilst heating for a long period decreased it. The catalyst, which gave a molecular weight value for acetic acid (measured after 3 weeks) of $2{\cdot}525 \times 60$, did not immediately produce its maximum effect on the complexity of the molecules.

Prof. Baker considers that all liquids may be regarded as analogous to a dissociable gas such as nitrogen tetroxide, the processes of association and dissociation, however, being much slower for liquids than for gases. The effect of the presence of solid catalysts, as would be expected, is much slower for the liquid than for the gaseous condition, and it is difficult to understand how their special influence is exerted. The president acknowledged the help given to him by his assistant, Miss Margaret Carlton, who has done a considerable portion of the experimental work.

University and Educational Intelligence.

Edinburgh.—Mr. V. Gordon Childe has been appointed by the University Court as the first occupant of the Abercromby chair of archæology. This chair was founded in 1925 in accordance with a provision for its endowment in the will of the late Lord Abercromby, the well-known archæologist and authority on the pottery of the bronze age in Britain. Mr. Childe was educated at the University of Sydney, where, after taking his M.A. degree, he was awarded a classical scholarship tenable at Oxford. He became a member of Queen's College, Oxford, in 1914, took his B.Litt. in 1916, and a first class in the honours school of *Literæ Humaniores* in 1917. After a short period spent in Australia, Mr. Childe returned to England, and since then has been engaged in archæological research and has acted as librarian of the Royal Anthropological Institute. He has published a number of papers in archæological periodicals and two books of great erudition and originality in the History of Civilisation Series—"The Dawn of European Civilisation" and "The Aryans."

Leeds.—The Miners' Welfare Committee has offered a contribution of £10,000 towards the cost of erection of a new building for the Mining Department of the University. This shares with the Department of Coal Gas and Fuel Industries a building which was erected in 1906, but now, owing to the growth of both departments, it has become inadequate. The Department has received loyal support from the industry. Since 1899 the West Yorkshire Coal Owners' Association has made an annual grant, and has recently contributed £25,000 to the University Development Fund, while contributions from individual members of the mining industry amount to more than £2500. The support thus given by the industry may not improbably result in the Mining Department being the first part of the building scheme to be undertaken.

London.—Mr. W. E. Le Gros Clark has been appointed as from Sept. 1 to the University chair of anatomy tenable at St. Bartholomew's Hospital Medical College. In 1924 Mr. Clark was awarded the Hunterian Medal for anatomical research, and was elected a member of the Board of Examiners for the Fellowship of the Royal College of Surgeons. He has published numerous contributions on the skulls of primates in the *Proceedings of the Zoological Society*, *Journal of Anatomy*, and similar publications.

Dr. Hamilton Hartridge has been appointed as from Sept. 1 to the University chair of physiology tenable at St. Bartholomew's Hospital Medical College. Dr. Hartridge has been a fellow of King's College, Cambridge, since 1912, and was awarded the Horton Smith Prize in 1918. Since 1919 he has been lecturer on organs of special sense and senior demonstrator in physiology at the Physiology Laboratories, Cambridge. He has published numerous papers in *Proceedings of the Royal Society*, 1922–25, *Philosophical Magazine*, 1923, and the *Proceedings of the Cambridge Philosophical Society*.

The following Doctorates have been conferred: D.Sc. in statistics on Mr. A. E. R. Church (University College), for a thesis entitled "On the Means and Squared Standard Deviations of small Samples from any Population"; D.Sc. in physics on Dr. R. C. Johnson, for a thesis entitled "The Structure and Origin of the Swan Band Spectrum of Carbon," and other papers.

Oxford.—The Delegacy for Extra-Mural Studies has arranged a special course of zoology, primarily for teachers of science in secondary schools, on Aug. 2-12. The course, which is part of the annual summer meeting organised by the Delegacy, will deal mainly with recent developments in zoology. Further particulars and application forms can be obtained from the Rev. F. E. Hutchinson, Acland House, Broad Street, Oxford.

The annual value of the Beit memorial fellowships for medical research has been increased and will take effect as from October 1 next. An election of junior fellows will take place in July next. Applications upon a prescribed form must be sent on or before June 1 to Sir James K. Fowler, Honorary Secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W.1.

The Air Council has decided to increase the number of prize cadetships in the Royal Air Force offered for competition annually from three to twelve. These cadetships enable boys to complete the two years' course at the R.A.F. Cadet College, Cranwell, at a cost of only £40 in all to their parents. Candidates are selected at an examination held by the Civil Service Commission in June and November; they must be between 17½ and 19½ years of age, and must be in possession of School Certificate A or B. Applications for the June examination must reach the Civil Service Commission on or before May 4. Further information can be obtained on application to the Secretary, Air Ministry, London. W.C.2.

The list of "Students from other Countries in the Universities and University Colleges of Great Britain and Ireland in October 1926," issued by the Universities Bureau of the British Empire (50 Russell Square, London, W.C.1), contains more than its title suggests. It is a register of the names of students from other countries attending each institution of university rank, and may appear, therefore, to have either the virtues or vices of a public card-index according to the purpose or predilection of the person seeking the type of information afforded by a list of actual names. It is to be noted, however, that on one page the number of students from each country is set out. The following extracts from that page may not be without significance: Africa, 1054; America, 824; Asia, 1754; Europe, 643; The Pacific, 321.

Calendar of Discovery and Invention.

April 3, 1449.—In the Patent Roll, 27 Henry VI., Part 2, No. 468, is the grant of letters patent, dated April 3, 1449, to John of Utynam, born in Flanders, for the exclusive right of making coloured glass for twenty years. This is the earliest known example of an industrial monopoly patent in England or elsewhere. John came to England at the King's command to make glass for Eton College and St. Mary and St. Nicholas College, Cambridge, and because the said art had never been used in England and John intended to instruct divers lieges of the King in many other arts never used in the realm, the King granted that no liege of the King learned in such arts was to use them for a term of twenty years against the will and consent of John under a penalty of £200.

