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The International Institute of Agriculture.

NOTWITHSTANDING the position of science in the life of the nation, little or nothing has been done by the administration of Great Britain to give 'a square deal' to the scientific and technical officers employed in the service of the State. Frequent references to the disabilities under which the specialist officers labour have been made in these columns; and whenever suitable opportunity occurs we shall continue to associate their cause with that of efficient administration. Readers of this journal will recall the recent discussion of the report of the Royal Commission on the Civil Service, when a number of proposals for reform were advocated (NATURE, Aug. 8 and 15, 1931).

Two things are needed to hasten these reforms. In the first place, an informed public opinion must be created which will insist that all important questions of the day involving scientific considerations are discussed with the full assistance of experts, who, moreover, must have free access to the supreme authority represented by the Minister. In this way the specialist officers will take their proper share in the formation of policy. In the second place, every blunder in administration which might have been avoided by the proper utilisation of scientific knowledge should receive the widest publicity.

A striking example of the maladministration of a scientific question has recently been brought to light by the publication of a detailed account of the founding, organisation, and administration of the International Institute of Agriculture at Rome.* This is the work of Dr. Asher Hobson, who for some years resided at Rome as the representative of the United States on the Permanent Committee of the Institute.

The inception of the International Institute is associated with something approaching romance. In 1884, a successful Californian merchant, the late Mr. David Lubin, bought a farm. To his intense surprise, the business ability which made him a successful merchant failed him entirely in the work of crop production. He became perplexed and at once set on foot an inquiry into the causes of his failure. This led to the study, among other things, of such subjects as railway freights, tariffs, and statistics of the area, yield, prices, and stocks of products like wheat. Eventually the idea took shape in his mind of an international organisation which would provide the farmer with all the

* The International Institute of Agriculture (An Historical and Critical Analysis of its Organisation, Activities and Policies of Administration). By Asher Hobson. Pp. vii+356. (Berkeley, Calif.: University of California Press, 1931.)

essential information as to the world production of agricultural staples. Instead of being a blind producer and seller of some raw product like wheat, he would be in possession of the main factors of the great producing and distributing industry of which he is a unit.

Lubin then proceeded as a private individual to Europe to place this idea before its governments and rulers. He was fortunate in obtaining the interest and support of the King of Italy. An international meeting was called at Rome to discuss the question, and in 1905 a Convention, establishing an International Institute of Agriculture, was agreed to by the nations. One of the main objects of the new undertaking, as stated in the Convention of 1905, was to " collect, study and publish as promptly as possible, statistical, technical or economic information concerning farming, both vegetable and animal products, the commerce in agricultural products, and the prices prevailing in the various markets, and to communicate to parties interested, also as promptly as possible, all the information just referred to ".

The various chapters of Dr. Hobson's book make melancholy reading. After the inspiring account of the personality of Lubin, it is sad to trace the gradual decline of the Institute as the inevitable consequence of unsound principles of organisation and of administration. Although a scientific institution, the man of science has from the very beginning not only been denied opportunities in direction but also has been relegated to a subordinate position. The direction of the Institute has failed to take note of the fact that the universities of the world for many years past have provided numerous examples of the successful administration of scientific work, and have never failed to attract and to retain talent of the first order.

Instead of following the well-tried methods of the great republics of learning, those responsible for the conduct of the International Institute of Agriculture have attempted other methods of getting things done. The members of the *corps diplomatique* and the retired Civil servants who have been in charge of the movement have, with the valour of ignorance, applied the conventional methods of departmentalism both to the organisation and governance of a scientific institute. The result has been a tragic failure, in spite of the recent efforts of the representatives of the United States and Great Britain on the Permanent Committee in obtaining funds for the development of the work and in urging reform. One after another the scientific men, who at the beginning were attracted to the movement, have resigned in despair. Instead of specialising in statistical work, and so making an honoured name for itself in international effort, the resources of the Institute from the very beginning have been thinly spread over a vast number of projects, none of which has been effectively handled.

The library of the Institute has been neglected, in spite of a generous provision for staff and equipment supplied by well-wishers in America. The publications can only be described as deplorable. Perhaps, however, the worst feature of all is the attempt in recent years to make programmes take the place of research. The most glaring example of this is the creation of the International Scientific Agricultural Council, consisting of 23 separate Commissions, with more than 600 members. The actual result so far accomplished has consisted in the holding of one meeting—in November 1927—and the issue of a vast programme covering the whole of agriculture, the conclusions alone of which occupy no less than 75 printed pages. It bears no relation whatsoever to the actual resources and work of the Institute.

In the last chapter of his book, Dr. Hobson deals with the future and with the reforms which must be adopted if the Institute is to fulfil its proper functions and become an important and effective body in the world's agriculture. This matter is dealt with in the following words:

" The Institute represents many peculiarities but perhaps none is so peculiar as the fact of its being a scientific organisation without a scientific staff. . . . It is safe to assert that the Institute will never be able to satisfy expectations until the Permanent Committee faces the task of recruiting a highly trained technical staff, thereby enabling the bureaus to turn out information of a reliable and usable variety. This task has always been relegated to the background on the basis of lack of funds, but it is suggested that the present salary budget distributed over fewer and carefully selected individuals, would go a long way in accomplishing the desired result. The fact that funds are limited makes it more urgent that unproductive employees be eliminated. To attempt to conduct a scientific institute without scientific and technical leadership is akin to the maintenance of a hospital without doctors, surgeons or nurses."

The present complex system of government consisting of a Permanent Committee and of an Assembly should be simplified. A scientific man, of the necessary standing, assisted by a properly trained staff, should be appointed for the future conduct of the Institute. If this were done, the prospects of future development would be much more promising than they are at present.

Our Mathematical Ancestry.

A Manual of Greek Mathematics. By Sir Thomas L. Heath. Pp. xvi + 552. (Oxford : Clarendon Press ; London : Oxford University Press, 1931.) 15*s*. net.

IT is scarcely necessary to introduce the reader to an author so well known and so distinguished for his writings upon Greek mathematics. Among those who are fortunate enough to have learnt something of the wonder and liveliness of ancient geometry, a new book by Sir Thomas L. Heath is always hailed with delight. On the other hand, there are doubtless many who may be tempted to think that, amid the distractions and interests of present-day science, it is a vain thing to spend time in reading up history of such a distant past. There is presumably enough to engage the attention of the most active mind in acquiring a working knowledge of current methods in mathematics or mathematical sciences. This is, of course, a mistaken idea: from the point of view of gaining proficiency in technique alone, there is much value in cultivating mathematical style, just as the young artist is encouraged to study the work of the early masters: and no boy plays worse cricket from watching Hobbs bat. Greek arithmetic, Greek algebra, and Greek geometry were all wrought by men of genius, who were working in a material of not too intricate a texture, so that an intelligent reader, with only the rudiments of mathematics, can follow their arguments without a long apprenticeship. It is therefore a boon to have a book which gives unstintedly an account of these early centuries, and enables a student to read for himself of the doings and discoveries of Euclid and Archimedes.

As the author remarks in the preface, the book is not written for experts, but for the student and the general reader who has not altogether forgotten his school mathematics. The treatment is straightforward and complete, giving a very judicious choice of interesting or important material, without the inevitable tedium of long preliminary proofs covering special cases. In the background is the sanction of a lifelong study of the documents: and the reader feels that he has been put in living touch with the men who fashioned mathematics. Here, for example, is the work of Euclid, no longer diluted, improved, or misunderstood, as the case may be, but given as it actually was. Whatever may be the defects of the " Elements " as a school textbook in geometry, the present reviewer is grateful that in his boyhood Euclid was still taught at school. How came it about that a Greek, of the name of Euclid, wrote a textbook which in an almost literal translation was used in our schools and colleges as the one recognised basis of instruction in elementary geometry until some thirty years ago ? The author addresses himself to answer this interesting question.

The present manual, which gathers into one volume the substance of earlier works by the same author, begins with an account of the origins of western mathematics in Babylonia and Egypt: it ends with the relatively undistinguished minor characters, of the sixth century of our era, who succeeded Diophantus, renowned for his algebra, the last great representative of the Second Alexandrian School. In recounting this impressive story of so many ages, the author has given himself a free hand, and has appeared in the rôle not so much of the cautious historian (which scarcely needs saying), but as that of the teacher or expositor who adds the suggestive touch that makes the picture live.

The book has its passages of special interest for the expert, as it embodies several notable and recent discoveries. The romantic discovery in 1906 of the "Method" of Archimedes in a Constantinople palimpsest has thrown light upon a perplexing problem: How did the Greeks find out their results? In the finished pages of Euclid or Archimedes, just as in the published results of Gauss, there is little to show the beginning of the quest—the guesses, conjectures, and tentative arguments which gave way to the final proof. But not until the "Method" was found by Heiberg was any light thrown upon the problem. In the present " Manual " we have considerable details of this newly found document. As Sir Thomas has remarked in his earlier " History ", it incidentally establishes Democritus as a pioneer in the integral calculus, for he was the first to state correctly the formula for the volume of a cone. Archimedes confesses that he discovered the analogous formula for the area of a parabolic segment by weighing it, theoretically or practically. At any rate, the theoretical proof might have come out of a current textbook on statics, illustrating the theory of moments and centroids with both elegance and precision.

Another passage of interest concerns Egypt and Babylonia. Recent exhaustive investigations of the Rhind Papyrus (by Prof. T. E. Peet in 1923 and Mr. Arnold B. Chace in 1929) have made the facts far more accessible than they were at the time when the " History " was written. Something of the yet unpublished Moscow Papyrus of the Twelfth Dynasty has also been included, and all this has greatly increased the prestige of Egyptian mathematics.

While it is still true that nothing comparable to a general proof has yet been found among all the Egyptian writings, more and more *ad hoc* formulæ are continually being brought to light; and some of these are very remarkable, such as the arithmetical instances which strictly illustrate the formula $V=\frac{1}{3}h(a^2+ab+b^2)$ for the volume of a truncated pyramid with parallel square faces whose sides are a and b: or again the still more remarkable formula

$$S=\{2d-\tfrac{1}{9}.2d-\tfrac{1}{9}(2d-\tfrac{1}{9}.2d)\}.d$$

for the surface of a hemisphere whose diameter is d (Moscow: Problem 10). If this is worked out, $S=2.\frac{2}{81}\frac{5}{81}\frac{6}{81}.r^2$ so that it gives 256/81 as the value of π, a very good approximation.

Even more wonderful is the state of mathematical science in Babylon, as it now appears in the light of the most recent discoveries. We are led to infer from the inscriptions that the Babylonian surveyor of 2000 B.C. had little indeed to learn from the modern practical textbook on quadratic equations. Not only was a sexagesimal number notation in vogue—involving a multiplication table up to 59×59 and the position-value system—but also a formula for the solution of quadratic equations was employed. For example, if

$$\xi^2-\frac{2d\alpha}{\alpha^2+\beta^2}\xi=\frac{A-d^2}{\alpha^2+\beta^2},$$

then

$$\xi=\frac{1}{\alpha^2+\beta^2}[d\alpha+\sqrt{\{d^2\alpha^2+(\alpha^2+\beta^2)(A-d^2)\}}].$$

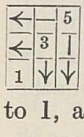
An inscription actually gives the detailed evaluation of this formula, with $A=1000$, $d=10$, $\alpha=40$, $\beta=60$. Examples of parametric bilinear equations in two unknowns, leading to a quadratic in one unknown, are also solved.

A few of the many passages of interest in the account of the Greeks may also be mentioned. On p. 27 appears a diagram of an abacus—no ordinary abacus, but something of a riddle. Its likeness to the full musical stave, with eleven lines, five for treble, five for bass, and one for middle C, may be a coincidence, but there it is.

The beautiful proof of the identity

$$1^3+2^3+\ldots+n^3=\{\tfrac{1}{2}n(n+1)\}^2$$

by Nicomachus is duly given. The series is equal to $1+(3+5)+(7+9+11)+\ldots$, but this neat result is certainly not told in all the ordinary textbooks, on algebra, where surely it should have place.



Border one small square with three equal squares and again with five, making $1+(3+5)=3^2$: a gnomon has been added to 1, and this gnomon is the cube of 2. Nichomachus proves the identity by adding the general gnomon after n terms, and by so doing he provides a genuine example of mathematical induction.

The author has sacrificed nothing (and has made the pages much easier reading) by exhibiting results in our familiar algebraic notation, as in the above Babylonish examples. Each formula is justified by the context.

The book is well printed and does credit to the publishers, who have performed their work most attractively. Considering its scope and contents, the book is reasonably priced, and is likely to be widely read.

H. W. TURNBULL.

Physical Anthropology of the American Indian.

The Indians of Pecos Pueblo: a Study of their Skeletal Remains. By Earnest Albert Hooton. Appendix on the Dentition by Habib J. Rihan; Appendix on the Pelves by Edward Reynolds. Statistical and Laboratory Assistants: Ruth Otis Sawtell, Ethel Clark Yates, Pearl B. Hurwitz. (Papers of the Southwestern Expedition, No. 4.) (Published for the Department of Archæology, Phillips Academy, Andover, Mass.) Pp. xxvii + 391 + 112 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1930.) 56*s*. net.

IT is not always sufficiently realised to what extent a study of the early history of man in the New World may throw light on the early history of man in the Old World. No doubt this arises from the fact that many anthropologists are content with the assumption that all the aboriginal inhabitants of America were from first to last Mongoloids. But "the theory of the originally and perpetually Mongoloid character of the American population is difficult to accept in view of the decidedly non-Mongoloid character of the stratigraphically early types". This opinion, quoted from the last paragraph of Dr. Hooton's elaborate and carefully prepared monograph, indicates one of the central problems which are presented as a result of his ten years' study of the skeletal remains of the Indians of Pecos.

The ruins of the Indian pueblo of Pecos lie on an easily defensible site in the valley of the Pecos river in central New Mexico. The village was visited by the first Spanish expedition which penetrated south-west in 1540. In 1620 the population is reported to have been about two

thousand. The historical period of the village lasted until 1838, when the remaining twenty inhabitants of Pecos migrated. On the basis of stratigraphy and pottery sequence, it was possible to recognise six periods in the life of the settlement of Pecos since its foundation about A.D. 800. Of these, four periods belong to the prehistoric phase, that is, prior to the date at which the natives came into contact with Europeans. The excavations of the ruins have clearly been carried out with the utmost scientific precision and only skeletal material of undoubted provenance and in good preservation has been included in the series upon which Dr. Hooton has based his study. We are impressed, therefore, with the suitability of the Pecos material for a study of the physical nature of the American Indian population before it became in any way affected by post-Columbian migrations.

Dr. Hooton's treatment of his unique osteological collection is eminently scientific. He is aware of the limitations of physical anthropology so far as skeletal material is concerned, and he is careful to distinguish clearly between legitimate deductions from ascertained facts and speculative considerations. In estimating the age and sex of the material, he has had the assistance of Prof. Wingate Todd. It is instructive to note that in the sexing of 264 complete skeletons, these two authorities (both of whom are to be regarded as experts in their subject) disagreed in 15 per cent of cases. To those less experienced anthropologists who are not aware of the difficulties of sexing a skeleton, even when the pelvis is intact, this result will appear surprising. Another interesting fact is that the inhabitants of Pecos seem not to have varied their stature over a period of a thousand years, in spite of the fact that since the Spanish intrusion there was a gradual extinction of the population through war, disease, and probably famine and malnutrition.

Most of the present volume is devoted to the craniology of the Pecos Indians, a study which was complicated by the fact that only 40 crania out of a collection of 615 showed no trace of artificial deformation. Dr. Hooton was able to distinguish a number of morphological cranial types, which he distinguishes as "Basket Makers", "Pseudo-Negroids", "Pseudo-Australoids", "Plains Indians", "Long-faced Europeans", "Pseudo-Alpines", etc., but at the same time he finds no evidence that any "new race" appeared during the history of Pecos. The question remains as to how far these cranial types represent valid morphological types and not the artificially selected extremes of a homogeneous but very variable group. The author believes that the former interpretation is correct, and his statistical evidence certainly seems to confirm this conclusion. He further illustrates his types by a series of photographs made by the superimposition of images of a number of skulls of the same type on the same negative. We think this method of composite photography to be not very sound. An examination of the composite photographs makes it clear that the impression produced on inspection is not that of an 'average' skull. In the contour outline of the skull as a whole, for example, the photograph, by its method of production, tends to lay much more stress on the smaller contours and more restricted outlines of the group. We should have been happier to have seen average contours constructed on the basis of actual measurements, as has been done so successfully by Parsons and others in Great Britain.

It is in the discussion of the affinities of these morphological types that Dr. Hooton especially attracts our interest. The Basket Maker type is very similar to the Basket Maker crania of Arizona, and also bears a strong resemblance to crania of the so-called Mediterranean race. Indeed, "in indices the South-western American crania are so similar to the crania of Egyptians as to be well-nigh identical". The author thinks, however, that we cannot go beyond the inference that "the Basket Maker and Ancient Egyptian groups represent divergent off-shoots of a common primitive race which may have sent colonies in many different directions during the neolithic period". The Pseudo-Negroid type is found to differ less from the African negroes than from other morphological types in the Pecos population. This leads to the conclusion that the earlier dolichocephalic invaders of America carried with them an infusion of negroid blood which had been derived from the tropical parts of the Old World. If this conclusion is not legitimate, then it is only possible to infer that craniological variability in a homogeneous population is much greater than most anthropologists would care to admit, and that, in fact, it is a very risky business to attempt the racial diagnosis of a skull when dealing with isolated specimens.

The Pseudo-Australoid type is admittedly a misnomer and the type is found to stand very close to the Ainu, though there are significant differences. The Long-faced Europeans and the Pseudo-Alpines were likewise provisional names given to types which on subsequent analysis were found, in this case, to be related to Mongoloid types, the former showing an affinity to Eskimos in general proportions

and the latter resembling crania of Tibetans, Burmese, etc.

As has been already indicated, Dr. Hooton's treatment of this material is exhaustive, and we sympathise with him when he says at last, "After traversing all of this weary waste of tables and statistical comparisons of measurements, indices, and anatomical details, I feel justified in permitting myself the luxury of expounding my present views on the anthropology and prehistory of the American Indian". Briefly, Dr. Hooton believes that his evidence indicates a migration by way of the Bering Straits into the New World, soon after the retreat of the last glaciation, of a mixed group of dolichocephals containing a Mediterranean element, a Negroid element, and a more primitive element represented in part by the Ainus of Japan. At a later period, the Mongoloid invasion of the New World took place and the invaders either supplanted or interbred with their predecessors.

This is an attractive theory and one of fundamental importance to students of Old World prehistory, for its acceptance must inevitably affect current ideas regarding the distribution of non-Mongoloid races in Asia during late Palæolithic and early Neolithic times. Further, Dr. Hooton's conclusions provide an additional and rather interesting basis of argument for those ethnologists who maintain that there was abundant contact between the Old and New Worlds in pre-Columbian epochs. This point of view, however, is not touched upon by Dr. Hooton, somewhat to our disappointment.

We heartily congratulate Dr. Hooton on the production of this monograph on the physical anthropology of the American Indian. If, as he himself says, the study of this subject is still in its infancy, the result of his work of ten years has done much to bring it towards maturity.

W. E. LE GROS CLARK.

Organic Chemistry.

An Introduction to Organic Chemistry. By Prof. John Read. Pp. viii + 365. (London: G. Bell and Sons, Ltd., 1931.) 6*s*. 6*d*.

WE confess this book makes a strong appeal to us: it approaches our ideal of how organic chemistry should be taught to that difficult person, the student—whose primary interest lies in other fields in which, if he only knew, he will make real progress only with difficulty unless his understanding of what to-day is comprised in organic chemistry is substantial.

Prof. Read is happy at the outset in his extract from that famous book of Mrs. Marcet on which we are told Faraday was nurtured. Organic chemistry is not a mass of dry facts or confined to analytical minutiæ; it is the livest of all sciences, full of unexpected and exciting happenings, and yet withal the game is played according to a set of rules based on molecular structure; rules which, elaborated in early days by Frankland, by van 't Hoff and Le Bel, by Kekulé, still prevail to-day; rules which have permitted us to glimpse at the inner structure of the sugars with Emil Fischer, of chlorophyll with Willstätter and porphyrins with Hans Fischer, of the alkaloids with Perkin, of the anthocyanin colours of plants with Robinson. Mrs. Marcet well said that "Nature also has her laboratory, which is the Universe". It is a happy inspiration of the author to develop aliphatic chemistry round the fats, the carbohydrates, and the proteins and to proceed to the closed chain aromatic, alicyclic, and heterocyclic compounds, treating them on the broadest lines. Actually the book contains the subject matter of a series of thirty lectures and it is interspaced with lecture experiments. A number of questions appear at the end of each chapter. There are several simple illustrations, a number of clear tables, and an ample index appropriately introduced by an extract from "Caroline's Conversations". We have special praise for the formulæ, which are not unnecessarily elaborate, whilst judicious use is made of heavy type.

We are not too satisfied with the author's repeated use of the term 'nucleus' for the carbon skeleton of a number of compounds. It is true that this is habitually used by chemists to distinguish the aromatic part of benzenoid from the side chains, so that he has some justification for the extension of the term, but to us the word nucleus does not imply a chain of carbons and we prefer the more usual words skeleton, grouping, or unit; this, however, is a very minor criticism of a successful attempt to make clear to the student how characteristic and how common certain arrangements of carbon atoms are.

It is surprising how much information has been included in so small a compass as the result of leaving out the old and, to the student, uninteresting details of preparation and reactions; space is even found to embody much information in relation to the utilisation of the compounds in practice and industry. Prof. Read has certainly succeeded in catching the spirit of the subject, and we shall be disappointed if students do not find his book inspiring.

E. F. A.

Short Reviews.

The Vitamins. By Prof. H. C. Sherman and S. L. Smith. (American Chemical Society Monograph Series, No. 6.) Second edition. Pp. 575. (New York: The Chemical Catalog Co., Inc., 1931.) 6 dollars.

MORE than nine years have elapsed since the previous edition of this American Chemical Society Monograph was reviewed in NATURE (vol. 110, p. 6, July 1, 1922). This second edition contains 349 pages of text and about 3000 bibliographic references; the corresponding figures for the first edition were 234 and 1000.

During the intervening period, 'fat-soluble A' has been split into vitamin A proper and the antirachitic vitamin D: the latter has been prepared photo-synthetically and obtained crystalline, though not pure, in two laboratories independently; vitamin E, essential for rats and some other animals to prevent resorption of the fœtus by the pregnant female and degeneration of the spermatogenic tissue in the male, has been discovered and styled the anti-sterility vitamin; vitamin B has been split certainly into two, probably into four and possibly into five or more different factors; of these, B_2 has been generally credited with the prevention of pellagra; vitamin B_1, the actual anti-neuritic factor, preventive of beri-beri, has been obtained crystalline in four different laboratories. Besides this, an enormous mass of investigation, proportionately indicated by the increase in bibliographical references noted above, has been conducted into the physiology of the vitamins.

The subject has come to be a recognised part of biochemistry, with its own technique and its own specialised schools, often associated with the names of distinguished individual scientific workers. It has been recognised, indeed, by the Nobel trustees, since at least three of the workers in this field have been honoured by their award.

This book is the only one in the English language—and, we believe, in any language, with one possible exception—covering the subject as a whole. It is not a popular exposition, but a technical monograph in the strictest sense, and of the highest order of excellence. It is indispensable to all concerned in any way with nutritional problems and to all biochemists, and should also be so to the majority of physiologists and to many medical men.

