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## Humanistic Science

IN recent years increasing recognition has been given to the contacts of science with social problems and public affairs. Many scientific workers, particularly those of the younger generation, are no longer content to be regarded as hewers of wood and drawers of water whose special knowledge is considered to disqualify them for administrative posts. They know how science enters into every department of national life or international undertaking, and they claim to be entrusted with a reasonable share of responsible control of the forces created by them. At present these new powers seem to be out of hand in their effects upon production and also their applications to destruction. Such disappointing results are not, however, essential consequences of scientific progress, but are due to the much slower rate of advance of man's ethical and spiritual nature.

During the past few years, several leading men of science have dealt with these aspects of modern life, and over and over again we have stressed in these columns the duty of scientific workers to assist in securing intelligent recognition of scientific values in civilised communities. During the five years of his presidency of the Royal Society, and particularly in his presidential address to the British Association in 1933, Sir Frederick Gowland Hopkins has on a number of occasions referred to this wider outlook of science, in which responsibilities as citizens are combined with the pursuit of natural knowledge. In his valedictory address to the Royal Society on November 30, extracts from which appear elsewhere in this issue, he deals with the subject again, and supplements the general theme by very appropriately describing the

benefits to humanity of scientific investigations of nutrition and food production.

Sir Frederick Hopkins points out that "The current interest in the subject of the national food supply and in right feeding is doubtless largely due to the awakening of the public conscience to this and other kindred social responsibilities ; but it has also been stimulated, I think, by the nature of the results which scientific studies during the last twenty years have revealed". In this department of science, at any rate, and in the control and conquest of disease, the knowledge gained has been of unqualified benefit to humanity. Whatever may be thought of modern progress, and however much some people may look back with longing eyes to the days when disease, born in filth and ignorance, stalked through the land practically unchecked, they must acknowledge that science has provided the means of reducing suffering and death due to disease, and of improving our social heritage.

This mastery over the powers—mostly microscopic—which continually tend to destroy mankind, has been obtained by scientific inquiry, the spirit of which has had a greater influence than is commonly understood. As Sir Frederick Hopkins said in his address, "History itself shows that it is wrong to deny ethical influence, even if it be indirect, to the scientific spirit. While, for example, the earlier stages of the Renaissance enriched men's minds by restoring to them the literary and philosophical heritage of antiquity, we all know that not until later, when the awakening scientific spirit demanded a courageous inquiry into the actual facts of Nature, did human thought begin its release from the shackles of authority and traditional dogma."

The intellectual expansion brought about by the workings of this spirit, together with the sense of justice which resulted from knowledge of the existence and permanence of law in Nature, profoundly influenced human thought, and resulted in social changes which had the widest civilising effects. In spite of these ethical aspects, there are some who still regard the humanities as belonging essentially to polite scholarship or classical learning and having an antipathetic relation to science. When Greek was introduced into the curriculum of schools with the Renaissance movement of the fifteenth century, it was because the scholars of that period were eager for the new light which the language could reveal. Humanism then meant the substitution of new teaching for old, and its followers aimed at moulding the nature of man as a citizen and an active member of the State rather than at continuing the studies of doctrines relating to the next world upon which the attention of teachers had been concentrated for a thousand years.

The foundation of the Royal Society in the seventeenth century was a natural development of the revolt against scholasticism and theological authority which had for ages discouraged inde-

pendent thought. The spirit of the new movement is represented by the Horatian motto, *Nullius in verba*, chosen by Evelyn for the Society and signifying "not bound by the words of any man"; and this intention, as the Earl of Athlone remarked at the anniversary dinner on November 30, was expressed by an even older motto: "Prove all things; hold fast that which is good". The object of the Society was the promotion of natural knowledge through observation and experiment as distinct from supernatural knowledge obtained through revelation. This new experimental philosophy was the method of inquiry which distinguished humanism of that epoch from medieval obscurantism, and its introduction was typical of progressive thought and action just as science is the humanism of to-day.

Science has not only emancipated human thought from the bondage of traditional authority, but also, through the concept of evolution onward and upward, has provided mankind with a new philosophy of life. It embodies, as Huxley pointed out long ago, the evolution of social ethics, and in this development through the right use of knowledge, scientific workers should take an effective part in shaping human destiny.

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## Culture and Peoples of Ireland

### Prehistoric Man in Ireland

By Cecil P. Martin. Pp. xi+184+11 plates. (London: Macmillan and Co., Ltd., 1935.) 21s. net.

ALL who occupy themselves seriously with the baffling problems of prehistoric Ireland will welcome this book with open arms. It is just what they have been longing for, ever since science undertook to dispel the accumulated rubbish of charlatanism. It is not Dr. Martin's fault that the first reading of his work induces a slight sense of disappointment: it is because, with all the energy and industry which he has brought to bear upon his undertaking, the actual amount of material which he has found available is comparatively small. But he has made the best possible use of it, and has been enabled to lay a foundation which, with a little underpinning to be supplied by future discoveries, will bear the weight of years of research to come.

Ireland occupies a singular position among the countries of Europe. The Romans left her alone;

they saw no advantage to be gained by occupying an island inhabited, as rightly or wrongly they believed, by cannibalistic savages. The country thus escaped Latinisation, and it afforded an extra-imperial refuge first for druids, and later for Christians, driven from their homes by persecution. The former introduced a literary tradition; the latter introduced a religion. But except for early invaders, tempted by the reputation of the auriferous gravels of the Wicklow rivers, and these refugees, the country stood aside, as the stream of culture flowed on elsewhere in the Continent. There is a biological 'lag' in the country, as is well known to biologists: these conditions produced a similar cultural lag, expressing itself in a self-centred absorption in domestic affairs, and an exaggerated appreciation of their importance. In the literature, developed first by druid refugees and afterwards by Christian scribes and teachers, there was enshrined a mass of contradictory legends, of very varying dates, about mysterious peoples called Nemedians, Fir Bolg, and so on, who had successively occupied the country:

notwithstanding which, these legends were overlaid with the boast that Ireland was the typical Celtic country, which had maintained Celtic blood, traditions and culture, undefiled and uncontaminated. This is the notion held by the layman even yet.

But archaeologists are digging, palæobotanists are making an intensive study of peat-bog pollination, 'higher critics' are riddling the documents which report these ancient fables, and Dr. Martin is applying his callipers to every ancient skull, recorded or unrecorded, that he can find in the country; and whether the layman likes it or not, he must awake, sooner or later, from his dreams, to a world of unpicturesque realities.

Preliminary chapters tell, clearly and succinctly, of chronological and craniological methods in modern research; and then the author gets to business. He begins with a few modern skulls, from five different districts in the country, which show, so far as they go, that the proportion of long-headedness increases as we proceed westward. Dr. Martin recognises environmental, as well as racial, causes as operating to produce this result. Next he gives us a brief résumé of early research in Irish ethnology, and of the endeavours made by Wilde and others to correlate the evidence of craniology, so far as it was understood in their time, with the invasion-traditions referred to above. Then comes a most valuable series of chapters, describing the craniological material from successive stages of Irish history—from the caves, the 25-ft. raised beach, the megalithic monuments, the later

Bronze Age, the Iron Age, the Crannogs, the Early Christian period, and the time of the Norse invaders. In the first of these chapters, the author is not inclined to reject summarily, on the ground of more recent research, the authenticity of the Kilgreany man (or rather woman) as a true cave-dweller. The evidence from the raised beach and the later sandhill settlements is of the scantiest; but, such as it is, it points to a race "of low stature, with very long, narrow, and high skulls".

The Megalithic people seem to be variants of the same stock, but not necessarily direct descendants of their shore-dwelling predecessors; but the later Bronze Age introduces us to a definitely distinct race, thereby confirming the testimony which archæology has been voicing with a growing insistence, to the effect that there was an abrupt interruption in cultural development about the middle of the Bronze Age. Unfortunately, the critical problems relating to the introduction of the Iron culture are not yet illuminated by osteological material; but certainly the later evidence shows that in early Christian times races were as inextricably mixed in Ireland as they are to-day. One by one the shadows of the 'Celtic twilight' are vanishing, in the cold clear light of common day.

The book is well printed, and excellently illustrated. There are a number of misprints here and there in the text which it might be well to correct in a later edition; but these trifles apart, we have nothing but praise for the book and gratitude for its author.

## Band-Spectra and Molecular Structure

**The Optical Basis of the Theory of Valency**  
By Dr. R. de L. Kronig. (Cambridge Series of Physical Chemistry.) Pp. x+246. (Cambridge: At the University Press, 1935.) 16s. net.

**T**HIS book is highly recommended to those interested in the determination of molecular structure by physical methods. Here a wide range of material will be found presented in a simple but authoritative manner. A noticeable feature is that each chapter is practically complete in itself; and this makes the book very readable.

The first chapter is short, and serves as introduction. The second explains how the size and shape of molecules can be determined from experiments on the scattering of X-rays and electrons. It is unfortunate that the very recent work of Brockway and Sutton on the diffraction of electrons

by the chloro-methanes appeared too late to be included in this chapter. Apparently only departures of the order of a degree or two can occur from the tetrahedral angle, in contrast with earlier conclusions based on X-ray evidence that they could be of the order ten degrees. The third chapter gives the usual account of the Periodic system, but has in addition a useful section on the charge, electron configuration and the size of ions. The fourth and fifth chapters are very good. They are the central portions of the book and represent the happy medium between an elaborate treatise on band-spectra and the few pages that are often considered sufficient for the subject. In them an account is given of the determination of molecular structure from band-spectra in the visible and infra-red regions of the spectrum. The significance of normal modes and force constants

is clearly explained and illustrated by numerous examples. The sixth and last chapter is also practically complete in itself, and deals with optical and thermal dissociation of molecules. This chapter is the lazy man's ideal, for it is so well illustrated with diagrams that there is scarcely any need to read the text.

Two minor criticisms may be levelled against the book, but of these perhaps the second is merely a prejudice on the part of the reviewer. The first concerns the title. One is not quite sure what to expect from "The Optical Basis of the Theory of Valency", but surely it is reasonable to hope for more than a very occasional reference to valency. The difficulty is of course appreciated. Obviously the best title is "Band-spectra and Molecular Structure", but unluckily this has already been used by Dr. Kronig for his earlier book. However, since more than half the book is covered by chapters beginning "Band-spectra and Chemical

Binding", this itself would not have made a bad title. Our second criticism is that we consider a separate chapter should have been given to theories of valency based on quantum mechanics. Certainly, these are no appendages to normal modes and band-spectra of polyatomic molecules, as they would appear from the book. We would have liked a fuller explanation of the Slater-Pauling theory of directed valency, and to have heard something of Mulliken's bonding, anti-bonding and non-bonding electrons.

This is one of the easier books to read, but it contains a great deal of information that is not easily digested. The style is clear and very much to the point, and the reader is carried swiftly but safely over many waters and through many rapids. As one now expects in any book by Dr. Kronig, the bibliography is most complete and the index good. There are half a dozen excellent plates and numerous well-drawn figures.

W. G. P.

## Faith and Fact

### Science and the Supernatural

A Correspondence between Arnold Lunn and Prof. J. B. S. Haldane. Pp. vii + 412. (London: Eyre and Spottiswoode, Ltd., 1935.) 10s. 6d. net.

THE method of controversy by correspondence has this advantage, when the correspondence is published in book form, that there is something very entertaining for the reader, who is in the happy position of a person watching a fencing bout or a game of billiards. But what such a book gains in entertainment value it may lose in other directions; it may, for example, be so discursive in method that it gets nowhere—or at least not nearly so far as the reader thinks he has a right to expect. Such indeed is the failing of the very interesting volume before us, wherein Mr. Arnold Lunn and Prof. J. B. S. Haldane engage in conflict for our edification.

The discursiveness, it is to be feared, is to be attributed very largely to the challenger—Mr. Lunn—who conveys the impression (like a bad chess-player) of not having laid his plans, with the result that the argument wanders like a lost child. For example, as early as p. 30, he makes the challenging and important statement that "We can prove that God exists by pure reason without entering a laboratory or consulting modern astronomers". In other words, he says (it is the beginning of all orthodox apologetic) that there are convincing metaphysical arguments for the

existence of God. This is an important point if you are arguing about science and the supernatural. But having opened so well, Mr. Lunn does not proceed along these lines. On the contrary, he has to be urged repeatedly by his opponent to expound these metaphysical proofs. In the end, it is Prof. Haldane who, on p. 169, outlines the proofs and proceeds to examine them himself; and it is not until seven months and several other letters have passed that Mr. Lunn, now on p. 254, proceeds to answer Prof. Haldane's criticisms.

Turning towards the end of the book (p. 352), we find Mr. Lunn's explanation of this apparent reluctance to come to close quarters:

"You introduced St. Thomas's metaphysical arguments, but apart from this digression I have made no attempt to develop the traditional arguments in defence of Christian theism, for I do not think we have yet reached that stage in the debate in which it is profitable to pass from a discussion of the existence to a discussion of the nature of God."

This looks like a belated justification of the course which the argument has taken, composed after the event. Prof. Haldane's examination of Aquinas's arguments would scarcely have been introduced had not the question of the metaphysical proofs of God's existence been already raised by Mr. Lunn himself at the outset. To term it a "digression" seems strange.

In this same examination of the course of the argument, Mr. Lunn observes that the

correspondence started "by debating whether the Christian approach to truth was more scientific, or, as you think, less scientific than your own approach". This also was a very important question, but is best discussed not, as Mr. Lunn discusses it, by accusing scientific men of scepticism and intolerance, but by making a serious examination of scientific method, inquiring how its 'abstractness' hinders contact with reality, and whether it can deliver qualitative, as contrasted with quantitative, judgments. All this is legitimate material for discussion, and is really of much more importance than the alleged shortcomings of scientific workers, who do not claim to be any less human than theologians.

A great deal of attention is devoted by Mr. Lunn to what he terms the "physical" (as contrasted with the "metaphysical") proofs of the existence of God. This involves an attack on Darwinism, since this tends to make life self-explanatory, and also an examination of the 'miraculous' cures of Lourdes and the results of psychical research. The attack on Darwinism, based largely on the theories of Berg, elicits what appear to be some convincing rejoinders from Prof. Haldane, who asserts that we can no more go behind Darwin in biology than we can behind Dalton in physics and chemistry, or Harvey in

physiology—though this, of course, does not involve the last word having been said in any of those spheres by any of the authorities named. As for Lourdes, Prof. Haldane is not satisfied of the miraculousness of any of the cures, real or alleged. There is the question of diagnosis, of the habit of skin diseases of clearing up rapidly, of the results of hypnosis, and so on. It is in fact impossible to say that a cause lies outside Nature until the whole of Nature has been explored.

After all, as Prof. Haldane points out, evolution is a minor question, and not worth the amount of space devoted to it here to the exclusion of more important topics such as "how a perfectly good and almighty creator could have made a world containing so much evil". It is a pity that Mr. Lunn definitely declined to tackle that question on the ground that there was now no space—the space having been squandered by himself on comparative trivialities and irrelevances.

"Our standards of intellectual valuation are so different", writes Prof. Haldane at the end, "that we found it hard to get to grips". The trouble is that the two disputants are not equally matched. Mr. Arnold Lunn, though a clever controversialist, is not in the religious sphere the equivalent of Prof. Haldane in the scientific sphere.