April 4, 1879.—During the course of his lectures at Birkbeck College, Chaloner remarked, "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune." This chance remark fixed itself in the mind of Sidney Gilchrist Thomas, the police-court clerk, who after some years' experiments solved the problem, and in 1877 and 1878 took out patents for the manufacture of 'basic' steel. He was assisted by several metallurgists, but it was Windsor Richards who on April 4, 1879, made the first successful experiments on a large scale, these being carried out at the works of Bolckow, Vaughan, and Co., Middlesbrough. Thomas reaped a fortune, but died at the early age of thirty-five years and was buried in the Passy Cemetery, Paris.

April 5, 1864.—An important improvement in photography was announced by Swan in his paper on the new carbon process read to the Photographic Society on April 5, 1864. Swan employed a tissue "as pliant as paper, and as transparent and smooth as glass, formed of collodion on the one side, and of gelatine impregnated with ammonium bichromate, carbon (indian ink) and saccharine matter (sugar) on the other." Swan's process was at once adopted, notably in France, and to it we owe the finest reproductions of famous pictures.

April 6, 1911.—Leaving New York in the *Roosevelt* in July 1908, Peary again set out for the Arctic, and on April 6, 1911, reached the North Pole, "the crowning result of twenty-three years' devotion to Arctic exploration."

April 7, 1795.—Before the Revolution there was no uniformity in French weights and measures. On May 8, 1790, the Constituent Assembly therefore charged the Paris Academy of Sciences with the organisation of a better system. Lagrange, Laplace, Cassini, Mechain, Lavoisier, Delambre, Prony, and others took part in the work, but it was the measurement of an arc of the meridian from Dunkirk to Barcelona by Delambre and Mechain which led to the adoption of the metre—$\frac{1}{10,000,000}$th part of the distance from pole to equator—as the standard of length, this important unit being made legal on April 7, 1795. The whole metric system of weights and measures was completed in 1799, and was made the only legal one on Nov. 2, 1801.

April 8, 1838.—Regular trans-Atlantic steam navigation was inaugurated by the s.s. *Great Western*, which left Bristol for New York on April 8, 1838. She was a fine wooden paddle-wheel vessel, especially designed by Brunel for this traffic, and was the most remarkable ship of her day. Other steam vessels such as the *Savannah*, H.M.S. *Rhadamanthus*, *Curacoa*, and *Royal William* had crossed the Atlantic before, but were quite unsuitable for continuous steaming, while the first Cunarder, the *Britannia*, did not begin running until 1840. E. C. S.

Societies and Academies.

LONDON.

Royal Society, Mar. 24.—Sybil **Cooper**, D. E. **Denny-Brown**, and Sir Charles S. **Sherrington**: Interaction between ipsilateral spinal reflexes acting on the flexor muscles of the hind-limb. The contraction evoked by reflexes exciting the same muscle when they are concurrent falls largely below the sum of the individual effects which they exert when apart. The effect of one of a pair of concurrent reflexes may default totally, *i.e.* be totally occluded. Such 'occluding' interaction is quite different from the inhibitory interaction of 'antagonistic' reflexes. Its explanation seems to be that, at some structure impinged upon in common by the 'allied' reflexes, (1) tetanic activation from one source precludes concurrent activation by a second, and (2) is not disturbed by the convergent activity of a second. The occlusion is a measure of the convergent overlap of 'allied' reflexes upon 'motor units' held in common. The occluded contraction emerges from occlusion without pause and step for step as the occluding activation subsides. Each individual afferent excites a reflex contraction which is of a pattern specific to that particular afferent.

R. J. **Ludford**: The Golgi apparatus in the cells of tissue cultures. The Golgi apparatus in the cells of tissue cultures undergoes a change in form with the spreading out of the cells on the surface of the cover-glass. It may be stretched until it fragments and its individual particles become dispersed in the cytoplasm; in other cells the osmophil substance of the Golgi apparatus becomes spread in the form of rodlets and granules upon a less deeply impregnated material (the idiosome, or sphere substance), and both substances become scattered together in the cytoplasm. Certain of the fatty globules in the cells of tissue cultures are considered to arise in relationship with the Golgi apparatus.

C. E. **Walker** and Margaret **Allen**: The nature of Golgi bodies and other cytoplasmic structures appearing in fixed material. If lecithin and kephalin are added to colloidal mixtures and films or drops fixed without using acetic acid, structures exactly resembling Golgi elements, etc., are produced. Mitochondria, etc., are also represented. These structures also do not appear if acetic acid is used in the fixative. These artificial structures behave in the same way as Golgi apparatus, etc., when treated with osmic acid and when washed with turpentine. On adding oleaginous emulsions to the colloidal mixtures the structures produced by fixation and osmication appear to behave in a similar manner in relation to the globules of the emulsion as do Golgi elements, etc., to the nucleus of the cell.

W. S. **Patton** and E. **Hindle**: The development of Chinese leishmania in *Phlebotomus major* var. *Chinensis* and *P. sergenti*, var. (See NATURE, Mar. 26, p. 460.)

G. S. **Sansom**: The giant cells in the placenta of the rabbit. Two kinds of giant cells are found in the uterus. The larger are derived from the fœtal trophoblast. They rapidly attain an enormous size, persist until about the 22nd day, and then break up into smaller bodies. Large numbers of these cells are also formed from a portion of the trophoblast which projects free into the uterine cavity after the attachment of the blastocyst to the placental folds on the 8th day. The cells proliferated from this 'trophoblastic fringe' pass into the uterine cavity and penetrate the regenerated uterine epithelium. The mesometrial giant cells are of maternal origin. Appearing about the 11th day and persisting until after the 27th day, they never attain great size. The

trophoblast of the chorion læve gives origin to great numbers of multinucleate spheres, which become free, and are inactive degenerate structures.