A. L. B.

Measures of Double Stars. By Prof. Francis P. Leavenworth. With which are included the Measures by William O. Beal. (Publications of the Astronomical Observatory, University of Minnesota, Vol. 1.) Pp. viii + 111. (Minneapolis: University of Minnesota Press, 1930.) 5 dollars.

THIS volume is published as a memorial to Prof. F. P. Leavenworth, who died in 1928. It contains the annual means of his observations of 1185 double stars, made between 1886 and 1927. They were made chiefly with the 10½-inch refractor of the University of Minnesota, but some were made at Yerkes, Haverford College, Leander McCormick, and Goodsell Observatories. Many stars that show motion have been followed regularly; thus Castor (*AB*) was observed forty-five times during an interval of thirty-nine years; the distant companion *C* was also observed five times; there are forty-six observations of Sirius, and seven of Antares, which shows no appreciable change of distance or angle in forty years.

The volume contains a brief sketch of Prof. Leavenworth's life and astronomical work; an appendix gives a full list of his papers; another appendix gives measures of 289 double stars by Prof. W. O. Beal, who was instructor in astronomy at the University of Minnesota from 1913 until 1926, and assistant professor from 1926 until 1930.

A. C. D. C.

A Laboratory Manual of Electrochemistry. By Prof. Dr. Erich Müller. Translated from the fourth edition by Dr. H. J. T. Ellingham. (Twentieth-Century Chemistry Series.) Pp. xiv + 363. (London: George Routledge and Sons, Ltd., 1931.) 15*s.* net.

THE present manual deals with practical electrochemistry in more detail than laboratory works on physical chemistry, and is more suited to a special course on the subject than to the ordinary course in physical chemistry, where there is not usually sufficient time available for so many experiments on electrochemistry. It includes inorganic and organic electrochemical preparations and potentiometric titrations as well as an excellent series of experiments on the fundamental laws. Brief but very clear accounts of the theories are given, and the book will be useful in the study of theoretical electrochemistry as well as in the laboratory. The translation is good and the printing well done, although the paper is too thick for a laboratory manual and the book will not stay open on the bench. The book should be in every university and technical college laboratory for reference.

The Story of Surnames. By William Dodgson Bowman. Pp. vii + 280. (London: George Routledge and Sons, Ltd., 1931.) 7*s.* 6*d.* net.

MR. BOWMAN'S popular account of the methods and material for the study of surnames will serve a useful purpose in making known a fascinating and instructive subject of investigation to a wider public. It is indeed surprising that the literature on the subject is relatively so small. Few investigations which can be so readily followed throw more light on the habits and mentality of our ancestors than the surnames they used and the reasons for which they gave them to individuals. Mr. Bowman's work is fully in accordance with accredited methods; nor does he fail to warn us by precept and by examples, which follow scientific method, of the dangers of the over-hasty conclusion which is nothing more or less than guesswork. The chapter on fourteenth century London is an excellent example of the intimate detail relating to the organisation and life of an urban population that this class of evidence can be made to yield.

On the Nature of Mind.*

By Dr. C. S. MYERS, C.B.E., F.R.S.

PSYCHOLOGY was given the status of an independent Section, with the approval of the Sections of Physiology and Education, at the Cardiff meeting of the British Association in 1920. The new Section met for the first time in 1921 under the presidency of Prof. Lloyd Morgan. Thus the present centenary meeting marks also the completion of ten years' existence of our Section. I can vividly recall the doubts which were expressed, not so much in words, as in general attitude, by the Committee of Recommendations of this Association when in 1920 it was asked to consider the formation of a separate Section of Psychology. Such hesitation was probably based on several grounds, not wholly on any one of them. But some of these grounds have lost much of their force to-day, because of the pronounced change that has since taken place in the attitudes and beliefs which were in vogue among physicists of that time. No physicists would then have dared, as now, to cast doubt on the sole sway of determinism in the physical world. None of them would then have suggested, as now, the impossibility of predicting what any *individual* atom (or still smaller *individual* entity) will do next. None would have questioned, as now, the universal truth of the second law of thermodynamics or of the principle of conservation of energy. None would have ventured, as now, to suppose that electrons change in the very act of becoming known to us, and that therefore the mental factor is ultimately inseparable from physical investigations. None would then have dared, as now, to conjecture that particles of matter correspond in their properties to certain *group* waves of the ether, the *constituent* waves of which, travelling at an enormous speed, 'guide' and 'direct' the group waves without any energy of their own.

Psychology has been similarly bereft of reality by the operations of mathematicians, present and past. The earliest example of this was the derivation by Fechner of the 'law' which now bears his name, that the intensity of a sensation is proportional to the logarithm of the magnitude of its stimulus. This statement was deduced by purely mathematical procedure from Weber's law that just appreciable differences between sensations depend on a constant ratio between the magnitudes of their respective stimuli. Weber's law, however, was based on direct observation and experiment; whereas Fechner's 'law' was the outcome of purely mathematical calculations which not only neglected a constant appeal to the 'reality' of experience, but also ran actually counter to it—neglectful, for example, of the 'facts' (i) that Weber's law holds for only moderate magnitudes of stimuli; (ii) that from the point of view of conscious experience it implies a *single experience* of difference, not a *difference between two* separate experiences; and that (iii) from the same point of view we are quite unwarranted in adding together or subtracting from one another two intensities of sensation or two sensation differences as such.

Elsewhere in his treatment of psychological data, as in his treatment of physical data, the mathematician has arrived at results that can directly be neither verified nor rejected by conscious experience. The establishment of 'general mental factors', involved in and influencing the performance of various mental tests and other processes, affords us another example. By mathematical operations on experimental data we can, it is claimed, deduce the existence of such general factors. But from the strictly psychological point of view the nature of these factors cannot be interpreted; for we are unable to appeal to direct experience to ascertain what these factors are. At best their significance in terms of actual experience can only be conjectured by abstraction and imagination; or it is expressible only in terms of general behaviour. At worst, as in the case of *g* (the so-called 'general intelligence'), we are quite ignorant of their psychical nature. We cannot hope for direct psychological evidence as to the precise mental nature of such mathematically deduced 'factors'.

PSYCHOLOGY AND BEHAVIOUR.

The escape from such difficulty on the physical side—so as to avoid dethronement of the literally divine claims which some mathematicians have made for the fundamental truth of their own science—is to regard the universe as constituting a vast nexus of ultra-physical and mathematical necessities and probabilities, only some of which can become physical through the further operation of the human mind. We might, perhaps, adopt a corresponding attitude towards some of the subjectively unverifiable conclusions arising from the applications of mathematics to psychological data.

In psychology an additional difficulty confronts us. We have to recognise that the data with which the 'mathematical psychologist' operates are not measurements of the fundamental subject matter of psychology—conscious mental processes. (Nor can they probably be measurements of unconscious processes, so long as the latter are regarded as mental in character.) For mental processes are not directly measurable: we can *grade* a series of conscious experiences according to their degree or amount, say of hue, brightness, loudness, pitch, temperature, extent, duration, clearness, pleasantness, etc.: we can say that one member of such a series has more or less of any one such character or quality than another member, or that the difference between two members of a series in respect to any one of these characters or qualities is greater or less than, or equal to, the difference between two other members. But the psychologist can only *measure* the amount of any conscious experience

* From the presidential address to Section J (Psychology) of the British Association, delivered in London on Sept. 28.

indirectly—either by reference to behaviour, that is, to the organism's *physical* response or expression, or by reference to the *physical* character of the relevant stimuli, in terms of objective standards of number, space, and time which are immediately independent of actual subjective experience.

Let us remember, then, that when we are attempting to measure any mental ability or character or quality by means of a test, or series of tests, we are not directly measuring that mental ability or character or quality, but only the corresponding stimulus or the outward response or expression by which that mental ability or character or quality is manifested. We are, no doubt, justified in assuming a broad correlation between the speed, accuracy, amount, etc., of the response or expression of a mental ability or character or quality and the degree in which that mental ability or character or quality is present. Even this broad assumption, however, is sometimes unjustifiable, as in the case where too much of a given mental ability or character or quality may lead to a deterioration, and no longer to an improvement, in the corresponding performance. But we are certainly never justified in assuming that we can measure accurately any mental process by measuring its objective response—that, for example, twice the amount of the response necessarily means twice the quantity of the mental process of which the response is the expression. All that we are measuring is *behaviour*—that is to say, something largely on the efferent side, something largely physical and indescribable in terms of pure immediate experience, involving a complex of factors many of which, indeed, may be remote from those which we commonly believe we are measuring; whereas what we ultimately aim at dealing with in psychology is *experience*—the meeting point of the afferent and efferent sides.

In fact, then, the 'behaviourists' are quite right when they insist that scientific measurement is applicable only to the behaviour of the organism. Where they are quite wrong is in their assumption that conscious processes must necessarily be ousted from scientific psychology, because measurement is excluded; the truth being that, even where measurement is excluded, the possibilities of systematic observation and experiment still remain. Natural science has surely a function wider than that of merely reducing its subject matter to units of space and time. Highly valuable and deserving of the utmost encouragement as is the measurement of behaviouristic data, however helpful be the light they may ultimately throw on mental processes and their general characters, however wider be mental processes than the range of mere conscious experience, the scientific study of the mind by direct observation and experiment is never to be discountenanced or discarded.

SELF-ACTIVITY.

Just as experimental physics patiently pursues its researches into Nature, heedless of such mathematical conclusions as are not amenable to verification by experiment, so experimental psychology must realise that its progress is not primarily dependent on, however much assistance it may receive from, the work of those who fail to recognise that the fundamental subject matter of psychology is conscious experience, not conduct. Now conscious experience can only be enjoyed by the active self, namely, the 'individual' (that is, undivided) mental activity of the entire living organism. It is the fundamental function of such self-activity—by recourse to past experiences, by receiving present experiences, by foreseeing future experiences and by creating new experiences—to select from alternative responses and from alternative environments those which are most advantageous to the ever-evolving and developing organism; to secure the most suitable movements and environments and thus to help in the evolution of the organism are the prime objects of consciousness. Where, as in plants, mobility and plasticity are at a minimum, self-activity and consciousness are inappreciable. Self-activity is to be regarded as the highest, unitary integration of the directive mental (conscious and unconscious) activity of the organism.

DERIVATION OF PRESENTATIONS (OR CONTENTS) FROM FEELINGS.

Self-activity and its inherent consciousness may presumably be traced back to a stage where self and not-self are but just distinguishable. At this remote stage in animal evolution there can scarcely have been more than a differentiation of self-activity into 'acts' of the self and 'modifications' of the self. These modifications of the self became early differentiated into (*a*) those which are due to internal happenings within the organism, and (*b*) those which are due to more variable external happenings in its environment, and later into (*a*) those which we come to recognise as 'affects' *of* the self and 'feeling tones', and (*b*) those which come to be regarded as 'presentations' *to* the self or as 'contents' of the self's consciousness. Sensations, perceptions, memories, and thoughts—all that we finally come to recognise as conscious *presentations* to the self—have been differentiated (onto- and phylo-genetically) from modifications of the self: instead of being *feelings* of the self, they have become *contents* of consciousness.

We end by 'projecting' certain of these original feelings. The external 'objects' of our perception have been separated from or carved out of originally vague external 'situations', of which we or our remote ancestors were first conscious merely as diffuse modifications or feelings of the self. So, too, any colour or sound comes to be regarded no longer as a self-feeling but as a something projected and existing outside us. The degree to which such projicience and presentation is carried out varies with different sensations: colours clearly have a projected, apparently independent, existence; sounds, smells, tastes, hardness, and temperature are only imperfectly projected; the painful prick of a pin and our sensations of movement, though not projected, are nevertheless regarded as 'presentations' to the self; whereas our experiences of visceral sensations are scarcely even presented:

they seem almost as clearly modifications of the self as are our emotions and other affects.

Origin of Acts and Contents.

This difference between the acts and the contents of consciousness — between the conscious *acts* of apprehending, recalling, deciding, inferring and *what* is consciously apprehended, recalled, decided, inferred—is a most important one. It is exemplified in the two kinds of memory which are distinguishable. On one hand, we may recall the *separate acts* of the self, say, in the course of solving a problem or of acquiring some specific skill ; these are individually unique and only individually revocable. On the other hand, we may recall the *generalised contents* of our consciousness, that is, of presentations we have received by a repetition of such acts, for example, in learning a prose passage or series of skilled movements.

I would suggest that the distinction between conscious acts and contents has come about with the gradual differentiation of higher and lower levels of mental activity—and in the following manner. There is no awareness of self-activity when we sense a colour or a temperature, or when we perceive a familiar object, or when an idea ' occurs ' to us. Our sensations, our perceptions, and many of our thoughts and ideas are, I suggest, the unconscious ' acts ' of relatively lower mental levels. But when these lower-level ' acts ' are accompanied and received by the self-activity of the highest levels, they become *ipso facto* ' presentations ' to the self. A loud noise to which we are impelled to attend or an idea which ' occurs to the mind ' is not a conscious presentation (or content of consciousness) until the self receives it.

I suggest that such differentiation of higher and lower levels has never occurred to the same extent in the case of our kinæsthetic and, especially, cœnæsthetic sensations and in the case of our feelings (which depend on a more primitive, thalamic, activity) : we fail, therefore, to objectify them immediately as presentations, and they continue to be received in their primordial undifferentiated state.

Unconscious Direction and Purpose.

The self is the highest controlling and directing power. The orders which it consciously gives and the efforts which it consciously makes may, once started, continue to be carried on unconsciously, that is, without the conscious participation of the self. Thus we may consciously but vainly try to recall some past experience or to solve some difficult problem ; and after giving up the effort, this directive activity may still persist unconsciously until suddenly the forgotten object, or the abandoned solution, suddenly flashes full-born and unbidden into the self's consciousness. So, too, we may go to sleep determined to wake up at a given hour, or we may accept, in the hypnotic state, a decision to carry out some prescribed act on the lapse of a prescribed period of time after emerging from that state ; and at the ordained moment the sleeper wakes, or an uncontrollable impulse is felt to perform the suggested act.

Not only is purposive activity not limited to the duration of conscious activity but also it need not originate there. The inspirations of genius and the intuitive judgments and decisions which, crude though they may be before submission to the self's judgment, arise apparently from the ' depths ' of the mind with impulsive force and compelling conviction afford striking examples of this fact. The well-known improvements in learning which continue after we have ceased to practise, so that it has been said of us that we learn to skate in summer and to swim in winter, are further examples of such activity—whether or not we choose to ascribe such improvement to the gradual disappearance of adverse initial inhibitions or to the direct strengthening (' consolidation ') of acquired integrations (or associations).

Further, the self is continually being played upon both by the impulsive and by the perseverating forces of lower mental systems. They struggle, not less than the self, for their own existence and for their own lower ' self-ish ' ends. Where they are modified by inhibition (or repression), it is only to ensure general harmony and general compatibility. Inhibition is not to be viewed as a mere act of passive drainage of energy from one mental constellation to another, but as an active repressive force against which the inhibited constellation ever tends to rebel in its endeavour to gain somehow or another liberty of action, in some lower degree purposeful and directive.

Cerebral Localisation of Consciousness.

While consciousness always implies self-activity, and while the self is to be regarded as the expression of the highest level of mental activity, we must guard against the notion that such high-level activity implies a narrowly limited zone of mental processes. On the contrary, it implies a wide sphere of activity rather than a punctate, pineal, gland-like soul. It follows, therefore, that we cannot hope to localise any act or any content of consciousness in one small region of nervous substance. Afferent-efferent localisations of function undoubtedly occur—regions where the incoming impulses become deflected to outgoing processes : our knowledge of the physiology and structure of the spinal cord clearly points to this. Sensori-motor localisations may, in a sense, be said to exist similarly in the brain. The occipital region of the cerebral cortex, for example, is concerned with vision. But because vision ceases when the *area striata* in this region of the cortex is injured, we are not justified in saying that this area is the *seat* or centre of our visual consciousness. All that we are warranted in concluding is that it is *essential* for our visual consciousness, that without it vision is impossible—a very different statement.

Once again, let me repeat, consciousness implies self-activity. There are no separate loci for different kinds or modes or qualities of consciousness. The nervous system and the system of self-activity work as a widespread unity. Different regions of the brain are more particularly concerned in *giving rise* to certain kinds of consciousness. The thala-

mus, for example, is especially concerned with the emotional consciousness ; but we are not justified in calling it the *seat* or centre of such consciousness.

We are, in fact, neither warranted in supposing that there are definite seats or centres of sensation or emotion, nor justified in supposing that our manifold percepts, images, or ideas each have their seat in different narrowly localised centres of the brain. A similar truth holds for the association (or integration) of such experiences. We can *mentally* picture an integration of two ' patterns ' of conscious activity occurring when two experiences *a* and *b* follow one another repeatedly, so that when *a* is later given, *b* (or rather the whole *a–b*) recurs ; but *neurologically* we can form no simple corresponding picture of two collections of nerve cells being associated together. We have no evidence to support such cerebral localisation of association areas ; indeed such experimental evidence as we have is against it.

Even if there were no evidence pointing in one direction or the other, how could such localisation of memories and habits possibly occur ? Consider the babe that is learning to associate its mother with the satisfaction of its hourly wants. Its mother is never twice the same—now in one dress or facial expression, now in another ; and the visual image of the mother received by the retina is never twice the same—for example, sometimes the mother is very near, sometimes farther off ; sometimes the image falls on one part of the retina, sometimes on another. How can we imagine, then, any definite collection of retinal or cortical nerve cells responsible for developing the image of ' mother ' ? What develops is surely rather a ' meaning '—a generalisation of images, ' standing for ' something, that is, for the assuaging of certain needs, for the execution of a wide range of adjustments of the infant.

Relationships and meanings are therefore the all-important mental acquirements. The acquisition of such relationships is shown, for example, in the many experiments conducted on a large variety of species, high and low in the animal scale, where by long practice the organism is trained to enter *B*, the brighter of two alternative compartments, *A* and *B*, in order to reach its food. When later, in place of *A* and *B*, *B* and *C* are substituted, *C* being now brighter than *B*, does the animal go to *B* to which it had previously been trained to go ? Generally, no. It enters the *C* compartment. That is to say, it has learnt to enter not a *particular* compartment, but the *brighter* of any two compartments. It has not learnt to select a ' particular ' object. It has learnt a ' relation '. Surely evidence of this kind is contrary to any atomistic localisation of individual mental functions in separate cerebral areas.

Relation between Directive and Mechanical Activity.

The fundamental purpose of consciousness is to enable the self to preserve the organism by guidance and direction—by the formation and satisfaction of ends and values. As in the evolution of living species something far more is involved than the mere blind running down-hill of a wound-up mechanism, so in the mental and bodily life of each organism the physical conceptions of ' entropy ' and of mechanical energy are inadequate. On the physical side we can form no conception of the mode of working, throughout life and mind, of anything resembling Clerk Maxwell's directive ' demon '. Physiologically, that is to say, physically, the brain-worker should need food with a far lower caloric value than he actually takes and requires for the successful maintenance of his purely mental activities. But, in fact, mental work appears to make far greater demands on metabolism than it should according to purely physical considerations of the expenditure of mechanical energy.

At present we can form no conception of the nature of the undoubted connexion between chemical metabolism and direction in the living organism —between senility of body and senility of mind, between the rise and decay of procreativeness and the rise and decay of the creativeness of genius. At present we can form no bridge between mechanical and creative, directive activity. We can only say that both activities are essential to a conception of the evolution and working of life and mind. Mental activity involves a quintessence of the non-mechanical, directive activity of life ; and consciousness is but that activity raised to its highest power. Even lower-level mental and neural systems, even the activities of the lowest living organisms, are characterised by unconscious creation, direction, guidance, and purpose in varying degrees. But conscious creation and direction, the consciousness of *acts*, is limited to the highest-level psycho-neural activity—the self.

I have suggested above that, when the physiological activities of the lower-level systems meet with the highest-level activities, they may become manifest as conscious *presentations* ; these highest-level activities are, I believe, to be regarded as arising from the supreme organisation and distillation of the directive activities of the living organism. The acts at this highest mental level constitute the purposeful, directive, creative, and contemplative self, and are the recipients of presentations from lower cortical, and also of feelings from lower, primordial, thalamic activity.

The psychologist's principle of the *conservation of self*, which corresponds to the biologist's inevitable principle of the *struggle for existence*, is the fundamental function of this conscious activity. It is as real and important as the physicist's principle of *conservation of energy*. We must leave to the future the task of bridging the present impassable gulf which yawns between these two principles. Meanwhile let us always remember that blind mechanism in the material world is a truth not more fundamental than the reign of guidance, creation, and purpose in the world of life and mind, and, it may well be, throughout the universe ; indeed, our very notions of these two principles, governing perhaps both the living and lifeless world, appear to be the outcome of, even if they do not wholly depend upon, the experiencing, reasoning, and imagining self.

Ultrasonics: Some Properties of Inaudible Sound.*

By Prof. F. LLOYD HOPWOOD.

THE intensity or loudness of a sound depends upon the extent or amplitude of the vibration set up, and its pitch upon the frequency or number of vibrations per second. Disturbances of the same type as sound waves may be inaudible either because the intensity (loudness) is insufficient or because the ear is deaf to those particular frequencies: the normal range of hearing of a human being extends approximately from 20 to 20,000 vibrations per second.

'Sounds' of higher frequency than 20,000 are called supersonic or ultrasonic. They can be generated in a variety of simple ways, as, for example, by rubbing a resined rag along a steel wire or by tapping the end of a short rod of material with a suitable hammer; thus, a steel rod 10 cm. long, clamped at its middle point and tapped at one end, will emit an inaudible 'note' of 26,000 vibrations per second, and when two steel balls 1 in. in diameter collide, they vibrate after impact at the rate of more than 100,000 vibrations per second.

Such ultrasonic emission is discontinuous, of feeble intensity, and is accompanied by parasitic audible sounds. The most convenient generator of sustained vibrations is the valve-oscillator. The vibrator itself is a disc of natural quartz crystal cut with its plane faces parallel to its optic axis and at right angles to an electric or binary axis. Such a disc was shown by MM. Pierre and Jacques Curie to possess the remarkable property that when it is compressed its faces become oppositely electrified, and that its electric charges become reversed in sign if the disc is subjected to extension instead of compression. Periodic reversal of stresses is immediately followed by periodic reversal of electrification. Prof. Pierre Curie also showed that natural quartz, in common with certain other crystals, possesses the converse property, namely, that if the opposite faces of a suitably cut disc are electrified, the crystal contracts in one direction and expands in another.

This latter property was utilised by Prof. Langevin of Paris to produce high-frequency sound vibrations by applying alternating electric potentials to electrodes in contact with a quartz plate. The plate vibrates with its maximum amplitude when the frequency of the electrical alternations coincides with a natural frequency of mechanical vibration of the quartz; in other words, when resonance is obtained.

For our experiments we use a quartz crystal cut in the form of a circular disc more than 7 centimetres in diameter and nearly 5 millimetres thick. This is clamped with one face in contact with a massive lead electrode and immersed in transformer oil contained in a small glass tank (Fig. 1). The second electrode, which is made of light copper foil, rests in contact with the other face, and both electrodes are connected to a powerful (3 kilowatt) valve-oscillator, executing half a million vibrations a second, or more. The use of the oil permits the application of very high voltages to the crystal, and also makes it easy to subject small objects to the influence of the very intense vibrations.

* From a Friday Evening Discourse delivered at the Royal Institution on Feb. 13.

EXPERIMENTS WITH A HORIZONTAL BEAM OF SOUND.