J. C. HARDWICK.

## Natural Philosophy in the Ninth Century

Encyclopædia of Philosophical and Natural Sciences as taught in Baghdad about A.D. 817, or Book of Treasures

By Job of Edessa. Syriac Text edited and translated with a Critical Apparatus by A. Mingana. (Vol. 1 of Woodbrooke Scientific Publications.) Pp. xlvi + 470. (Cambridge: W. Heffer and Sons, Ltd., 1935.) 42s. net.

**J**OB of Edessa, "Job the Spotted", or Ayyūb ar-Ruhāwī, was born in Edessa, possibly about A.D. 760, and seems to have survived until about A.D. 835. He was a member of the Nestorian church, and has achieved fame as one of the earliest and most prolific translators of Aristotle and Galen into an oriental language. Besides translations, he wrote many original works, of which only two are extant, namely, a treatise on canine hydrophobia, and the "Book of Treasures" which Dr. Mingana has here edited and translated from a manuscript—the sole copy in a European library—in his own collection. The "Book of Treasures", probably written about A.D. 817, is a kind of philosophical

and scientific encyclopædia; it affords a clear perspective of the intellectual background of Bagdad under Hārūn ar-Rashīd and Al-Ma'mūn, and shows that, while Aristotle and other Greek writers were regarded as the great masters of secular knowledge, independence of thought was more prevalent than might be expected.

The scope of the book is wide; it includes metaphysics, theology, psychology, biology, anatomy, physiology, medicine, chemistry, physics, music, mathematics and astronomy. Among points of special interest are Job's rejection of astrology, his development of the idea of the elemental origin of the universe and of the different bodies comprising it, his denial of a material hell, and his explanation of the cipher—an arithmetical sign which reached Bagdad during his lifetime. The cipher, according to Job, is a circular link between number nine and number one, causing numbering in general to proceed in a succession of cycles between one and nine; the figure of the cipher is a circle made by linking the forefinger and the thumb together, and its

very shape represents the 'emptiness' of its unattached value.

In general, the book conveys the impression that its author was a man of vigorous and balanced mind, though, like the vast majority of his contemporaries, he shows astonishing credulity in many directions, and is anxious to leave nothing unexplained. Thus, he says that the functional ground for the non-existence of hair on the human forehead and cheek-bones "is to prevent dust, sand and other things which happen to fall on those places, from getting a footing there, and thus impeding vision"; further asserting that animals walk on all fours because, if their posture were upright, they could not be of much

use as beasts of burden. On the other hand, he correctly explains the appearance of the Milky Way, and has a reasonable, even though incorrect, hypothesis to account for the salinity of sea-water.

Whether right or wrong, however, credulous or sceptical, Job is always interesting and lively, and his treatise is worth the attention of both the general reader and the historian of science. Dr. Mingana is to be thanked for having rendered it accessible, and for the valuable notes and commentaries which he has added. Unfortunately, there is no index, though the want is partly supplied by a fairly full table of contents.

E. J. HOLMYARD.

## Experimental Botany

Botany as an Experimental Science in Laboratory and Garden

By Dr. Lilian J. Clarke. Pp. xvi+138+9 plates. (London: Oxford University Press, 1935.) 6s. net.

LILIAN J. CLARKE entered on her career as science mistress at James Allen's Girls' School, Dulwich, in 1896, at a time when science was still the Cinderella of the curriculum; long before her retirement in 1926 she had raised its status to such a degree that much of the renown of the school was based upon the results of its teaching of science. At the outset there was no laboratory, no apparatus, no available ground, no money. Within five years, however, a small general laboratory had been built, a few order beds established in the school gardens, while the pupils were already taking the highest places in botanical examinations in competition with other schools in London and elsewhere.

The earliest teaching was on more or less orthodox lines, and matriculation candidates spent much time on elaborate section cutting and work with the compound microscope. Gradually this was all changed, and individual experimental work became the objective for each pupil. Increasing stress was laid upon plant physiology, every step being elucidated by experimental work, usually of the most simple character. Plant nutrition was studied by means of water cultures, with such success that many generations of a single species were grown over periods of years, in spite of untold difficulties arising from the shortness of school terms.

Eventually more adequate accommodation was provided in the form of a science block with

separate laboratories for botany and other branches of science. At the same time the development of the botany gardens proceeded steadily. For years no grant was forthcoming, all the plants being provided by the girls and mistresses and all the work done voluntarily by the girls in their spare time. At last, by dint of sheer enthusiasm and persistence on the part of Dr. Clarke, the value of the gardens for teaching purposes was recognised and an annual grant, which is still continued, was given by the Board of Education. The upkeep of the gardens is still by voluntary work, and the layout of the lawn, wood, ponds, sand dune, heath and other sections is such as to beautify the grounds as well as providing invaluable training in many aspects of botany.

The record of thirty years' struggle and progress has been written by Dr. Clarke, who completed the text, but did not live to see it through the press. She has given accounts of the many experiments with the details of technique which are apparently so insignificant, but which make or mar the success of the work. A great feature is made of the recording and comparison of results year after year, which has provided an accumulation of valuable data of which it has only been possible to give some indication. The book should prove a mine of information for teachers, and can equally well be used by the students themselves, as it is full of ideas and suggestions which stimulate the imagination and encourage independent investigation. As a textbook it is unique, and as a record of progress perhaps only those who were among Dr. Clarke's earliest pupils can appreciate fully the greatness of the achievement.

W. E. B.

**A Text-Book of Organic Chemistry: Historical, Structural and Economic**

By Prof. John Read. (Bell's Natural Science Series Second edition. Pp. xiv+703. (London: G. Bell and Sons, Ltd., 1935.) 12s. 6d. net.

PROF. READ'S textbook differs from many others on organic chemistry by its insistence on the importance of a knowledge of the early development of the subject, so that the student is enabled to follow the growth of the science from very ancient days to the present time. The theme has been presented in most attractive fashion by including in the text quotations of famous passages from documents of historical interest. Thus the problems, which were faced successively by Wöhler, Liebig, Kekulé, Pasteur, le Bel and van 't Hoff are set vividly before the reader. The rapidity with which chemical theory has been developed is most strikingly illustrated by a footnote on p. 276 from which we learn that Chevreul, who was born before the theory of phlogiston was abandoned, survived into the era of the asymmetric atom, the ionic hypothesis and synthetic indigo.

The historical aspect of the subject, however, has been by no means overstressed. The author has kept in mind not only the academic but also the industrial and economic interest, whilst biochemical discoveries have also received attention. Thus the chapter on carbohydrates includes an account of the economic aspect of sugar manufacture and a summary of the main features of interest in connexion with the various cellulose industries. The author does not discuss the actual structure of starch and cellulose, although a formula is given for the starch unit. It is rather surprising to find that the pyranose ring formulæ, which are so helpful to the student of stereochemistry, have not been adopted. Indeed, the chapter on stereochemistry might well have been expanded to include an account of some of the numerous types of molecular dissymmetry which are not associated with the asymmetric atom.

Turning to the polycyclic and heterocyclic compounds, we find useful summaries of the properties and composition of explosives, dyestuffs, drugs, perfumes, photographic chemicals and alkaloids, while a new chapter deals with the hormones and vitamins and another with the electronic theory of valency. The book provides a useful introduction to the subject, and should help the beginner to realise not only the practical value of certain organic products but also the important contribution which the organic chemist has made to the building up of chemical theory.

**Paläohistologie der Pflanze:**

Grundzüge einer Gewebelehre über fossile Pflanzen. Von Dr. Elise Hofmann. Pp. vii+308. (Wien und Berlin: Julius Springer, 1934.) 25.20 gold marks.

THE author presents a brief review of the anatomical structure of fossil plants, with a concluding section surveying the history of their various tissues and cell types. The descriptions are illustrated by numerous figures, some of which are original. Certain topics, such as the structure of fossil cuticles, receive fuller

consideration than in any earlier book of the same character, but other subjects, such as the structure of the elements described by palaeobotanists as phloem, receive a rather superficial treatment. In several sections the author seems to have taken all her information from recent papers, to the neglect of older work in which more complete descriptions are to be found; but she gives references to all the more important papers.

The value of the work is difficult to estimate. It will probably be of considerable use to Continental students, who have often underestimated the value of anatomical work in relation to morphology and taxonomy. When compared with the English works which deal with the structure of fossil plants, it often seems rather poor, but on the other hand it covers a wide field and gives an adequate introduction to some of the modern aspects of palaeobotanical research. It is not entirely free from mistakes, both in the naming of the specimens figured and in the text.

**Erdöl-Muttersubstanz:**

Beiträge zu dieser Frage. Von Dr. F. E. Hecht, Prof. Dr. K. Krejci-Graf, Prof. Dr. R. Potonié, Prof. Dr. H. Steinbrecher, Dr. A. Treibs, Dr. E. Wasmund, Dr. Dora Wolansky. (Schriften aus dem Gebiet der Brennstoff-Geologie, herausgegeben von Prof. Dr. Otto Stutzer, Heft 10.) Pp. vi+181. (Stuttgart: Ferdinand Enke, 1935.) 17 gold marks.

A VALUABLE collection of essays on the vexed question of petroleum origin has recently been made available through the good offices of Prof. Otto Stutzer. The collection includes articles by well-known chemists, geologists and hydrologists. Dr. Erich Wasmund gives his opinion as to the origin of adipocere ('corpse wax') and also advances the theory that anaerobic anabiten bacteria can also originate in bitumen. Dr. Karl Krejci-Graf discusses the varied theories of origin of bituminous sediment, and projects interesting and novel conclusions for the attention of the reader. Dr. Hecht traces the chemical history of organic substance in the sea from the moment of death until final fossilisation and entombment. Dr. Treibs first reviews the works of J. E. Hackford and E. Berl on the transformation of plant substance, especially carbohydrates into oil, and then in his contentions that porphyrines are contained in petroleum derived from chlorophyll and hæmin, and that a higher formation temperature than 200°C. is out of the question for petroleum, shows that he differs from both. Prof. R. Potonié reports the results of geochemical investigations of sapropel from the Unterrücker Lake near Prenzlau and the Sakrower Lake near Potsdam. Prof. Steinbrecher emphasises the chemists' proved point of view that petroleum normally found in oilfields is not high temperature petroleum, since it contains constituents which would decompose at high temperatures. Finally, Dr. Dora Wolansky summarises such views as have appeared in Russian literature on petroleum origin, thereby giving a synopsis of valuable ideas which in their original form are incomprehensible or inaccessible to the majority of people.

**Electricity in Poultry Farming**

By C. A. Cameron Brown. Pp. 73+12 plates. (Oxford: Institute for Research in Agricultural Engineering, 1935.) 2s.

EVERYONE who is interested in poultry farming should read this book. It is written to help the average farm worked by its owner. The author has not in view the large 'luxury farm', worked sometimes altogether by electricity, the true economic value of which it is difficult to estimate. In this book the facts relating to the use of electricity on poultry farms in many different parts of the country are given, together with the work done by research institutes. Lancashire and Yorkshire are very favourably situated, since farmers can buy electricity at  $\frac{1}{2}$ -1d. per unit. In districts where the cost is  $1\frac{1}{4}$ d. the user has to be economical in its use. All those consulted agree that there is a distinct saving in labour, a gain in cleanliness, safety from fire and exactness of operation by using electricity.

The economies that might be effected by relieving the hen from hatching eggs and brooding chicks and keeping it to its irreplaceable duty of laying eggs has been recognised from the earliest times, particularly by the Egyptians and Chinese. The author describes many types of incubators and gives the relative prices of hot-air machines when worked with oil and with electricity. He states that there is now no question about the technical success of electrical methods in poultry farming. Preston Corporation supplies 300 poultry farms with electricity, the average consumption of each being 7,000 units, and rapid developments are taking place in other areas.

**Introduction to Electric Transients**

By Prof. B. Kurtz and Prof. G. F. Corcoran. Pp. xv+335. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 22s. 6d. net.

As an introduction to the study of the curious effects produced initially when the switch is closed in an electric circuit due to its inductance and capacitance, we can recommend this book. Each type of transient phenomenon is considered from three angles. The student first analyses the problem by means of the principles and laws of physics. It is then discussed mathematically, and this usually involves solving a differential equation. Finally, the solution is illustrated by actual oscillograms. This experimental verification of sometimes quite unexpected mathematical results will greatly encourage the student and show him that theory is sometimes a great help in practical work.

In addition to showing voltage and current waves, power waves and sound waves obtained experimentally are given. The electrical records of three different tones obtained from the same instrument are very instructive. In this case the relatively pure tone has a fundamental frequency of 466 cycles a second, while the other two composite tones have frequencies of 173 and 87 cycles respectively. A useful chapter is given on Heaviside's operational calculus.

**Elementary Textbook of Chemistry: with Laboratory Experiments**

By John J. Guenther. Pp. xiv+274. (New York: The Macmillan Co., 1934.) 7s. 6d. net.

THE contents of this book are quite unlike anything a reader would be led to expect from the indication of the title, as ordinarily understood in Great Britain. The preface explains that the volume is designed mainly to meet the needs of schools of nursing, and the curriculum of these, as required in the United States, and to provide a course for presentation in "45 hours of time". The ground covered ranges from basic definitions in chemistry and physics, over elementary theory, formulae, equations and calculations, and the general chemistry, chiefly of the non-metals, to complex organic substances such as higher fatty acid derivatives, aromatics, carbohydrates and foodstuffs, the organic chemistry occupying roughly one-third of the book. Sufficient attention is given to household, hygienic and everyday applications as to provide, virtually, a treatise on domestic science.

The course is intended to be followed rigidly, in the nature of a drill, and copious lecture and practical experiments are detailed. The amount of matter is remarkable, and might provide material for a year's study. Although the needs of the curriculum might be met, it is difficult to see in what respect the cause of scientific education would be furthered by covering the ground in forty-five hours, the distribution of which is left unspecified. An efficient index covers twenty-four pages.

N. M. B.

**The Calculus**

By Prof. Hans H. Dalaker and Prof. Henry E. Hartig. Third edition. Pp. viii+276. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 12s. 6d. net.

THE application of the calculus to the problems of engineering and physics has now become so extensive that writers on the subject no longer confine their treatment solely to the purely theoretical side. This is very encouraging, and, in the volume under review, the authors have made a very commendable attempt to combine theory and practice without sacrificing the fundamental principles of the calculus. The course covered is fairly comprehensive. Beginning with the ideas of functionality and limits, the student is led on to differentiation, with its manifold applications; integration up to double and triple integrals; infinite series and expansion; and finally, to a brief outline of differential equations. The principles developed are well illustrated by many fully worked-out problems drawn from mechanics, physics and engineering, and the accompanying diagrams are very clearly produced.

For the student, numerous carefully graded exercises, with answers, are provided both for purposes of drill and in illustration of practical problems. A complete and useful summary of formulæ, curves and integrals is given as a final chapter. The whole text is clearly printed and the book should prove very valuable to the advanced practical student.



## Science in Modern Life\*

By Sir Frederick Gowland Hopkins, O.M., F.R.S.

### SOCIAL RESPONSIBILITIES OF SCIENCE

OWING to what would seem to be a confusion in thought, the supposed social harms created by science have been vaguely attributed in some not unprejudiced quarters to its own unethical character. General Smuts, on the other hand, holds that among the values gradually recognised by the developing human mind, science ranks with religion and art, and that while to-day religion, art and science are separate values, they may not always remain so. Indeed, he thinks that one of the greatest tasks before the human race will be to link up science with ethical values. It is perhaps not quite easy to follow closely his thought concerning the future extension of the scope of science, but his own assurance that its teaching can be linked up with ethical values is a corrective for some of the accusations from which science is apt to suffer.