Linnean Society, Feb. 17.—Miss Eleanor **Vachell**: An unusual specimen of Anagallis. The plant was noticed in a newly constructed public park at Coldknap, Barry, Glamorgan, in July 1926. It had eleven stems—seven bearing scarlet flowers and four bearing blue flowers. Two types, *A. arvensis* Linn. and *A. fœmina* Mill., are apparently represented on the same plant.—Julian S. **Huxley**: On the relation between egg-weight and body-weight in birds. The analysis of Heinroth's data on the body-weight and egg-weight of 432 species of birds reveals certain points not brought out in his paper. For birds as a whole, the relative egg-weight decreases from 12·2 to 1·8 per cent. of body-weight as we pass from the class of lowest to that of highest body-weight. The relation between egg-weight (y) and body-weight (x) can best be expressed by an equation of the form $y = bx^k$, in which b is constant, but k gradually decreases with increasing body-weight. The limiting value of k appears to be 1·0 for low body-weights. The differences in relative egg-weight between different groups remain approximately constant throughout; but in the smaller members of a group of high mean body-size, relative egg-weight is increasing much more rapidly with increasing body-size than in birds of the same absolute size constituting the heavier members of a group of small mean body-size.—J. T. **Cunningham**: Natural ambicoloration and the production of pigment in flat-fishes. The coloration of the lower side in naturally ambicolorate specimens is not due to the action of light, but seems to be rather a mutation arising from some abnormal condition in the gametes and fertilised eggs.

EDINBURGH.

Royal Society, Mar. 14.—J. H. **Ashworth**: Distribution of anopheline mosquitoes in Scotland. Three species occur, as in England, namely, *A. maculipennis*, *A. bifurcatus*, and *A. plumbeus*. The first is known from only four localities in Scotland, *A. bifurcatus* from 36 localities—this being apparently the most abundant and widespread species—and *A. plumbeus* from eight localities, all in proximity to the east coast or to its estuaries, but except for the Clyde area the west is practically unexamined. The areas in which ague was common in the eighteenth century are unfortunately those in regard to which little or nothing is known of their mosquitoes; there is therefore no basis for a consideration of the present distribution of Anopheles in relation to the former distribution of ague. In the single recent case of indigenous malaria, the history of which points to infection having been acquired at Kirriemuir (Forfarshire) early in August 1919, the mosquito probably acquired the organism (*Plasmodium vivax*) from an infected soldier there.—A. D. **Hobson**: A study of the fertilisation membrane in the echinoderms. Confirmation is given of the view that the zona pellucida is unnecessary for the formation of the fertilisation membrane. Artificial activation of the eggs of *Asterias rubens* by isotonic solutions of various salts is accompanied by normal membrane formation and shows that a decrease in surface tension is unnecessary for this process. These eggs may be partially activated by sperm during the earliest stages of maturation and show formation of Seifriz's 'protoplasmic papillæ.' Fertilisations of eggs of *Echinus miliaris* were made in media of varying *p*H and salinity. Under these conditions, elevation of the membrane is caused by the presence of proteins beneath it; the membrane is completely permeable to salts but impermeable to colloids from the time of its first appearance.—W. L. **Calderwood**: Salmon of the River Grand Cascapedea, Canada. Scale examination of a sample of 182 fish from this river shows that the early river life is retarded, the great majority of the fish descending to the sea when three years old. The high average of 23 lb. amongst the adult fish caught is accounted for by the absence of grilse and small spring fish. No grilse has ever been taken in the river. Three consecutive years' feeding in the sea is recorded on the scales of the great majority of the catch.

PARIS.

Academy of Sciences, Feb. 21.—Charles **Moureu**, Charles **Dufraisse**, and René **Chaux**: Autoxidation and anti-oxygen action (xxi.). Experiments at higher temperatures. Application to the problem of the mode of action of the antidetonants. Details of the experimental study of the rate of oxidation by gaseous oxygen at 100° C. of paraffin wax, petroleum, naphthalene, tetrahydronaphthalene, decahydronaphthalene, some animal and vegetable oils. The effect of the addition of various catalysts in slowing down or accelerating the oxidation has also been studied. Starting with the conception that detonation in internal combustion engines (knocking) is due to the formation of peroxides in the liquid phase, a new theory of the action of antidetonants is developed.—Pierre **Weiss**: The atomic moment in complexes of the iron group.—Henri **Villat**: An extension of the method of Oseen.—W. **Slebodzinski**: The quadrics of Riemann space of three dimensions.—Paul **Alexandroff**: The decomposition of space by closed ensembles.—Paul **Mentré**: Certain displacements of a quadric in ruled projective space.—Georges **Bouligand**: Potential and some connected theories.—André **Roussel**: Equally continued functions.—Paul **Flamant**: The development of a linear transformation in a series of powers of the derivative and the extension of a distributive transformation.—Florin **Vasilesco**: The limit values of harmonic functions.—Gr. **Fichtenholz**: The integration of suites of summable functions.—Th. **De Donder**: The relativistic quantification of continued systems.—Henri **Gutton** and Jean **Clément**: The dielectric properties of ionised gases.—G. **Foëx** and Mlle. A. **Brunet**: The magnetic properties of manganese pyrophosphate at various temperatures; measurement of the moment of the Mn″ ion. Manganese pyrophosphate follows the law of Weiss exactly over the temperature range, $-80°$ C. to $+485°$ C. The atomic moment of the Mn″ ion is found to be 30 magnetons.—Nicolas **Perrakis**: The constant paramagnetism of pentavalent vanadium; V_2O_5, both in the solid state and in solution, has constant paramagnetism $64{\cdot}4 \times 10^{-6}$.—Albert **Pérard**: Metrological researches on some neon and helium lines.—C. V. **Raman** and K. S. **Krishnan**: The constant of magnetic double refraction of benzene. On the basis of some simple hypotheses on the structure of the benzene molecule and on the optical anisotropy of the same molecule, the value of the Cotton-Mouton constant can be calculated.—A. **Piccard** and E. **Stahel**: The ether wind. Reply to a criticism of E. Brylinski.—R. **Descamps**: The anomalous rotatory dispersion in the ultra-violet of three aqueous solutions of tartaric acid containing boric acid. With the aid of a photographic spectropolarimeter, measurements of the rotatory power of tartaric acid solutions containing boric acid for wave-lengths varying from λ5780 to λ2537 were made. Contrary to the conclusions of Lowry and Martin, it is found that the $1/[\alpha]$, λ^2 diagrams are not straight lines, and the curves of rotatory dispersion appear to belong to the anomalous complex type in Lowry's classification.—J. **Errera**:

The specific inductive capacity of heterogeneous mixtures.—Charles **Prévost**: Some derivatives of 1 . 3 . 5-hexatriene.—**Lespieau**: True doubly acetylenic linear hydrocarbons, $C_{13}H_{20}$, and $C_{20}H_{34}$. Details are given of the preparation and properties of $CH:C—(CH_2)_9—C:CH$ and $CH:C—(CH_2)_{16}—C:CH$. —Maurice **Delaville**: Comparative migratory aptitude of the phenyl and diphenyl groups.—P. **Nottin**: Study of the deposit of starch on the tables of starch factories. It is shown that the conditions realised in the industrial preparation of starch are such that a large proportion of the smaller granules is lost in the waste liquors. An improvement is to be expected if the tables are not inclined.—Mlle. V. **Malychef**: The podzolic soils of the north-west of Tunis.—G. **Ollivier**: The tetrasporangia of *Falkenbergia Doubletii*.—Pierre **Dangeard**: The nucleus and nuclear evolution in the Bangia.—H. **Vignes** and **Coisset**: Calcium and halogen contents of the organism in the course of gestation.—H. **Labbé** and A. **Kotzareff**: The action of radium emanation on glycæmia in white mice.—Maurice **Azéma**: The accumulation of fatty reserves by the kidney of *Ascidia mentula*.—J. **Chaine**: The progressive loss of the posterior insertions of certain cephalic muscles.—E. **Derrien**: Porphyrins and parasite worms. The use of Wood's light for the detection of parasites in meat.—E. **Kohn-Abrest**: The estimation on the spot of traces of nitrogen peroxide in air.—Léon **Blum** and D. **Brown**: The pathology of uræmia.

GENEVA.

Physical and Natural History Society, Feb. 3.—W. H. **Schopfer**: General results on the molecular concentration of the liquids of parasites. The molecular concentration of the parasites depends on that of the medium. There is constant adaptation to a medium the choice of which is caused by other physico-chemical factors still unknown.—L. **Duparc**: The tectonic of Abyssinia. The Abyssinian plateau has undergone an epirogenic movement in steps from the Trias to the Tertiary, with a steady withdrawal of the sea towards the east. A subsidence of recent date has opened a depression (Aouache valley) communicating with the great lakes and with the sea.—Ed. **Claparède**: The greatness of Pestalozzi and its numerical evaluation. If seven contemporary works on pedagogy are arbitrarily chosen the number of pages devoted to Pestalozzi, Rousseau, Herbart, Froebel, Coménius, Locke, Kant, Fénelon, Luther, Rollin, Montaigne, Erasmus, Basedow, Rabelais, the following percentages are found: 24·6, 13·4, 11·8, 9·2, 8·8, 5·8, 4·6, 3·9, 3·8, 3·5, 2·9, 2·9, 2·7, 2.—Sw. **Posternak**: The phosphorus-containing nucleus of milk casein. The nucleus of milk casein containing phosphorus, a proteid elaborated by the maternal organism for the phosphorus nutrition of the young animal, is formed of four serin phosphoric acids.—Em. **Cherbuliez**: The destruction of organic matter with the aid of perchloric acid. The destruction of organic material by oxidation is easily effected, without the intervention of non-volatile substances, with strong sulphuric acid to which has been added some perchloric acid containing a little fuming nitric acid. —G. **Tiercy**: The ionisation of gases and the temperatures of the stars. If, applying the formula of M. Saha and of Nernst, in which according to the author it is necessary to correct the constant (Saha's formula), the temperatures of the stars are calculated, the figures found agree remarkably well with those of H. N. Russell.

MELBOURNE.