Following Prof. R. W. Boyle, the production of *stationary waves* in the oil can be rendered visible by the striæ formed in coke dust scattered on a horizontal opal-glass plate placed in the sound beam. The distance between successive striæ, that is, half a wave-length of the sound in oil, is here between 1 mm. and 2 mm. This wave-length is so short in comparison with the dimensions of the crystal and other objects in the tank that these waves exhibit

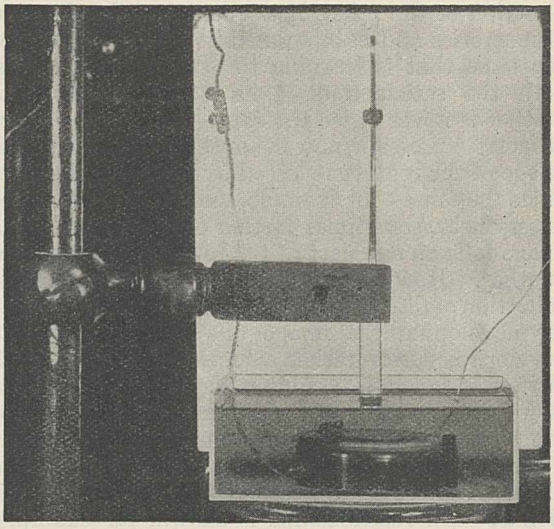


FIG. 1.—Arrangement of quartz crystal and electrodes in oil bath when projecting a vertical beam of sound.

the directional properties ordinarily associated with light waves. Thus, by using plane and curved reflectors, the well-known laws of reflection are verified. In the same way refraction of sound waves by prisms and lenses can be demonstrated. Fig. 2 shows that sound waves travelling through pentane, and falling on a parallel layer of transformer oil, are transmitted if the angle of incidence is less than a certain value (critical angle), but totally reflected if it exceeds this value (total internal reflection). In fact, most objective optical phenomena, except polarisation, can also be faithfully paralleled by these means.

Another application of the coke-dust method of showing stationary sound waves is to the study of architectural acoustics. Fig. 3 shows the 'whispering gallery' effect in a model of the lecture theatre of the Royal Institution, using ultrasonic vibrations instead of audible sound. The clinging of the waves to the circular wall is very marked.

The *pressure of radiation* to which an obstacle is subjected when sound waves fall upon it is shown

by the rotation of the vane of a torsion pendulum placed in the horizontal ultrasonic beam. This affords a convenient method of estimating the intensity of the sound, which can be used for measuring the acoustic reflection and transmission coefficients of different materials.

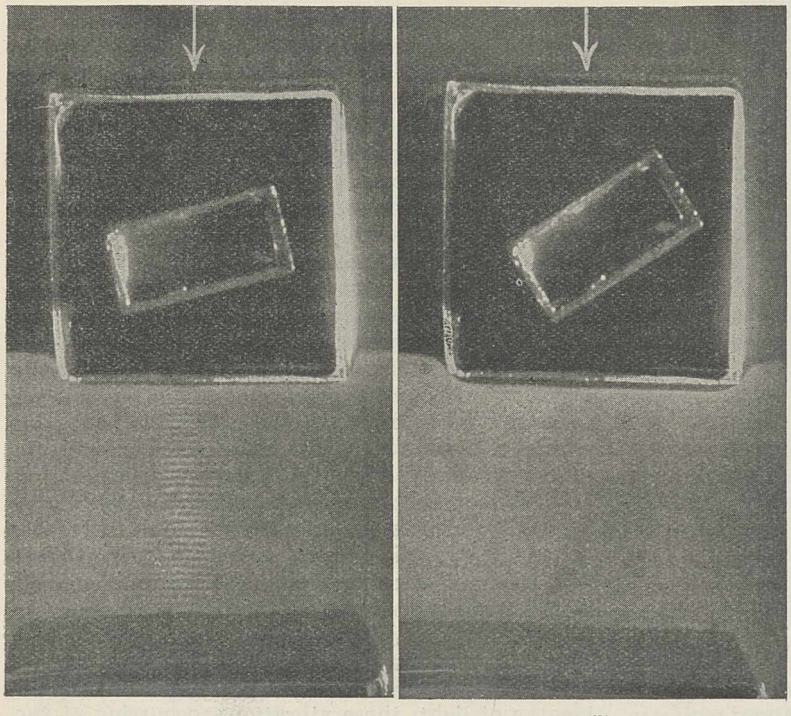


Fig. 2.—Transmission of ultrasonic waves through layers of pentane and transformer oil for (*a*) angle of incidence less than critical angle; (*b*) no transmission for angle of incidence greater than critical angle. The outer vessel contains pentane and the inner oil.

Experiments with the Ultrasonic Beam directed towards the Surface of a Liquid.

The properties of ultrasonic waves described above were predicted from theoretical considerations before they were experimentally demonstrated by Langevin, Boyle, and others. Remarkable and hitherto quite unforeseen effects can, however, also be produced by ultrasonic vibrations when these are of great intensity and very high frequency.

With the crystal arranged as shown in Fig. 1, the ultrasonic beam is confined mainly to the column of liquid between the upper crystal face and the surface of the oil. Prof. R. W. Wood and Mr. Loomis have shown that in these circumstances the great concentration of energy causes the amplitude of vibration of the disturbed particles of liquid greatly to exceed the amplitude of vibration of the crystal itself. At the same time the pressure of radiation produces on the surface a mound of oil, several centimetres or even inches in height, which erupts droplets like a miniature fountain. On plunging vessels of appropriate form into this mound of oil, vibrations of great intensity may be communicated to the walls of the vessels, or through the walls to liquids contained in them. If a test-tube containing water is partially immersed in the oil, bubbles of dissolved gas are usually liberated in it (Fig. 4). These behave in a peculiar manner. For moderate intensities of vibration the bubbles form slowly and remain practically stationary at the nodes of the waves formed in the water. As the bubbles grow in size they oscillate and tend to rise to the surface in an irregular zigzag manner as if they were going up a staircase. For still greater intensities we have found that no visible gas bubbles can either exist or be formed. The density of the gas being much less than that of the liquid, the bubbles formed at low intensities must experience the same forces and therefore have greater amplitudes of vibration than the particles of liquid they displace. The result is that at high intensities they are deformed and shattered and so dispersed through the liquid as to become and remain effectively in solution.

Cavitation can be produced in liquids such as pentane or benzene, by using a U-tube closed at one end, the closed limb being filled with the liquid, and placed in the mound of oil above the vibrating crystal. The bubbles of vapour formed in the interior of the liquid and collected in the closed limb can be again condensed into liquid by raising the air pressure on the open limb. Using now an inverted U-tube or Ω-tube, which is completely sealed up and contains liquid in one limb only, we observe the rapid vaporisation of liquid in the agitated

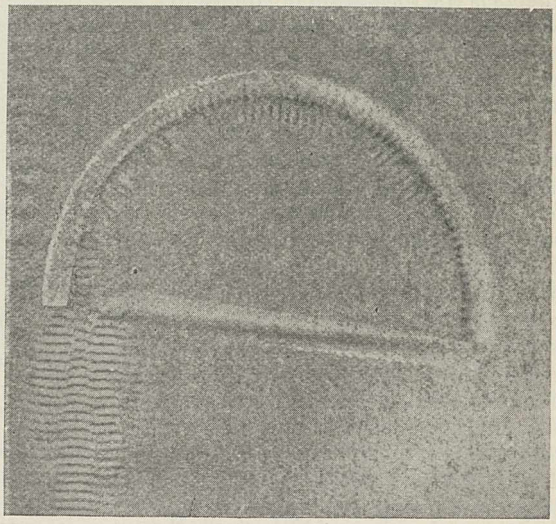


Fig. 3.—Model of lecture theatre of Royal Institution, showing 'whispering gallery' effect, illustrated by stationary waves of ultrasonic 'sound' of 2 mm. wave-length. Notice how the waves hug the wall.

limb and its deposition as liquid in the previously empty limb. This might appropriately be called *acoustic distillation*.

On substituting for the inverted U-tube a similar tube which contains a little dry lycopodium powder

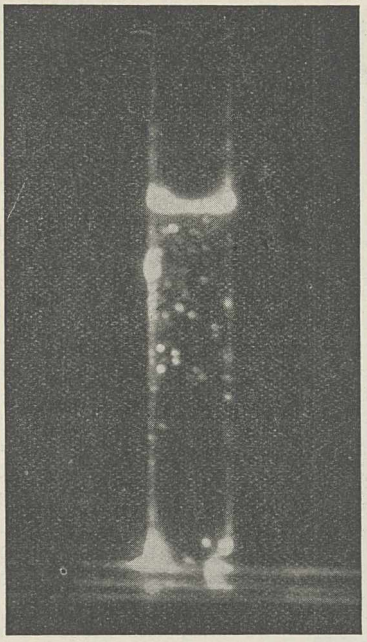


FIG. 4.—Expulsion from water of dissolved air as bubbles.

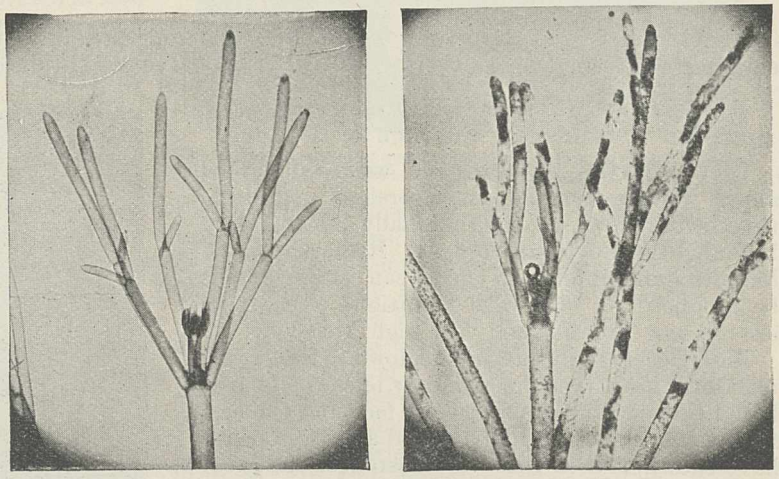
but is otherwise highly evacuated, an astonishing result is obtained. The powder sometimes moves in this case *towards* the limb which is subjected to the more intense vibration. This last effect is one of a number of phenomena due to the transverse vibrations of various types set up in the walls of the vessel itself. Another of these effects is the formation of ripples in the oil splashed on the tube and the repulsion of the oil drops away from the source of disturbance.

The most striking thing, however, about the oil drops is their behaviour at a constriction, or at the narrower parts of a tube such as is shown in Fig. 1. High inputs of ultrasonic energy cause intense local heating at such places, and the oil is thrown off as spray and jets of vapour as from diminutive geysers. If the tube is drawn off into a fine fibre and firmly grasped between the fingers, a severe burn is experienced. In addition to the calorific effects produced in the walls of various containers, the absorption of sound energy which occurs in their contents causes appreciable rises of temperature in them also. Amongst other effects which we can produce by our installation, we may cite the acceleration of certain chemical reactions, the flocculation of suspended matter, and the emulsification of oil and water, etc.

Most of the effects obtainable with the ultrasonic beam directed towards the surface of a liquid were discovered by Wood and Loomis in the United States. Acoustic distillation, the anomalous movement of lycopodium powder, and the non-liberation of bubbles from water with very high intensities are, we believe, described now for the first time.

Biological Effects of Ultrasonics.

Some fifteen years ago, while carrying out experiments at sea, Langevin and his co-workers observed that fish which swam into a beam of ultrasonic waves were disabled or killed. During the past few years I have been able to investigate this phenomenon. Quite independently, Wood and Loomis covered much the same ground. Let us notice first what happens to an object the dimensions of which are large compared with the wavelength of the sound waves which irradiate it. One result can be seen from Fig. 5. These are reproductions of photomicrographs of a freshwater plant —*Nitella*. The irradiated specimen shows how certain regions in a cell are denuded of their chloroplasts, which are then piled up in other spots. A gentler irradiation merely causes the streaming of the protoplasm to cease either temporarily or permanently according to the duration of exposure. The mechanical action which has taken place here can be understood when it is realised what occurs in the water in which the plant is immersed. Although the excursion of a disturbed particle during a single vibration is only equal to a few wavelengths of light, these vibrations, occurring at the rate of nearly a million times a second, cause the maximum velocity of the particle to be very high ;



(*a*) (*b*)

FIG. 5.—(*a*) Normal *Nitella*; (*b*) *Nitella* after exposure to ultrasonic vibrations. ($n = 750{,}000$.)

its maximum acceleration may become as great as 10 km. per sec. per sec. We have, in effect, a *micro ultra-centrifuge*, which subjects specimens to very intense though highly localised forces.

This explanation accounts quite satisfactorily for certain other effects we have obtained, such as the breakdown of the red blood-corpuscle and the disruption of Planaria and similar small living organisms. The same explanation may possibly account

for the decreased response to stimulation of an irradiated muscle-nerve preparation and the arrest or retardation of the beating of the isolated frog's heart and embryonic heart of a chick.

Further explanation is required to account for the action on bacteria and viruses—bodies which are of microscopic and ultra-microscopic dimensions. We have found that the agglutinating power of certain streptococci is increased after irradiation, but the virulence of a strain of pneumococcus was unchanged or changed in an indefinite manner. (Preliminary experiments with bacteriophage have given a negative result.)

Positive effects have been obtained with one virus. The accompanying table shows the effect of ultrasonic vibrations in increasing the potency of the virus of vaccinia. Through the kindness of Dr. Mervyn Gordon, the irradiated and control lymphs in various dilutions were used to vaccinate the skin of a rabbit. The 'takes' were recorded after the requisite period of time had elapsed for the characteristic lesions to be produced. Two series of experiments were carried out, the lymph in the first case being given only one-fifth of the exposure given in the second case. It will be noticed that the result is the same in both cases. Presumably the effect of the exposure was merely to disengage inert foreign material from the virus so that the latter could exhibit its intrinsic potency.

Effect of Ultrasonic Vibrations on Vaccinia Virus.
(Frequency 700,000.)

Dilution.	*1st Expt.*	*2nd Expt.*	*Control.*
1/1	+	+	+
1/10	+	+	+
1/50	+	+	+
1/100	+	+	+
1/500	+	+	−
1/1000	+	+	−
1/2000	−	−	−

We have seen that fish may be killed by means of inaudible sound waves. With so many effects occurring simultaneously—the breaking up of blood corpuscles; liberation of dissolved gases; paralysis of muscle and nerve; localised mechanical action and heat production—this should no longer surprise us. In conclusion, it may be added that ultrasonic radiation is not a menace to human life. The vibrations are of necessity produced in a liquid because at these high frequencies the waves are so rapidly attenuated in air that their propagation through it is practically impossible.

Obituary.

Dr. Thos. A. Edison.

BY the death at Llewellyn Park, West Orange, New Jersey, on Oct. 18, of Thomas Alva Edison, America has lost one of its most famous men, and one whose name, like those of his countrymen Fulton, Whitney, Colt, Morse, Bell, Maxim, Westinghouse, and the Wright brothers, will always be remembered as that of a great inventor. When a youth, Edison bought a set of Faraday's works, and he afterwards said, "I think I must have tried everything in those books." It was in this direction his great strength lay; for, gifted with a vivid imagination and a quick and active mind, he possessed a remarkable willingness to put everything to the test, and to seek in any and every direction for a solution to the problem of the moment.

Edison came of Dutch and Scotch descent, and was born at Milan, Ohio, on Feb. 11, 1847. It was apparently from his mother that he inherited his intense mental activity, while from his father's side came his exceptional physique and powers of endurance. His great-grandfather lived to the age of a hundred and four years, his grandfather to a hundred and two, and his father and several uncles to more than ninety years of age. The romantic story of his early life has many parallels in American biography. Owing nothing to schools or masters, he was his own instructor and the founder of his own fortunes. As a train boy of fifteen years of age he printed a small newspaper, the first ever produced on a train in motion; at sixteen years he was a telegraph operator; at nineteen he took out his first patent; at twenty-two he was working for a telegraph company at 300 dollars a month, and soon afterwards was able to sell his improvements in 'stock tickers' for 40,000 dollars, and in 1876 to open his laboratory at Menlo Park, Newark, New Jersey.

The record of the work of Edison and his assistants during the next twenty years at Menlo Park and at West Orange, to which he removed in 1887, probably has no parallel in the history of invention, and it is no wonder he became popularly known as the 'Wizard of Menlo Park'. It has been said of him that "he could always be counted upon to play his part in the mechanical evolution of new inventive arts", but his part often became the principal one. In telegraphy he will be remembered for the invention in 1872 of the type printing receiver and his subsequent work on quadruplex telegraphy, while to telephony he contributed the important invention of the carbon transmitter. Bell invented the telephone in 1876, Hughes the microphone in 1878, and Edison the carbon transmitter in 1877. To that year also belongs his outstanding invention of the phonograph.

Two years later Edison successfully solved the problem of "the subdivision of the electric light" by the invention of his incandescent lamp, his work in this direction being contemporary with that of Maxim, Lane Fox, and Swan. His improvements in the dynamo, made about the same time, gave him a place beside Gramme, Siemens, Crompton, Brush, and Hopkinson; while the first central power stations in both the Old World and the New World, the former in Holborn Viaduct, London, and the latter in Pearl Street, New York, were the direct outcome of his many inventions. Both these stations began operations in 1882.

In Menlo Park, in 1880, Edison made experiments with electric traction, while he afterwards

contributed to the advancement of photography and cinematography. One fruitful observation he made in 1883—the Edison effect—he left for others to utilise; and from this, through the work of Sir Ambrose Fleming, came the thermionic valve. The work of an inventor responsible for more than a thousand patents cannot be adequately dealt with in an obituary notice, but, in conclusion, mention may be made of his nickel and iron storage cell patented in 1900 and improved in subsequent years.

Many biographies of Edison have been written and many writers have put forward extravagant claims on his behalf. But he himself stood in need of no such panegyrists. His works speak for themselves, and the *Times* remarks that though his older friends and staff have passed away, "those who survive him retain an abiding impression of him as a great man, and a singularly delightful personality, devoid of egotism, inspiring enthusiasm and exceedingly human, as all who share his love of children must be".

For fifty years Edison's name has been a household word, and it is nearly forty years since it was included in the list of recipients of the Albert Medal of the Royal Society of Arts, where it is found beside those of Faraday, Wheatstone, Bell, Hughes, Kelvin, Swan, Parsons, Fleming, and Marconi. It is among such as these he rightly takes his place.

DR. C. A. KEANE.

DR. CHARLES ALEXANDER KEANE, who died, at the age of sixty-seven years, on Sept. 18, had been identified for the last thirty years with the development of technical education in London. After studying at Manchester under Roscoe and at Erlangen under Otto Fischer, he served as lecturer and demonstrator in chemistry at Liverpool for fifteen years before coming to London to take up the post of first principal of the newly established Sir John Cass Technical Institute. This Institute was founded out of the increased revenues of the trust established by Sir John Cass (1661–1718) for the maintenance of a Foundation School for the children of the Ward of Portsoken. Appointed in 1901, almost a year before the opening of the new building in Jewry Street—now, in eloquent testimony of the success of his administration, undergoing extensive enlargement—Keane at once gained the confidence of the governors, and was able to determine from the very beginning the lines on which the Institute should develop. As soon as possible another building was provided for Sir John Cass's Day School, and all elementary teaching was given up in favour of more advanced work. Two chief principles were adopted: first, the encouragement of research among the teachers and senior students, and, secondly, close association with the industries of the district. In both these respects the Sir John Cass Institute has fulfilled the wishes of its promoters; a long list of original researches has been published from its laboratories, while its industrial classes, each controlled by a consultative committee representing its special subject, are a characteristic and flourishing feature of its work.

Keane contributed a number of papers on organic chemistry to the *Journal of the Chemical Society*, but his chief interests lay in applied chemistry, and he did pioneer work on electrolytic methods of analysis and the analysis of gases. He wrote a book on "Modern Organic Chemistry", intended for readers with no special chemical training, and edited the English edition of Lunge's "Technical Methods of Chemical Analysis", which was completed in 1914 and was followed by a revised edition on which he was engaged almost to the time of his death. He was an active member of the various societies associated with chemistry, and acted as chairman of the London Section of the Society of Chemical Industry in 1917–19, a position in which his sound common sense and business acumen proved of great value.

Keane retired from his post at the Cass in 1926 after a period of ill-health culminating in a serious operation, and spent the remaining five years of his life at his country home near Canterbury, actively engaged in local affairs. A man of wide interests and culture, and a charming companion, his loss will be severely felt. A. H.

PROF. FRITZ FOERSTER.

WE regret to record the death on Sept. 14 of Prof. Fritz Foerster, Director of the Laboratory of Inorganic Chemistry of the Technische Hochschule, Dresden, and we are indebted to the *Chemiker-Zeitung* for Oct. 7 for details of his career.

Born in 1866 at Grünberg in Silesia, Foerster proceeded in due course to the University of Berlin, where he studied under A. W. von Hofmann. After graduation he became assistant to Mylius at the Physikalisch-Technische Reichsanstalt, and in 1894 he joined the staff of the Technische Hochschule in Charlottenburg, but in the following year he accepted a post as lecturer under Walter Hempel at the Hochschule in Dresden, where in 1900 he was appointed to the new chair of electrochemistry and physical chemistry. In 1905 a new laboratory of electrochemistry was established under his direction, and in 1912, on the retirement of Hempel, Foerster was elected to the chair of inorganic and technical chemistry. After the War he applied himself to the task of rebuilding the Chemical Institute, which was ready for occupation in 1925.

Foerster's experimental work lay chiefly in the field of electrochemistry, the bulk of his original papers being published in the *Zeitschrift für Elektrochemie*. The problems which he investigated cover a very wide field, and include the electrolysis of alkali chlorides and the salts of the halogen oxy-acids, as well as electro-analytical methods and technical applications. During the last twelve years he was particularly concerned with an investigation of the chemistry of the oxy-acids of sulphur and the electrolytic reduction of compounds of polyvalent metals. His well-known handbook "Elektrochemie wässeriger Lösungen" (1905) is recognised as a standard work on the subject. In 1923 he began to remodel the whole work, and the first volume was approaching completion at the time of his death.

News and Views.

The Pedler Lecture of the British Science Guild was delivered to the University of Durham Philosophical Society at Armstrong College on Oct. 21 by Prof. J. Irvine Masson, who took as his subject "Problems in the National Teaching of Science". Reviewing, on a national scale, education in pure science, as it is carried on at our universities and in schools, Dr. Masson asked if the pendulum has overswung. Are we teaching too much science or teaching science too much? To those who are going to be lifelong scientific workers we have to, and do, give an intensive training; but every science is now swelling so quickly that it can no longer be confined within the three-year limit of the undergraduate course. Two more years are needed and are actually expected of a young man before he is eligible for a first post as a practising scientific worker. This needs universal recognition. Prof. Masson is of opinion that we are trying to teach too much and too specially to those who are not going to be professional scientific workers. The figures for the whole country show a great preponderance of 'honours' over 'pass' students, and a great many of these honours specialists do not go on with further training in their science, but turn to school-teaching, besides other occupations.

Teachers carry into schools the same exclusive specialisation, and a vicious circle is created, which is helped by the higher salaries paid to school-teachers who are honours graduates. Prof. Masson thinks that if this were altered, and the universities reformed their pass-degree courses, we should get much better balanced teaching in schools; and the whole series of educational sieves through which our young people pass (or are forced) would work naturally. In the schools, especially the secondary schools, exaggerated science teaching is given on a very large scale from absurdly youthful ages, while other subjects (for example, German) are neglected. These things are as bad for the future scientific worker as they are for all other students. They can be cured by the reforms already mentioned, coupled with a change in the functions of the school certificate. In an appendix to the printed lecture, these arguments are supported by a statistical survey, which shows the trend during recent years in the choice of pursuits at the universities and schools of the realm.