Indeed, possible future developments apart, the gap between what science provides for humanity and what are usually spoken of as values in religion, literature and art, has been and is less wide than some assume. History itself shows that it is wrong to deny ethical influence, even if it be indirect, to the scientific spirit. While, for example, the earlier stages of the Renaissance enriched men's minds by restoring to them the literary and philosophical heritage of antiquity, we all know that not until later, when the awakening scientific spirit demanded a courageous inquiry into the actual facts of Nature, did human thought begin its release from the shackles of authority and traditional dogma. This release was surely ethical in its effects. In later times, throughout the years of the Royal Society's existence, the growth of intelligent interest in the material universe was slowly preparing the ground for that last great step in the progress of intellectual freedom which came in the middle years of the last century. The influence of Darwin and Lyell did more, of course, than establish a new outlook for science itself. It re-orientated all thought. It caused heart-searchings where there had been mere complacency in the acceptance of tradition, and its impacts subtly encouraged the growth of that intellectual honesty for which Huxley and others then so nobly fought. The history of those days is familiar enough, but we sometimes forget the debt we owe to them.

It was the influence of science which, more than any other influence, established the idea of progress, replacing as it did a static by an evolving universe, and incidentally a faith that man himself has an inherent capacity for advance. There are not a few to-day who profess to disbelieve in progress; but for the majority it is now a faith ingrained if sometimes only subconsciously held. Evolution, we know, may not at each step tend upwards, but we have reason to believe that in the long run it does, and that in spite of occasional disillusionments we may believe in the upward tendencies of mankind. By this faith, hope is fed, human efforts towards betterment are encouraged, and ethical values emerge. The depressing belief that man and the social fabric he has contrived for himself, while so imperfect, are yet incapable of ultimate betterment, was the one excuse for that particular form of professed otherworldliness which from time to time has been an essential part of narrow religious ideals, but which was surely evil in its almost contemptuous indifference to social wrongs and to the urgent problems of this world.

The tendency of late, however, has been not so much to reiterate the theme of science's gifts to the powers of destruction, but rather to urge in a more general sense that scientific workers have not shown sufficient interest in the social implications of their work, or in the public responsibilities of their calling. We have only to look closely into this view as usually expressed to realise that, after all, its basis is vague, and, did it involve any charge against the individual worker, unreal. The individual investigator must realise that, *qua* scientist at least, he has little opportunity for effective action. Commonly he concludes that he will be most useful, even to society, by continuing his chosen work in its proper environment.

It is, I think, impossible not to sympathise with this view. The special endowments acquired by the scientific investigator are not those of a politician or of a missionary. Needless to say, it remains his duty to give his skilled services to the public whenever they are legitimately required and invited, and in so giving them he may do much to promote the interests of science itself.

What seems to be really desirable is some method of closing the gap between the mind and outlook of the publicist and those of the trained scientist. It is a just claim that in a civilisation so largely based on science as that of to-day, the scientist

\*From the anniversary address to the Royal Society, delivered on November 30, 1935.

should have more influence on policy than he has hitherto been allowed. Not long ago the gap in question was wide ; it is now, I think, lessening. Occasionally at least, modern statesmen do seek scientific guidance, and, I think, know better than they did how rightly to obtain it. But it is time, perhaps, that the building of a bridge should begin on the scientific side of the gap. This is a task for organised scientific effort and the pooling of knowledge.

#### PROBLEMS OF NUTRITION AND A NATIONAL FOOD POLICY

There is a branch of scientific inquiry which can claim to yield knowledge of unqualified benefit to humanity, and one in which investigators, though inspired by the extreme scientific interest of the problems involved, have, I feel, always had the public importance of their solution in view, and have themselves done their best to encourage the practical applications of the knowledge they have won. I refer to the study of the nutritional needs of the body.

The last two decades have seen a quite remarkable activity in research upon nutritional problems, and it is now even increasing. Publications describing original work upon various aspects of these come from almost every country where science is pursued, and have amounted to many hundreds during the course of each single year. In Great Britain much research on nutrition has been generously endowed, organised and encouraged by our Medical Research Council, and it has received financial support from various other sources. We have begun to follow the example of the United States in founding chairs in dietetics, and emphasis is being placed upon the subject in physiological and biochemical teaching in the universities.

A desirable happening at the present moment is the international approach at Geneva for full discussion of the nutritional problems of the world ; for, viewed broadly, the problems are undoubtedly international. On a demand from the representatives of twelve nations including Great Britain and Australia (which has played a leading part in the movement), the health organisations of the League have set machinery in motion for securing full and intimate discussion. Policies concerned respectively with the production, transport, distribution and consumption of foods will all, we may hope, be discussed. They seem to be the very proper business of the League, and if discussion goes deep enough and is frank enough, it may well do no small service to the interests of peace itself.

Many are concerned just now to know the truth concerning the degree and extent of malnutrition as it exists among the less fortunate sections of

the community at the present time. They have seen certain desirable steps taken to mitigate whatever may exist, as, for example, the diversion of surplus milk to the schools ; but they yet ask how far is an extension of such measures an urgent need of the moment. That underfeeding and ill-feeding exist is sure, but to measure their extent is, for reasons to which I will allude, a task of some difficulty.

We have only to read the successive annual reports from numerous medical officers of health to believe that, in the case of children at least, nutrition, inadequate for one reason or another, exists in various districts to an extent which is far indeed from being negligible. Nevertheless, we have to realise that the numerical data supplied from different centres are based upon varying standards, and the opinions expressed depend to no small degree on the temperament and perhaps on the acuity of individual officers. The difficulty before all concerned is that there is no clear definition of the term 'malnutrition', and no satisfactory objective methods for measuring its degrees. Sir George Newman, formerly Chief Medical Officer to the Ministry of Health, always felt justified in taking an optimistic view concerning the available food supply for children in Great Britain, and he was wont to insist upon the circumstance that though under-nourishment may be due in part to an insufficient quantity of food, it depends also on other factors. "The principal cause," he wrote, "is a body unable to assimilate the food supplied to it." In certain cases this must, of course, be true, but we are entitled to ask whether in many such cases the disability of the body when observed has not followed upon malnutrition at an earlier period. What we know to-day justifies this view.

In any event, the essential question is whether food adequate in quantity and quality is within the reach of all. In the annual report for 1934 issued by the present Chief Medical Officer of the Ministry, it is made clear in a section devoted to the effect of unemployment on national health and dealing with evidence based upon a conjoint investigation by officers of the Ministry and the Board of Education into conditions in certain depressed areas in Durham, that the statistics of actual diseases there do not indicate unfavourable effects of present economic conditions. We may conclude from this, and take comfort from the fact, that malnutrition even in such areas has not been at its severest, but it may be highly deleterious in its ultimate effects when not such as to affect the current statistics of disease. Moreover, full normal nutrition was only claimed for some 70-80 per cent of the children, varying between these figures in different areas, and though, as I have

said, criteria for establishing the existence of sub-normal nutrition are not satisfactory, it is difficult to be content with such figures. The Ministry's investigators admit further that in the areas studied the condition of adolescent youths, especially those aged 14-15 years, was found unsatisfactory. These are years when good nutrition is quite especially desirable.

As a measure of the state of health of younger adults at the present time, the results of medical examinations for recruiting are not without importance. The War Office report on the health of the Army for 1933 shows that in that year nearly 38 per cent of the prospective recruits were rejected as unfit. Although, as the report points out, many of these rejections were on account of disabilities which unfitted them for military service in particular, and therefore did not reflect on their general health, yet a glance at the stated reasons for rejection shows that a large proportion of the men suffered from defects which might well be due to faulty nutrition in childhood or adolescence, and a considerable proportion in which it almost certainly contributed to their unfitness.

The current interest in the subject of the national food supply and in right feeding is doubtless largely due to the awakening of the public conscience to this and other kindred social responsibilities; but it has also been stimulated, I think, by the nature of the results which scientific studies during the last twenty years have revealed. They have shown that our nutritional needs are so much more numerous, subtle and specific than was earlier thought, and they have shown how extraordinarily potent and how entirely indispensable material may be, even though consumed in infinitesimal amounts. We know now that a fault in quality may be as deleterious as a failure in quantity. This fact the general public is now rapidly assimilating, though not always to its profit. Indeed, a certain vocal section of the public is (as it has always been) so perverse in its views concerning food that it is almost necessary to remind it that, after all, quantity still counts. We cannot live on vitamins alone! A more intelligent section of the public seems, I notice, to assume with impatience that so much scientific talk about food may lead to individuals being dragooned with respect to what they shall or shall not eat. A self-constituted committee whose propaganda against malnutrition I respect for its wisdom and fairness has appreciated this attitude, and in a recent memorandum made the following wise statement: "certain diet habits must be classed as cultural, and of personal and psychological necessity, and to upset these in the service of protein or vitamin content is to provoke a natural reaction against [the advice that science

can legitimately give]". It is, of course, unthinkable that there should be any such dragooning. The intelligent public will learn to apply the newer knowledge of nutrition without discomfort to itself.

The same memorandum says—again wisely—"to a working class housewife with restricted purchasing power, education in food values alone can only add one further problem to an already insoluble series of anxieties and worries". This of course is true, and so long as we see that foods of the right variety are all within her purchasing power, elementary instruction in terms of the foods themselves and not in technical food values will set the housewife on the right path. I am tempted to add that what the English housewife in the poorer classes needs most to be taught is the art of simple but good cooking! It is not beneath the dignity of nutritional science or of administrative policy to take note of the circumstance that in Great Britain, more than in perhaps any other country, is good food ruined, and its nutritional value impaired, by unintelligent treatment in the home.

One last consideration. Is the time yet ripe for the initiation of a comprehensive national food policy: one that will endeavour to adjust production, in a qualitative as well as a quantitative sense, to right consumption, and at the same time organise all the details of distribution on national lines?

I note that those responsible for the contents of that very impressive book entitled "The Next Five Years", which has appeared under the ægis of many influential names, hold that no administrative action less comprehensive than a national policy of the kind in question could deal adequately with existing problems. They suggest that it should now be taken in hand. Others have urged that, apart from the almost prohibitive magnitude of effort the policy would require, it is one which should await the arrival of more knowledge. The latter suggestion has, I think, but little point. There is doubtless much more scientific knowledge to be gained about nutrition and food production, but we know enough to guide administration on to the right lines.

More to be thought of perhaps is the fact that if we take a long range view, any policy concerned with food production must ultimately, if it is to be ideal, become part of a world policy. At Geneva, Mr. Bennett, speaking of such a world policy, said that its aim would be to "marry agriculture to health". Such a marriage, if ever properly consummated, would greatly profit the world. The interests of both partners must be equally guarded, however, in the marriage contract. In Great Britain, one may venture to say, the first mentioned is at present receiving preferential treatment.

## The Advance of Herring Research

ON April 21, 1881, Prof. T. H. Huxley delivered a striking lecture at Norwich on the herring, during the National Fishery Exhibition held there. Reference to the text of that lecture (published in full in the issue of NATURE of April 28, 1881) shows that Huxley made the following statement: ". . . And all kinds of real knowledge and insight into the facts of nature do so bear upon one another and turn out in strange ways practically helpful, that I propose to pour out my scientific budget, in the hope that something more may come of it than the gratification of intelligent curiosity". Fifty-four years later, in the same city of Norwich, during the recent meeting of the British Association, the members of Section D (Zoology) listened to a symposium on the herring problem which demonstrated beyond any doubt the truth of Huxley's assertion, and realised his hope. Indeed, the symposium can best be described as an account of current investigations for the express purpose of rendering direct assistance to the commercial herring industry, not only by predicting the quantity and quality of the fish likely to be available during an impending season, but also by stating where and when nets should be set in order to secure the best possible catches. That is to say, the 'problem' with which the symposium really dealt was the entirely practical one of how to aid industry by scientific research.

The four papers of the symposium were read by Mr. E. Ford, Dr. W. C. Hodgson, Prof. A. C. Hardy and Mr. R. S. Wimpenny, in the order named. The first paper confirmed and extended Huxley's view that practised eyes distinguish local breeds of herring, dealing in particular with the study of vertebral variation as evidence in this connexion. It was shown that although the simple count of the total number of vertebrae in a herring falls far short of the ideal specification of so important an organ of the body as the backbone, its use as a statistical character in population studies has proved of very material assistance in acquiring knowledge of the life and movements of the different local forms of herring within their own limited territories of the sea. Using the average number of vertebrae for a sample of herrings as a statistical estimate of the average for the population from which the sample was drawn, real population differences have been demonstrated by comparing sample with sample: and by considering the results in conjunction with corresponding differences in other characters, the 'ground-plan', as it were, of the complex of local

forms by which the species *Clupea harengus* is represented has gradually revealed itself. The reliability of this work remains unaffected by the fact that scientific opinion is at present divided as to the precise nature of a local form of herring, and the parts played by heredity and environment in preserving its continuity from generation to generation.

Having learned the essential facts in the life-history of the particular local form with which he is concerned, an investigator may then inquire into the factors which determine the success or failure of the commercial fisheries based on that local form. Important researches of this kind in connexion with the great East Anglian drift-net fishery in the Southern North Sea formed the subject of the second paper in the symposium. The sharp and irregular fluctuation in the annual yield of the fishery is partly accounted for by the natural waxing and waning in numerical strength of the fishable stock. This, in its turn, is a sequel to the unequal production of young from year to year. Reliable evidence, direct or indirect, as to the brood production of to-day is therefore a portent for good or ill in the fishery of to-morrow. Hence, the announcement that there is indication of a positive correlation between brood production and the January temperatures of the sea, in the vicinity of the Varne lightship, is one of much interest and promise.

Inequality of brood production, however, does not entirely account for good and bad fishing yield. Whether the fishable stock be rich or poor, the best possible catches will only be made when fishing is conducted at the right time in the right place. It is important to know that the yield is best at the time of full moon, and that the most favourable conditions for a productive season is when the October full moon occurs during the second week. The conditions of wind blowing over the fishing grounds must also be taken into account, for it is held that herrings tend to swim into the wind; and it is easy to understand that persistent winds from an unusual quarter may cause the shoals to move away from places which they normally visit and where fishermen expect to find them.

It is not only in connexion with the great East Anglian exploitation of shoals making their way to the spawning grounds that scientific investigation is proving its worth. We know that, in the intervening months between annual spawning migrations, the shoals are ranging the sea in

search of food. Information as to the places in which such shoals are likely or unlikely to be found is thus of real value to fishermen wishing to intercept them. Work in this direction was described in the third and fourth papers of the Norwich symposium. Ingenious instruments and methods have been used in a comprehensive and continuous survey of the floating animal and plant plankton of the North Sea with relation to the movements of herring. Positive correlations between the number of herring caught and their food *Calanus*, and negative correlations with phytoplankton, have already been demonstrated. The practical outcome of this is that fishermen can be assured of a greater return for a season's labour if they will regularly use a plankton indicator in deciding where to set their nets. It has also been shown that the phytoplankton at times

forms dense patches which interfere with the movements and shoaling of herring, with serious consequences to the dependent fisheries. The study of the origin, disposition and fate of these patches, therefore, is in itself of major interest to the industry. We must also know whether the observed tendency for the autumn herring shoals of both 1933 and 1934 to mass against the edge of a diatom patch is a regular phenomenon.