Royal Society of Victoria, Dec. 16.—Gerald F. **Hill**: Termites (Isoptera) from South Sea and Torres Strait Islands. These termites were collected by A. M. Lea in 1924. Of five species representing three genera, obtained in Fiji, two are proposed as new and three are referred to species originally described from Samoa. A number of immature Calotermes from New Caledonia are most probably referable to species previously described from this locality. The above appear to be the first records of termites from Fiji, Rennel, and Murray Islands.—F. **Chapman**: A Silurian jellyfish. This new species of a well-preserved jellyfish, *Discophyllum mirabile*, from the Silurian (Melbournian) beds at Brunswick, Melbourne, is closely related to *D. peltatum* J. Hall sp. from the Hudson River series below Troy, N.Y. The Melbourne fossil has a probable diameter of 6½ in. It shows the radial and concentric frills of the umbrella, four gastro-genital pouches and extended tentacles. Both forms were fringed Scyphozoa. In associated strata in which the jellyfish was found there was a well-preserved example of *Bythotrephis gracilis* J. Hall sp. which shows the outer cellular layer of the plant.—F. **Chapman**: On a Limestone containing Lepidocyclina and other Foraminifera, from the Cape Range, Exmouth Gulf, Western Australia. The white limestones and chalky beds of this range, discovered by Dr. F. G. Clapp, belong to the older Lepidocyclina series, characterised by *L. dilatata*, a form hitherto unknown in Australian Tertiary deposits. 67 species of foraminifera are recorded, including one new species, *Bolivina spiroplectiformis*, and two species of Ostraceda, *Aglaia clavata* G.S.B. and *Cythere lactea* G.S.B., both of which range through the Tertiary in Australia and are found living around the coast. It is concluded that the limestone is of Aquitanian age.—Z. A. **Merfield**: Total solar eclipse of May 9, 1929. On May 9, 1929, a total solar eclipse will take place and will be visible from northern Sumatra, Malaya, and south Cochin China. This is the only eclipse in the next twelve years to exceed 150 sec. duration. The duration on the west coast of Sumatra will be 5 min. 6 sec., and will afford a splendid opportunity for solar research. A series of meteorological observations has been organised by the Solar Eclipse Circle of the Solar Physics Commission of the International Astronomical Union, and will be made available in due course.—Z. A. **Merfield**: Solar radiation in the Lyman region. From observations made at the total solar eclipse of Jan. 14, 1926, with a moving plate anastigmat grating spectrograph, it is found that Na reaches a height of 3300 km., Ca 1500 km., Ca^+ 10,000 km., Ba^+ 1400 km. Similar results were obtained in Australia in 1922. When the ionisation potentials are taken into account, a comparison of the heights leads to the conclusion that stripped or ionised sodium is not supported by radiation pressure, and as a corollary, that solar radiation is deficient in the Lyman and far ultra-violet regions. The intensity of bright line emission in the far ultra-violet due to highly ionised atoms (taking Ca^{++} as a typical example) depends on a mobile equilibrium and, as a result, radiation from this source is also weak. Solar radiation in this region of the spectrum does not appear to play any important part in the ionisation of the earth's upper atmosphere.—F. Erasmus **Wilson**: New Australian Coleoptera, with notes on some previously described species, Part iii. This paper deals mostly with minute beetles belonging to the family Pselaphidæ, of which thirteen species are described, belonging to the following genera: Schistodactylus (1), Narcodes (2), Schaufussia (1), Pselaphus (6), Tyromorphus (2), and Tinesipharus (1). A species of Daulotypus belonging to the family Endomychidæ and a species of Techmessa of the family Oedemeridæ are also described as new.

Official Publications Received.

BRITISH.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 1, No. 7: The Igneous Geology of Ardsheal Hill, Argyllshire. By Frederick Walker. Pp. 147-157+1 plate. 1s. 9d. Vol. 55, Part 1, No. 8: On a Tetracotyle in the Brain of the Minnow. By Prof. J. H. Ashworth and Janet C. W. Bannerman. Pp. 159-172+1 plate. 2s. Vol. 55, Part 1, No. 9: A Critical Examination of the Vittarieae with a View to their Systematic Comparison. By Dr. S. Williams. Pp. 173-217+3 plates. 6s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Committee on Education and Industry in Scotland. First Report. Pp. 32. (London: H.M. Stationery Office.) 1s. net.

Proceedings of the Royal Society of Edinburgh, Session 1926-1927. Vol. 47, Part 1, No. 4: The Evaporation of Water and Salt Solutions from Surfaces of Stone, Brick and Mortar. By Principal A. P. Laurie and John Milne. Pp. 52-68+1 plate. 1s. 6d. Vol. 47, Part 1, No. 5: The Distribution of Intensity in the X-ray Spectra of the Normal Saturated Dicarboxylic Acids, their Diethyl, and Mono-Ethyl Esters. By Alexander R. Normand, John D. Ross and Edward Henderson. Pp. 69-80. 1s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Department of Agriculture, Jamaica. Entomological Circular No. 12: Insecticides and Fungicides. By C. C. Gowdey. Pp. 12. (Jamaica: Government Printing Office, Kingston.)

Brighter Biochemistry: being the Illustrated Journal of the Biochemical Laboratory, Cambridge. No. 4, February. Pp. 46. (Cambridge: Sir William Dunn Institute.) 2s. 6d.

Proceedings of the Royal Physical Society for the Promotion of Zoology and other Branches of Natural History, Session 1925-26. Vol. 21, Part 2. Pp. 33-108. (Edinburgh: Oliver and Boyd.) 7s. 6d.

The Solar Eclipse of 1927: Catalogue of Books on Astronomy in the Wigan Public Libraries; together with a Note on the Total Eclipse of the Sun to take place on Wednesday, June 29th, 1927, and a Map showing the Area of West Lancashire under the Shadow. Compiled by Arthur John Hawkes. Pp. 14. (Wigan: Central Public Library.) 3d.

Journal of the Chemical Society: containing Papers communicated to the Society. February. Pp. iv+iv+281-531. (London: Gurney and Jackson.)

Memoirs of the Department of Agriculture in India. Veterinary Series, Vol. 3, No. 7: Experiments on the Treatment of Hookworm Infection in Dogs. By Amarnath Gulati. Pp. 167-185. 11 annas; 1s. 3d. Veterinary Series, Vol. 3, Nos. 8, 9: On the Occurrence of a Lung Fluke *Paragonimus edwardsi*, n.sp., in a Palm Civet (*Paradoxurus grayi*) in Kumaon Hills, by Amarnath Gulati; On the Occurrence of *Isospora* and *Balantidium* in Cattle, by Hugh Cooper and Amarnath Gulati. Pp. 187-193+2 plates. 4 annas; 6d. Chemical Series, Vol. 8, No. 12: A Study of Absorption of Moisture by Soils. By Dr. Jatindra Nath Sen and Bhailal Motibhai Amin. Pp. 235-253. 6 annas; 9d. Chemical Series, Vol. 9, No. 1: The Selection of Burma Beans (*Phaseolus lunatus*) for Low Prussic Acid Content. By J. Charlton. Pp. 36. 10 annas; 1s. Chemical Series, Vol. 9, No. 2: Bangalore Maintenance Experiments, First Series. By F. J. Warth. Pp. 37-61. 11 annas; 1s. 2d. (Calcutta: Government of India Central Publication Branch.)