Dr. F. C. Benham, in a report on "Fluctuations in Employment in Great Britain", prepared for the recent meeting of the World Economic Congress in Amsterdam, stated that the general standard of living in Great Britain is now probably higher than before the War. A recent inquiry by the Ministry of Labour showed that weekly full-time rates of wages, for those classes of adult workpeople for which information is available, averaged between 70 and 74 per cent in December 1930 above the level of August 1914. Weekly earnings of which the wage index takes no account have increased still more, while there have been also considerable reductions in normal weekly working hours, which in effect mean that hourly rates of wages are between 90 and 100 per cent higher. The cost of living, however, is less than 60 per cent higher. Thus 'real' weekly wages are appreciably greater and hours of work are less. At the same time, the transference of income, through the machinery of public finance, from the relatively rich to the relatively poor is much greater. Yet against all this must be set the large numbers of unemployed, which tend to bring down average 'real' yearly earnings. During the past twenty years, methods of production have improved, technical efficiency has increased, and the productive capacity of the world appears greater than ever before. Undoubtedly a marked increase of economic welfare would take place if only the vast number of unemployed could be absorbed into industry. The problem, however, is a world problem, and will only be solved by intelligent co-operation between the various nations.

The Annual Report of the Director of the Meteorological Office for the year ending March 31, 1931, which has just been published by H.M. Stationery Office, describes the principal activities of our national meteorological institution's seventy-sixth year. It records a steady all-round increase in the application of theoretical meteorology to the practical affairs of everyday life, shown by an always growing number of applications for expert advice in matters connected with climate and weather, in each of the various sections into which the Office is divided. We learn that in addition to activities of this kind, much of the time of the staff was devoted to carrying out decisions made at three important conferences held in 1929, namely, the International Conference on Safety of Life at Sea, the Conference of Empire Meteorologists, and the International Conference of Directors of Meteorological Services. Among the changes involved are those relating to the interchange of weather reports by wireless on land and at sea. Owing to the increasing amount of interference between the wireless issues on land of different countries consequent on expansion of programmes arising from the needs of growing aviation services, it was found necessary to arrange for fewer, but more comprehensive, wireless messages. These are issued by powerful stations in the United States, Great Britain, France, Germany, and Russia. The exchange of wireless weather reports at sea has been comparatively little affected. The increasing responsibilities of official meteorology have been met to a large extent by frequent revision of methods of work with the object of making the most efficient use possible of the available establishment, but the creation of a few new posts was found to be unavoidable, and among these may be mentioned the appointment of an officer to take charge of special investigations into problems of atmospheric visibility connected with aviation, naval operations, and lighthouses.

AT a recent meeting held at Locarno, the International Meteorological Committee agreed upon the programme of meteorological, magnetic, and electrical research to be undertaken in the Arctic regions during the winter 1932–33, in accordance with the decision to organise a second 'International Polar Year' on the fiftieth anniversary of the first undertaking of this character. The scheme involves the setting up of a circumpolar chain of temporary observatories, equipped with special apparatus for the work to be done. In view of the long Arctic coast-line in Russia and Siberia, it is obvious that the co-operation of the Russian Government is particularly desirable; it is satisfactory to learn, therefore, not only that such co-operation will be forthcoming, but also that the Russian contribution is likely to be the largest made by any one country. It is unfortunate that the organisation of an enterprise such as this, which involves financial expenditure without immediate economic return, should coincide with the 'economic blizzard'; but although this has prevented some governments from assisting financially, private help has generally resulted in the necessary funds being available, and on the whole the scheme promises well. Of the many great improvements in equipment that the past fifty years have made possible, those due to the development of wireless telegraphy may be noted especially. There is a possibility that the problem of obtaining observations of pressure, temperature, and humidity at high levels in the atmosphere, in regions where the ordinary instruments sent up in registering balloons are not likely to be recovered, may be solved by an apparatus which automatically emits wireless signals when the quantities to be measured reach certain predetermined values.

THE wet nature of the recent summer in England considerably increases interest in the results of the combined harvester-thresher machine trials. Demonstrations have been given in different parts of the country, and information from the Institute of Agricultural Engineering at Oxford regarding the performances of the machines is given in a recent statement issued by the Ministry of Agriculture. Eleven machines in all were used, one of which for the first time is owned by a contractor, while nine belong to private farmers. About 1500 acres of cereals was cut, most of which was barley, the superiority of the combine over ordinary methods of harvesting being particularly marked with this crop. Good malting samples, fetching prices of 45*s*.–50*s*. per quarter, have been obtained where, owing to the wet season, the crop would have been seriously damaged if exposed in stooks in the normal way. The additional use of a drying machine is not essential, but as it allows of starting harvesting operations much sooner after rain, the advantages may be considerable. The best day's work was done by a caterpillar combine used by Mr. G. H. Nevile of Wellingore, Lincs, and consisted of cutting 14 acres of oats, yielding altogether 144 sacks. The question of straw remains a problem, as the present type of combine, designed to suit American conditions, is unable to deal with a crop more than 3 ft. in length. Messrs. Clayton and Shuttleworth have, however, now produced a British machine which seems able to overcome this difficulty. As an alternative, in districts where the straw is very long and of sufficient value, a binder may be used in conjunction with the harvester-thresher, or shorter straw can be gathered with a hay-loader and put in a rick or baled in the field. Apart from these minor difficulties, it is evident from this year's experience that combine machines are a thoroughly practical proposition for use in England, and that they are of particular benefit to the barley grower in wet seasons.

A MEETING of the administrative council of the Empire Cotton Growing Corporation was held in Manchester on Oct. 21, and the Right Hon. the Earl of Derby, president, presented the quarterly Report of the Executive Committee. One important point in the Report is that the Committee has decided to recommend that each experimental station should only be required to produce a full report every third year. Thus each annual volume would contain four full reports, while the remaining eight stations would produce summaries only of the work of the last season. The stations would thus produce their full reports in rotation. The Committee recommends that stations from which summaries only are required should, nevertheless, take care to include in those summaries, or in a separate note if desired, any observations or results that may be of immediate use to co-workers. Lord Derby remarked that the finances of the Imperial College of Tropical Agriculture are a source of anxiety to the governing body of the Empire Cotton Growing Corporation, owing to a reduction made by the Empire Marketing Board in the grant and the possibility of a diminution in the amount of the sums receivable from overseas contributors. The Corporation takes the greatest interest in the work of the College, which has led to great improvement in the standard of the agricultural officers in the Colonial service. Any curtailment of the activities of the College or impairment of its efficiency would be a real calamity.

IN the Report are references to administrative changes and work at the various experimental stations. Before the Research Committee, Dr. Harland reported on the work of the Genetics Department, and gave a résumé of what had been accomplished during the first five years since the Research Station at Trinidad was established. The climate has provided no obstacle to progress which it was not possible to overcome, but it has been found necessary to adapt the technique of the work to meet difficulties that have arisen. Various insect pests have, however, proved rather a limiting factor, and for this reason Dr. Harland is extremely glad that the Corporation has reopened the Experiment Station in St. Vincent, where the obstacles to cotton growing are less formidable. At the same meeting, Sir James Currie, Director of the Corporation, reported certain matters which had arisen since the Report was drafted. In the Sudan this season, the crop has so far suffered much less from disease than last year, and it is hoped

that satisfactory yields will be obtained. In the rainfall districts, it is interesting to note that the variety tests with American cotton have indicated that the Corporation's U.4 strain from Barberton has yielded better than all other varieties, both in Mongalla and in the Nuba Mountains. Its quality, moreover, appears to be satisfactory.

Capt. J. M. Donaldson in his presidential address to the Institution of Electrical Engineers on Oct. 22 dealt mainly with the work being done by the large electric power companies, which are out of touch with the national network of power lines now being rapidly erected round Great Britain. In London, the London Power Company has been carrying out in a quiet and unostentatious manner a remarkable work of unification and consolidation. The company controls and has linked up the power stations at Deptford, Bow, Grove Road, and Willesden, and the large Battersea station now being erected will form part of the group. Last year its output was 819 millions of units, and the maximum demand at any one time was 283,400 kilowatts. Another group consists of the County of London and City of London companies. The main power station of this group is at Barking, where plant producing 240,000 kilowatts is installed. At the present time this is the largest power station in Great Britain. A further extension of 150,000 kilowatts has been authorised. A large fraction of the output is sold outside London. The possibility of linking up the large private companies was considered, but it is very doubtful if the companies would have been willing to agree to this some years ago when the national scheme was first introduced. The dwellers in the country are well aware of the low prices of electricity which are charged in many towns. They naturally think, therefore, that the much higher price they have to pay is inequitable. This is not the case, for the cost of supplying electricity in the rural areas depends more on the density of the population than on other considerations. In technical language, it depends on the revenue per mile of the supply main.

In a paper on radio research in the British Empire read by R. A. Watson Watt and O. F. Brown to the British Association on Sept. 28, an account was given of the collaboration between the home and dominion boards of radio research. The study of atmospherics has proved that in order to make real advances in our knowledge, the observing network must be spread over the whole surface of the globe. This problem is of vital importance to the radio engineer. Attenuation and fading may reduce the received intensities, but it is easy to compensate for them by gain control at the receiver. With atmospherics, however, the compensation can only be usefully carried to the point at which the noise level due to atmospherics, to artificially generated disturbance, or to internal set noise becomes comparable with the signal. Set noise can be mitigated, artificial disturbance avoided, but an irreducible minimum of atmospheric disturbance must be accepted along with the desired signal. The Radio Research Board, therefore, does not deal with the elimination of atmospherics but with their nature and origin. On the radio communications side the Board has made its contribution to the demonstration of the limits of atmospheric mitigation. On the geophysical side it is still exploring the possibilities of utilising atmospheric observations in practical meteorology. It is now proved that the interesting phenomena of reflection from the Kennelly-Heaviside layer are related to the terrestrial magnetic field. It will therefore be of great interest to compare the data obtained from observations made in the northern and southern hemispheres.

His Majesty the King has graciously placed on loan in the Department of Botany of the British Museum (Natural History) a collection of plants presented to him by the University of Buenos Aires. The collection contains 302 named plants, which are of great scientific and historical interest, as they were gathered during the Delimitation Expedition (1902–3) under Sir Thomas H. Holdich, the Royal delegate appointed by Edward VII. on the request of the presidents of Argentina and Chile to determine the Patagonian Argentine-Chile frontier. The University of Buenos Aires charged certain members attached to the Arbitration Commission with the making of a systematic botanical survey of the difficult areas. The dried specimens were divided into three lots—one was retained at Buenos Aires, another was presented to the Valparaiso Museum, and the third was preserved until an opportunity arose of delivering "with the homage of Argentina to His Britannic Majesty this historical material collected in the fulfilment of the judgment which re-established peace and harmony between the sister nations." The collection was entrusted to Lord Moynihan on his recent visit to Buenos Aires. It is accompanied by two volumes of collotype reproductions, one containing unpublished letters of A. von Humboldt, the other the botanical journal of his pupil, A. J. A. Bonpland. The Department of Botany has also been presented with a collection of 446 Angolan plants by Mr. J. Gossweiler, well known for his botanical exploration in Angola. Mr. J. J. Joicey has added to his previous benefactions to the Department of Entomology of the Museum by presenting the whole of his Indo-Australian Noctuidæ, the Geometridæ other than the African species, the Ægeriidæ (Clearwings), and the types of many species belonging to several other families. Recent acquisitions by the Department of Mineralogy include one of the many masses of meteoric iron found in June 1931 around the large meteorite craters near the Henbury cattle station, Finke River, Central Australia, presented by Prof. Kerr Grant.

In *Engineering* of Oct. 16 is an illustrated account, by Mr. A. E. Williams, of the coco-nut oil industry, with descriptions of the machinery in use. There are approximately 7,000,000 acres of coco-nut palms under cultivation, of which area more than one-half is in the British Empire. The chief botanical specimen cultivated is *Cocos nucifera*. Some seven or eight years elapse between the planting of the palms and the time they bear fruit, while the fruiting period is from sixty to seventy years. Each tree yields annually from

eighty to ninety nuts. Of the nuts, the dried kernel, called copra, is used for its oil, the husk can be spun into coarse yarn, while the shell is used for fuel or for the manufacture of charcoal. The essential parts of a modern plant for obtaining coco-nut oil include drying furnaces for the copra, grinding mills for reducing the copra to meal, and hydraulic presses for expelling the oil from the meal. Before being pressed, the copra meal is heated in steam-heated kettles, and by this means it is possible to reduce the oil content from 70 to 6 per cent. The residual meal is valued as a cattle foodstuff. Coco-nut oil represents about twelve per cent of the total oils and fats used in soap manufacture in Great Britain and about twenty per cent in America, while it represents about fifty per cent of the total margarine made in America and about thirty-five per cent made in Great Britain. It is also used in chocolate and toffee manufacture.

THE Government of India has authorised the issue by the Zoological Survey of India of a third serial, additional to the *Records of the Indian Museum* and the *Memoirs of the Indian Museum*. Since the appointment of Dr. B. S. Guha as anthropologist to the Zoological Survey, provisionally for a period of two years in 1927 and permanently as from 1929, a considerable amount of research work in anthropology has been and is being carried out; while it is hoped that from time to time reports will be available for publication dealing with research on the population, both past and present, of India. Up to the present the *Memoirs* and *Records* have dealt solely with zoological subjects, with one exception, a paper by the late Dr. Nelson Annandale. In order to avoid a change in the character of these publications, it has been decided to inaugurate a new series of *Anthropological Bulletins*, with the first of which, a report on the human relics recovered by the Naga Hills (Burma) Expedition, we deal elsewhere (p. 762).

THE Report of the Irish Radium Committee for 1930 in *Sci. Proc. Roy. Dublin Soc.*, vol. 20 (N.S.), No. 10, p. 99 (also separate issue), states that the generosity of members of the Royal Dublin Society and of the general public enabled an additional amount of 496 mgm. of radium to be purchased, bringing the total quantity available up to 907 mgm. From the several medical reports included, it is evident that rodent ulcers and skin cancers react most favourably to radium treatment, with a cure in some 80-90 per cent of the cases. Cancer of the tongue, when not too extensive, and of the uterine cervix, yield 40-60 per cent of cures. Cancers of the breast, rectum, and other regions are seldom cured, though now and then a striking result is obtained. It has to be remembered, however, that most of these cases are too advanced for successful operation. Certain non-malignant conditions, such as uterine hæmorrhage, also react favourably to radium treatment.

IN NATURE for Sept. 12, p. 440, reference was made to the obscurity that prevails as regards the function of the forceps of the common earwig. We have since received letters from Mr. M. H. Lapidge, of Hampton Wick, and Dr. van der Sleen, of Haarlem, concerning this subject. Both correspondents mention having personally observed these insects to use their forceps in manipulating their wings. Mr. Lapidge states that he has several times seen earwigs use their forceps to fold up their wings beneath the tegmina. Dr. van der Sleen, on the other hand, remarks that he has observed these insects using their forceps for opening their wings. While it seems certain that one of the functions of the forceps is in connexion with the manipulation of delicate and complexly folded wings, their main use can scarcely be regarded as having been definitely settled.

THE monthly journal *Mikrokosmos* with the October issue commences its twenty-fifth annual volume. *Mikrokosmos* aims at extending knowledge of microscopy, and publishes papers on current topics and progress in all branches of microscopy. In the present number, Prof. W. J. Schmidt reviews the progress of histology during the last twenty-five years, Dr. H. Dohrer describes the infection of flies with the fungus *Empusa muscæ*, Dr. Karl Berger writes on the early 'flea' magnifiers, and Dr. G. Venzmer describes what tropical medicine owes to microscopy. Other articles deal with microscopy in schools and with laboratory technique. The journal is well produced on good paper, so that photomicrographs, of which there are several, are adequately reproduced. *Mikrokosmos* is edited by Dr. G. Stehli and published by Franckh'sche Verlagshandlung, Stuttgart, at 2·40 gold marks a quarter.

THE Council of the Institution of Chemical Engineers has appointed Mr. H. W. Cremer to be honorary secretary of the Institution in succession to the late Prof. J. W. Hinchley.

ON the occasion of the opening of the new laboratory of physical chemistry at the University of Freiburg im Breisgau on Oct. 30, honorary degrees were conferred on Lord Rutherford, Prof. Manne Siegbahn, professor of general physics in the University of Uppsala, and Prof. V. M. Goldschmidt, of Göttingen.

THE Ministry of Agriculture and Fisheries has appointed Mr. J. S. L. Gilmour, Curator of the University Herbarium and Museum, Botany School, Cambridge, to be Assistant Director of the Royal Botanic Gardens, Kew. Mr. Gilmour was educated at Uppingham School and Clare College, Cambridge, where he took the Natural Sciences Tripos, Part I. and Part II., Botany.

IT is announced in *Science* for Oct. 9 that Prof. Stephen H. Langdon, professor of Assyriology at the University of Oxford, and Dr. Ludwig Diels, Director of the Botanical Garden and Museum of Berlin-Dahlem, have been elected corresponding members of the Field Museum of Natural History, Chicago, by the board of trustees, in recognition of their eminent services to the museum.

A COURSE of twelve public lectures by Prof. Lancelot Hogben, research professor of social biology in the University of London, on "Genetic Principles in Medicine and Social Science", has been arranged by

the London School of Economics and Political Science, Houghton Street, Aldwych, London, W.C.2. The first lecture will be given on Nov. 27, and the following eleven lectures on Fridays, at 5 P.M. Admission to the whole course is free and without ticket.

AT the conversazione of the Belfast Naturalists' Field Club, which was held on Oct. 20 to mark the opening of the winter session, the Club medal was awarded to Mr. S. A. Bennett, formerly science master at Campbell College, for his scientific attainments and his work with the Club from 1908 until 1926. Mr. Bennett was on the Committee of the Club from 1913 until 1926, for three periods was secretary of the botanical section, and from 1919 until 1923 was joint editor of the *Proceedings*. In 1920 he was elected president of the Club, and held that office for two years. Mr. Bennett has contributed much to the knowledge of plant distribution in Northern Ireland, and has done valuable work in local geological and anthropological problems, especially on the recently discovered prehistoric site in County Antrim.

PROF. R. H. DASTUR, of the Royal Institute of Science, Bombay, and his students arranged an interesting and instructive series of experiments illustrating the life processes and the life history of plants, on Sept. 30, at the C.J. Hall, Bombay. This date was arranged so that the exhibition should fall within the week of the centenary meeting of the British Association. Amongst the numerous exhibits were an apparatus for measuring the temperature of a leaf and an apparatus showing automatic records of the air diffusing into leaves through minute pores on their surface. The research work carried on in the Botany Department of the Royal Institute on the physiology of the rice plants has yielded results of practical value, and there were exhibits of living rice plants showing those results. The exhibition was followed by a lecture, illustrated with lantern slides, on "Plant Life on the Earth", by Prof. R. H. Dastur, when the vegetations of the different parts of the globe were illustrated on the screen, mostly in their natural colours.

THE Worshipful Company of Woolmen gives a silver medal each session for theses relating to wool and the processing of wool. The nomination Committee this year has recommended that two medals be granted, namely, to Miss Emma Stott, of the University of Leeds, for a thesis entitled "A Contribution to the Theory of Milling", and to Mr. Kenneth Nicholls, of the Bradford Technical College, for a thesis entitled "Sulphur Content of Wools in Relation to Processing". The Committee has also recommended that certificates of merit be awarded for the following theses: Miss Evlyn Boyd (University of Edinburgh), on "Pigmentation of the Fleece of the Sheep"; Dr. R. O. Hall (University of Leeds), on "The Ventilating Properties of Textile Materials and Fabrics"; Mr. Arthur Johnson (University of Leeds), on "The Influence of Cloth Structure on the Rate of the Milling of Fabrics"; Mr. M. Tempelhof (University of Leeds), on "Studies in the Regularity of Yarns and Slivers by a New Mechanical Tester"; Dr. A. E. Wilson (University of Leeds), on "Physico-chemical Properties of Wool"; and Mr. George Bancroft (Bradford Technical College), on "The Influence of Environment on Wool". These recommendations have now been approved by the Court of the Worshipful Company of Woolmen.

WE have received from Messrs. Gallenkamp the new issue of their "Catalogue of Chemical and Industrial Laboratory Apparatus". This is a handsome volume of 1471 pages, fully illustrated, and covers the scientific equipment applicable to practically every branch of industry. In a large number of cases brief but adequate descriptions of the use of the apparatus are included, so that the catalogue is much more than a mere list of prices. It should, in fact, be most useful in the school, university, or technical laboratory. The apparatus includes physical, botanical, and general biological equipment, and there is a detailed list of chemicals. At the end of the catalogue there is a useful list of books on various branches of chemistry, biology, medicine, and industry. Messrs. Gallenkamp are to be congratulated on the completeness of their catalogue and on the production of a useful and instructive volume.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior assistant in the Bacteriological Laboratory of the Public Health Department, Glasgow—The City Bacteriologist, 20 Cochrane Street, Glasgow, C.1 (Nov. 7). An assistant in electrical engineering at the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors, Education Offices, North Street, Wolverhampton (Nov. 9). A secretary of the Institute of Physics and Editor of the "Journal of Scientific Instruments"—The President, Institute of Physics, 1 Lowther Gardens, S.W.7 (Nov. 20). A secretary of the Welsh National School of Medicine—D. B. Anthony, University Registry, Cathays Park, Cardiff (Nov. 21). A superintendent of Greenwich Park—The Secretary (1A), H.M. Office of Works, Storey's Gate, S.W.1 (Nov. 21). An assistant in the Art and Ethnographical Department of the Royal Scottish Museum—The Director, Royal Scottish Museum, Edinburgh (Nov. 29). An assistant lecturer in physical chemistry at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (Dec. 1). A principal of the Borough Road Training College for Men, Isleworth—The Secretary, British and Foreign School Society, 114 Temple Chambers, Temple Avenue, E.C.4. A teacher of workshop practice (metalwork and technical drawing) at the Sheerness Technical Institute and Junior Technical School—The Principal, Technical Institute and Junior Technical School, Sheerness. Two resident masters for engineering, metalwork, woodwork, art, at Old Swinford Hospital, Stourbridge—The Headmaster, Old Swinford Hospital, Stourbridge. A director of research and head of the Research and Standardisation Department of the Institution of Automobile Engineers—The Secretary, Research and Standardisation Committee, Institution of Automobile Engineers, Watergate House, Adelphi, W.C.2.

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.*]

Crystalline Vitamin D.

FOUR crystalline preparations of vitamin D have recently been described [1] having approximately equal antirachitic activities (20,000-25,000 International Units per milligram) and similar absorption spectra, but differing widely in their optical rotations. It follows either that there are several substances having antirachitic activity or that none of these preparations is pure, and that the varying optical rotation is due to the presence of one or more impurities.

When we described our own preparation, to which the name 'calciferol' was provisionally applied, we could not exclude the possibility that it contained a certain amount of an inactive impurity. We have since found that when the crystalline material is heated at 180°, an inactive substance of very high dextro-rotation, 'pyrocalciferol', is formed. Since calciferol was obtained by distillation, it seemed probable that it was contaminated with pyrocalciferol, which would account for its remarkably high dextro-rotation. Evidence of the existence of isomorphous mixtures was given, moreover, by the fact that different preparations on repeated recrystallisation retained constant but different optical rotations.