A word or two must suffice to deal with a line of investigation about which the symposium was silent. Nothing was said regarding the urgent necessity of a greatly improved market for herrings, to prevent the complete collapse of the British industry. For of what use to the fishermen is scientific aid in his fishing if he cannot sell the catches he is already making without such aid?

E. FORD.

## Erosion Surfaces

SINCE Ramsay recognised in 1878 that the even skyline of South Wales represented a plain of marine denudation, uplifted and dissected, upland surfaces of low relief have been recognised in all parts of the world, and their probable relation to the great unconformities of the stratified rock succession has been discussed. Some, following W. M. Davis, have preferred to regard them as sub-aerial peneplains rather than marine features, but few certain criteria exist for distinguishing sub-aerial from submarine surfaces, after uplift and dissection, and each case must be judged on its merits. Recent years have witnessed a concentration of interest upon such features, commonly known as 'platforms'. In America, the work of the late Joseph Barrell, and of D. W. Johnson, has emphasised the importance of this line of study. A committee of the International Geographical Congress, on which Prof. A. G. Ogilvie is the British representative, is at present seeking to organise the work of mapping erosion surfaces in Europe, using an agreed, though tentative, scheme of symbols. Interest has also been fostered by the publication of Prof. Baulig's recent monograph<sup>1</sup> in which high-level platforms are discussed in the context of the daring theory of major eustatic changes of sea-level.

With the field thus fertilised, Sections C (Geology) and E (Geography) devoted a session to a joint symposium and discussion on "Denudation Chronology" at the Norwich meeting of the British Association on September 9. The regions discussed included south-east England, Devon and

Somerset, South Wales, southern Ireland, the East Midlands, Yorkshire and the Channel Islands. Any attempt fully to correlate work from so wide an area would be premature, but a most welcome concurrence of opinion was manifest both as to the methods of research and the general results obtained. The histories of denudation in the several areas proved indeed so generally comparable as to point a most hopeful future for such investigation and to foreshadow theoretical results of high importance.

An initial problem to be solved in most areas is the differentiation of older surfaces—stripped planes of unconformity, from those formed during the middle and later portions of Tertiary time. There is a general tendency among the students of the older rocks tacitly to underestimate the erosional work of Tertiary time, and to regard the dominant hill-top surfaces of relict Palæozoic uplands as the basal planes of Triassic, Jurassic or Cretaceous rocks, which, buried far beneath the adjoining plains, rise to join the hill-top surface of the 'Massifs', thus signifying a former wide extension of the sediments above them. So cavalier a dismissal of some sixty million years of geological work is theoretically unacceptable, and as a hypothesis it fails to fit the facts. Wherever they are examined in Britain, the 'fossil peneplains' of pre-Permian to pre-Cretaceous date are relatively steeply inclined away from the Palæozoic uplands. Even if their slope flattened as traced away from the heavily loaded areas of the plains, they must nevertheless have passed far above the

existing hill-top surfaces, having, in general, been destroyed in cycles of erosion which ran their course before the current cycle or its immediate predecessor. Recent American work points to a similar conclusion. The Schooley peneplain which bevels many of the summits of the Northern Appalachians was formerly regarded as a landward continuation of the surface below the coastal plain sediments (the fall zone peneplain). D. W. Johnson gives good reasons for supposing that it is a much later feature<sup>2</sup>, probably not younger than Early Tertiary.

These considerations enforce the necessity of beginning work on any general scheme of denudation chronology in south-east England, where surfaces can be dated by reference to known Tertiary deposits. There are two major surfaces in this region: (a) the folded sub-Eocene surface, which emerges from beneath its sedimentary cover on the lower slopes of the chalk round the margins of the London and Hampshire Basins, and (b) the mid-Tertiary (probably late Miocene) surface which forms the general hill-top plane of the south-east, bevelling the escarpments. Most of the true clay-with-flints rests on this latter surface, which was locally warped down before uplift to admit a Pliocene sea over parts of the area. It is hence difficult in places to distinguish between the late Miocene sub-aerial peneplain and the sub-Pliocene marine surface, largely stripped of its thin veneer of sand and shingle. Later, less extensive, surfaces of Pliocene and Pleistocene date—in reality old valley floors—can be traced throughout the region, and the record is supplemented and confirmed by the testimony of cyclic river-profiles, which reveal former sea-levels, closely comparable with those deduced by J. Hanson-Lowe in the Channel Islands. It cannot be too strongly emphasised that the whole south-eastern region (excluding the margins of the unstable North Sea depression) has evolved under the influence of uniform changes of base-level, during its later history. The last traceable act of warping was that which slightly deformed the late Miocene peneplain.

The two major surfaces noted above represent periods of erosion so protracted that corresponding features should certainly be distinguishable in the uplands of the north and west. In south-west England a convenient upper datum in time is provided by the Pliocene marine notch and associated coastal ledge at about 400 ft. O.D. This is unwarped, but the Early Tertiary (pre-Oligocene) surface is evidently largely warped or faulted, as witnesses its depression to low levels along a zone running from Bideford Bay via Petrockstow and the Moretonhamstead syncline to the Bovey Tracey basin. Nevertheless, it may conceivably

be represented by the sloping hill-top surface of parts of Exmoor and the Brendon Hills (1,100–1,400 ft.). At lower elevations, there is a 900–1,000 ft. platform and a well-marked very uniform surface which dominates central Devon, ranging in height from 600 ft. to 800 ft. One of these surfaces, probably the latter, is to be identified with the Miocene peneplain of the south-east.

Comparable features have been investigated by A. A. Miller in South Wales and South Ireland. In both regions he finds a sloping surface extending from low levels near the coast to an upper limit at 800–900 ft. This might be interpreted as the product of an advancing or a retreating sea, or even as a sub-aerial feature. It should be added that Prof. Trueman and Miss Goscar find some evidence in South Wales that the general profile is 'stepped' or composite in places, revealing separate platform levels, at 200 ft., 400 ft. and 600 ft., and Miller's work on the river-profiles and the wind-gaps lends some support to such an idea.

In northern England, Prof. H. H. Swinnerton has recognised a high-level surface in south Derbyshire, possibly the sub-Cretaceous plane, but more probably, in the light afforded by the other regions, an early Tertiary feature. Lower platforms representing stages in the excavation of the Trent valley fall into a series generally comparable with those of the Thames valley. Of particular interest has been the discovery by Dr. H. C. Versey, following J. W. Stather and others, of probable early Tertiary deposits on the higher parts of the Yorkshire wolds. These rest on a surface which appears to be traceable in the North York Moors and also, though less certainly, in the Pennine region.

In conclusion, it may be remarked that the study of erosion surfaces is far from being of purely academic interest. From the geological point of view, such surfaces afford a record complementary to that of deposition, but there is a geography as well as a geology of surfaces. Recognition and delimitation of landscape facets is an essential part of geographical analysis, if only because of their influence on soil character and land-utilisation. It is clearly a matter of first importance whether a surface retains relics of an Eocene, Cretaceous or other covering, recently removed, or is mantled by a strongly leached regolith exposed to the atmosphere since Middle or Early Tertiary times. Many agricultural contrasts in Britain can be explained on these lines, and whether in conducting soil-surveys or planning the improvement of agricultural land, such facts should receive full attention. S. W. WOOLDRIDGE.

<sup>1</sup> Institute of British Geographers. Publication No. 3 (1935), "The Changing Sea Level".

<sup>2</sup> D. W. Johnson, "Stream Sculpture on the Atlantic Slope". New York, 1931.

## The Interaction of Gases with Solids

THE last important discussion on adsorption phenomena in Great Britain took place in January 1932 at Oxford, under the auspices of the Faraday Society. At that meeting, the topic which evoked most controversy was that of the activated adsorption of hydrogen on metals and on metallic oxides, that is, on solids particularly active as hydrogenating catalysts. While a great deal of work has been done in the intervening four years, it cannot be said that the matter is at all thoroughly elucidated. Meanwhile, however, several new independent lines of attack have been brought to bear on the varied phenomena encountered in the interaction of gases with solids, which may ultimately lead to more precise views on the question of activated adsorption. On November 21, therefore, Prof. E. K. Rideal opened a discussion at the Chemical Society in order to direct attention to recent work and to focus opinion on a subject still in a state of flux.

Many of our modern ideas on the mechanism of heterogeneous catalysis are based on the pioneering work of Langmuir on the interaction of gases with hot filaments. That the subject is far from exhausted is amply demonstrated by the recent work of Roberts<sup>1</sup> with tungsten. The basis of these experiments is the development of two separate physical methods of studying adsorption. The first arises from the fact that the accommodation coefficient of a neon atom on a tungsten surface is particularly sensitive to the presence of adsorbed films. For example, the accommodation coefficient on a bare surface at 273° K. is 0.08. When the tungsten is covered with a layer of oxygen atoms, the value rises to 0.25. The second method consists in actually measuring the heat of adsorption of gases on a clean tungsten filament by determining the rise in temperature (only 0.01°) which occurs when gas is adsorbed.

One of the most surprising results of the application of these methods is that hydrogen is practically instantaneously adsorbed when it encounters a tungsten surface even at so low a temperature as 83° K. If very small amounts of hydrogen are admitted, the gas is completely adsorbed, the heat of adsorption being about 40 kgm. cal. After sufficient hydrogen has been admitted to cover the tungsten surface, that is, one hydrogen atom to one tungsten atom, there is no further adsorption, and therefore no heating of the filament. That the hydrogen is chemisorbed is proved by the high heat of adsorption and by the fact that the film of hydrogen can only be removed (probably as

atoms) by heating the filament to 700° K. The chemisorption of hydrogen on tungsten therefore proceeds with a very small energy of activation. This is in marked contrast to the considerable energy of activation observed for metallic powders, such as tungsten, nickel and copper. To prevent sintering, these absorbents cannot be outgassed at high temperatures. Hence it may well be that the surface is not free from gas, and that therefore the phenomenon usually observed is really the interaction of hydrogen with a gas-covered metallic surface. It is a matter for further experiment to decide whether this non-activated type of chemisorption on clean surfaces will be observed with metals other than tungsten.

Similar phenomena occur with oxygen and tungsten: the oxygen is immediately adsorbed. From the heat evolved and the energy of dissociation of molecular oxygen, it may be shown that the energy of desorption of an oxygen atom is about 130 kgm. cal., which is in good agreement with Langmuir's value of 160 kgm. cal. derived from the effect of oxygen on the thermionic emission of tungsten. Oxygen atoms go on in pairs, one oxygen atom to one tungsten atom. As this bombardment goes on, a time will come, if the oxygen atoms are immobile, when only single isolated atoms of tungsten are left. It is evident that an oxygen molecule cannot be dissociated on colliding with these isolated atoms. Instead, it is adsorbed as a molecule with a smaller heat of adsorption. Thus at high enough oxygen pressures, the ordinary film of atomic oxygen, necessarily containing gaps, has on top a relatively dilute film of molecules covering about 8 per cent of the surface.

Having obtained conclusive evidence of the nature of adsorbed atomic films, the next question which arises is the rate of migration on the surface of the solid and the rate of penetration into the body of the metal. One ingenious way of following surface migration has been developed by R. C. L. Bosworth<sup>2</sup>. By means of a positive ion gun, a beam of sodium ions is projected on to a negatively charged tungsten strip. The strip is then heated electrically, the sodium atoms migrating. The progress of migration is followed by allowing a spot of light to fall on the sodium-covered tungsten surface, the resultant photo-electric emission at various positions along the strip serving as an indicator of the surface concentration of the sodium atoms. In this way, the rate of migration may be

determined as a function of the temperature and of the surface concentration.

The diffusion of gases through solids is controlled partly by the interaction of the gas with the surface and partly by processes occurring in the body of the solid, both of these in general being specific, for example,  $H_2$ -Pd,  $O_2$ -Ag,  $N_2$ -W. An exception to the rule is the diffusion of hydrogen, helium, neon, argon, nitrogen and oxygen through silica glass<sup>3</sup>. There is no doubt in the case of the inert gases that the forces which the atoms encounter in their passage through silica are purely of the van der Waals' type. In fact, it may be shown by calculation that the energy of activation for the passage of an inert gas atom through a square of similar atoms can attain values commonly associated with chemical reactions, such as 30 kgm. cal. Migration appears to take place through the solid lattice, for the rate is independent of the firing and other treatment of the silica. With oxygen and nitrogen, on the other hand, the rate is very sensitive to surface imperfections, firing and the like, which would point to the diffusion occurring along slip-planes and cracks in the glass.

Much has been written about the usefulness of deuterium as a tool for investigating the mechanism of chemical reactions. Taken along with the ortho-para conversion, the behaviour of deuterium yields important evidence about catalytic hydrogenation and dehydrogenation reactions. For example, if ammonia and ortho deuterium are allowed into contact with an iron catalyst, A. Farkas has found that the rate of conversion of the ortho deuterium is inhibited by the ammonia, and simultaneously there is a slow exchange reaction resulting in the production of deuterammonia. This shows at once that ammonia partially covers the iron surface, that deuterium is dissociated on the portions not covered with the ammonia, and that the rate of exchange is slower than the dissociation of deuterium molecules, the latter reaction therefore not being the rate-determining step.

These few examples suffice to demonstrate that the field of inquiry is an extending one, and that well-defined progress is being made in drawing a more precise picture of the interaction of gases with solids.

H. W. MELVILLE.

<sup>1</sup> *Proc. Roy. Soc., A*, 152, 445; 1935.

<sup>2</sup> *Proc. Roy. Soc., A*, 150, 58; 1935.

<sup>3</sup> R. M. Barrer, *J. Chem. Soc.*, 378; 1934.

## Obituary

Mr. F. Escombe

EVERY student and teacher of botany must be familiar with the classic work of Brown and Escombe on the germination of refrigerated seeds; the relative roles of endosperm and embryo in germinating barley; on the static diffusion of gases and liquids in relation to photosynthesis and translocation in plants; the influence of varying amounts of atmospheric carbon dioxide on photosynthesis and plant growth; the interchange of energy between the leaf and its surroundings; the determination of carbon dioxide in the air absorbed by plants, based on the rate of its absorption by a free surface of a solution of caustic alkali; and they will learn with regret of the sudden death of the surviving author of these important researches on October 12. Brown, who was a much older man, died in 1925. Fergusson Escombe, who was only sixty-three years of age, had given up his active career at a comparatively early age owing to ill-health and other circumstances, and thus, though his work will always hold a high place in botanical research, he himself had almost been forgotten, save by a few.

Born in Hampshire in 1872, Escombe went to a preparatory school at Bournemouth and thence to Haileybury for two years. He matriculated in 1892, and later obtained the degree of B.Sc., with honours in botany, at the University of London, from King's College, London. There he won the Carter Gold

Medal and Prize for botany. He studied also at Hownton Agricultural College, at Neuenheim College, Heidelberg, and at the Kaiser Wilhelm University at Strassburg. Whilst at the latter, he worked on the chemistry of the cell membranes of lichens and fungi, and published a paper on it in 1896, "Beitrag zur Chemie der Membranen der Flechten und Pilze" (*Hopp.-Seyl. Z. Phys. Chem.*, 22, 288-306; 1896-97), a preliminary investigation to determine the existence of chitin and cellulose in these groups. This showed his early leaning towards biochemistry.