The Journal of the Indian Mathematical Society. Edited by M. T. Naraniengar. Vol. 16, No. 12, December. Pp. 265-292+177-192. (Madras.) 1 rupee.

Journal of the Indian Institute of Science. Vol. 9A, Part 7: Reactions of Chromates at High Temperatures. Part ii: The System CaO-Cr_2O_3-O_2. By K. S. Nargund and H. E. Watson. Pp. 149-167. 1 rupee. Vol. 9A, Part 8: i, The Catalytic Hydrogenation of Carone, by Subramania Narayana Iyer and John Lionel Simonsen; ii, Conessine, by Darab Dinsha Kanga, Panchandana Ramaswami Ayyar and John Lionel Simonsen. Pp. 169-177. 8 annas. (Bangalore.)

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 12, Part 1: Contributions to our Knowledge of the Dermaptera and Orthoptera of the Transvaal and Natal. By James A. G. Rehn. Part ii: Mantidae. Pp. 54+2 plates. (Cambridge: Printed at the University Press.)

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 3. Pp. 357. (Cardiff: University of Wales Press Board.) 2s. 6d.

The Botanic Gardens, Singapore. Illustrated Guide. Pp. 67. (Singapore.) 1 dollar; 2s. 4d.

Ministry of Health. Report of the Departmental Committee on the Treatment of Flour with Chemical Substances. Pp. 24. (London: H.M. Stationery Office.) 6d. net.

Quarterly Journal of the Royal Meteorological Society. Edited by a Committee of the Council. Vol. 53, No. 221, January. Pp. 98. (London: Edward Stanford, Ltd.) 7s. 6d.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 530: Surface Water Supply of the United States, 1921. Part 10: The Great Basin. Pp. v+194+2 plates. 25 cents. Water-Supply Paper 555: Surface Water Supply of Hawaii, July 1, 1921, to June 30, 1922. Pp. iv+177. 20 cents. Water-Supply Paper 564: Surface Water Supply of the United States, 1923. Part 4: St. Lawrence River Basin. Pp. iv+171+3 plates. 25 cents. Water-Supply Paper 592: Surface Water Supply of the United States, 1924. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+178+3 plates. 20 cents. Bulletin 788-A: Topographic Instructions of the United States Geological Survey. A: Administration. Compiled by H. M. Fryer. Pp. v+45. 10 cents. Professional Paper 137: The Fauna of the Ripley Formation on Coon Creek, Tennessee. By Bruce Wade. Pp. ii+272+72 plates. 1 dollar. Professional Paper 147-C: American Tertiary Mollusks of the Genus Clementia. By W. P. Woodring. (Shorter Contributions to General Geology, 1926.) Pp. ii+25-49 +plates 14-17. (Washington, D.C.: Government Printing Office.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1926. Pp. vi+375+5 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 137: The Collection of Primitive Weapons and Armor of the Philippine Islands in the United States National Museum. By Herbert W. Krieger. Pp. iii+128+21 plates. (Washington, D.C.: Government Printing Office.)

Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung. Jahrgang 1922. Neue Folge, Band 69. Pp. xvi+A30+B39+C42+D3. (Wien: Gerold und Ko.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene in de Arktiske Have (The State of the Ice in the Arctic Seas) 1926. Pp. 34+5 maps. (København: G. E. C. Gad.)

Proceedings of the United States National Museum. Vol. 69, Art. 19: *Kentriodon pernix*, a Miocene Porpoise from Maryland. By Remington Kellogg. (No. 2645.) Pp. 55+14 plates. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 78, 1926, Supplement: Synopsis of North American Diatomaceae. Part i: Coscinodiscatae, Rhizoselenatae, Biddulphiatae, Fragilariatae. By Charles S. Boyer. Pp. 228. (Philadelphia, Pa.)

Proceedings of the Imperial Academy. Vol. 2, No. 10, December 1926. Pp. xxvii-xxviii+521-564+ix+ii. (Ueno Park, Tokyo.)

State of California: Fish and Game Commission. Twenty-ninth Biennial Report for the Years 1924-1926. Pp. 127. (Sacramento, Cal.)

Bernice P. Bishop Museum. Bulletin 29: Ancient Hawaiian Music. By Helen H. Roberts. Pp. 401+5 plates. Bulletin 30: Pyroclastic Geology of Oahu. By Chester K. Wentworth. Pp. iv+121+22 plates. Bulletin 31: Insects of Hawaii, Johnston Island and Wake Island. By E. H. Bryan, Jr., and collaborators. (Tanager Expedition, Publication No. 3.) Pp. 94. Bulletin 32: History and Traditions of Niue. By Edwin M. Loeb. Pp. iv+226+13 plates. Bulletin 33: The Products and Structure of Kilauea. By John B. Stone. Pp. 59+2 plates. Honolulu, Hawaii.)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 65, No. 5. Pp. xv+381-385. (Philadelphia, Pa.)

Conference on the Future of the Smithsonian Institution, February 11, 1927. Pp. 40+7 plates. (Washington, D.C.: Smithsonian Institution.)

Reprint and Circular Series of the National Research Council. No. 72: A Bibliography of the Analysis and Measurement of Human Personality up to 1926. By Dr. Grace E. Manson. Pp. 59. 1 dollar. No. 73: List of Publications of the National Research Council and its Fellows and Partial List of Papers having their Origin in the Activities of its Committees to January 1, 1926. Pp. 70. 75 cents. No. 74: The Need for Scientific Research in the Fishing Industries. By Maurice Holland. Pp. 8. 15 cents. (Washington, D.C.: National Academy of Sciences.)

Bulletin of the National Research Council. Vol. 11, Part 2, No. 56: Transactions of the American Geophysical Union, Seventh Annual Meeting, April 29 and 30, 1926, Washington, D.C. Pp. 134. (Washington, D.C.: National Academy of Sciences.) 1.25 dollars.