The preparation of crystalline esters, the 3 : 5-dinitrobenzoates, which was reported in a paper read by one of us (R. K. C.) at the meeting of Section B of the British Association on Sept. 25, made available a new method of determining the nature of our crystalline material. Evidence had been obtained of the separation of the ester into two components, and the hypothesis was put forward that the distilled product was a mixture, or perhaps a molecular compound, of a substance with a higher antirachitic activity than any product yet obtained, and pyrocalciferol. The provisional conclusions then advanced have now been confirmed. On the basis of the biological tests so far completed, it would appear that our original preparations contained 30-50 per cent of inactive material, the dominant impurity being pyrocalciferol. Nevertheless, we think it may be justifiable to retain the name 'calciferol' for the active main constituent.

The product obtained by the action of 3 : 5-dinitrobenzoyl chloride on the crystalline material in pyridine has been separated by fractional crystallisation into two esters, each of which has been repeatedly recrystallised. *Calciferyl* 3 : 5-*dinitrobenzoate*, lemon-coloured plates, m.p. 145°-147°, $[\alpha]^{20}_{5461} + 104°$ in acetone, $[\alpha]^{20}_{5461} + 68°$ in benzene, yields on hydrolysis *calciferol*, m.p. 114·5°-117°, $[\alpha]^{20}_{5461} + 119{\cdot}5°$, $[\alpha]^{20}_{D} + 105°$ in alcohol, $[\alpha]^{20}_{5461} + 99°$, $[\alpha]^{20}_{D} + 81°$ in acetone, antirachitic activity 40,000 International Units per mgm.; the solution in alcohol has an intense absorption band with a maximum of $\epsilon = 46{\cdot}0$ at 265 mμ. *Pyrocalciferyl* 3 : 5-*dinitrobenzoate*, orange-coloured prisms, m.p. 167·5°-169·5°, $[\alpha]^{20}_{5461} + 250°$ in benzene, yields *pyrocalciferol*, m.p. 92°-94°, $[\alpha]^{20}_{5461} + 608°$, $[\alpha]^{20}_{D} + 494°$ in alcohol, showing no antirachitic activity; the solution in alcohol has an absorption band with maxima of $\epsilon = 15{\cdot}7$ at 296 mμ, 27·1 at 284 mμ, and 26·1 at 274 mμ. Both calciferol and pyrocalciferol are shown by analysis to have the same empirical formula as ergosterol.

Prof. Windaus recently suggested that our crystalline material was a mixture of his vitamin D_1 with a substance of very high rotation; [2] but calciferol, as now separated from pyrocalciferol, is evidently not identical with vitamin D_1, since the latter has a lower antirachitic activity and absorption coefficient and a higher optical rotation. Calciferol, however, resembles closely, in such physical properties as have been described, the "vitamin D_2" (m.p. 114°-115°, $[\alpha]_D + 85°$ in acetone) which Windaus mentions in an addendum to his paper as having been more recently prepared by Linsert. By the courtesy of Prof. Windaus we have seen the proof of a forthcoming paper in which the absorption coefficient of vitamin D_2 at 265 mμ is given, and corresponds closely with that of calciferol. The identity of the two substances however, cannot be assumed unless further experiment should show that vitamin D_2, like calciferol, has a substantially higher antirachitic activity than vitamin D_1, and not approximately the same activity, as stated. The antirachitic activity of calciferol is the highest yet recorded in known units for any preparation. Identity of calciferol with the 'substance L' of Reerink and van Wijk seems to be excluded by the great instability, lower absorption, and lower antirachitic activity of their product.

The supposition that calciferol is a direct product of the irradiation of ergosterol has been confirmed by the preparation of the 3 : 5-dinitrobenzoate directly from the undistilled, crude irradiation product. The ester and the sterol thus obtained show complete identity of properties with those from the distilled product, and the yield is such that the greater part of the antirachitic activity of the crude resin can be accounted for by the calciferol actually separated as the ester.

We much regret that Dr. Bourdillon, the leader of our team, has been prevented by illness from taking a direct part in this stage of the work.

F. A. ASKEW.
H. M. BRUCE.
R. K. CALLOW.
J. ST. L. PHILPOT.
T. A. WEBSTER.

National Institute for Medical Research,
Hampstead, London, N.W.3,
Oct. 22.

[1] Askew *et al.*, *Proc. Roy. Soc.*, B, **107**, 76; 1930: Angus *et al.*, *ibid.*, B, **108**, 340; 1931: Reerink and van Wijk, *Biochem. J.*, **23**, 1294; 1929: **25**, 1001; 1931: Windaus, *Proc. Roy. Soc.*, B, **108**, 568; 1931: and *Liebigs Ann.*, **489**, 252; 1931.

[2] Windaus *et al.*, loc. cit.

A New Type of Magnetic Birefringence.

IT is well known that salts of cerium and other rare earths exhibit in aqueous solution a Faraday effect or magnetic gyration of light in the *opposite* sense to that shown by the great majority of fluids. The phenomenon has been explained by Ladenburg, Becquerel, and others as an effect connected with the paramagnetism of the ions and their orientation by the magnetic field. The study of magnetic gyration in paramagnetic substances generally therefore possesses great interest. Incidentally, also, the question arises if, as has been suggested by Ladenburg, the paramagnetic ions are orientated by the field, whether the solutions should not exhibit magnetic *birefringence* when observed in a direction transverse to the field. Investigations made on both these points have yielded very interesting results.

A magnetic birefringence of the kind suggested by the orientation theory is definitely shown by salts

of cerium, praseodymium, erbium, and yttrium in aqueous solutions, when observed in strong magnetic fields. In every case, using light in the visible region of the spectrum, the birefringence is *negative*, that is, of the same sign as that exhibited by carbon disulphide; and appears to be proportional to the concentration of the solutions. Solutions of lanthanum and gadolinium, on the other hand, fail to exhibit the effect, though gadolinium is strongly paramagnetic. The effect in dilute solutions where it is observed is of the same order of magnitude as that exhibited by organic liquids of the aliphatic class.

So far, no investigation has been made of the variations of the effect with the wave-length of the light used or with the temperature. There appears, however, to be a significant parallelism between it and magnetic gyration in each of the substances studied. The fact that gadolinium salts exhibit neither a birefringence nor any marked magnetic gyration, though they are strongly paramagnetic, seems very significant. Evidently, the question whether the magnetic moment of the ions arises from orbital motion or spin of the electrons is all-important.

It may be mentioned in passing that ferric chloride solutions free from any suspended colloidal matter exhibit a noticeable magnetic birefringence.

C. V. RAMAN.
S. W. CHINCHALKAR.
210 Bowbazar Street, Calcutta,
Sept. 14.

Multiple Ionisation and Secondary X-ray Absorption Edges.

A GOOD verification of the existence of multiple ionisation in X-ray spectra would be to find a secondary edge, corresponding to the simultaneous transition of one K- and one L-electron. This edge will be

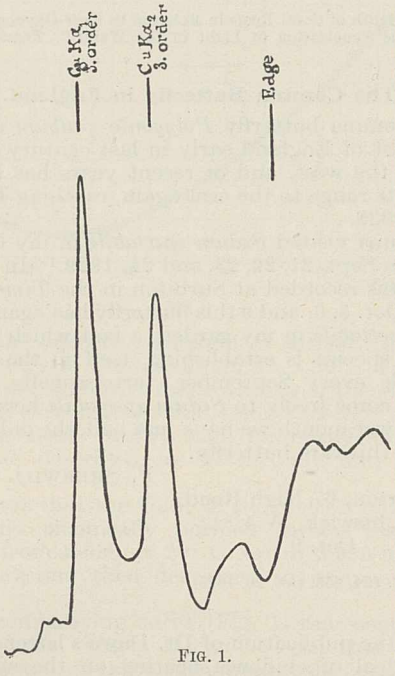


FIG. 1.

at a considerable distance from the main edge. Since in X-ray spectra the question of multiple ionisation is of great importance, I have undertaken to search for an edge produced by sulphur answering to the above mentioned condition.

It is easy to calculate beforehand the approximate position of this edge. For sulphur the level M_{III} is incomplete. According to the selection rules,[1] a K-electron then jumps to M_{III}, but for an L-electron we have either $L_I \rightarrow M_{III}$ or $L_{II,III} \rightarrow M_{IV}$. However, since the three L-transitions will be difficult to separate and the difference between M_{III} and M_{IV} is small, we have only to consider the combined transition $\begin{cases} K \rightarrow M_{III} \\ L \rightarrow M \end{cases}$. When calculating the energy of the L-transition, it should be noted that with one K-electron ejected the energy of an outer orbit should be estimated for an atom the nuclear charge of which is one unit higher than for the element considered. In the case of sulphur, we therefore use the L-energy value of chlorine. For the expected secondary-edge we then find the wave-length to be 4635 X.U.; the value for the main K-edge being 5009 X.U.

Working with a Siegbahn vacuum spectrograph, the crystal being calcite, and pure sulphur as absorber, I found an edge with the wave-length 4644·0 X.U. There is a discrepancy between the observed and calculated values, the observed being 9 units larger, a discrepancy easily explained. First, the K-electron is not ejected to infinity; and secondly, the screening effect of the K-shell is not complete. Therefore the increase in nuclear charge as regards the remaining electrons is a little less than one unit. Hence the edge corresponds to an energy a little less than that calculated.

In Fig. 1 is shown a mean curve of three separate photometrical curves of one of the spectral plates. The two lines are copper $K\alpha_1$ and $K\alpha_2$ in the third order. They were used as reference lines. Between them and the new edge can be seen a region with increased blackening. Possibly another edge is to be found here, and further investigations may reveal its real nature. I also noticed an edge of this kind for the elements chlorine and calcium.

A fuller account of this investigation, now in progress, will be published in the *Zeitschrift für Physik*.

A. SANDSTRÖM.
Physical Laboratory of the University,
Uppsala, Sept. 5.

[1] M. Siegbahn, *Zeit. für Physik*, 67, 567; 1931.

Isotope Effect in the Band Spectrum of Lithium Hydride.

IN a recent paper,[1] I have analysed the band spectrum of lithium hydride. The general features of the band spectrum were somewhat different from ordinary molecular spectra, and definite edges or heads were hard to trace. Consequently, in the study of the isotope effect of lithium upon this spectrum, the vibrational isotope effect together with the rotational one have been examined in each line of the band spectrum.

The proportion of the two isotopes Li^7 and Li^6 should be about 13 : 1 from the chemical atomic weight 6·94 and Costa's values 7·012 and 6·012 for the isotope masses of lithium. Consequently, the expected isotope lines (Li^6H) should be found in the fainter lines which had not been classified in the former research.

The isotope effect is clearly established for each strong line in the spectrum due to the less abundant molecule Li^6H, the lines of which were found in their calculated positions within the error of measurement. This shows that our scheme in the numeration of the band spectrum of lithium hydride was correct.

Much experimental evidence concerning the relative abundance of the two isotopes has been offered by different workers. The results obtained by Thomson [2] and Dempster,[3] the former with the parabola method and the latter with a magnetic spectrograph and an ionisation chamber, showed that the relative

proportion of the isotopes of lithium varied with the physical conditions, which are inconsistent with those obtained by Aston [4] and Bainbridge.[5]

In our optical method a definite change in the relative intensity of the isotope lines with the physical conditions has also been observed. At the initial stage of heating of the absorption tube, containing metallic lithium in a hydrogen atmosphere, lithium begins to combine with hydrogen, forming lithium hydride. In the absorption spectrum in such a condition numbers of fainter lines (those of Li^6H) are greatly enhanced, the ratio of the two isotope lines (Li^7H : Li^6H) being about 2 : 1. However, this value becomes larger as the vapour of lithium hydride tends to reach a stationary state up to about 8 : 1. This is in good agreement with the result of Dempster obtained by a different method and our latter value with 7·2 of Wijk and Koeveringe [6] from intensity measurements of isotope lines in the band spectrum of lithium.

GISABURO NAKAMURA.

Physical Laboratory,
Hokkaido Imperial University,
Sapporo, Sept. 5.

[1] *Zeit. für Phy.*, **59**, p. 218; 1930.
[2] *Phil. Mag.*, **43**, p. 857; 1920.
[3] *Phys. Rev.*, **18**, p. 420; 1921.
[4] *Phil. Mag.*, **43**, p. 420; 1920.
[5] *Phys. Rev.*, **37**, p. 1706; 1931.
[6] *Proc. Roy. Soc.*, A, **132**, p. 98; 1931.

Symbiotic Algæ of Corals.

IN a recent contribution [1] Dr. C. M. Yonge, summarising his physiological work on corals published by the Trustees of the British Museum, took the opportunity to express his disagreement with Prof. Gardiner on the question of the significance of the symbiosis between corals and zooxanthellæ.

I am neither physiologist nor hydrologist, but it appears to me that Dr. Yonge may be basing on a false premise his argument that reef corals can get on quite well without the oxygen produced by the photosynthetic action of their zooxanthellæ. Dr. Jan Verwey, director of Den Helder Zoological Station, who has just returned to Europe after several years ecological study of corals in the East Indies, tells me that even when there is a good current flowing over a reef yet there may be a basal layer of very slowly moving water, so that a populous reef may easily suffer from a shortage of oxygen. It is, therefore, not by any means safe to assume that the movement of water round a reef always ensures a constant supply of oxygen.

Reviewing the ecological work of Vaughan, Mayer, and other Americans, the work of our own Great Barrier Reef Expedition, and that of a group of Dutch workers in the East Indies, it will be realised how rapidly our understanding of corals and coral reefs is being advanced.

A. K. TOTTON.

Natural History Museum,
South Kensington, Sept. 3.

[1] NATURE, **128**, 309, Aug. 22, p. 309.

I HAVE read Capt. A. K. Totton's letter and also Dr. J. Verwey's recently published paper [1] with the greatest interest. There can be little doubt that where reef corals grow in still water the oxygen produced by their zooxanthellæ may be of vital importance to them. Though here it must always be borne in mind that were not the zooxanthellæ present their place would be taken by a much more abundant phytoplankton continually producing oxygen in the water round about. But still water is seldom found (except during short periods of summer calms, and even then currents and upwelling continue) on the outer slopes of fringing and barrier reefs or of atolls, which are *the* essential areas of coral growth. In the case of the last two, indeed, which rise abruptly from deep water, there is frequently an upwelling of oxygenated water from deep waters as well as the continual agitation by the surf near the surface.

In enclosed areas, such as the Bay of Batavia, where Dr. Verwey has carried out his important work, or within atoll lagoons, the ability of corals to form reefs may well be controlled by the production of oxygen by their zooxanthellæ. But on the other hand, the vital factor even here may still be the removal of excretory products from the corals by the zooxanthellæ. It is very difficult to obtain adequate experimental proof one way or the other. For a long time during my work on the Barrier I believed that the production of oxygen by the zooxanthellæ was of vital significance to the corals, but, unable to obtain any adequate confirmation, I finally abandoned this belief. I hope to discuss the whole matter in detail in forthcoming papers in the Scientific Reports of the Great Barrier Reef Expedition.

Progress is certainly being made in the elucidation of the many biological problems connected with coral reefs, but each expedition raises almost as many problems as it, wholly or in part, solves. We are now, I think, nearing the solution of one most important problem, namely, the factors controlling the depth to which reef-building corals can live. For that reason I trust that an opportunity will soon present itself of making further progress towards the solving of this great oceanographical riddle, the key to which will probably be found in the nature of the relationship between reef-building corals and the zooxanthellæ.

C. M. YONGE.

Marine Biological Laboratory,
Plymouth, Oct. 10.

[1] "The Depth of Coral Reefs in Relation to their Oxygen Consumption and the Penetration of Light in the Water", *Treubia*, **13**, pp. 169-198.

The Comma Butterfly in England.

THE Comma butterfly *Polygonia c-album* died out in the east of England early in last century but survived in the west, and of recent years has been extending its range to the east again, reaching Twickenham in 1928.

A Comma visited *Sedum spectabile* in my Chiswick garden on Sept. 21, 22, 23, and 24, 1929.[1] In October 1929 it was recorded at Surbiton in the *Times*. This year on Oct. 5, 6, and 9 this butterfly has again visited *Sedum spectabile* in my garden, a fact which suggests that the species is establishing itself in the district. As a rule every September, tortoiseshells and red admirals come freely to *Sedum spectabile* here, but in the cold, wet month we have just had, the only visitor has been this rare butterfly.

F. SHERWILL DAWE.

Ashburton, 67 High Road,
Chiswick, W.4,
Oct. 9.

[1] NATURE, **124**, 653, Oct. 26, 1929.

SINCE the publication of Dr. Dawe's letter in 1929, a good deal of evidence bearing on the spread of *Polygonia c-album* in south-eastern England has accumulated. At that time, only one definite record for Kent (in 1916) could be found; it has now been seen in East Kent (1929) and at Sandhurst (1930). In Sussex it appears to have established itself fairly securely along the South Downs about Chichester and Arundel, and also farther east at Lewes and East-

bourne. In Surrey, from which county it had not been reported in 1929, except for one record of an occurrence at Walton-on-Thames, it has since been met with at Sutton, Farnham, and Grayshott (1930), and at Mickleham (1931). In what might be termed the London district itself, in addition to Dr. Dawe's record, it was seen at Surbiton again, at Hounslow, West Wickham, and Gravesend in 1930, and even, as reported in the *Times* of Oct. 10, at Kensington in 1931. From the repeated occurrence of the butterfly on the western outskirts of London, one is forced to the happy conclusion that this attractive species must really have established itself somewhere in that neighbourhood, in many parts of which indeed its food plant, hop, grows fairly freely, more or less as a weed.

N. D. RILEY.

British Museum (Natural History),
South Kensington, S.W.7,
Oct. 12.

Change of the Dielectric Constant of Carbon Disulphide with Temperature.

H. ISNARDI [1] has found that the dielectric constant of liquid carbon disulphide increases linearly with the lowering of temperature, up to a maximum at − 90°, and then decreases also linearly with further lowering of temperature. This author has not, however, made a sufficiently careful study on the neighbourhood of the congelation point. His data do not permit us, therefore, to draw inferences as to the behaviour of the dielectric constant of carbon disulphide at its freezing point (− 112°).

On the basis of analogy with ethyl ether, I have supposed that at − 112° there appears a jump in the

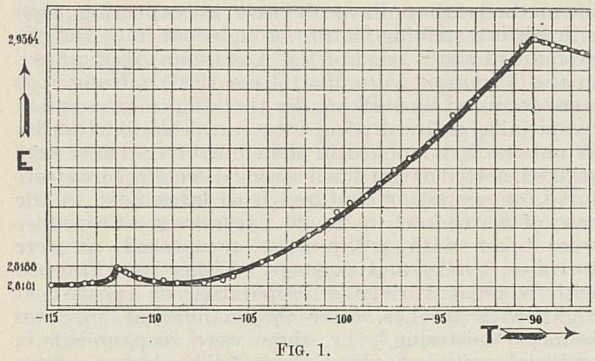


FIG. 1.

value of the dielectric constant of carbon disulphide independently of the maximum at − 90°. To check this supposition, I have made a study of the dielectric constant of carbon disulphide, using a method depending on the beats of two high frequency oscillation circuits, as described by M. Wolfke and W. K. Keesom.[2]

It appears that the value of the dielectric constant of carefully chemically purified carbon disulphide increases from 2·630 at 20° C. up to 2·936 at − 90° (maximum), and then decreases, to jump again at − 112°.

The accompanying curve (Fig. 1) represents these changes of the value. It can be seen that the dielectric constant of carbon disulphide behaves similarly to that of ethyl ether.[3]

J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Sept. 22.

[1] *Zeit. für Phys.*, **9**, 153 ; 1922.
[2] *Comm. Leiden*, 190a.
[3] NATURE, **126**, 649, Oct. 26, 1930 ; and *Comptes-rendus* des Séances de la Soc. Polon. de Physique, **5**, 181 ; 1931.

Cosmic Evolution and Earthly Needs.

I IMAGINE that no journal has ever published even an approach to so wonderful a supplement as that to NATURE of Oct. 24 on "The Evolution of the Universe". The transcendental discussion reported is the more remarkable, as it is held at a time when ordinary folk are beginning to think that there may be difficulty in living much longer, in passable comfort, upon the pimple we are privileged to inhabit and are doing so much to spoil. From beginning to end, however, the British Association proceedings were Neroic : little effort was made by anyone to pay serious attention to our present earthly situation or to consider how we are to get out of the muddle 'science' has created. Pity 'tis that Sir Arthur Eddington did not "'eave 'is 'arf a brick" to this end. A century of science seems to have brought us to a wonderful understanding of things that do not matter, whilst 'larning us' little that will help to fill our bellies and suffer one another with equanimity, let alone gladly and with Christian amity.

The essays are not for the likes o' me to understand. Still, as a chemist, I should like Prof. Millikan to loan me a volt or two out of his visionary 25,000,000. He speaks of an atom-building act of this energy-order "that is more fundamental than all others and must take place more often than all others, . . . namely, the formation of helium out of hydrogen, because we have abundant evidence that all the elements are actually built out of hydrogen and helium", and so on. What is here meant by hydrogen ? What is the process pictured ? Have we such evidence ? Physicists will use our words, unfortunately, in their own ways : as for example, *ion*, which is now used in so many ways that it means 'what you please', apparently. Whatever cosmic hydrogen may do in cosmic space, no laboratory hydrogen that we know gives helium, even in the Langmuir blowpipe.

While on words, may I take formal objection to my friend Dr. Aston's continued use of the term *constitution* when he means the *composition* of the mushes we still term elements. Constitution is used by the chemist only as implying structure in uniform materials.

HENRY E. ARMSTRONG.

Chemical Nature of the Tigroid.

THE chemical nature of the tigroid (Nissl's granules) of nervous cells is still unknown. On morphological grounds they are generally supposed to be related to the nucleus.

The brains of freshly killed guinea-pigs were fixed in alcohol, embedded in paraffin, and dissected. If stained with toluidine blue, the cells showed an abundance of tigroid. If, however, before staining, the slides were digested for thirty minutes with saliva, the cells no longer showed such granulation. This strongly suggests that the tigroid is a reserve polysaccharide of the nervous cells, similar to glycogen, but not identical with the latter, since it does not stain with iodine. This would be in good agreement with the disappearance of the granules after strong functional activity of the nervous system.

A more detailed report will appear in the *Acta* of the Hungarian Biological Research Station, Tihany.

A. SZENT-GYÖRGYI.

Biochemical Department,
University Szeged, Hungary,
Sept. 26.

Research Items.

Human Skulls and Bones from the Naga Hills.—The skulls and bones which are the subject of a report by Dr. B. S. Guha, anthropologist of the Zoological Survey of India, and Mr. P. C. Basu, published as the first *Anthropological Bulletin of the Zoological Survey of India*, were surrendered in 1926–27 to the expedition of the Burmese Frontier Service for the abolition of slavery and the suppression of human sacrifice among Naga tribes living in the unadministered area of Burma. The skulls and bones are those of human sacrificial victims from 41 out of the 70 villages in the Triangle which are under the influence of two Kachin families, the Ningmoi and the Shingbwiyang. Little information was available as to the tribe or place of origin of the victims, as they had passed through many hands and villages before reaching their destination. They would seem to have been forwarded from the south-west and west by middlemen engaged in the traffic. Though they probably belong to the head-hunting Naga tribes of south-west and west of the Triangle in the main, foreigners may have been included. At least one Assamese was sacrificed. Some of the heads had been smoked in accordance with custom, and each of the bones, some with flesh and shreds of skin still adhering, had been pierced by one or more holes for suspension. Some of the smaller bones were bound in lots. In one case a piece of skull and portion of radius were covered with leaves and bound to a bamboo which had two strings for suspension. The total number of bones was 217, of which 21 were whole, or portions of, arm and leg bones, and 117 and 43 were frontal and occipital bones respectively. The skulls and bones have been examined and measured exhaustively, the measurements being given in detail. The skulls fall into two classes, of which the first is markedly Mongolian, while the second in addition shows characteristics of the Australoid type.