Shortly afterwards, Escombe went to work with Brown at the Jodrell Laboratory, Kew, on the researches which were published jointly in the Royal Society *Proceedings* and *Philosophical Transactions*, 1897-1905, and which gained for Escombe an established place in botanical science. There is no necessity to summarise these researches—indeed it would be quite impossible except at great length—since they have passed into botanical history and are described in every botanical textbook. They marked, however, a great advance in the state of knowledge then of the essentials of the physiological processes of germination and nutrition. Being reduced to mathematical precision, the results were enunciated so that in some cases they could be stated in formulæ. Special methods and apparatus had to be devised to carry out such delicate experiments, and novel



methods of study adopted to demonstrate the physical laws that controlled plant activity.

Following these fine contributions to biochemical and biophysical science, both Brown and Escombe took up appointments in the Scientific Research Laboratory of Messrs. Guinness and Co. at Dublin, Brown as director and Escombe as vegetable physiologist. The work on improving the malting qualities of barley was published (unsigned) in the *Laboratory Transactions*. Escombe worked there from July 1901 for three years. Readers of NATURE will remember the excellent reviews by Escombe on German biochemical works by Emmerling, Schulz, Czapek and Wieler about this time (1902-6). He wrote for *Science Progress*, 1897-98, two papers on germination generalised from the Royal Society researches.

Escombe then held the post of lecturer in botany and head of the Botanical Department at the South-Eastern Agricultural College, Wye, following Mr. (now Sir) Albert Howard, and at the same time gave County Council lectures in Kent and Surrey. He was at Wye from July 1905 until July 1907. This ended his active career at the age of thirty-five. He returned to Kew to do some physiological work at the Jodrell Laboratory in March and April 1910. After that, save for work during the Great War at the Admiralty (1917-22), he retired, from ill-health and other circumstances, to his native county, Hampshire (where also lived his great friend, Dr. D. H. Scott), living with his family, and latterly, since 1929, in rooms at East Meon, where he made his home until his death.

There Escombe took an active part in the life of the village, and his chief hobbies were reading and walking, and exploring the flora and fauna of the district. He studied the two Arums, and carried out an exhaustive series of researches on their life-history and ecology, later studying that difficult group of trees, the elms. In both cases he wrote valuable notes upon the species, which, with excellent material, he sent to Kew. He also there wrote a treatise on "Buds in Winter". All these should be published posthumously, since they are characterised by the same masterly grasp of details, and the clear and well-conceived enunciation of principles, or of classification, with brilliant and sound analogy, which marked the Royal Society papers published in conjunction with Brown.

Fergusson Escombe was a very reserved man, and of a refined nature. Properly understood, he was a charming companion. He had a most gentle nature, and a great love of animals and for children and old people. His scientific work was characterised by thoroughness and avoidance of hurry, and his experiments were conducted with carefulness and exactitude. It seems a tragedy that a man gifted by Nature with exceptional scientific ability, enlarged by special training, and with so sound a knowledge of biochemistry and physiology, should have had to disappear, through ill-health, from the arena of science at so early an age. Ill-health caused his career to be prematurely shortened, and heart failure has now snatched him from the world, his relations and friends all too soon.

A. R. H.

#### Senator Paolo Orsi

WE regret to record the death of Senator Paolo Orsi, the distinguished Italian archaeologist, which took place at Rovereto on November 8 at the age of seventy-six years.

Paolo Orsi was born in 1859 at Rovereto, which was then Austrian territory, but on completing his studies he settled in Italy. In 1888 he became an inspector of the Museum of Syracuse, and soon afterwards was appointed its director. He applied himself to the exploration of the antiquities of the island of Sicily, and by his discoveries revealed the sequence of Siculan culture from early chalcolithic times down to the period of Greek colonisation, a sequence in which he showed that four separate types of civilisation were to be distinguished. His excavations, more particularly in the neolithic villages of Stentinello, the burial grounds of Megara near Syracuse, and at Gela, made his museum one of the richest, and in some respects of the first importance, for the study of certain aspects and periods of Mediterranean archaeology.

In 1907, Orsi was appointed *superintendente* of Calabria and Basilicata. Here he continued his investigations and discovered the pre-Hellenic sites of Torre Galli, near Monteleone, and of Canale, near Locri, both of crucial importance for the study of the prehistory of the Calabrian peninsula. He undertook a number of excavations under the auspices and mainly at the expense of the Societa Magna Græcia, of which he was president at the time of his death. Among his discoveries was that of an Ionic temple at Locri, the only known example in Magna Græcia. The material from these excavations will be exhibited in a museum now in course of construction at Reggio-Calabria. He was also an authority on Byzantine antiquities, which he had studied in both Sicily and Calabria.

At the close of the Great War, Orsi took up his residence in retirement at Rovereto. He was a member of the Accademia dei Lincei, and was made a Senator in 1924. He was an honorary member of the Society for the Promotion of Hellenic Studies and an honorary fellow of the Royal Anthropological Institute.

WE regret to announce the following deaths :

Prof. James H. Breasted, professor of Egyptology and oriental history in the University of Chicago from 1905 until 1933, and director of the Oriental Institute, Chicago, on December 2, aged seventy years.

Prof. J. D. Cormack, C.M.G., C.B.E., regius professor of civil and mechanical engineering in the University of Glasgow, on November 30, aged sixty-five years.

Prof. David C. Gillespie, professor of mathematics in Cornell University, for several years editor of the *American Mathematical Monthly*, on October 13, aged fifty-seven years.

Prof. J. E. A. Steggall, emeritus professor of mathematics at University College, Dundee, in the University of St. Andrews, on November 26, aged eighty years.

## News and Views

### The Royal Society: Officers and Council

THE anniversary meeting of the Royal Society was held on Saturday, November 30, being St. Andrew's day, and the following officers and members of council were elected: *President*: Sir William Henry Bragg; *Treasurer*: Sir Henry George Lyons; *Secretaries*: Sir Frank Edward Smith, Prof. Archibald Vivian Hill; *Foreign Secretary*: Prof. Albert Charles Seward; *Other Members of the Council*: Prof. Edgar Douglas Adrian, Mr. David Leonard Chapman, Prof. Arthur William Conway, Dr. William Henry Eccles, Prof. Arthur Stewart Eve, Prof. Louis Napoleon George Filon, Dr. James Gray, Sir Alfred Daniel Hall, Dr. Stanley Wells Kemp, Sir Patrick Playfair Laidlaw, Sir Gerald Ponsonby Lenox-Conyngham, Dr. Gilbert Thomas Morgan, Prof. Robert Robison, Dr. Bernard Smith, Prof. Walter Stiles, Mr. Wilfred Trotter. An unusually large number of fellows took part in this election on account of a notification that it was to be contested. Several months ago, a group of about ninety fellows of the Society signed a memorial advocating certain changes in the methods of nominating and electing the officers and members of council and in their periods of service. Following up their suggestions, the memorialists substituted other names for those of fellows nominated officially as president, treasurer, two secretaries, and foreign secretary, and of four members of council. Fellows were not asked to support the individual claims of those included in the unofficial list, but to record their votes for them as an expression of no confidence in the existing methods of selecting officers and council. The result of the ballot was nearly ten to one in favour of the Council's list printed above, the number of votes for each officer and member of council in this list being about 190 and that of fellows in the unofficial list being about 20. In the absence of a postal vote, it may therefore be assumed that the general body of fellows of the Society are satisfied with the existing rules and with the statement issued by the Council after full discussion of the changes suggested by the memorialists.

### Industry and Technical Education

THE Right Hon. Oliver Stanley, president of the Board of Education, distributed prizes and certificates at the Northampton Polytechnic, Clerkenwell, on November 28. During the course of his address, Mr. Stanley referred to the changes which have been accelerated by the War and which have resulted in the loss of the advantage as an industrial nation which we acquired a century earlier. Yet with all these difficulties in the way of production, we have got to compete if we are to live; and we are being driven more and more to rely on superior skill, superior technique, superior training and superior workmanship, to take the place of those more fortuitous advantages which used to give us our superiority before the War. We can only regain the

prosperity of our own traditional industries if we adopt new and up-to-date methods. We are forced to keep ahead of new and severe competition in the new industries, and it is natural that we should turn to institutions like the polytechnics to ask how they can help and are helping both with the old and with the new. Speaking of the type of training for which polytechnics are responsible, Mr. Stanley said that in talking with leaders of industry about technical education he has found everywhere the feeling that colleges should keep in closer touch with actual experience in the workshop. From this point of view he commended the 'sandwich' course of training in engineering, and expressed his regret on learning from the Principal's report that, owing to changes contemplated in the University of London regulations for degrees in engineering, difficulties have arisen with regard to the organisation of such a course in the future.

### The Engineer and the Community

IN an address to the Birmingham and District Association of the Institution of Civil Engineers on October 31, Mr. C. H. Bailey made an eloquent plea for wider vision and much closer concern on the part of the engineer with the consequences of his work. We live to-day in an engineer's world, he said, yet an attempt to give a continuous direction to the efforts of the engineer is needed, and in the past, engineers have too lightly assumed that all their achievements result in benefits to their fellow men. Machines are neither wholly good nor wholly bad. They are bad in so far as they hinder men and women from developing creative skill of hand and eye; the mere use of better and more abundant goods can never compensate for the loss of constructive opportunities or powers. It is certain, however, that such production must go on, and that the engineer must continue to strive for more and more efficient machines while mankind learns to adapt itself to the new conditions. While, however, the engineer has transformed our powers of production and means of communication, we are still attempting to force these inventions into an economic, financial and political system which they do not fit. On the other hand, these same developments in production and communications have brought men closer together and made them more dependent on one another. At the same time, the engineer has given the world a greater chance of real freedom than ever before, if we learn to use our new resources and try to modify the new conditions, seeking to create new beauty where we have destroyed. While the engineer should beware of extravagant claims to a larger share in the control of the community, he should endeavour to participate more effectively in the planning required under the new conditions, and to devise some form of co-operation which would make available the benefits latent in his achievements.

### Science and the Architect

DR. R. E. STRADLING, director of Building Research under the Department of Scientific and Industrial Research, opened a materials gallery at the Liverpool School of Architecture in the Leverhulme Building of the University of Liverpool on November 29. In his address on the "Architect and Building Materials", Dr. Stradling said that the architect is required to create some form of protection, usually from the weather, which shall meet some intimate practical requirement of human existence, and in a progressive society meet it in such a way that beauty is added to everyday life. It seems almost self-evident that the knowledge of materials must be an ever-present mental background upon which the architect's mind must instinctively call if his artistic ability is to have reasonable scope. He must be equipped to meet his modern conditions, and there is an absence of adequate training on this side. In traditional English house design one usually finds a pitched roof with appreciable eaves, reasonable sills at the top and bottom of windows and doors, the walls constructed of brick or stone, or may be rough cast. No matter whether this type of design is artistically good or bad, such construction is usually thoroughly weatherproof if reasonably carried out in traditional materials. A typically modernist design consists of a box-like structure with flat roof, no weather projection over parapets, windows or doors; walls rendered in smooth Portland cement rendering. From inquiries received at the Building Research Station, it seems such structures are often anything but weather-proof. Before discarding old forms, it is essential to make sure that the new ones meet the essential protection requirements for which the building industry really stands. The real architect-artist is urgently required with all the pioneering fire of which man is capable, but he must be properly trained to meet modern conditions. This can only be done by very much more intensive science work than is usual at present, for he must have a very real knowledge of the media in which he is to design.

### Minoan Survivals in Later Crete

SOME remarkable vistas in the history of European civilisation are opened up in the report by Sir Arthur Evans of the discovery in October last of a temple of early Greek age in the island of Crete. The temple, which has been excavated by Dr. Marinatos, Ephor of Antiquities, is situated in the eastern part of the island on the hill site of the ancient town of Dreros, overlooking the lagoon of Spinalunga. It dates from the early part of the eighth century B.C., and is, therefore, the earliest known temple of the Greek age in the island. It differs, however, in proportions and character from other early Greek temples, and Sir Arthur in his communication in *The Times* of November 20 fully concurs in the view of Dr. Marinatos that it presents close affinities with pre-existing Minoan cults, such as might be preserved in an ancient Cretan tradition. He recalls that it was in this part of the island that the ancient Eteo-Cretan language survived down to historic times. Among

the more noteworthy objects of the shrine, which was found in the characteristic Minoan position on the back-wall of the cella, are the cist-like altar filled with earth and quantities of goats' horns, reminding Dr. Marinatos of the altar erected by Theseus in honour of Ariadne, his Cretan consort, and bronze figures made of hammered plates, which had been fitted on to a wooden core, the first known examples of a technique to which reference is frequently made by Greek writers. Of these figures two, one male and one female, are evidence of the persistence of the 'mother and son' cult, which provides Sir Arthur with a link in a chain of evidence by which he traces the fundamental religious belief of the eastern Mediterranean from Knossos to Bethlehem.

### Explorations in New Guinea

ADDITIONAL interest was attached by recent controversy to the account of his explorations in New Guinea which Mr. Michael Leahy gave to the Royal Geographical Society on November 21. It will be remembered that it has been suggested that Mr. J. G. Hides, who recently brought back some remarkable data relating to the unknown peoples he had encountered in the interior, had been in touch with some of the peoples of the Mount Hagen area discovered by Mr. Leahy, of whom an account has already reached England through Mr. E. W. P. Chinnery, the Government anthropologist of Papua. (See *NATURE*, September 1, p. 328, August 17, 1935, p. 251 and August 24, p. 290.) The culture of the Mount Hagen people as described by Mr. Leahy does indeed present certain features of similarity, such as the interest the people display in their gardens, which justify the comparison. Mr. Leahy's cinematograph film, especially in the war scenes—he was fortunate enough to obtain a record of an inter-tribal war in actual progress—gave a detailed picture of a remarkable, and in its environment unusual, culture. Especially interesting to archaeologists was his report of the custom of cutting off a finger-joint at the death of a relative. This custom of finger mutilation is widespread among the more primitive peoples, and, as is well known, evidence of it is to be seen in the imprints of hands found among the prehistoric cave and rock paintings. The Mount Hagen peoples also practice preserving the skulls and some of the bones of their deceased relatives, which are placed in shrines along the road-side. It is to be noted that they are not cannibals, and expressed horror at the suggestion, although the practice exists among tribes nearer the coast. As a whole, Mr. Leahy's report has provided much interesting material for comparative study.

### Stone Age Culture in Colorado, U.S.A.

DR. FRANK H. H. ROBERTS, JR., of the Bureau of American Ethnology, has resumed his investigation of the Lindenmeier site in Northern Colorado, U.S.A. (see *NATURE* of October 5, p. 535), and for some weeks has been engaged in driving trenches in various directions near the habitation and factory site of Folsom man which he discovered in 1934. No less

than seven hundred implements belonging to this early phase of the American stone age, it is stated in a communication issued by Science Service of Washington, D.C., have been discovered, among them being a number of new types. The variety in type of the implements continues to be a marked feature of the site. A find of considerable importance is recorded, which corroborates conclusively previous evidence for the contemporaneous existence in this region of man and an extinct fauna. This is the discovery of the vertebra of a bison, in which is still embedded the stone point of the lance or dart with which it had been struck by the primitive hunter. The vertebra belongs to the extinct form of bison already found here and elsewhere in association with the artefacts of Folsom man. It has already been pointed out (see NATURE, *loc. cit.*) that the Lindenmeier site gives *in situ*, for the first time, a view of the Folsom implement as forming part of a cultural complex, and thus justifies the use of the term 'Folsom culture'. To this complex must now be added an art form, the first known in this early phase of culture, which appears on a flat bone disc showing decorative marks around the edge. No information is as yet available on the further investigation of the stratigraphy of the site and its relation to adjacent gravels, from which it is hoped to attempt a dating of this centre of the Folsom culture.