Proceedings of the United States National Museum. Vol. 70, Art. 7: Notes on Cestode Parasites of Birds. By Edwin Linton. (No. 2656. Pp. 73+15 plates. (Washington, D.C.: Government Printing Office.)

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 36: The Uredinales or Rusts of Connecticut and the other New England States. By Dr. Willis Roberts Hunt. (Public Document No. 47.) Pp. 198. 1 dollar. Bulletin No. 37: Catalogue of the Lichens of Connecticut. By Prof. Alexander William Evans and Rose Meyrowitz. (Public Document No. 47). Pp. 56. 60 cents. (Hartford, Conn.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 354: Tides and Currents in South-east Alaska. By R. W. Woodworth and F. J. Haight. (Special Publication No. 127.) Pp. iv+149. (Washington, D.C.: Government Printing Office.) 25 cents.

Smithsonian Miscellaneous Collections. Vol. 78, No. 6: The Lyell and Fresh field Glaciers, Canadian Rocky Mountains, 1926. By Dr. J. Monroe Thorington. (Publication 2911.) Pp. 8+12 plates. (Washington, D.C.: Smithsonian Institution.)

Department of the Interior: Bureau of Education. Bulletin, 1926, No. 21: Record of Current Educational Publications; comprising Publications received by the Bureau of Education to October 1, 1926. Pp. 24. (Washington, D.C.: Government Printing Office.) 5 cents.

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 4. Pp. iv+163. (Paris: Les Presses universitaires de France.)

The Royal Colonial Institute at Amsterdam: Origin, Scope and Future. By C. J. Hasselman. Translated from the Dutch by E. J. Labarre. Second, revised edition. Pp. 104. (Amsterdam.)

Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 311: Stucco Investigations at the Bureau of Standards, with Recommendations for Portland Cement Stucco Construction. Pp. 34. (Washington, D.C.: Government Printing Office.) 15 cents.

Diary of Societies.

SATURDAY, APRIL 2.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall, Bradford), at 2.

INSTITUTION OF BRITISH FOUNDRYMEN (Lancashire Branch) (Annual General Meeting) (at College of Technology, Manchester), at 3.—At 4.—B. Hird: Absorbed Gases in Iron and the Creation of Gas Holes in the Casting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford The Alpha Rays and their Application to Atomic Structure (3).

MONDAY, APRIL 4.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. S. M. Zwemer: The Place of Woman in Islam.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Large Intestine.
SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—G. C. Workman: Some Aspects of Reinforced Concrete.
INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—W. G. Ruggins: Automobile Repairs.
ARISTOTELIAN SOCIETY (at University of London Club), at 8.
SOCIETY OF CHEMICAL INDUSTRY (London Section, jointly with Fuel Section) (at Chemical Society), at 8.—Dr. R. Lessing: The International Conference on Bituminous Coals at Pittsburgh.

TUESDAY, APRIL 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. W. Cobb: Some Properties of Coke (2).
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—E. G. Boulenger: Exhibition of Photograph of a Crab with Abnormal Claw.—Dr. J. Beattie: The Anatomy of the Marmoset, *Hapale jacchus* Linn.—Dr. H. H. Woollard: On the Brain of the Marmoset, *Hapale jacchus* Linn.—Major R. W. G. Hingston: Protective Devices in Spiders' Snares.
INSTITUTION OF CIVIL ENGINEERS, at 6.—I. J. Jones and G. Curry: The Enlargement of the City and South London Railway Tunnels.
LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—R. Green: Bird Portraiture.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester) (Annual General Meeting), at 7.—F. H. Clough: The Stability of Large Power Systems.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—M. Barford: Pictures from the Pyrenees.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at University, Birmingham), at 7.15.—A. A. King: Ultraviolet Light.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—A. P. Young and L. Griffiths: The High-Tension Magneto, with Especial Reference to its Design, Manufacture, and Service.
RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—J. V. Sparks: Uses of Lipiadol as an Aid to Diagnosis in Diseases of the Chest.—F. Melville: X-Ray Cinematography.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. C. Singer: Tradition and Observation as illustrated by the Herbal 100 B.C. to 1500 A.D.

WEDNESDAY, APRIL 6.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. H. L. Hawkins and Miss S. M. Hampton: The Occurrence, Morphology, and Affinities of the Silurian Echinoidea Echinocystis and Palæodiscus.—V. G. Glenday and Dr. J. Parkinson: The Kateruk Series and Associated Rocks of the Northern Suk Hills (Kenya Colony).
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—F. E. Wentworth-Sheilds: Methods of Preserving Structures.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—P. R. Coursey and H. Andrewes: Battery Eliminators or Appliances for the Operation of Radio Receiving Apparatus by Energy Derived from Electric Supply Mains.
INSTITUTION OF SANITARY ENGINEERS (at Caxton Hall, Westminster), at 6.—R. C. N. Newport and E. O. Danger: Kingsbury Main Drainage Scheme, 1924–1926.
ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, Strand), at 7.—T. Settle: Women's Place in the American Electrical Industry.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—W. W. Bath: A Modern Power Station.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—C. Ainsworth Mitchell and T. J. Ward: The Sequence of Strokes in Writing.—Dr. D. W. Kent-Jones and C. W. Herd: (*a*) Some Observations on the Wasting of Gluten from Flour; (*b*) A Numerical Expression for the Colour of Flour.—Dr. H. B. Dunnicliff and Kishen Lal: The Determination of Free Mercury in Commercial Products.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL SOCIETY OF MEDICINE (Odontology and Study of Disease in Children Sections), at 8.—A. T. Pitts (Odontology), Dr. R. Hutchison (Disease in Children), and others: Discussion on Oral Manifestations of General Disease in Children.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section) (Laboratory Meeting at London School of Hygiene and Tropical Medicine), at 8.
INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).—Annual General Meeting.

THURSDAY, APRIL 7.