Balun Bidai.—In the *Journal of the Federated Malay States Museums*, vol. 15, pt. 2, Mr. Ivor H. N. Evans records some information relating to a mythical aquatic animal, which will be of interest to students of folk-lore on account of analogous beliefs recorded from other parts of the world and from other times. While engaged in excavation work near Kuala Nyong, on the Timbeling River, Pahang, he was informed by his coolies of a curious mythical animal, known as Balun Bidai, which is supposed to live in a deep pool in the Timbeling. The word *balun* in the Malay language has the secondary meaning ' to roll as a mat or a cigarette '. Further inquiry elicited the information that this mythical animal is also said to exist at Lahar Jintang, near Kuala Kitil, where it is known as Gulong Bidai. As *balun* and *gulong* are synonyms, the meaning in both cases is ' the enveloping chick ' (native venetian blind), corresponding with the creature's reported habits. The Pahang Malays say that Balun Bidai is rectangular like a mat, with a mouth at each corner, and is ginger coloured. It used to attack boats on the river, wrapping itself around them. It lives in deep pools in rivers and brings up great masses of rubbish " as big as a house ", which are said to be quite dry when brought up. None of the coolies claimed to have seen it but one had seen the masses of rubbish. One of the animals is said to live at a village in Lower Perak called Balun Bidai, not far above Kuala Kinta. At Batu Kurau, Larut, Perak, Gulong Bidai kills men by enveloping them and sucking their blood, though leaving no wound.

Birds of the Galapagos Islands.—In 1905–6 an expedition was made on behalf of the California Academy of Sciences to study and collect the fauna and flora of these islands. The report on the bird collections by Harry S. Swarth is a memoir of ecological as well as taxonomic importance (*Occ. Papers Calif. Acad. Sci.*, **18**, 1931). There are 108 species and subspecies of birds in the Galapagos list. Eighty-nine are breeding and resident upon the islands, and of these the very large proportion of 77 are peculiar to the islands. The author supports the view that when the bird fauna arrived, Galapagos was already an island group, for although the birds which show clear affinities point unmistakably to American relationships, the islands are remarkably destitute of the highly characteristic bird life of the adjacent coast of South America. A very great amount of variation, however, has taken place since the islands were colonised by birds, and although the variations exhibit many extremes, intergradations between the extremes can always be traced, but not always between geographically adjacent forms. The extraordinary variants that crop up in many of the series, for example in the bill structure of *Geospiza fortis* and *fuliginosa*, give an impression of a process of change and experiment still going on. Here, in the very islands that aroused his mind to the possibility of evolution, appear to be the " numerous transitional forms " and the confusion in Nature, which Charles Darwin expected and looked for in vain.

Food of Australian Aborigines.—That a primitive people like the Australian aborigines should be skilled in Nature lore is not surprising, but the variety of methods they have devised in capturing food animals is a striking feature brought out in C. Daley's account of the " Food of the Australian Aborigines " in the *Victorian Naturalist* (June 1931). Kangaroos were captured by stalking, by tracking to exhaustion, by pitfalls, or by driving into corral-like enclosures. Wombats were smoked in their burrows ; emus were stalked, netted or run down by dogs; smaller birds were lured, or snared or captured with large nets, in the case of water-fowl up to 60 yards long. Crocodiles were taken with a slip-noose or speared, as were tortoises, turtles and dugongs. Fishes were trapped with a great variety of apparatus, or speared at night with torches, after the manner of our own salmon ' leistering ', or they were impounded in artificial weirs or stone dams. The honey stores of wild bees were discovered by marking a bee by attaching a piece of white down to it, and tracing its flight home, and so on. The above gives some notion of the variety of food used by the aborigines, but a more vivid picture is contained in Major Mitchell's account of the contents of a ' lubra ' or plaited bag of almost a hundred years ago : " three snakes, three rats, about 2 lb. of small fish like whitebait, crayfish, and a quantity of the small root, tao, usually growing on the plains with a bright yellow flower, *Microseris Forsteri* ". Nothing seems to come amiss, for, particularly in Queensland, clay from the outside of ' ant-hills ', or kaolin, is freed from grit, made into a smooth stiff paste, dried, wrapped up, subjected to heat, and is much appreciated as an article of food.

Anal Gland of *Squilla*.—T. Komai and Y. M. Tung have examined the anal gland of *Squilla* (*Mem. Coll. Sci.*, Kyoto Imp. Univ. Ser. B, vol. 6, No. 1, 1931), which consists of two pairs, an anterior and a posterior, of small sacs communicating with the posterior end of the mesenteron by short ducts. The cells which compose the wall of each sac are secretory. The cells

of the anterior sac are vacuolated, and in the lumen is either a number of secretory spherules or more usually a single concretion, formed of concentric layers, which is eventually passed out by the duct into the gut and so to the exterior. In the posterior sac the secretory substance is liberated as a vacuole constricted off from the distal part of each cell and no concretion is formed in this sac. The authors regard the sacs as carrying out the excretion of waste products in the posterior region of the body, acting as auxiliaries to the maxillary glands which are the primary excretory organs. In *Squilla* the proctodæum, which forms the rectum, is short—1-2 mm. in length. Details of the anatomy of the heart and the distribution of the arteries of *Squilla* are also given.

The Gondwana System.—A most important and interesting contribution to the geology of Gondwanaland has been written by Dr. C. S. Fox and published as *Mem. Geol. Surv. India*, vol. 58, 1931, pp. 241. It includes a summary of all the available information on the Gondwana System. This ' system ' represents more than a geological period ; its formations cover a time interval from the Upper Carboniferous to the Lower Cretaceous, and thus represent an *era* which cuts across the division between Palæozoic and Mesozoic. The general classification now adopted in India consists of two chief subdivisions : Lower Gondwana (Talchir, Damuda, and Panchet) and Upper Gondwana (Mahadeva to Jabalpur), but the break occurs, not between the Permian and Triassic, but in the middle of the Triassic, when there was a cessation of effective sedimentation owing to widespread land conditions. Weighty evidence is presented to justify the abandonment of the tripartite classification formerly widely accepted. The climatic changes of Lower Gondwana times can be traced from the ice wastes of the Talchir epoch, through the damp, temperate conditions of the Damuda period, to the hot arid climate of the Panchet age. Following the regional uplift that marks the break, there was a return to humid conditions in Upper Gondwana time. The lake-waters of Central India found their way to the sea that was established during the Jurassic over the site of the Bay of Bengal, and later, especially in the Cretaceous, to the sea that extended from the west to Kathiawar. The valleys that then were formed were filled to overflowing with the lavas of the Deccan trap, and from then to the present day laterite formation, characteristic of tropical monsoon conditions, has been active. The memoir is enriched with a large correlation table, four palæogeographical maps, and a fine series of plates illustrating the plant life of Gondwanaland.

Cohesion.—The issue of the *Proceedings of the Physical Society* for Sept. 1 contains the address on " Cohesion " delivered by Prof. Lennard-Jones before the Society in May last. In it he shows how much the new wave mechanics has contributed in the last three or four years to our knowledge of atomic structure and of the interaction between atoms, in directions in which the orbital theory of the atom could provide no information. Many atoms may be pictured as globular clouds in which the density of the cloud at any point is proportional to the probability that an electron may be present in unit volume about that point. The motion of an electron in one atom tends to make an electron in a neighbouring atom move on the average in phase with the first, and this produces an attraction between the atoms inversely proportional to the seventh power of their distance apart and a slight deviation from the perfect gas law. This attraction is usually masked by the much greater one resulting from the migration of an electron from one atom to another, which in some cases is sufficient to produce the firm structure of a solid. These ' homopolar forces ' are shown to follow from the expression for the joint probability that an electron may be found in each of two specified small volumes. They are intimately connected with the spin of each electron, and the cohesion which results from them depends on whether these spins are in the same or in opposite directions. In the latter case the electrons are said to be paired, and the pairing of electrons provides for the valency rules of chemistry. (See also NATURE, vol. 128, p. 462, Sept. 12, 1931.)

The Cosmical Constant and the Wave Equation.—Sir Arthur Eddington has contributed a paper to the October issue of the *Proceedings of the Royal Society* in which he has attempted to weld together in a new way the ideas of the quantum theory and of the cosmical relativity theory. His idea is that the appropriate space-time in which the wave-equation for an electron should be considered valid is not the flat system which is ordinarily employed, but the more general and cosmically important curved space-time. So long as the former is employed, no light can be expected to be thrown on the nature of the term in the wave-equation representing the mass, but by introducing the latter the mass-term can be incorporated into the theory. The step involved is not really foreign to the ordinary ideas of quantum theory, for it is a fundamental conception in this that particles cannot be considered individually, but that their behaviour is conditioned to a greater or less extent by all other particles in the universe. The mass of an electron thus becomes an interchange energy with all the other charges in the universe suitably averaged. The mathematical development, which is indeed not very elaborate, leads, fortunately, to a prediction that can be tested experimentally from the speed of recession of the spiral nebulæ, Hubble's value of 465 km. per sec. per megaparsec being obtained to within fifteen per cent.

Ultra-Violet Spectrum of Ozone.—An investigation of the effect of temperature on the ultra-violet absorption spectrum of ozone, described by O. R. Wulf and E. H. Melvin in the second issue of the *Physical Review* for July, may be of importance in meteorology. The spectrum consists of diffuse bands on a continuous background. It has been shown that the relative intensity in the bands and background depends upon the temperature of the ozone, the contrast between the two increasing when this is reduced from 250° to −78°. The alteration is not large, but may, nevertheless, have a bearing on the interpretation of the changes observed in ultra-violet solar and stellar spectra, if fluctuations occur in the temperature of the ozone in the upper air. Alternatively, it may prove possible to obtain a new estimate of the temperature in the ozone layer from the appearance of the bands, and it is noteworthy that Prof. A. Fowler and Lord Rayleigh have stated that the bands are, as a whole, more diffuse in the photograph of Sirius than in the laboratory spectrum. Barring other complications, such as an effect of pressure, this could be taken to indicate that the temperature of the ozone layer was higher than that of the laboratory.

The Atomic Weight of Thallium.—A revision of the atomic weight of thallium which is in close agreement with Hönigschmid's value, but markedly different from that of Crookes, is described by Prof. H. V. A. Briscoe and a number of collaborators in the October number of the *Proceedings of the Royal Society*. Crookes's work, which was published in 1873, was based on a determination of the ratio $Tl : TlNO_3$, and gave $Tl = 204{\cdot}04$. This held the field until quite recently, when Hönigschmid, employing thallium halides and silver in a very concordant

series of measurements, found the higher value 204·39. Prof. Briscoe, employing the ratio TlCl : Ag, has now obtained as a final result 204·34, with an average deviation of ±0·015. Apart from one point of technique—the fusing of thallium chloride in place of the process of sublimation adopted by Hönigschmid—Prof. Briscoe makes no special claim for his own result in preference to that of Hönigschmid, and suggests that the actual value is within one or two hundredths of a unit of 204·37. The large departure of the atomic weight from a whole number shows that it is a mixture of isotopes, a conclusion which is confirmed by Dr. F. W. Aston's announcement in NATURE of Oct. 24, p. 725, that the mass-spectrum indicates two isotopes, of atomic weight 203 and 205 respectively.

New High Permeability Alloys.—Ordinary 'permalloy', the alloy of iron with 78·5 per cent of nickel, is specially suitable for direct current circuits. For A.C. circuits a higher electrical resistance is desirable to minimise eddy current losses, and in the *Bell Laboratories Record*, Sept. 1931, vol. 10, No. 1, G. W. Elmen gives an account of work done on similar alloys in which part of the iron is replaced with chromium or molybdenum. Both these elements increase the resistivity, and with 3·8 per cent peaks are obtained in the curve of initial permeability, which in the case of molybdenum actually rises above that for the original alloy. Above a flux density of about 2000, however, the plain nickel-iron alloy is the more permeable. This latter alloy also suffers from the disadvantage that in addition to an annealing treatment at about 950° C., further heat treatment at 600° C. followed by rapid cooling is necessary if the full magnetic qualities are to be developed. With some of the newer alloys the original annealing is unnecessary, and slower rates of cooling give the highest values of the permeability. It is of interest that the addition of a non-magnetic metal such as molybdenum may, in certain circumstances, render a magnetic alloy still more magnetic. For the annealed alloy, 3·8 per cent of molybdenum gives an initial permeability of 12,000, and when heat-treated in hydrogen, of 35,000, values far higher than that of ordinary 'permalloy' in the annealed state and three to four times that even of the material in the heat-treated condition. As the molybdenum content is raised, the Curie point—the temperature at which the alloy loses its magnetisability—is reduced, which is in accord with the general rule that the addition of a non-magnetic element to a ferro-magnetic one lowers the Curie temperature. It is concluded that no one such alloy is the best for all purposes, and that a range of materials will be developed each suitable for some specific electrical purpose.

Astronomical Topics.

Galactic Rotation.—Prof. P. Stroobant, Director of the Uccle Observatory, has been making a study of the radial velocities of the helium stars (types B_0 to B_7) in connexion with the problem of galactic rotation (*Bull. of Acad. Roy. de Belgique*, 1930, No. 10). His results indicate galactic longitude 141°, or 321° for the centre; the work of others leads to the selection of the second value. The centre is placed at a distance of 9250 parsecs from the sun; adopting 270 km./sec. as the sun's rotational speed, the period of rotation would be about 200 million years. The central mass required to control the motion is given as 16×10^{10} sun. The diameter of the galaxy is estimated as 23,000 parsecs. The Uccle Observatory is soon to have a new telescope with an aperture of a metre: also a new transit circle. Prof. Stroobant hopes to continue the research with the aid of these instruments.

The Variability of Betelgeux.—Sir John Herschel seems to have been the first to discover that this star was a variable. But it was not until the present century that any law was detected in its light changes. The evidence on the subject is collected and reviewed by B. W. Kukarkin in the *Bulletin of the Friends of Astronomy*, Nishni Novgorod, for June. A period somewhat less than six years is plainly shown by the curve that he gives. The observations of radial velocity at the Cape are of great use in the determination, as the change in this appears to be more regular than that in the light; but evidently both have the same period, which is given as 2070 days, or 5·67 years. The variable radial velocity is ascribed not to orbital motion but to expansion and contraction of the star. Assuming this, and taking the parallax as 0·015″ (which is the mean of the best five values), the radius of the star is found to change from 262 to 416 times that of the sun; this would make the diameter of the star change from 0·037″ to 0·058″, in fair agreement with the values given by the interferometer.

Both the radial velocity results and the light measures suggest that secondary oscillations may be superposed on the curve of principal variation, but the data are insufficient for determining them. The amplitude of the light-variation is close to 0·7 mag., but may be variable; in visual observations of brightness a comparison star at some distance has to be used, which adds to the difficulty. Aldebaran is often chosen, being of similar colour.

Quite a number of the red stars easily visible to the naked eye are variable; but comparatively few observers devote themselves to these bright objects; it is necessary in their case to use comparison stars at some distance, which adds somewhat to the difficulty. *Astr. Nach.*, No. 3817, contains a series of such observations, made at Prague by J. Mrazek and J. Plassmann.

The observations of α Herculis range from 2·73^m to 3·88^m; those of Betelgeux (which was compared with Aldebaran) from 0·41^m to 1·34^m; those of β Pegasi from 2·35^m to 3·25^m. Unusually short intervals from maximum to minimum were noted in α Cassiopeiæ in 1927 and 1928; the maxima were on July 22, 1927, and July 8, 1928; the minima were 8 days and 7 days later, respectively.

Elements of the Trojan Planet Æneas.—Three new members of the Trojan group of minor planets were found in 1930. Æneas was found by Dr. Reinmuth at Königstuhl, Heidelberg, on Oct. 17, and was followed for five months at that observatory and at Yerkes by Prof. G. van Biesbroeck. C. J. Krieger has investigated its orbit, and gives the following elements in *Astr. Jour.*, 960:

Epoch 1931 Jan. 1·0 U.T.
M 97·7850°
ω 45° 2′ 12·1″
Ω 246° 31′ 59·0″ } 1931·0
i 16° 40′ 32·3″
e 0·100455
a 5·21903
n 297·592″

The mean position of the planet is 60° from Jupiter on the side of smaller longitude. There are now four known Trojans on this side of Jupiter and five on the other. It will be noticed that the mean distance of Æneas is practically the same as that of Jupiter; but owing to its large eccentricity its distance from Jupiter will fluctuate through about 12° on each side of the mean value.

It is curious that another Trojan planet, Anchises, was discovered on the same photographic plate as Æneas.

Modern Glasses at the Science Museum.

AN Exhibition of Modern Technical and Artistic Glasses at the Science Museum, South Kensington, to remain open until the end of the year, was formally opened on Oct. 21 by Sir Richard Gregory (see NATURE, Oct. 24, p. 697). The organisers, who represent the Society of Glass Technology and the Glass Research Delegacy of the University of Sheffield, have endeavoured in this exhibition to illustrate the more striking advances arising from scientific studies in glass technology during the past fifteen years. In doing so, it has been necessary, in view of the limitations of space, to make a selection of the subjects which are comprised within the term 'glass technology' and a further choice of material even in those subjects represented. Thus, in the main, the problems involved in the manufacture of glasses in modern times which have given rise to many important researches, such as the solution of gases in molten glasses, and the diffusion and flow of viscous liquids at high temperatures, receive no attention, and it has not been found possible to find space for exhibits illustrating researches on raw materials, on the special characteristics of refractory materials required for various manufacturing conditions, and the applications of glasses to the many types of scientific apparatus.

In general, the exhibition may be said to illustrate the relationships between the chemical composition and the physical properties of glasses, with indications of the industrial results of the researches involved. Fourteen sections are employed in classifying the subjects dealt with. Section *A* comprises a review of the most important literature on glasses (excluding works on optics and optical instruments) which has been published since 1915. In this collection are the journals of scientific bodies devoted to the study of glasses, trade technical journals, technical books, and works devoted to the historical and artistic side of glasses. Sections *B* to *E* are concerned with fundamental properties of glasses; *F* to *O* illustrate how the results of fundamental researches on the relationships between chemical composition and physical properties have been utilised in recent developments in the production of specific types of glasses, the types dealt with including coloured glasses for artistic and utilitarian purposes; optical, chemical, heat-resisting, illuminating, and electrical glasses; sheet and plate, safety or laminated, and fused silica glasses. Specimens, photographs, and numerous diagrams of data are employed to convey information to the visitor.

It is impossible to do more than refer to a few of the more interesting results of modern work. Section *B* is devoted to the nature of glass, and illustrates, amongst other matters, the study of the equilibrium diagrams of the complex systems in which glasses fall, and some pretty specimens of crystallisation from glasses are shown. The effect of heat treatment on crystal growth is set out pictorially. A whole case is also devoted to the most modern methods and results of the study of the nature of glasses by the X-ray method. Section *C* contains many interesting specimens, Roman, medieval, and modern, which have undergone weathering and decay as the result of unsuitable composition; and modern researches which have shown the way to produce very durable glasses are described and illustrated. Section *D* is devoted to certain physical properties of glasses. Particular attention is paid to modern work on the thermal expansion; and in this sub-section are shown examples of graded glass seals which enable a glass of low thermal expansion to be united to one of high expansion through intermediate joints, and of glass to metal joints. The mechanical properties of glass are illustrated, and types of fracture produced by thermal and mechanical forces are exhibited. The low thermal conductivity of glass is further reduced when drawn into a mass of fibres with intervening air spaces, and British glass 'silk', shown in various forms, is coming into widespread use for heat insulating purposes.

The most spectacular of the sections is *F*, dealing with the colouring and decolourising of glasses. The six cases devoted to this subject stand in the entrance hall of the Museum and at once arrest the eye. The first case starts with some beautiful specimens of coloured Egyptian glasses of the Eighteenth Dynasty. Below them, and extending to the second case, are numerous specimens, specially melted at the Department of Glass Technology, Sheffield, to illustrate the tremendous range of colouring materials available to the modern glassmaker. More effective illustrations of colouring than these are the specimens of artistic glasses. Three roses, with glass petals of white, pale yellow, and rich red, respectively, simulate the real flowers to a remarkable degree. Amongst the more striking colouring agents in the artistic glass exhibited are selenium (various shades) and the oxides of didymium, neodymium, and praseodymium. The utilitarian division of Section *F* includes such objects as Crookes glasses, various protecting glasses for furnace workers and welders, signal glass, and colour filters. An offshoot of this section is that devoted to illuminating glasses (*L*), where 'daylight' lamps and other objects are shown. Also in section *M* (sheet and plate glasses), reference is made to research on coloured glasses suitable for keeping away flies.

Toughened glass samples appear in Section *L*, and are referred to in Sections *E* and *J* also. The nature, methods of manufacture, and sources of defects in 'safety' or laminated glass are well set out in Section *N*. The neighbouring Section *O* (fused silica) contains a number of historical specimens, as well as others showing that many massive, as well as small, objects of fused silica are now obtainable.

Three cases are devoted to optical glasses and one to optical lens systems. One of the most important advances has been the improvement in transmission both in the ultra-violet and in the infra-red brought about by painstaking efforts to reduce the iron oxide content. A massive specimen shown contains only 55 parts of iron (as Fe) per million of glass, and it is claimed that British optical glass is now superior to any other in regard to transmission at both ends of the spectrum.

Foot-and-Mouth Disease Research.*

THE Fourth Progress Report of the Foot-and-Mouth Disease Research Committee, just issued, is a record of extremely interesting observations and experiments. We agree with the Committee when it says that "the knowledge of foot-and-mouth disease and the conditions which promote the infection and the means of its prevention have been materially advanced by work in many parts of the world, and that the researchers in this country have taken their fair share in furthering that progress". It is true that we have still no very clear vision of the time when scientific methods of prevention and spread are to be substituted for slaughter. The causal virus is familiar

* Ministry of Agriculture and Fisheries. Fourth Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 375+12 plates. (London: H.M. Stationery Office, 1931.) 7*s*. 6*d*. net.

and the disease can be produced experimentally with it. Further, it has been clearly demonstrated that with this virus, weakened in various ways, immunity against the disease can be produced. This immunity, however, does not seem to last very long, and until the virus can be grown on artificial media, sufficient of it cannot be obtained to do a very large series of immunisation experiments. The work of Prof. and Mrs. Maitland in Manchester gives us hope of culture, for they have shown quite conclusively that multiplication of the virus will take place in the presence of living embryo tissue of guinea-pigs. This is a decided advance.

Further evidence is given in the Report of the different types of the virus, but the most encouraging fact in relation to treatment, especially serological treatment, is that 92 per cent of the strains obtained from outbreaks in Great Britain belong to the *O* type. If, therefore, we were able to obtain an anti-virus of this type, we could deal hopefully with almost all the cases that occur.

Much valuable information has been collected on the survival of the virus in sewage, in milk, in carcases after storage at different temperatures, and of its resistance to pickling, etc. In administrative work these results should prove of great importance. Again, the infection of rabbits, hedgehogs, and rats opens up a suggestive field for investigation of the method of spread. In 1924, I reported to the Committee the results of experiments by myself and colleagues which showed that rats could be infected with the disease, confirmed this by further reports in 1928, and suggested that the rat, by its migratory habits, might be a carrier. The infection in rats has now been fully confirmed by the Committee, and in a note on the origin of fresh outbreaks it is stated that "the discovery of very inconspicuous signs of the disease in rats must increase the care with which symptoms of infection in these animals are sought, and add fresh importance to the warfare waged against these animals". To the farmer and dairyman this possible carriage is of the utmost importance.