#### A Thames Barrage

WITH the arrestive title of "Dam the Thames", a brochure has been issued by the Thames Barrage Association advocating the scheme put forward a short time back in a paper read before the London Society by Mr. J. H. O. Bunge, who is honorary secretary of the Association since formed to promote the impounding of a large section of the Thames estuary. The original proposal is modified in respect of the position of the proposed barrage, which it is now suggested should be located at Woolwich. The cost of the scheme is estimated at about  $4\frac{1}{2}$  millions sterling, but, as has been abundantly demonstrated in other projects of corresponding magnitude, this figure must be received with a certain amount of reserve. According to the pamphlet, the resultant savings, enumerated under eighteen categories, would aggregate about £611,000 per annum, representing a capitalised value of 20 millions sterling. Some of the items of this calculation seem to be based on data of a rather uncertain character, so that here, too, the estimate must be considered more or less speculative. An official, public inquiry into the merits of the scheme is urged on the grounds that the scheme, if carried out, would be of great advantage to navigation in maintaining a permanent water level in the river and so enabling craft to move freely, and independently of tidal restrictions, in and out of the docks, and to and from the riverside wharves above Woolwich; in excluding sewage effluent at present brought up-river by tidal flow from the outfalls at Crossness and Barking; and in avoiding the risk of flooding at times of abnormally high tides. Various other benefits are categorically enumerated.

ALTHOUGH an inquiry, which would involve some time and expense, might resolve some of the problems connected with the formulation of the barrage scheme, it must be borne in mind that an enterprise of this magnitude cannot be embarked upon without a considerable degree of risk to important interests, however propitious the general circumstances may appear to be. It will be recalled that a cognate scheme, the Severn Barrage, was definitely promoted by the Government and became the subject of a prolonged and searching inquiry by experts; but the findings of the committee, although favourable, have not, so far, resulted in the materialisation of the project, which, in the language of the Ministry of Transport, was to bring "within the reach of all classes of the community the blessings of light, purity and power". It is also to be noted that the Port of London Authority has had the present proposals before it, and has not accorded them its support. The reasons have not been stated, but it is clear that they were such as to carry preponderant weight with those most intimately concerned with the great shipping and commercial interests of the port. This does not, in itself, suffice to condemn the project; but it rather discounts the florid assertions of the promoters, and justifies an attitude of caution and reserve.

#### Ice Accretion on Aircraft

LECTURING before the Royal Aeronautical Society on November 4, Mr. Lockspeiser, of the Royal Aircraft Establishment, Farnborough, described experiments upon this subject which have led to the recommendation of a certain method of combating this. It consists of forcing ethylene-glycol through a porous leather strip which can be attached to, or form part of, those surfaces upon which ice appears to form. This presents the greatest danger when on the leading edges of the various lifting surfaces and the airscrew. In such cases it not only adds to the weight to be carried but it also reduces the efficiency by changing the shape, and in the case of the propeller it causes out of balance forces that necessitate slowing it down with still further loss. The action of the ethylene-glycol is to prevent the ice from adhering to the surface. Mr. Lockspeiser referred to thermal methods for prevention of ice formation, and mechanical methods for dislodging it, but said that neither of these has the simplicity and the general application to all cases of the evaporation method. Thermal methods, using the engine heat to warm the wing surfaces, may become more attractive upon larger thick-winged monoplanes, where the 'plumbing' difficulties would be less. Mechanical methods of dislodging the ice from the planes have been used for some time in the United States, but are not applicable to the propeller. Experiments are now being made with devices similar to the British ones, using rubber sheathing and oil. The experiments described were undertaken originally for R.A.F. requirements; but the question was considered to be so vital to civil aviation, that the results have been made public and the device is to be marketed by the Dunlop Company.

### Forestry Research

THE Forest Products Research Laboratory at Princes Risborough has begun a new issue entitled *Forest Products Research Records*, of which Nos. 1 and 2 have been issued (H.M. Stationery Office, 1935). No. 1 deals with the testing of timbers at the Forest Products Research Laboratory, and describes in clear language the *raison d'être* for the Laboratory and the objects at which it aims. It is pointed out that the object underlying the work of investigating the properties of timbers, the practical application of the results of the tests and their importance to the timber-using professions and industries as well as to timber merchants, are not fully understood. Nor are the facilities offered by the Laboratory for supplying information fully realised. It is the object of the *Records* to supply this want. The first number describes the work of the different sections of the Laboratory under the headings: structure, timber physics, seasoning, timber mechanics, woodworking and preservation, with sections dealing with entomology, mycology, wood chemistry and utilisation.

IN the second number of the *Forest Products Research Records* the subject of "The Strength Tests of Structural Timbers" is discussed. Both Canada and the United States have been engaged upon research work in this direction for a number of years. Until recently the subject has received very little attention in Europe, which accounts perhaps for the fact that handbooks providing tables do not agree among themselves owing to important factors being overlooked by earlier investigators. For example, mention is made of one record which cites Memel redwood as 60 per cent and English oak as 20 per cent stiffer than greenheart, whereas it has now been established that redwood and oak are approximately equal in this property and no more than half as stiff as greenheart. With the object of coming into line with the Canadian and American research work, an extensive programme of tests was commenced some time ago at Princes Risborough. Work was started in testing redwood from the White Sea and from Gefé. The Timber Trade Federation became interested in the work, and with its co-operation the scope was considerably extended. The results of the tests on redwood from those two areas are detailed in the *Record*.

### New Box Testing Laboratory

THE Department of Scientific and Industrial Research has set up equipment at the Forest Products Research Laboratory for testing packing-cases, boxes, etc., under stresses similar to those encountered during rail or road transport. The installation is the first of its kind in Great Britain, but several are in use in the United States, where the experience gained has considerably reduced the claims for damages paid by the railways. The plant at Princes Risborough tests both the endurance and strength of the boxes. For the former test, the cases are placed inside a large rotating drum, which revolves twice a minute, wooden baffles on the inner face causing the article

to fall in different positions in turn. A moderately well-made container was found to collapse after about thirty falls, whereas one of really good design could withstand 150 or more falls. A 'dropping machine' tests the resistance to falls on the face, corner or edges at will, while in a further apparatus resistance to crushing can be determined. The efficiency of nailing, different types of fastenings and packings are also being investigated, and on behalf of the Ministry of Agriculture special tests are being made with the view of drawing up a standard specification for fibre-board containers for National Mark eggs. The Box Testing Laboratory will be available to manufacturers and others who wish to study possible improvements in methods of box construction and in the packing of contents to give the greatest protection. The scale of charges, and a statement of the conditions under which tests will be made, can be obtained from the Director, Forest Products Research Laboratory, Princes Risborough, Bucks.

### Air-Conditioning in the Tropics

ATMOSPHERIC conditions in the tropics have serious effects, both physical and mental, upon the inhabitants. In an article in the *Electrical Review* of November 8, Prof. C. A. Middleton Smith of the University of Hong-Kong states that it is difficult for those who live in temperate regions to realise the depression produced on human energy by living for months in a climate with a night and day temperature of about 90° F. and a relative humidity of more than 90 per cent. With the help of electrical power and the new methods of producing cold mechanically, it is now possible to manufacture climatic conditions that are almost perfect. By the use of a small electrically driven machine in his private room in the University, Prof. Smith can make the climate in it as pleasant as on a summer day in England. Six hours after the machine has been at work, it has extracted a gallon and a half of water from the air in the room. The effect of the two contrasting atmospheric conditions within and outside the room upon bodily comfort is most marked, and he has found by experience that he can double his lecture hours and yet be less fatigued at the end of the day. He says that no educated person in the tropics who can afford an electrically driven refrigerator would now risk having a 'disease carrying' ice box. He has for the last sixteen years advocated air-conditioning in the tropics. One of the most extensive applications of the system in China to-day is that of the new million pound building of the Hong-Kong and Shanghai Bank. There are six air-conditioning plants for the whole building. Electric motors are used for driving the ammonia compressors. Three pumps are required for the condenser water circulation and there are six inlet fans which drive 229,000 cubic feet of air a minute. The total rating of the electric motors used is 800 horse-power.

### Radio Research Laboratories Abroad

THE rapid and widespread growth of radio communication and its associated industries has been one of the most notable events during the past fifteen

years. The inception and development of broadcasting, and later of television, resulting from the earlier introduction of the thermionic valve to industry, have revolutionised the scope of normal commercial telegraphic and telephonic communication. These developments have naturally been accompanied by the establishment of radio frequency research laboratories in all parts of the world, some of these being controlled by government administration, while others are associated with private enterprise. The issue of *La Nature* of September 15 is devoted to an illustrated account of several such radio research laboratories. Much space is devoted to the work of the French institutions, Le Laboratoire National de Radio-Electricité, Le Laboratoire du Comité Consultatif, Les Laboratoires de Recherches du "Matériel Téléphonique", and to the private laboratories engaged on television. In addition, however, the work of the Heinrich Hertz Institute and of M. von Ardenne in Berlin are described briefly; while attention is also devoted to the Philips Laboratories at Eindhoven, the Bell Telephone Laboratories in New York, the Italian Television Laboratory and that of the Baird Television Laboratory, the only English laboratory mentioned. Further articles deal with work in France in connexion with broadcasting, valve manufacture and research on the interference problem. The whole issue presents an interesting summary of the scope and position of research in the institutions enumerated.

#### Solar Physics Observatory, Cambridge

IN his twenty-third annual report to the Solar Physics Committee the Director of the Solar Physics Observatory, Cambridge, is able to point to a number of interesting results obtained from a particularly active year. To begin with, the 3-ft. Common mirror has been refigured by Dr. Burch, who has developed a special new method of testing paraboloids in this connexion. The performance of the mirror is greatly improved, and it is hoped to improve the 10-in. secondary mirror used with this large mirror and so obtain really good definition with the 3-ft. telescope. The year's work on stellar spectroscopy has been notable on account of special observations made during the eclipse of  $\zeta$  Aurigæ and for the work on Nova Herculis. A very special effort was made, and altogether 284 spectra were secured on 137 nights between December 13, 1934, and July 31, 1935. This is a very fine performance for the climate of Great Britain, and was only made possible by enthusiastic team work by the staff and research workers at the Observatory. An item of interest is the attempt made by Drs. Redman and Bullard to determine the diameter of Antares by observing the brightness during an occultation by the moon. Unfortunately, the apparatus broke down at a critical point in the observation, but there appears to be nothing unworkable in the method, which is of extreme interest, and it is to be hoped that the experiment will be repeated at the next favourable occultation. The solar work has continued, perhaps the most noteworthy item being the accurate determination of the central intensity of the line at

4227 Å. (due to  $\text{Ca}^+$ ) by Dr. Redman, the result being 2 per cent—possibly the lowest central intensity yet accurately measured. The Observatory has arranged to send an expedition to observe the total solar eclipse of June 19, 1936, the site chosen being in the island of Hokkaido. Finally, the work on meteorological physics has been continued, and the work on the  $\text{Fe}^+$  laboratory spectrum has been brought to a successful conclusion, 58 new multiple terms and 157 levels having been determined.

#### Archæology in South-East Essex

LOCAL archæologies and local histories have a useful function which is seldom fulfilled satisfactorily. To write them successfully requires a nice perception of the balance between the foreground of local interest and the background of the general trend of history or cultural development. Of the importance of the detailed record of local finds there can, however, be no two opinions. The studies of East Anglian archæology which we owe to Sir Cyril Fox have demonstrated the almost kaleidoscopic changes in the generalised picture as the records of local finds are brought more and more into focus. An excellent example of a method of treatment of local antiquities, which may be followed to advantage, is afforded by "The Archæology of Rochford Hundred and South-East Essex" by Mr. William Pollitt (Southend-on-Sea Museum, Handbook No. 7, pp. 59 with 22 plates, 6*d.*), in which the author follows up a survey of the archæology of the district from pre-palæolithic down to and including Saxon times with a detailed list of the 'finds' in the area, classified according to period and arranged under parishes, the present location of each specimen being noted where known. The distinction to be drawn between south-east Essex and the central and north-western areas of the county on geographical lines is no less apparent in its archæology. For this reason, if for no other, the general background becomes of no little importance for the appreciation of the significance of the finds. Here, it will be found, fully adequate provision has been made for the needs of those who will use the handbook. A map, or series of maps, showing the localities in which the antiquities were found, would have been a useful addition to the ample and excellent illustrations.

#### Shipbuilding by Welding

ELECTRIC-ARC welding has now arrived at the stage where it is recognised as an important aid to shipbuilding, and its field is being extended so rapidly that there are few shipbuilders or repairers who do not now avail themselves of its use. With this statement, Messrs. N. M. Hunter, vice-president, and H. W. Townshend, associate member, opened a paper read to the North-East Coast Institution of Engineers and Shipbuilders on November 15. They deal with the subject descriptively, and explain the methods used in the fabrication of various parts of the hull structure. The amount of work now done by welding and the marked advantages gained in some instances testify to its growing importance. Welding the steel decks has, for example, produced

water tightness, greatly to the benefit of the crews, while in trawlers the welding of seams has eliminated the trouble with loose rivets caused by the impact of the heavier portions of the fishing gear. It is inevitable that this method will profoundly modify both the design and the building of ships, as the pre-construction of parts is more suitable to the technique of welding.

#### Catalogue of Earthquakes, 1925-30

ALL those who have used the late Prof. Turner's catalogue of earthquakes for the years 1918-24 will welcome its continuation for the next six years by Miss E. F. Bellamy "as a contribution to earthquake science and as a personal memorial of respect to Prof. H. H. Turner". The catalogue (British Association, Burlington House, London, W.1. 2s.), as before, is compiled from the International Seismological Summary, and gives for each earthquake the time at the origin, the position of the epicentre, the number of stations providing records of the earthquake, the last occasion on which the same focus was in action, and the number of "minor entries" or records that are not sufficient to determine the position of the epicentre. The appendix contains notes on earthquakes with unusually deep foci, etc. The number of new epicentres determined is 1,052, raising the total number of known epicentres to 6,215. A remarkable feature of the catalogue is that, with its thousands of entries, it yet seems unusually free from errors, printer's or otherwise, only one so far having been discovered (Nov. 31 for Nov. 13, p. 12).

#### Investigation of British and Irish Earthquakes

THE study of British and Irish earthquakes, carried out by Dr. C. Davison between 1889 and 1916, has been resumed by Dr. A. T. Dollar, who appeals for assistance in completing the catalogue of those earthquakes which occurred between January 1, 1916, and the present date, and also in recording future disturbances of the same kind. Personal experiences, or relevant cuttings from accounts in scientific journals and newspapers are sought. To facilitate the reporting and recording of data, a questionnaire and circular letter will be forwarded (together with a stamped, addressed envelope) on request to Dr. A. T. Dollar, Emmanuel College, Cambridge.

#### An Earthquake Research Commission for India

THE Bihar earthquake of 1934 and the Quetta earthquake of the present year have shown the need for an Earthquake Research Institute in India on the same lines as that which has done such admirable work in Japan. A recent issue of *Culture and Science* (1, 233, 274, 288; 1935) has several paragraphs on the subject. A committee of the Geological Survey, consisting of Dr. A. M. Heron, Mr. W. D. West and Mr. J. B. Auden, has drawn up a list of Indian stations at which it is desirable that seismographs should be erected. The list was communicated to the Council of the National Institute of Sciences, India, and it was agreed that the Institute should urge the Government to instal instruments at the

places mentioned. The Council has also appointed a subcommittee—Dr. S. Banerji, Dr. M. N. Saha, Dr. N. R. Sen and Mr. W. D. West (secretary)—to advise the Institute on seismological questions, and it was considered that the subcommittee might afterwards be merged into an Indian National Commission for the study of earthquakes. It is satisfactory to learn from the daily Press that the Government is contemplating the appointment of such a commission.