LINNEAN SOCIETY OF LONDON, at 5.—G. C. Robson: Exhibition of Preparations and Lantern-slides illustrating Bacterial Luminescence in Cephalopoda.—Prof. J. Percival: The Species and Races of Wheat and their Relationships.
ROYAL SOCIETY OF MEDICINE, at 5.—W. G. Spencer, Dr. H. French, Dr. Fortescue Fox, and others: Discussion on Blood-letting.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—H. J. E. Peake: The Beginnings and Early Spread of Agriculture (2).
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. B. Wedmore, W. B. Whitney, and C. E. R. Bruce: A Contribution to the Study of the Number of Tests required to establish the Rupturing Capacity of an Oil Circuit-Breaker.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Prof. C. V. Raman: Huygens' Principle and the Phenomena of Total Reflection.—H. W. Lee: The Hartmann Formula for the Dispersion of Optical Glass.
CHEMICAL SOCIETY, at 8.—H. King: Trypanocidal Action and Chemical Constitution. Part VI. Amphoteric *s*-carbamidoarylarsinic Acids.—E. J. B. Willey: On Active Nitrogen. Part III. Active Nitrogen and the Metals.
HARVEIAN SOCIETY OF LONDON (at Paddington Town Hall), at 8.30.—T. P. Dunhill, Dr. C. M. Wilson, and others: Discussion on the Treatment of Graves's Disease.
INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).—Annual General Meeting.
OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, APRIL 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. E. W. Brown: Note on Dr. Fotheringham's Paper entitled "Trepidation."—P. A. Curry: The Effect of reversing a small Transit Instrument.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Anatomy and Physiology of the Cæcum and Appendix Vermiformis.
MALACOLOGICAL SOCIETY (at Linnean Society), at 6.
WOMEN'S ENGINEERING SOCIETY, at 6.30.—Miss E. M. Kennedy: A Business Woman's Trip to America.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. Ambrose: Electrical Osmosis.
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—E. A. Smith: Refined Silver for Electro-plating Anodes.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Prof. S. Russ and Miss G. M. Scott: (*a*) The Growth of Tumours in Tissues Exposed to X-rays and Radium; (*b*) The Action of Radon Seeds upon Tumours and Some Normal Tissues of the Rat.—Dr. J. C. Mottram: On the Co-relation between the Experimental and Clinical Radiation of Tumours.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Ernest Rutherford: Early Days in Radio-activity.
INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).—Annual General Meeting.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section).—Annual General Meeting.

SATURDAY, APRIL 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Alpha Rays and their Application to Atomic Structure (4)

PUBLIC LECTURES.

SUNDAY, APRIL 3.

GUILDHOUSE (Eccleston Square), at 3.30.—Prof. J. P. Bruce: Confucianism.

THURSDAY, APRIL 7.

FULHAM CENTRAL PUBLIC LIBRARY, at 8.—J. Weathers: Some Common Mistakes in Gardening.

SUNDAY, APRIL 10.

GUILDHOUSE (Eccleston Square), at 3.30.—Rev. Father Andrew: Christianity.

COMMEMORATION.

LISTER CENTENARY, APRIL 4, 5, AND 6.

April 4, at 3.—King's College Hospital.—Sir Watson Cheyne, Bart., Sir Lenthal Cheatle, and others: Lister's Personality.—At 8.30.—Royal Society of Medicine.—Sir StClair Thomson: The Centenary of Lister, Personal Recollections by One of his House-surgeons.
April 5 (at British Medical Association, 19 Tavistock Square, W.C.), at 11.30 A.M.—Reception of Delegates by the Prime Minister.—At 4.—Conversazione at Royal College of Surgeons of England.
April 6 (Westminster Abbey), at 11.15.—Bishop of Birmingham: Address.—(At Royal Society of Medicine, 1 Wimpole Street, W.), at 3.—Discourses by Sir Charles Sherrington, Prof. W. Bulloch, and Sir Berkeley Moynihan, Bart., on Lord Lister as Physiologist, Bacteriologist, and Surgeon.—At 9.—Conversazione at Royal Society.

CONFERENCES.

APRIL 7 TO 9.

TUBERCULOSIS SOCIETY AND SOCIETY OF SUPERINTENDENTS OF TUBERCULOSIS INSTITUTIONS (at Oxford).
April 7, at 2.30.—Prof. L. Cummins: The Bovine Tubercle Bacillus in Immunisation.
April 8, at 10 A.M.—Dr. Leonard Hill and others: Discussion on the Defensive Mechanism of the Body against Tuberculosis from the Physical and Chemical Aspect.—At 2.15.—Dr. J. Freeman: The Defence of the Body from the Bacteriological and Immunological Side.—Dr. A. G. Gibson: Secondary Infections in Relation to the Progress of Pulmonary Tuberculosis.—Dr. A. D. Gardner: The Laboratory Diagnosis of Tubercle.
April 9, at 10 A.M.—Dr. J. M. Martin, Dr. D. P. Sutherland, and Dr. P. Edwards: The Gaps and Flaws in the Public Health Administration of Tuberculosis.

APRIL 20 TO 24.

JOURNÉES MÉDICALES MARSEILLAISES ET COLONIALES (at Marseilles).—Prof. Cantacuzène: The Rôle of the Streptococcus in the Etiology of Scarlet Fever.—Dr. Mayer: Recent Advances in the Treatment of Cancer.—Prof. Ottolenghi: Malaria.—Dr. N. Bernard: Beri-beri.—Prof. Imbert: Bone-grafting.

APRIL 25 TO 28.

GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).—Discussions on Psychotherapy, introduced by Gaupp and Fleischmann; Results of Recent Functional Investigations of the Stomach and Duodenum, introduced by G. Katsch.—A joint meeting with the German Röntgen Society will be held on April 28, with a discussion on the Significance of Röntgen-ray Examination of the Lungs and Mediastinum for Internal Medicine (excluding Tuberculosis), introduced by Dietlen, Assmann, Haenisch and Lorey, and Fleischner.