The whole Report is full of interest, and the scientific workers under the Committee are to be congratulated. All their work is leading to the goal of prevention. J. M. BEATTIE.

Cotton Growing in Egypt.

DR. W. L. BALLS and his assistants in the Botanical Section of the Egyptian Ministry of Agriculture have published within recent years two bulletins on the "Operation of the Seed Control Law upon the Pedigree of Cotton Seed".* The first is a survey of the effect of the control during the first two years, and the second includes the first and extends the period to four growing years from 1926 until 1930. Egypt supplies the bulk of cotton for the fine spinning industry, in which quality is of great importance, and competition with lustrous fabrics made from synthetic fibres is making the use of good quality cotton more and more essential.

It would appear that the maintenance of the purity of good strain cottons is desirable for both the farmer in Egypt and the spinner in England, and that little difficulty should be met in operating a law designed to help in securing plentiful supplies of high quality pedigree stocks. Unfortunately, the tests applied by the botanical staff show that as the law becomes better known, methods of evasion are discovered and practised. Cotton seed is used both for growing and crushing, and it is this dual purpose which leads to malpractices. The law has improved commercial stocks with commendable rapidity, and the method of evaluating the improvement, and incidentally of detecting evasions, is surprisingly simple. There exists in Egypt a low quality cotton, known as Hindi, which is very easily recognised when growing and also in seed form. The percentage of Hindi seed has been found to be a very good index of the amount of contamination in seed stocks. A simple count is all that is required, and the method of plotting these counts shows very vividly how the law is operating.

The curves in these publications are so easily interpreted that it is possible to obtain from them the maximum allowable Hindi-content from year to year, although the legal limit has been reduced yearly to a very low percentage. There can be little doubt that deliberate adjustment of the Hindi-content to fall with the legal limit is being practised, but if mixing could be kept within the limit the purpose of the law would be fulfilled.

There are many cases where the Hindi-content is well above the limit, and the system of analysis employed is searching enough to locate the law-breakers with scientific if not legal conviction. It seems that the offenders can only be made to mend their ways if the penalties for evasion are as carefully regulated as the system of diagnosing the culprits. While the Hindi-content is a simple and reliable index of either careless or deliberate lowering of the standard of purity of the seed stocks, it is not a true index of the purity of the cotton types, as natural crossing and other deteriorating influences are unavoidable in large scale cultivation.

The botanical staff clearly recognises that the most effective way of cleaning commercial stocks is by renewal of seed from clean stocks, and the methods adopted to achieve this are given in a bulletin entitled "Developments of the Existing System for Seed Supply of Cotton in Egypt".* Perhaps the most interesting technical item in this publication is the use of large cages of high light-transparency made of fine 'staybrite' steel wire, for the propagation of pure types. The mesh is fine enough to prevent natural crossing, and improvement in the design and production of these cages has advanced to the stage when the cost per unit area covered is little more than the cost of the pre-War cages made of corrodible wire.

The raising of sufficient seed from such small cage stocks to supply the extensive growing areas of Egypt is a story in itself, and the scientific organisation of the expansion process leads us almost to accept the statement that the botany of the cotton plant is better known than that of any other plant. It might be contended that the method of seed renewal is adequate for the maintenance of clean stocks, and that the pruning effect of the seed control law is antithetical. Assuming it is possible to provide adequate seed supplies from reliable sources at one or two years' remove, accident or carelessness will lead to premature contamination, but if all concerned in the handling of the stocks are compelled by rigorously enforced law to exercise necessary care to prevent mixing, the burden of seed renewal will be lightened. Pruning and seed renewal are thus complementary, and all who have an interest in the prosperity of the cotton industry will wish success to the botanical and agronomic sections in Egypt in their efforts to improve by both means the quality and uniformity of cotton seed stocks. F. P. SLATER.

* Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 85: The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Seasons 1926–27 and 1927–28. By Dr. W. Lawrence Balls and Armenag Eff. Bedevian. Pp. 61+27 plates. 5 P.T. Bulletin No. 100: Developments of the Existing System for Seed Supply of Cotton in Egypt. By Dr. W. Lawrence Balls. Pp. 11+3 plates. 5 P.T. Bulletin No. 104: The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Season 1926 to 1930, with a Discussion of Evasions of the Law. By Dr. W. Lawrence Balls and Armenag Eff. Bedevian. Pp. 28+23 plates. 10 P.T. (Cairo: Government Press, 1929–1931.)

The Study of Forest Entomology in India.

THIRTY years ago the entomology of the forests of India and its study were still a closed book. Types of forest insects had found their way into the national museums and private collections in Europe, and thus received a name. But, as became apparent during the first decade of the present century, numbers of the insects of forest importance, as probable or possible pests, were unnamed and their biology unknown. The early pioneer work of the forest officers who were first set to grapple with the position proved by no means easy, but extraordinarily fascinating.

In India, during those first few years, the assistance of a dozen or two expert systematists was required to enable progress to be made at all, and the preliminary publications of results (expected by and demanded by Government) to be issued.

The *Indian Forest Records*, parts 9 and 10 (Calcutta: Government of India Printing Office, 1930), afford a typical example of this progress. Both these parts are devoted to the genus *Xyleborus*, a genus of wood borers (the so-called pinhole and shothole borers) well known to foresters. In part 9, Hans Eggers, of Stolberg, Harz, Germany, discusses "Neue *Xyleborus* Arten (Col. Scolytidæ) aus Indien". In this paper the author describes some forty new Indian forest species, and also proposes a new genus, *Pseudoxyleborus*, in which he describes one species, *P. Beesoni*.

Part 10 of the *I.F. Records* is written by Dr. C. F. C. Beeson, forest entomologist at the Dehra Dun Research Institute, and is entitled "The Biology of the Genus *Xyleborus*, with more New Species". Chap. i. is devoted to the new species, and is indicative of the valuable knowledge we now possess upon this important genus.

Chap. ii. is devoted to the main theme. "The present *Record*", the author says, "summarises the available biological information on Indian species of *Xyleborus*, their regional distribution, food plants, life histories, and gallery patterns." The importance attached to the systematic study of groups of pests of this type, if solely from the economic point of view, will become evident from the following remarks: "Pinholes and shotholes in timber in India are made by a specialised group of borers (often called 'ambrosia beetles') comprising the extensive genus *Xyleborus*, as also *Webbia* of the family Scolytidæ, and Crossotarsus, Diapus, and Platypus of the family Platypodidæ. The term 'pinhole' is applied to holes the size of a pinprick and 'shothole' to holes corresponding in size to various small shot up to 3 mm. in diameter; otherwise there is no fundamental difference in the mode of origin of the holes or in the habits of the borers in making them. The tunnels are bored in wood by the female beetle, and the wood-dust resulting from their excavation is thrown outside, so that a free space is provided in which eggs are laid and the larval breed is reared to maturity. Unlike the majority of borers of timber, the larvæ of ambrosia beetles do not feed on wood, but on fungus (the ambrosia) that grows on the walls of the tunnel in a mycelial layer of variable thickness and produces highly nutritious fruiting bodies. Tunnels that have been occupied for a short time get stained black, and in some species secondary saprophytic fungi develop, that discolour the wood vessels for a little distance around the tunnel. Timber that has been attacked by pinhole and shothole borers thus shows defects in the form of black spots and lines on the sawn surfaces, which spoil it for ornamental purposes and for special uses as matches, veneer, plywood, etc.; unless heavily attacked, it is not seriously weakened for structural purposes."

The paper ends with an excellent index to food plants of Indian species of *Xyleborus*. The author is to be congratulated upon an excellent piece of work.

Of a different type, emanating from the same research branch at Dehra Dun, is the series of papers dealing with the immature stages of the Indian Coleoptera, by Mr. J. C. M. Gardner (*I.F. Records*, Entom. Ser., vol. 16, part 3, 1931). Mr. Gardner produces his eighth paper, "*Cerambycidæ* (Continued)", which completes the description of the identified material in the Dehra Dun collections. The classification of the family Cerambycidæ, and, says the author, "especially of the sub-family Laminæ, has always presented difficulties to workers, who have relied almost entirely on the external morphology of the adult; the study of immature stages should help in a more satisfactory phylogenetic grouping of genera. So far, attention has been concentrated on larvæ, but the pupal stage certainly deserves more attention than it has received."

That Indian research work should be giving what might almost be termed a lead in a branch of study which may prove of considerable practical importance, would seem to merit being placed on record. Certainly, Mr. Gardner's admirable and patient work should enable the forest officer out in the forest, or in the temporary timber depot, to recognise a pest, abundantly represented by the larvæ in the timber but with no trace of the perfect insect; a position only too well known to many forest officers.

Palæolithic Flint Implements.

IN the course of the work in southern Palestine of the British School of Archæology in Egypt, a large number of palæolithic implements of early type have been collected near Gaza. A number of these were exhibited at a meeting of the Royal Anthropological Institute about two years ago by Sir Flinders Petrie, and it was then determined to submit them to Mr. Reid Moir for inspection and report.

In making his report, which is published in the Institute's *Journal* (vol. 60, pt. 2), Mr. Reid Moir finds that the implements fall into two clearly defined groups. The first consists of massive specimens, produced by the removal of thick wide flakes, and much abraded: the second is formed by the detachment of thin flakes tending to be of greater length than width, for the most part showing no sign of abrasion and clearly the product of a different technique. The difference in morphology is fundamental. Mr. Reid Moir considers that the first group belongs to the series worked out for East Anglia by him, which exhibits the transition from the rostro-carinate to the earliest palæolithic hand-axe. Rostro-carinates and transitional forms have been found in Uganda, Rhodesia, India, and now Palestine. Notwithstanding the fact that the Palestine implements have not been found in any ancient deposit, Mr. Reid Moir is still inclined to assign them to the early Pleistocene. The second group is classified as Acheulean, comparable with Acheulean implements of the second inter-glacial in East Anglia.

This conclusion raises the question, as Mr. Reid Moir puts it, "how to account for the presence in

southern England and in Palestine of groups of flint implements made upon precisely the same definite and specialised plan". It seems scarcely probable that a race of people in Palestine worked out a series of this kind of flint implements on exactly the same lines and produced identically the same technique as another race living in southern England and—unless the early Pleistocene age of the Palestine implements is accepted—at a much later date. Mr. Burkitt, in discussing implements from India (see *Antiquity*, September 1930), compared them with implements from South and East Africa, and suggested that they were on a periphery of distribution of a single industry. Mr. Reid Moir is now strongly inclined to the view that the implements of Early Chellean type from Africa, India, and Palestine are to be referred to the same age as those in England, the early Pleistocene, and that at certain periods of past geological time stone implements were being made on the same highly specialised plan over enormous areas of the earth's surface, having started from a common centre. Hence it is not surprising to find that Mr. Reid Moir accepts the almost inevitable corollary that in the conditions governing movement, whether of culture or of race, at this early age, great periods of time must have been involved, with the implication that in most of the current computations man's antiquity is much underestimated.

Development of Weather Forecasting.

THE *Quarterly Journal of the Royal Meteorological Society* for July 1931 contains an interesting survey of the present position of weather forecasting, by C. K. M. Douglas. The author pays tribute to the work of J. Bjerknes and other Norwegian meteorologists, who have developed in greater detail the system of analysis of synoptic weather charts according to the past history of the different air streams begun by Shaw and Lempfert many years ago in "The Life History of Surface Air Currents". He points out that for short-period forecasting the value of the method is undoubted, especially for periods up to twelve hours ahead. Any adequate discussion, however, of practical forecasting must always take note of peculiar tendencies observed, at least in European weather, described as 'persistence of type' and 'mood'. An excellent example of the first is mentioned, that of the severe spring snowstorms of April 2 and 11, 1917. The synoptic charts that accompanied these storms are said to have had features in common not shared by any other charts during the present century. The second tendency is for rain to be absent in certain seasons when the distribution of pressure is such that in an ordinary year it would be accompanied by rain at that season.

The mere recognition of these two tendencies does not greatly help the forecaster, but does indicate a line of research that might lead to important advances. In the case of persistence of type, it may be that by using synoptic charts covering a very wide area, most cases where a particular type of pressure distribution over, say, the British Isles and the North Sea appears to return after an interruption of two or three days, there will be seen to be a distribution of pressure over a much larger area that has been persistent during the interruption, the latter appearing as a mere local disturbance.

'Mood' is less easy to explain, and very difficult to investigate with our present limited information about the upper atmosphere, if, as seems probable, it is due, as the author suggests, to long-period fluctuations of temperature and humidity in the upper atmosphere.

University and Educational Intelligence.

CAMBRIDGE.—The treasurer of the University has received a cheque for £1000 from the Worshipful Company of Goldsmiths, for the better equipment of the Metallurgical Laboratory.

Mr. J. W. A. F. Balfour-Browne has been elected to a Frank Smart studentship in zoology at Gonville and Caius College.

At St. John's College, G. Bateson and R. O. Redman have been elected to fellowships. Mr. Bateson is an anthropological student, while Mr. Redman is assistant director in the Solar Physics Observatory.

For the eleventh year in succession, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to come to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year. The same College offers, as usual, dominion and colonial exhibitions to students of dominion and colonial universities who wish to come to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40; if the financial need of an exhibitioner cannot possibly be met by this amount, the Council has power, if it sees fit and if funds are available, to award him an additional payment. Candidates must apply through the principal authority of their university. Applications for the studentship and exhibitions should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1932.

OXFORD.—Dr. Herbert H. E. Craster, fellow of All Souls College, has been elected by the curators of the Bodleian Library, to be Bodley's Librarian, subject to the approval of Convocation on Nov. 3.

APPLICATIONS are invited by the Grocers Company, Grocers Hall, E.C. 2, for research scholarships in sanitary science, each of the annual value of £300, plus an allowance for expenses. The necessary form of application and information respecting the scholarships are obtainable from the clerk to the company.

THE Council of the Institution of Naval Architects has made the following awards: Vickers Armstrong scholarship in naval architecture (1931) to Mr. Leonard Redshaw, of Messrs. Vickers-Armstrongs, Ltd., Barrow-in-Furness—the scholarship is of the value of £150 per annum and will be held at the University of Liverpool for three years; and the Duke of Northumberland prize (in connexion with the 1931 examinations for national higher certificates in naval architecture) to Mr. James Irwin, of the Royal Technical College, Glasgow.

Birthdays and Research Centres.

Oct. 31, 1872.—Sir JOHN RUSSELL, O.B.E., F.R.S., Director of the Rothamsted Experimental Station, Harpenden.

My work—indeed, my whole life—is so intimately bound up with Rothamsted and my colleagues there that I find it difficult to disentangle myself from them. Our general purpose is to see how far science can go in solving the problems of country life. The most fundamental problems are those associated with crop production: the management of the soil, the nutrition of the plant, the ways of dealing with destructive insects, fungi, and other pests, and the ways of utilising

the crop to the fullest advantage in the service of men and of animals. These problems, therefore, form the basis of our work.

The method is to gain knowledge about the soil, the growing plant, and the animal. Experience has shown that this is incomparably better than the search for ways of overcoming particular difficulties; it gives a solid foundation of knowledge on which to develop agricultural education, advisory activities, and further research, and it has proved highly successful in adding to the resources of the countryman in his hard task of wresting a living from the soil.

Nov. 1, 1857.—Prof. JOHN JOLY, F.R.S., professor of geology and mineralogy in the University of Dublin and president of the Royal Dublin Society.

In 1914 I contributed to the *Proceedings of the Royal Dublin Society* a paper on the subject of the radioactive treatment of malignant disease and urged that uniformity of radiation would seem to be more hopeful than the use of concentrated central dosage as then generally practised. Ultimately the present extensively used 'needle method' of application resulted, and was first put into practice by the late Dr. Walter C. Stevenson.

I have since contributed to the Royal Dublin Society suggestions for the use, in certain cases, of biradiant needles, namely, needles emitting rays differing unilaterally in density. Suggestions regarding deep-seated radium therapy have also been contributed to this journal as coming from our Irish Radium Institute. No problem is more urgent than this.

I have also in view considerations arising out of the surface history of the earth; the elements of which history I believe to be now well established.

Nov. 4, 1855.—Prof. F. O. BOWER, F.R.S., formerly regius professor of botany in the University of Glasgow.

Since my retirement from the chair of botany in the University of Glasgow in 1925, circumstances have not been favourable for continuing detailed observation as in former years. The opportunity has, however, been used for completing "Ferns", vol. 3, published in 1928, and a small volume on "Size and Form in Plants" in 1930. This leaves me free to draw together many facts and arguments—partly included in volumes already published, partly scattered in isolated memoirs and addresses—into a collective and revised statement relating to archegoniate plants. This will take time, and its completion—if it ever be completed—cannot be expected at any early date. All my available time will now be devoted to this end.

Nov. 5, 1876.—Prof. H. B. FANTHAM, professor of zoology in the University of the Witwatersrand.

The study of animal parasites has always interested me, and for some years I have been working on surveys of the parasitic and free-living Protozoa found in South Africa. The former have been considered from the morphological, biological, and experimental points of view with the view of shedding light on the evolution of pathogenicity among them. The free-living Protozoa have been studied ecologically, while making a first survey of those occurring in various types of soils and fresh waters. Human biology is also of deep interest to me. My investigations have been chiefly on cases of human heritable conditions and on racial admixture, a problem of increasing importance in South Africa, as well as in other parts of the world.

Nov. 5, 1892.—Prof. J. B. S. HALDANE, Reader in Biochemistry in the University of Cambridge, head of the Genetical Department, John Innes Horticultural Institution.

I am directing and conducting research into the biochemistry of individual and specific differences, both in higher plants and bacteria. Progress in genetics demands as exact a knowledge as possible of what genes do. For example, it would appear that one gene may cause the oxidation of a particular substance, another its methylation, and so on. In some cases at least, this is done through a definite enzyme. Exact data as to the effect of genes on viability are also being collected with the view of quantitative testing of the Darwinian theory. I am developing a mathematical theory of natural selection, in which a population is represented by a point in many-dimensional space, and its trajectory under a given selective system is investigated. A number of differential, integral, and finite difference equations arising in this theory demand investigation.

Nov. 6, 1886.—Prof. I. M. HEILBRON, D.S.O., F.R.S., Heath Harrison professor of organic chemistry in the University of Liverpool.

My main interests at the present time are directed towards: (*a*) the chemistry of the sterols with special reference to ergosterol and vitamin D, and (*b*) investigations relating to the occurrence, isolation, and structure of vitamin A. Under the first heading, I am attempting to elucidate the structure of the ergosterol molecule, concerning which, apart from its obvious relationship to cholesterol, little is definitely known.

Under the second section, I am continuing, in conjunction with Dr. R. A. Morton, a spectrographic and chemical investigation of vitamin A and related substances.

When time permits, I intend to extend my investigations so as to include a detailed study of the unsaponifiable matter of many animal and vegetable oils, preliminary work upon which has revealed the presence of many interesting substances.

Nov. 7, 1888.—Sir C. V. RAMAN, F.R.S., Palit professor of physics in the University of Calcutta, and Nobel laureate in physics, 1930, honorary secretary of the Indian Association for the Cultivation of Science, Calcutta.

During the last ten years, the attention of the workers at the Indian Association for the Cultivation of Science has been principally directed to the study of the scattering of light and its relation to the nature of radiation and the constitution of matter. Since 1928, monochromatic light has been exclusively employed and the scattered radiations have been analysed spectroscopically. This has led to a very great extension of the field of study. Probably the most important problem now under investigation is the nature of light itself. The phenomena of light-scattering make it clear that we have to atomise light and ascribe to it a specific quantum of energy and also definite values of linear and angular momentum. They also suggest that we must atomise sound, and consider it as being associated with molecular aggregates of variable size. The discovery of the phenomenon of anomalous polarisation in light-scattering has also opened up new vistas of research, which are being actively pursued. Light-scattering is also being applied to numerous physico-chemical problems.

Magnetic and magneto-optical researches are also receiving attention at the present time at Calcutta.

Societies and Academies.

LONDON.

The Optical Society, Oct. 15.—**F. Twyman** and **A. Harvey**: The validity of the Schwarzschild relation as applied to the use of the logarithmic sector. A direct experimental test is made of the Schwarzschild relation as applied to the logarithmic sector used in conjunction with a quartz spectrograph. The relation is found to hold within the limits of the experiments, from which it follows that the length of a spectral line on the photographic plate is proportional to the logarithm of its intensity.—**F. Twyman**: The 'Spekker' photometer for ultra-violet spectrophotometry. With the original Hilger sector photometer a glass disc was supplied, with its absorption curve in the ultra-violet. This was to enable a calibration of the sector to be made on each photographic plate, and thus to avoid errors due to any assumption concerning the Schwarzschild constant. Although the original rotating sector withstood the criticisms levelled against it on the score of intermittency, there were a number of real objections to its use. The photometer described in the present paper is now made by Adam Hilger, Ltd., under the trade mark 'Spekker'. The risk that the intensity of illumination from the two aspects of the light source may be unequal is overcome by the use of two rhombs.

PARIS.

Academy of Sciences, Sept. 14.—**Serge Bernstein**: The absolute maximum of a trigonometrical summation.—**E. Bataillon** and **Tchou Su**: The experimental dissociation of the male and female kinetic rhythms in the normally impregnated egg of *Bombyx*.—**Depreux**: The resistance of the air behind projectiles.—**P. R. Bohn**: The mechanism of the synthesis of fats at the expense of glucides. A comparative study of the action of *Sterigmatocystis nigra* on cultures containing dextrose and levulose, to see if there is any relation between the presence of the aldehyde and ketonic group and the formation of fat. The proportion of fat in the mycelium is higher as the concentration of the sugar increases: the change in the amount of proteins is sufficient to prevent any positive conclusions being drawn regarding the effect of substituting levulose for dextrose in the cultures.—**Raoul Lecoq**: The production of an osteo-dystrophic syndrome in the guinea-pig by disturbance of the mineral equilibrium.—**H. Quéré**: The oxidation of the alcohols by the acetic ferments, considered as a form of cell respiration. A comparison of the oxidation of ethyl, propyl, isobutyl, and isoamyl alcohols shows that the amounts of oxygen used up are approximately in inverse proportion to the molecular weight of the alcohol. The mechanism of oxidation is analogous with the mechanism of respiration.—**P. Cayrol**: The action of various halogen derivatives on alcoholic fermentation. From a study of the action of a number of halogen compounds on the process of fermentation, the conclusion is drawn that the action of the halogen atom depends on its position in the molecule: the most active halogen derivatives appear to be those which are hydrolysed at the ordinary temperature.—**Paul Wintrebert**: Sketches of *Discoglossus pictus* at the end of the blastula and at the end of the neurula stages.—**P. Delanoë**: The jackal and hedgehog reservoirs of the Moroccan spirochæte *Sp. hispanicum* var. *marocanum*. The following animals have now been proved to be carriers of the Moroccan spirochæte: porcupine, merion, fox, jackal, and hedgehog.