#### Centenary of Ampère

ACCORDING to the *Revue Scientifique* of October 26, arrangements are being made at Lyons to hold an exhibition next spring in connexion with the commemoration of the centenary of the death of the eminent French physicist, André Marie Ampère. The exhibition will be arranged to illustrate the many applications of electricity. Ampère was born at Lyons on January 22, 1775, being the son of a merchant of that place who was beheaded during the Terror. He became a professor at the Ecole Polytechnique in 1805, and was elected a member of the Paris Academy of Sciences in 1814. His discovery of the fundamental laws of electro-dynamics was made in 1820. His death took place on June 10, 1836, at Marseilles, where he was buried, but in 1869 his remains were transferred to the cemetery at Montmartre, Paris. A statue of him was erected at Lyons in 1888.

#### Exhibition of Microscopes

MESSRS. W. WATSON AND SONS, LTD., have arranged an exhibition of microscopes to be held in the Central Hall, Westminster, London, S.W.1, on December 9-14. A large number of representative microscopes will be on view, many with prepared slides already mounted. The object of the exhibition is not only to popularise the microscope, but also to demonstrate its utility in various forms of scientific inquiry, in biology, geology, metallurgy, etc. Some telescopes will also be on view. Messrs. Chance Bros. will exhibit various glass products and Messrs. Kodak will exhibit different types of photomicrographs. The Quekett Club is arranging an exhibition of various slides, including specimens of living pond life. During the exhibition, the following lectures will be delivered: "The Part the Microscope plays in the Scientific Control of the Railway", by T. H. Turner, on December 10; "The Microscopist at the Seaside", by Martin Duncan, on December 11; "The Manufacture of Optical Glass", by H. C. Rands, on December 12. The lectures are at 7 p.m. The exhibition is open to the public free of charge. Catalogues and further information can be obtained from Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

#### Another Large Sunspot

FOR the third time within a month, a new group of sunspots large enough to be seen with the naked eye has appeared, and is in transit across the sun's disk from November 26 until December 9, the date of central meridian passage being December 2.1.

The area of the present group, which consists of a long stream of spots over 100,000 miles in length with a large component in the middle, increased from about 400 millionths of the sun's hemisphere on November 27 to 1500 millionths on November 29. Since the typical curve of growth of large spots shows the maximum area to be reached between the fifth and tenth days after their initial formation, it is probable that the group may grow still larger before it disappears around the western limb. In any event, a maximum area of 1500 millionths has not been equalled since February 1933, when the last big group of the preceding cycle (ending about 1933.8) was recorded.

#### Announcements

PROF. F. O. BOWER, emeritus professor of botany in the University of Glasgow, has been elected a corresponding member of the Prussian Academy of Sciences.

PROF. W. H. HOFFMANN, of the Finaly Institute of Havana, has been elected president of the recently founded Cuban Society of Biology.

SOVIET RUSSIA has fifty aeroplanes fitted up as small hospitals, the smallest having room for three patients, a doctor and two assistants. In urgent cases, important operations can be performed during flight.

A CONFERENCE on "Mechanization in Mixed Farming" will be held under the joint auspices of the School of Rural Economy, the Institute for Research in Agricultural Engineering and the Agricultural Economics Research Institute of the University of Oxford at Rhodes House, Oxford, on January 7-10. The opening address will be delivered by Prof. J. A. S. Watson, Sibthorpean professor of rural economy in the University. Further information can be obtained from the Conference Secretary, Institute for Research in Agricultural Engineering, Parks Road, Oxford.

THE seventh Pan-Russian Congress of Balneology will be held at Moscow under the presidency of Prof. Danilevsky on December 25-31, when the following subjects will be discussed: the balneological resources of the Soviet Union and the immediate prospects of their utilisation; mineral waters and the indications for their application; radioactive waters; comparative action of sulphurous and bicarbonate waters; medical climatology and climato-therapy; bath treatment of children's diseases. Further information can be obtained from the organising committee, Boulevard Novinsky 9, Moscow.

At the Sixth International Congress of Genetics held at Ithaca, New York, 1932, a Permanent International Committee of Congresses of Genetics was elected consisting of representatives of fifteen different countries, and Prof. Otto L. Mohr, professor of medicine in the University of Oslo, was elected chairman. This committee has accepted the invitation of the Academy of Sciences of the U.S.S.R. to

hold the Seventh International Congress in Moscow and Leningrad in 1937. The date of the Congress will be decided upon later. It may be mentioned that in 1937 an All-Union Agricultural Exhibition will be held in Moscow, which undoubtedly will prove of great interest to many members of the International Congress on Genetics.

THE issue of "Illustrations of New Conifers" by the late H. Clinton-Baker and A. Bruce Jackson, in one volume at 84s. is announced. The book will supplement the "Illustrations of Conifers" issued more than twenty years ago. It will be published by Messrs. Simson and Co., Ltd., 12 and 14 Parliament Square, Hertford, Herts.

WE have received from Messrs. Flatters and Garnett, Ltd., 309 Oxford Road, Manchester, 13, their new Catalogue "S" of stains and reagents for microscopical work, chemicals, and bacteriological culture media. A new item included is their "neutral mountant" for mounting microscopical specimens in the place of the ordinary Canada balsam. This is stated to be quite neutral in reaction and non-crystallisable, and not to affect stains.

WE have received the first number of *Revista de Quimica e Farmacia*, July 1935, published at Rio de Janeiro and edited by C. H. Liberalli, who writes an introductory preface. The journal, which is published monthly, is divided into scientific and professional sections: articles in the first part include one by Prof. Costa on the biochemistry of zinc and another by Liberalli on the reaction of tartrates with the Möhler-Deniges reagent: gluconic, lactic and pyruvic acids also give a red-violet colour with the reagent, and bromine and iodine hinder its appearance, but permanganate and bichromate in small amounts do not interfere. The journal also contains abstracts from current literature.

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

An assistant (Grade III) for research on internal combustion engines in the Royal Aircraft Establishment, South Farnborough, Hants (Dec. 13).

A lecturer in electrical engineering in the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (Dec. 16).

A director of sponge fisheries investigations, and a biological and a chemical assistant—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 31).

A Lancashire-Spencer professor of physics in University College, Nottingham—The Registrar (Jan. 20).

A director of the Indian Lac Research Institute, Namkum, Ranchi—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Dec. 21).

A professor of physics in Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1.



## Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 917.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Isotopic Structure of Iridium

FROM an examination of the hyperfine structure of certain lines of the arc spectrum of iridium, Prof. B. Venkatesachar and L. Sibaiya<sup>1</sup> have recently concluded that iridium must have two isotopes, and give reasons for assuming the mass numbers to be 191 and 193. I have recently verified this conclusion by a direct mass-analysis of the iridium ions formed by a high-frequency spark between electrodes made of platinum-iridium alloy.

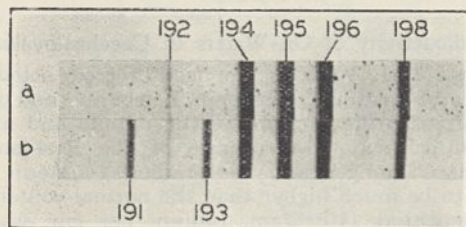


FIG. 1.

The analysis of the five platinum isotopes from an iridium-free electrode has been previously reported<sup>2</sup>, and a print of one of these mass-spectra is reproduced in Fig. 1 (a). The centre lines are much over-exposed in order to bring out the very faint isotope at 192. When electrodes made of platinum-iridium alloy were used, two new lines appeared, as shown in Fig. 1 (b), indicating that iridium has two isotopes with mass numbers 191 and 193.

These two masses are the only gaps in the mass number scale in this region not occupied by osmium or platinum isotopes. No further isotopes would be expected from the rule followed by elements of odd atomic number. The heavier isotope at 193 is definitely stronger than the one at 191, thus giving a third exception, along with thallium and rhenium, to the rule that the lighter of a pair of isotopes of an odd numbered element is the more abundant.

A. J. DEMPSTER.

University of Chicago.  
Oct. 30.

<sup>1</sup> Venkatesachar and Sibaiya, NATURE, 136, 437; 1935.

<sup>2</sup> A. J. Dempster, NATURE, 135, 993; 1935.

## Thermal Decomposition of Certain Gaseous Organic Compounds

IN a letter in NATURE of March 30, I asked for suspension of judgment regarding a difference of opinion between Mr. Hinshelwood and his colleagues on one hand, and myself and my co-workers on the other, with regard to the possibility of measuring the rate of chemical reaction in the thermal decomposition of gaseous acetaldehyde by observing the rate

of increase of pressure at constant volume, and also as to the mechanism of the chemical process involved. Mr. Hinshelwood has published an account of his latest work on this subject, and Mr. R. V. Seddon and I have carried on our own work to a point at which publication is possible. We believe that our results support our views on the case.

In the thermal decomposition both of ethylene oxide and of acetaldehyde the main reaction is represented by the equation,  $C_2H_4O = CH_4 + CO$ . The reaction can only be followed accurately by observing the rate of formation of methane, for in each case the main reaction is accompanied by secondary reactions which do not yield methane. Unless the rates of these reactions are also known, the results of observations of increase in pressure cannot be interpreted.

In the case of acetaldehyde, there is a secondary reaction which leads, through the aldol condensation, to propylene, and the propylene undergoes condensation. The formation of propylene is certainly a wall reaction; for if, for example, the surface area is increased five times, the rate of formation of propylene is increased four times, and the rate of the main reaction is decreased to one half. The main reaction, and the process leading to the formation of propylene, result, individually, in increase of pressure in the system, and if the rate of one falls off, the increase in the rate of the other may balance it. The condensation process involves a decrease in volume; so that increase in the rate of formation of propylene, by packing a reaction tube, may have the result that the final volume of the system, at an apparent end point, is less when the tube is packed, than when the tube is empty. Thus all the results obtained by Mr. Hinshelwood and his colleagues are fully accounted for, and also the fact that, by relying on pressure measurements as a means of following the course of the main reaction, they have missed the fundamental fact that increase in surface materially decreases the rate of it.

When the rate of the main reaction is followed by means of the analytical method which has been fully described elsewhere, by measuring the rate of formation of methane, it is observed that in neither case does the rate of reaction diminish with time, as the classical theory demands. In the case of acetaldehyde it either increases slightly at first, or remains constant; but in the case of ethylene oxide, there is a marked induction period, during which the rate of reaction increases very quickly. In both cases, when the reaction has proceeded for a time, it suddenly slows down, and then again accelerates, continuing at a rate slower than the initial rate. The phenomenon is similar to that attributed by Mr. Hinshelwood to the existence of acetaldehyde molecules in different states of activation. However, the pressure measurement method does not reveal the exact nature of the phenomenon, since the rate graphs are not segmented,

but may rather be described as being looped, since the sudden reduction in the rate seems always to be followed by a rapid recovery.

It will now be clear that phenomena, which are generally accepted as criteria of chain mechanism, are observed in both cases. In the case of acetaldehyde, the initial rate of decomposition is considerable, and we must suppose that the main process is carried forward both by the formation of new primary centres, and to a very material extent by chain mechanism. In the case of ethylene oxide, the rate of formation of primary centres is obviously very small, and the main process is carried forward mainly through the operation of the chain mechanism. In this case, surface does not influence the rate of the main reaction.

In both cases the secondary process conforms to the main reaction, and when breaks occur in the graphs representing the latter, they also appear simultaneously in the graphs representing the former. It would appear therefore that the *breaking of chains*, at the walls or in the gas phase, does not merely involve the dispersal of energy, but also the formation of new primary centres, of the kind referred to by Semenov as *degenerate*, from which the secondary process originates. Three-body collision must obviously play an important part in these processes.

We have made a further study of the influence of neutral gases, such as hydrogen and methane, on the rates of reaction. The phenomena are much more complex than was indicated by our first experiments. The work is being continued, and will, we hope, throw light on the phenomena associated with the breaks in the rate graphs.

This work, and investigation carried out with Mr. P. F. Gay on the thermal decomposition of dimethyl-ether into methane and formaldehyde, and other similar experiments, seem to be leading definitely to the conclusion that in all spontaneously occurring processes of this kind, the probability that the process will be continued by a chain mechanism is never zero. Semenov has referred to the free energy of the process as giving a measure of the probability of the continuation of the process by chain mechanism. The term 'free energy' can only be used qualitatively, but so far as our work goes the principle seems to be well established.

MORRIS W. TRAVERS.

Chemistry Department,  
University, Bristol.  
Nov. 16.

#### Initial Formation of Methyl Alcohol in the Oxidation of Methane

ALTHOUGH a paper published about a year ago from our research laboratories, by Dr. D. M. Newitt and Mr. P. Z. Szego<sup>1</sup>, described experiments in which large yields (up to 50 per cent of the theoretical) of methyl alcohol had been obtained by the slow reaction of methane-air mixtures at 430° and 50 atmospheres pressure, up to then no direct evidence had been obtained of its formation during the slow combustion of methane at atmospheric pressure.

Since then, however, further experiments by Dr. Newitt and Mr. J. B. Gardner have resulted in the isolation of methyl alcohol from the reaction products of a  $2\text{CH}_4 + \text{O}_2$  mixture at 450° and atmospheric pressure, in contact with a porcelain surface, proof also being forthcoming of its formation preceding that of formaldehyde.

Such result led Dr. J. Bell to repeat some former experiments upon the explosions of a  $5\text{CH}_4 + 2\text{O}_2$  mixture at initial pressure of about 50 atmospheres in a bomb (1 litre capacity), so arranged that the burning medium would be suddenly cooled by expansion after bursting a disc at a point (320 atmospheres) during the actual combustion period short of the maximum pressure of 430 atm., and that the cooled products would be retained in a large expansion chamber for subsequent analysis. Later examination of the suddenly cooled products has proved the presence therein of about 0.13 per cent of methyl alcohol and 0.03 per cent of formaldehyde, the alcohol having been isolated and identified as methyl 3:5 dinitro benzoate, m.p. 107.5°.

In none of the experiments referred to could even the faintest sign of 'peroxide' formation be detected.

WILLIAM A. BONE.

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and Technology,  
London.  
Nov. 22.

<sup>1</sup> *Proc. Roy. Soc., A*, 147, 7555; 1934.

#### Radioactivity of Oil-Waters in Czechoslovakia

PROF. V. J. VERNADSKY has directed attention to the investigations of Chlopin, Kurbatov<sup>1</sup> and other Russian scientific workers on the radium and mesothorium content of the brine of the Russian oil districts. In general, the radium content was found to be much higher than the normal content of surface waters ( $10^{-15}$  gm. radium per gm. water). The maximum was found in the water of the oil beds of Novyj Groznyj in the Northern Caucasus, with  $1.46 \times 10^{-10}$  gm. radium per gm. water. In several places the mesothorium content was likewise considerably higher, though there were scarcely any traces of thorium.

Later, O. Hahn and H. J. Born<sup>2</sup> put forward the view that the high radium content of the waters of the oil beds would account for the occurrence of helium in sylvine, as the alkali chlorides form mixed crystals with lead. During its secondary formation, the sylvine might therefore receive the isotope of lead, radium D, from underground waters rich in radium.