Sept. 21.—**Louis Lapicque**: The measurement of large chronaxies. Remarks on a note by M. Bourguignon. The author states that there is no reason to use different methods for measuring large and small chronaxies.—**Lucien Féraud**: The periodicity conditional to the neighbourhood of a point of stable equilibrium.—**A. Etévé**: Anemogirouttes. A discussion of instruments in use for the automatic control of aeroplanes.—**P. Fourmarier**: Studies of photo-electric cells as depending on the frequency of illumination.—**J. Fallou**: Measurements of the propagation constants of an aerial cable with earth return, as a function of the frequency.—**J. Bougault** and **J. Guillou**: Some reactions of certain barbituric derivatives (veronal, dial, gardenal, etc.). Study of the reaction of bromine and iodine in alkaline solution on some barbituric derivatives in use in medicine.—**P. Fallot**: The marginal inequalities of the limestone chain of the Rif to the north of Oued Lau.

LENINGRAD.

Academy of Sciences—*Comptes rendus*, No. 5, 1931.—**L. Berg**: The Black Sea sprat. A description and discussion of the synonymy of the Black Sea sprat, which is considered to be a subspecies of the Atlantic sprat and named *Spratella sprattus phalerica* (Risso).—**N. Vlodavec**: The extraction of alumina and alkalis from the nephelines and nephelinites of the Chibin Mountains. Discussion of commercial methods based on laboratory experiments.—**S. Kurbatov**: The pyrophyllite from the Tchistaya-Gora deposits in the Southern Ural. A talcum-like rock from the Tchistaya-Gora proved to contain 73·55 per cent of pyrophyllite, 23·63 per cent of quartz, 1·68 per cent of sericite, and 0·62 per cent calcium and magnium carbonates. This is the fifth known bed of pyrophyllite in Russia.

Comptes rendus, No. 6, 1931.—**V. Vernadskij**: (1) Biogeochemical studies of the phenomena of life. (2) The influence of living organisms on the isotopic mixtures of chemical elements. Both papers contain an exposition of general theoretical ideas on the subject.—**V. Vernadskij** and **A. Vinogradov**: Chemical composition of *Lemna* as a specific character. Analysis of four different species of *Lemna* proved that there exist definite and constant differences in chemical composition between species. Thus *L. polyrrhiza* and *L. trisulca* contain more carbon than *L. minor* and *L. gibba*, while *L. trisulca* is richer in manganese than any other species. In all Lemnaceæ the quantity of manganese is higher than that of iron.—**K. Nenadkevic**: An electro-colorimetric method for the determination of small quantities of manganese. The method is based on the electrolytic oxidation of manganese salts by ozone and oxygen *in statu nascendi*.—**V. Barovskij**: The first representative of the genus *Plateros* (Coleoptera, Lycidæ) in the Russian fauna. Description of *Plateros ussuriensis*, sp. n. from the Ussuri region.

Official Publications Received.

BRITISH.

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1931-1932. Pp. 96. (Edinburgh.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 230, A687: A Research on Faraday's "Steel and Alloys". By Sir Robert Hadfield. Pp. 221-292+plates 4-12. (London: Harrison and Sons, Ltd.) 14*s*. 6*d*.

First Annual Report of the Sugarcane Research Station of Department of Agriculture, Mauritius, for the Year 1930. Pp. 21. (Mauritius.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 4 (New Series), No. 8, August. Abstracts Nos. 1339-1546. Pp. 259-294. (London: H.M. Stationery Office.) 9*d*. net.

FOREIGN.

Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1931. 97e année. Pp. 282+6 planches. (Bruxelles: Maurice Lamertin.)

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 17: Über die Beziehung zwischen Lotabweichungen und Schwereanomalien sowie über das Lotabweichungssystem in Süd-Finnland. Von V. R. Ölander. Pp. 23. (Helsinki.)

CATALOGUES.

Synthetic Organic Chemicals. Vol. 5, No. 1, October. Pp. 4. Eastman Organic Chemicals. Supplementary List, October. Pp. 4. (Rochester, N.Y.: Eastman Kodak Co.)

Watsons' Microscopic Record. No. 24, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

The Mercury-in-Steel Thermometer. Pp. 39. (London: Negretti and Zambra.)

Africana. (Catalogue No. 541.) Pp. 72. (London: Francis Edwards, Ltd.)

List of Books and Periodicals on Agriculture, including Horticulture and Forestry and Animal Husbandry. Pp. 32. (London: Baillière, Tindall and Cox.)

Sotheran's Price Current of Literature. Annotated and Classified Catalogue of Ancient and Modern Books on Exact and Applied Science. Part 2, including Astronomy, Dialling and Horology, Physics. (No. 828.) Pp. 153-292. (London: Henry Sotheran, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 30.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science and Technology), at 11.30 A.M.—R. H. Stoughton: Nuclei, Reproductive Bodies, and Cell-fusion in a Bacterium.—T. H. C. Taylor: Control of the Lavuana Moth in Fiji.—Dr. P. H. Gregory: The Fusarium Bulb Rot of Narcissus.—At 2.30.—Dr. W. B. Brierley, Prof. J. W. Munro, and others: Discussion on The Training of Biologists for Economic Posts.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Isostasy. Speakers: Sir G. P. Lenox-Conyngham (who will communicate a paper by Dr. De Graaf Hunter), Prof. A. M. Davies, Dr. Harold Jeffreys, H. L. P. Jolly, Prof. O. T. Jones. Chairman: Admiral H. P. Douglas.

ROYAL SANITARY INSTITUTE (at Town Hall, Wolverhampton), at 5.—W. Clifford: The Flow of Sewage through a Sewage Works.—Miss M. R. Baskett and Dr. H. Paul: Experiments in Reconditioning of Houses.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Anatomy of the Pyloric Sphincter in Cases of Hypertrophic Enlargement.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—Mrs. E. M. Smith-Keary: The Effect of Immersion on Propellers.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—G. J. Shaw and G. A. M. Hyde: The Business of Electrical Apparatus Manufacture.

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. E. F. Armstrong: Hydrogenation (Lecture).

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30.—P. Good and others: Discussion on Some Impressions of the I.I.C. Floodlighting.

INSTITUTION OF MECHANICAL ENGINEERS (East Midland Branch) (at University College, Nottingham), at 6.30.—Prof. C. H. Bulleid: The Importance of Metallurgy to the Engineer.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Adelphi Hotel, Liverpool), at 6.30.—T. E. Jones: The Horse—Its Place in the Scheme of Transport.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—R. Borlase Matthews and others: Discussion on Engineering in Agriculture.

IRON AND STEEL INSTITUTE (jointly with West of Scotland Iron and Steel Institute) (at Royal Technical College, Glasgow), at 7.15.—J. H. Andrew, W. R. Maddocks, D. Howat, and E. A. Fowler: The Equilibrium of Certain Non-Metallic Systems.—B. Matuschka: The Solidification and Crystallisation of Steel Ingots: the Influence of the Casting Temperature and the Undercooling Capacity of the Steel.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Technical College, Cardiff), at 7.15.—R. D. Owen: Chemistry of Dairy Products.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—J. N. Waite: Combustion and Boiler-house Efficiency.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. John A. Cranston: The Chemist, the Community, and the Individual (Chairman's Inaugural Address).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Clifton: Automatic Combustion Control.

INSTITUTE OF CHEMISTRY (Belfast Section) (at Royal Belfast Academical Institution), at 7.45.—R. G. Baskett: Recent Advances in Animal Nutrition.

ROYAL AERONAUTICAL SOCIETY (at Eton College).—The Master of Sempill: Lecture.

SATURDAY, OCTOBER 31.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—W. Cochran-Carr: Inaugural Presidential Address.—Dr. A. Crawford: The Hydrogenation of Coal.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—J. N. Waite: Combustion and Boiler-house Efficiency.

MONDAY, NOVEMBER 2.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—G. W. Tyrrell and M. A. Peacock: Petrology of Iceland. Part II. The Petrology of the Acidic and Intermediate Intrusives and Extrusives, by M. A. Peacock.—Dr. Tudor Jones: The Primitive Conducting Mechanisms of the Vertebrate Heart: An Introduction to the Study of their Appearance and Development in *Lepidosiren paradoxa*.—G. W. McCrea: An X-ray Examination of *d*-Manitol and *d*-Mannose.—W. O. Kermack and W. H. McCrea: An Operational Method for the Solution of Linear Partial Differential Equations.—H. S. Ruse: On the Definition of Spatial Distance in General Relativity.

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Secondary Tumours of the Bone.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—T. J. Gueritte: Esperanto in the Field of Engineering.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—F. Schonell: Research of Specific Disability in Spelling.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Hull Chemical and Engineering Society and Institute of Chemistry—Leeds Area Section) (at Station Hotel, York), at 6.45.—Emulsions:—A. H. Dodd: Types of Industrial Emulsions.—J. Pryce Jones: Some Aspects of Thixotropy.—Dr. A. N. Mosses: One Molecule Thick.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—R. M. Charley: Recent Progress in Large Transformers.—W. E. M. Ayres: The Application of the Induction Voltage Regulator.

BRITISH KINEMATOGRAPH SOCIETY (in Gaumont British Theatre, Wardour Street), at 7.45.—B. Pontifex: Nickel Alkaline Storage Batteries.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Drs. H. A. Auden and W. P. Joshua: The Saccharification of Wood.

TUESDAY, NOVEMBER 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. G. I. Finch: The Combustion of Gases in Electric Discharges (1).

NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (in North Staffordshire Technical College, Stoke-on-Trent), at 5.30.—B. R. Lawton: The Aneroid Barometer as an Aid to Improvement of Atmospheric Conditions in Deep Workings.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—T. L. Green: On the Pelvis of *Anura*.—C. John: On the Anatomy of the Head of *Sagitta* (Chætognatha).—Dr. Susan Finnegan: On a New Species of Mite of the Family Heterozerconidæ.—Prof. F. Werner: Further Notes on the Indian Mantids or Praying Insects.

MINERALOGICAL SOCIETY (Anniversary Meeting) (at Geological Society), at 5.30.—Dr. F. C. Phillips: On Crystals of Brookite, Tabular, Parallel to the Basal Plane.—Prof. T. Ito: On Scorodite from Japan.—Dr. E. S. Simpson and D. G. Murray: On a New Siderolite from Bencubbin, Western Australia.—W. Campbell Smith: On a New Meteoric Stone from Suwahib, Arabia, found by Mr. Bertram Thomas in 1930.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Cyril Reginald Sutton Kirkpatrick: Presidential Address and Presentation of Medals.

LONDON NATURAL HISTORY SOCIETY (at London School of Hygiene), at 6.30.—Exhibition of Ciné Films of The Buzzard, Crabs and Camouflage, The Ant Lion, and The Swallows.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—B. G. Robbins: The Training of Young Automobile Engineers.

ABERNETHIAN SOCIETY OF ST. BARTHOLOMEW'S HOSPITAL, at 8.30.—Dr. W. Langdon Brown: Dr. Robert Bridges, the Poet of Evolution (Inaugural Address).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—F. S. Smythe: The Garwhal Himalaya around Kamet.

ROYAL PHOTOGRAPHIC SOCIETY.—T. Thorne Baker: The Spicer Dufay Colour Process.

INSTITUTION OF GAS ENGINEERS (at 28 Grosvenor Gardens).

WEDNESDAY, NOVEMBER 4.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. Meyerhof: A Short History of Ophthalmia during the Egyptian Campaigns of 1798–1807.

GEOLOGICAL SOCIETY, at 5.30.—Prof. A. Holmes and Dr. H. F. Harwood: The Petrology of the Volcanic Fields East and South-East of Ruwenzori, Uganda.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Col. A. S. Angwin: Chairman's Inaugural Address.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—S. J. Benham: Recent Developments in Cooking Apparatus.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—D. Tagg and R. G. P. Weighton: Supercharging: its Aims and Application.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. W. R. Schoeller and H. W. Webb: The Separation of Tin from Tantalum and Niobium.—Dr. W. R. Schoeller and C. Jahn: A Reliable Method for the Quantitative Separation of Titanium from Tantalum and Niobium.—Dr. J. Reilly, N. Noonan, and P. J. Drumm: The Evaluation of the Menthone Content of Peppermint Oil.—D. M. Freeland: The Extraction and Estimation of Vanillin in Chocolate and Cocoa Butter.—H. R. Ambler: The Direct Determination of Nitrogen in Gases.

ROYAL SOCIETY OF ARTS, at 8.30.—Sir Edward A. Gait: British Research Work in India, in the Fields of History, Archæology, Philology, and Ethnology.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—G. Williams and others: Discussion on Treatment of Acute Osteomyelitis.

INSTITUTION OF GAS ENGINEERS (at 28 Grosvenor Gardens).

ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B.M.A. House).

THURSDAY, NOVEMBER 5.

ROYAL SOCIETY, at 4.30.—Sir F. Gowland Hopkins and K. A. C. Elliott: The Relation of Glutathione to Cell Respiration with Special Reference to Hepatic Tissue.—Lord Rutherford and Dr. C. D. Ellis: The Origin of γ-Rays.—Prof. A. V. Hill: Myothermic Experiments on the Frog's Gastrocnemius.—*Papers to be read in title only*:—J. L. Burchnell and T. W. Chaundy: Commutative Differential Operators II.—F. Relton: The Steady Broadside Motion of an Anchor Ring in an Infinite Viscous Liquid.—L. E. Sutton: The Significance of Difference between the

Dipole Moments of Saturated and Unsaturated Compounds.—Prof. W. A. Bone and R. P. Fraser: Photographic Investigations of Flame Movements in Gaseous Explosions. (IV., V., and VI.—Sir Robert Hadfield, Bt.: A Research on Faraday's Steel and Alloys.—A. F. H. Ward: The Sorption of Hydrogen on Copper. I., II.—T. Iredale and A. C. Mills: Absorption Spectra of the Alkyl Halides: Energies of the C–I and C–Br Bonds.—Prof. G. I. Finch and H. H. Thompson: The Effect of Frequency on the Condensed Discharge Ignition of Carbonic Oxide–Air Detonating Gas.—J. H. Gaddum: A Simple Method of Measuring Surface Tension.—K. Lonsdale: An X-Ray Analysis of C_6Cl_6 using the Fourier Method.—M. G. Evans: The Sorption Process in the Zeolite Chabazite.—S. Werner: Electron Scattering in Helium at Low Velocities.—E. J. Brown, C. N. Hinshelwood, and E. A. Moelwyn-Hughes: The Kinetics of the Decomposition in Carbon Tetra-Chloride Solution of Ozone and of Ozone-Chloride Mixtures.—H. B. Heywood: On Finite Sequencies of Real Numbers.—Prof. J. C. McLennan, E. J. Allin, and K. E. Hall: The Nuclear Moment of the Indium Atom.—C. V. Jackson: Interferometric Measurements in the Spectrum of the Iron Arc in Air in the Region λ3100-λ3500.—K. R. Rao: The Third Spark Spectrum of Arsenic (As IV.).—Prof. J. S. E. Townsend: Elastic Collisions.—H. M. Taylor: The Interaction Energy of Two α-Particles at Close Distances, Determined from the Anomalous Scattering in Helium.—R. W. Gurney: The Quantum Mechanics of Electrolysis.—W. Riezler: The Scattering of α-Particles by Light Elements.—Prof. R. Whytlaw-Gray, H. S. Patterson, and W. Cawood: The Atomic Weight of Xenon.—D. T. A. Townend and L. A. Bhatt: Isotherms of Hydrogen, Carbon Monoxide, and their Mixtures.—G. S. Hartley and C. Robinson: The Diffusion of Colloidal Electrolytes and other Charged Colloids.—L. Rosenhead: The Formation of Vortices from a Surface of Discontinuity.—E. C. Bullard and H. S. W. Massey: The Elastic Scattering of Slow Electrons in Gases. II.—A. Michels and R. O. Gibson: The Measurement of the Viscosity of Gases at High Pressures: The Viscosity of Nitrogen to 1000 ATMS.—Sir William Pope and J. B. Whitworth: The Optically Active Spiro-5:5-Dihydantoins.—Lord Rutherford, C. E. Wynn-Williams, and W. B. Lewis; Analysis of the α-Particles emitted from Thorium C and Actinium C.—O. Gratias and C. H. Collie: The Half Life Period of Uranium γ.—B. Lambert and A. G. Foster: Studies of Gas-Solid Equilibria. III.—Sir Arthur Eddington: On the Value of the Cosmical Constants.—Prof. J. C. McLennan, A. B. McLay, and M. F. Crawford: Interpretation of Hyperfine Structure.—Prof. E. N. da C. Andrade: (*a*) On the Circulation caused by the Vibration of Air in a Tube; (*b*) On the Groupings and General Behaviour of Solid Particles under the Influence of Air Vibrations in Tubes.—G. D. Bengough, A. R. Lee, and F. Wormell: The Theory of Metallic Corrosion in the Light of Quantitative Measurements. V.—Dr. F. D. Chattaway and E. J. F. James: The Condensation of Chloral with Urea and Phenyl Urea.—Prof. J. C. McLennan and A. B. McLay: Arc Spectrum of Gold.—Prof. J. C. McLennan, A. B. McLay, and M. F. Crawford: Spark Spectrum of Mercury HgII.—C. W. W. Read: Intensity Distribution in the Band Spectrum of Helium (He) for the Region λ6100-λ6500.—G. V. Praagh and Prof. E. K. Rideal: An Investigation of the Attack of Platinum and Tungsten by Iodine.—A. R. Ubbelohde and A. Egerton: The Kinetics of Adsorption Processes.

LINNEAN SOCIETY OF LONDON, at 5.—Prof. F. E. Weiss: Naturalisation of *Sarracenia purpurea* in Switzerland.—H. W. Pugsley: A New *Juncus* in Scotland.—A. G. Lowndes: Elutriation and some of its Applications to Biology.—Major R. W. G. Hingston: Artificial Concealment Devices in Nature.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. A. Watson: Coil Ignition Systems.

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Midland Institute, Birmingham), at 6.—T. J. Gueritte: The Construction of the Reinforced Concrete Bridge over the Mouth of the River Elorn between Brest and Plougastel, in Brittany.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. B. Irving and A. V. Stevens: Safety in Spinning.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—B. G. Robbins: The Training of Young Automobile Engineers.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at University, Bristol), at 7.30.—Drs. L. A. Jordan and W. H. J. Vernon: The Relation between Corrosion and Paint.

CHEMICAL SOCIETY, at 8.—H. L. Riley and V. Gallafont: A Potentiometric Investigation of Electrolytic Dissociation. Part I. Cadmium Halides.—Prof. G. T. Morgan and F. H. Burstall: Dehydrogenation of Pyridine by Anhydrous Ferric Chloride.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall).—R. B. Grey: The Elimination of Vibration.

ELECTRICAL ASSOCIATION FOR WOMEN (at Institution of Electrical Engineers).—Dr. Elizabeth Sloan Chesser: Electricity and Health (1).

FRIDAY, NOVEMBER 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—N. Patterson: The Training of an Oto-laryngologist (Presidential Address).—E. W. Williams: Treatment of Suppurative Meningitis.—Dr. D. McKenzie: Some Graphs Illustrating Otosclerosis.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Sir Arthur Eddington: The Expanding Universe (Presidential Address).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Pathology of Hydrocephaly.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Ll. B. Atkinson: The Mechanical Aspects of Electricity (Thomas Hawksley Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of Society of Dyers and Colourists, Institute of Chemistry, and Chemical Section of Manchester Literary and Philosophical Society) (at College of Technology, Manchester), at 7.—Prof. H. Mark: The Significance of the New Cellulose Models (Molecular Structure) for the Technical and Dyeing Properties of the Fibre.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—F. C. Knowles: Inaugural Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Institute of Chemistry) (at Thomas' Cafe, Swansea), at 7.30.—Dr. Sladden: Chemistry in the Service of the Doctor.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Quarrell: The Cooling of the Crude Oil Engine.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Liverpool).—N. Heaton: Modern Developments of Inorganic Pigments.

ROYAL PHOTOGRAPHIC SOCIETY.—Pictorial Photography.

SATURDAY, NOVEMBER 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. E. Yerbury: Present-Day Architecture on the Continent (1): Modern Buildings in Holland.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—W. B. Gourlay: Plant and Animal Collecting in Chili (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London) (Informal Meeting), at 6.45.—Debate on: That a College Education is Desirable in the Training of a Mechanical Engineer.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—J. Lang: Chairman's Address.

PUBLIC LECTURES.

FRIDAY, OCTOBER 30.

BRITISH MEDICAL ASSOCIATION, at 5.15.—Dr. F. J. McCann: The Prevention of Cancer (Chadwick Lecture).

SATURDAY, OCTOBER 31.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 3.—H. B. Creswell: The Uses of an Architect.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: A Naturalist in Western Cornwall.

MONDAY, NOVEMBER 2.

UNIVERSITY OF LEEDS, at 5.15.—Prof. J. A. Crowther: The Life and Work of Michael Faraday.

ROYAL ANTHROPOLOGICAL INSTITUTE (at University College), at 5.30.—F. J. Richards: From Pariah to Brahman in Southern India.

KING'S COLLEGE, LONDON, at 5.30.—Prof. H. Cloos: Problems and Methods of Structural Geology. (Succeeding Lectures on Nov. 9 and 11.)

UNIVERSITY COLLEGE, at 5.30.—Col. T. C. Hodson: Caste and Creed in Northern India.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at Royal Society of Arts), at 6.—Eric Farmer: Recent Research into the Causes of Industrial Accidents. (Succeeding Lectures on Nov. 9 and 16.)

UNIVERSITY OF LEEDS, at 8.—Prof. F. Challenger: The Chemistry of the Friendly Microbe.

TUESDAY, NOVEMBER 3.

KING'S COLLEGE, LONDON, at 5.30.—Sir Bernard Pares: Russian History to 1861: Western Neighbours: Novgorod.

WEDNESDAY, NOVEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—L. E. Claremont: The Dental Health of the Citizen.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—Capt. P. F. Knightley: Practical Uses of Office Machinery in the Registration Department of a Company.

THURSDAY, NOVEMBER 5.

ROYAL SOCIETY OF MEDICINE, at 5.—W. D. Harmer: The Relative Value of Radio Therapy in the Treatment of Cancer in the Upper Air Passages (Semon Lecture).

KING'S COLLEGE, LONDON, at 5.30.—Dr. Eveline Martin: West Africa of To-day: The Gold Coast: the Old English Forts on the Coast, and the New Inland—Kumasi.

KING'S COLLEGE, LONDON (at 16 Russell Square), at 5.30.—S. P. Turin: Economic Conditions in Russia To-day; the Five-year Plan in U.S.S.R.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Conversazione.

SATURDAY, NOVEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—A. W. Siddons: The First Two Years of Geometry in a Secondary or Preparatory School.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Age of Dr. Johnson.

ANNUAL MEETING.

OCTOBER 31 TO NOVEMBER 2.

INTERNATIONAL SOCIETY OF MEDICAL HYDROLOGY (at American Hotel, Amsterdam).—Discussions on the Influence of Chill in the Causation of Disease, opened by Profs. Schade and van Loghem, and on Factors in Marine Treatment, opened by Prof. Moll and Dr. Häberlin.

CONFERENCE.

NOVEMBER 16 TO 21.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL (at Carnegie Institute of Technology, Pittsburgh, U.S.A.).—Subjects for discussion:—Coal as Locomotive and Steamship Fuel; Coal in the Electric and Gas Industries; Competition of Coal with other Fuels in Heating Buildings; Coal in the Metallurgical Industries; Coal and its By-products in the Chemical Industries; Problems of Coking; Origin and Classification of Coals; Cleaning and Preparation; Mechanism of Combustion; Pulverised Coal; Relationships of Coal, Oil, and Natural Gas; Coal versus Water Power; Hydrogenation and Liquefaction of Coal; Fertilisers from Coal; Economics of Low Temperature Carbonisation; Storage and Weathering of Coal; Smoke Abatement; Stream Pollution.