In connexion with these questions and also to ascertain how far the higher radium content of the oil-waters depends upon the kind of oil and the place of its occurrence, a preliminary survey has been made of the radium content of the brine of two oil beds in Czechoslovakia, at Gbely (Slovakia) and at Jasina (Carpathian Ruthenia).

Technically important occurrences of naphtha and natural gas are found in Czechoslovakia only in the Carpathian system. Compared with the other Carpathian countries—Poland and Rumania—the naphtha resources of the country are at present neither so important nor so well explored (Fig. 1). We find here two types of naphtha beds: beds of a light paraffinic naphtha limited to the Carpathian flysh belt (Cretaceous and Palaeogene beds), and beds of a heavy naphtha without paraffin and without asphalt, of the naphthenic series, occurring in the Neogene of the Vienna basin. Light naphtha is met with in Moravia at Bohuslavice nad Vlárrou and at Ratiškovice, in Western Slovakia at Turzovka and at Popradné in the Trenčín district, in Eastern Slovakia at Kómárník na Dukle, at Miková,

Krivá Olka and Radvaň near Medzilaborce, in Carpathian Ruthenia at Luhy in the Užok Pass and at Jasina. Heavy naphtha forms far more important beds and it is extracted from the Sarmatian Cerithian beds at the State mines at Gbely in Slovakia and at the mines of the Moravian Company at Hodonín in Moravia. At Gbely exploitation began in 1914 shortly after the occurrence of naphtha had been discovered by chance.

The naphtha-bearing area has been explored since then by nearly four hundred borings, hand-borings as well as exploitation- and deep-borings. At Gbely, naphtha is exploited in two fields, in the so-called "old field" and in the new field opened up in 1929. There are two naphtha horizons in the Sarmatian beds, which are covered by the younger Congerian beds of the so-called Pontian. Quaternary sediments are well represented (diluvial gravel and sand, loess,

borings at Gbely and one sample from a boring at Jasina (Carpathian Ruthenia) was determined. The samples of water came from different horizons and different depths (between 8.7 m. and 521 m.). The highest content of radium found was  $7.25 \times 10^{-10}$  gm. in one litre of water (the water from the horizon at a depth of 262 m.). Only eight samples of water had a radium content of the order of  $10^{-10}$ , the others being of the order  $10^{-12}$ – $10^{-11}$ . No distinct correlation between the depth of the horizon and the radioactivity of the corresponding oil-water could be established; even from the greatest depths, activities of the order of  $10^{-12}$  were established. From the experimental boring at Jasina the water from the horizon at 779–786 m. was examined with regard to its contents in radium; and it was found to be no higher than that of the waters from Gbely ( $3.8 \times 10^{-10}$  gm. in one litre). Waters from other borings at Jasina are also to be examined with regard to their radioactivity.

With turbid and polluted waters, the muddy particles were separated by filtration and the radium content was measured separately in the filtrate, but without obtaining any abnormally high values. An experiment was made by the Elster-Geitel method with the residue by evaporation from waters with radium content of the order  $10^{-10}$  in one litre, so as to ascertain the nature of the radioactive elements the water contains. The presence of elements of

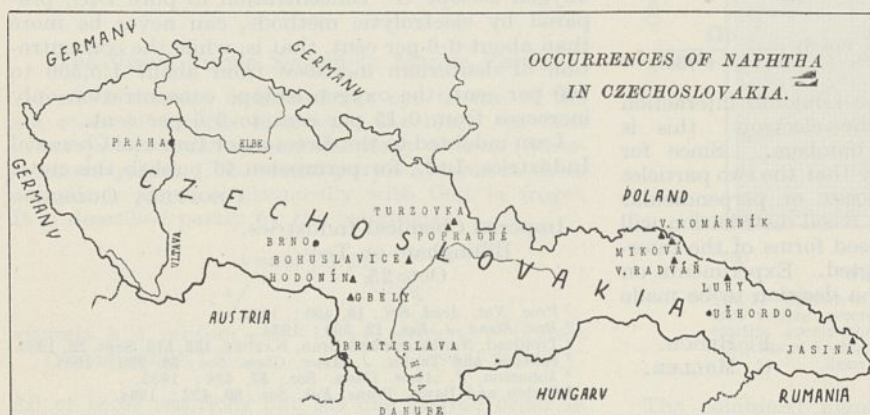


FIG. 1.

river deposits and quicksand). Several deep borings go down through the Sarmatian into the Second and First Mediterranean, the deep borings  $H_2$  and  $H_3$ , with a depth of 986 metres and 1,420 metres respectively, going down even to the Palaeogene. (For details of the geological structure, see, for example, L. Sommermeier, "Erdölgeologie der Tschechoslowakei", Höfer, "Das Erdöl", second edition.) In the experimental measurements of the radioactivity of the waters at Gbely, we studied samples taken from the water horizons in the diluvial, Pontian, Sarmatian and Mediterranean beds. Some of them are characterised by a fairly high content of iodine.

One of the samples from Jasina-Stebná examined with regard to its radioactivity came from a depth of 779–786 metres, from the experimental boring No. 1. This occurrence, which was studied last century to some extent by forty not very deep borings, when it yielded a small quantity of light naphtha, is situated in the Palaeogene flysch beds. These beds are composed of variegated clays and sandstones of the lower Eocene and of slaty marls of the upper Eocene (the so-called upper hieroglyphic layers) and of menilitic slates and sandstones of the Oligocene.

The radium content was determined by measuring the emanation. The coefficient of repartition of the emanation was determined for oil waters and air. This coefficient does not differ much from the coefficient generally given for water (0.25 at a temperature of  $20^\circ\text{C}$ .).

The radium content of thirty samples from different

the thorium series could not be proved. The content of radium elements is therefore much lower in the oil-waters of Czechoslovakia than in those of Russia.

F. BÉHOUNEK.

V. SANTHOLZER.

State Radiological Institute,  
Prague.

F. ULRICH.

Mineralogical and Petrological Institute  
of Charles University, Prague.

<sup>1</sup> V. Vernadsky, *C.R.*, **190**, 1172; 1930. V. Chlopin and V. Vernadsky, *Z. Elektrochem.*, **38**, 527; 1932.

<sup>2</sup> O. Hahn and H. J. Born, *Naturwissen.*, **22**, 138; 1934.

#### Recoil by $\beta$ -Decay

If one investigates the recoil of a light nucleus by emission of an electron and a neutrino, it is important to consider that for a given direction of the electron the angular distribution of the neutrino is not isotropic. The details of the  $\beta$ -decay naturally depend on the assumptions made about the interaction between the heavy particle and the electron-neutrino field; in particular, they determine the energy distribution of the electron. But even if this distribution were known, apart from any theory, the recoil would still depend on the special form of the interaction energy, in so far as this form also determines the coupling between the directions of electron and neutrino. Such a coupling is a general consequence

of the theory of  $\beta$ -decay, although the wave-lengths have to be assumed to be large compared with the nuclear dimensions. In the case of the two forms of interaction proposed by Fermi<sup>1</sup> and Konopinski and Uhlenbeck<sup>2</sup> of the type (0,0) and (0,1) respectively<sup>3</sup>, the coupling is due to the fact that the four amplitudes of the wave-functions depend on the direction of the particles. For the type (1,1) as well as in the case of higher derivatives, the coupling appears explicitly in the interaction energy.

For a given velocity  $v$  of the electron, the probability that it will be emitted within the solid angle  $d\Omega$  under an angle  $\delta$  against the direction of the neutrino, is in the three cases mentioned given by:

$$(0,0) : (1 + \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi}$$

$$(0,1) : (1 - \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi}$$

$$(1,1) : (1 - \frac{v^2}{c^2} \cos^2 \delta) (1 - \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi(1-v^2/3c^2)}$$

Here we have neglected the Coulomb interaction between the nucleus and the electron; this is justifiable for small atomic numbers. Since for (0,0) (0,1) (1,1) it is most likely that the two particles will be emitted parallel, opposite or perpendicular to each other respectively, the recoil distribution will depend on which of the proposed forms of the interaction energy has to be accepted. Experiments on the  $\beta$ -recoil might thus enable a decision to be made between the alternatives.

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C. MÖLLER.

Universitetets Institut for  
Teoretisk Fysik,  
København.  
Oct. 26.

<sup>1</sup> E. Fermi, *Z. Phys.*, **88**, 161; 1934.

<sup>2</sup> *Phys. Rev.*, **48**, 7; 1935.

<sup>3</sup> For the different possible forms and our notation, see E. J. Konopinski and G. E. Uhlenbeck, *Phys. Rev.*, **48**, 107; 1935.

### Electrolytic Separation of the Oxygen Isotopes

WASHBURN and Urey<sup>1</sup> first directed attention to the fact that fractionation of the isotopes of oxygen occurs simultaneously with that of the hydrogen isotopes during the electrolysis of water. The electrolytic separation coefficient  $\alpha$  for the oxygen isotopes has been determined in a series of experiments carried out in the Research Laboratories of Imperial Chemical Industries, Ltd., and was found to be 0.87 when using nickel electrodes and 1.25N NaOH as the electrolyte. This value is in good agreement with that of  $\alpha = 0.85$  calculated from the results of Washburn, Smith and Smith<sup>2</sup> who used nickel-plated cast iron electrodes—the electrolyte being 5N NaOH.

A sample of pure D<sub>2</sub>O has recently been prepared, in which the oxygen isotope ratio has been adjusted to its normal value<sup>3</sup>. The density was found to be  $d_{25}^{25} = 1.1074$ , which is lower than the value previously cited<sup>4</sup> of  $d_{25}^{25} = 1.1079$ . If the difference is ascribed to concentration of oxygen isotope during the process of electrolysis, then it is possible to calculate an approximate value for the oxygen isotope separation coefficient  $\alpha$ , and this is found to be 0.84. The separation coefficient probably depends to a certain extent on the electrode material and the nature of the electrolyte, for Johnston<sup>5</sup>, using iron

electrodes and caustic potash solution as the electrolyte, obtains a value of  $\alpha$  of  $0.992 \pm 0.003$ .

It is possible to arrive at a theoretical value for  $\alpha$  if the assumption is made that whatever the mechanism of electrolysis, the rate-determining step is the passage of a O<sup>18</sup>H or O<sup>16</sup>H complex over or through an energy barrier. Previously, it has been assumed that the possibility of 'tunnelling' by particles of mass greater than 2 would be so small as to be negligible. Actually, it can be shown using a modification of the method applied by Ogden and Bawn<sup>6</sup> to the hydrogen isotopes, that there is a small but quite definite probability for the 'tunnelling' of energy barriers by complexes such as O<sup>16</sup>H and O<sup>18</sup>H. From these considerations it can be shown that  $\alpha$  has values lying between 0.86 and 1, depending on the width and height of the energy barrier.

Taking the most favourable value for  $\alpha$ , the oxygen isotope O<sup>18</sup> concentration in pure D<sub>2</sub>O, prepared by electrolytic methods, can never be more than about 0.6 per cent, that is, while the concentration of deuterium increases from about 1/5,500 to 100 per cent, the oxygen isotope concentration only increases from 0.15 per cent to 0.6 per cent.

I am indebted to the directors of Imperial Chemical Industries, Ltd., for permission to publish this note.

GEOFFREY OGDEN.

Imperial Chemical Industries,  
Billingham-on-Tees.  
Oct. 25.

<sup>1</sup> *Proc. Nat. Acad. Sci.*, **18**, 496; 1932.

<sup>2</sup> *Bur. Stand. J. Res.*, **13**, 599; 1934.

<sup>3</sup> Tronstad, Nordhagen and Brun, *NATURE*, **136**, 515, Sept. 28, 1935.

<sup>4</sup> Selwood and Taylor, *J. Amer. Chem. Soc.*, **56**, 998; 1934.

<sup>5</sup> Johnston, *J. Amer. Chem. Soc.*, **57**, 484; 1935.

<sup>6</sup> Ogden and Bawn, *Trans. Far. Soc.*, **30**, 432; 1934.

### Chemistry of Oestrogenic Substances

WE have reported that we were unable to obtain any evidence of oestrogenic activity in rats with benzylidenepyruvic acid and furylidenepyruvic acid or their sodium salts<sup>1</sup>. These negative results were attributed by Friedmann<sup>2</sup> to the use of insufficient doses (100 mgm. per rat), and to an unsuitable spacing of the doses. Friedmann predicted that 240 mgm. of dry sodium salts would be sufficient to produce oestrus in rats, and claimed to have obtained oestrus in mice with 24 mgm., injected in three doses at intervals of 24 hours.

We have carried out further experiments using both rats and mice. Five ovariectomised rats, which had been shown to respond normally to oestrone, were each given subcutaneous injections of 300 mgm. of sodium benzylidenepyruvate dissolved in 3 c.c. of water, the injections being spaced over three days. Three rats died on the third day of the test, one on the fourth day, and neither these nor the surviving rat showed any sign of oestrus.

The mice used in our tests were pure strain 'Simpson' mice, all of which, after castration, gave a full oestrous response with 0.2 $\gamma$  of oestrone. Ten mice were injected with sodium benzylidenepyruvate, and ten with sodium furylidenepyruvate. Each animal received three subcutaneous injections, at 24-hour intervals, of 8 mgm. of the sodium salt, dissolved in 0.25 c.c. of normal saline. Thus, the total dose was 24 mgm. per mouse. Vaginal smears were examined twice a day for 72 hours following the last injection, and then daily for four days. Although the injections produced considerable

necrosis, 18 mice survived the whole experiment (9 in the case of each compound), and none of these showed the slightest suggestion of oestrous response.

These results give no support to Friedmann's claim that the compounds in question have oestrogenic properties.

J. W. COOK.  
E. C. DODDS.  
F. L. WARREN.

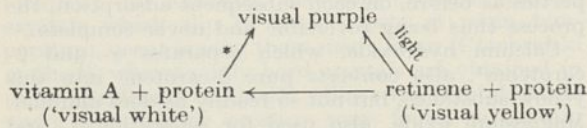
Research Institute,  
The Cancer Hospital (Free),  
London, S.W.3,  
and

Courtauld Institute of Biochemistry,  
Middlesex Hospital,  
London, W.1.

<sup>1</sup> J. W. Cook and E. C. Dodds, *NATURE*, **135**, 959; 1935.  
<sup>2</sup> E. Friedmann, *NATURE*, **136**, 108; 1935.

The Visual Purple System in Marine Fishes

I HAVE recently examined the eye tissues of the sea robin (*Prionotus carolinus*), the black sea bass (*Centropristes striatus*), and the porgy or scup (*Stenotomus chrysops*). The visual purple system in these animals is identical chemically with that in frogs<sup>1</sup>. It is described partly by the equations :



All of these reactions but the one starred occur in the isolated retina as well as in the intact eye.

The results of an experiment with scup retinas, typical for the other forms also, are shown in Fig. 1. Right and left retinas of five dark-adapted scup were prepared separately. One set of five retinas was extracted thoroughly in the dark with benzine. The extract, tested with antimony trichloride reagent, yielded a blue colour of which the lower curve is the absorption spectrum. The dark adapted retina contains a small quantity of vitamin A alone (615 m $\mu$  chromogen).

The same retinas were bleached to an orange colour ('visual yellow') in bright light, and immediately re-extracted with benzine. The extract, tested as before, yielded the upper left curve. Light, in bleaching the visual purple to yellow, liberates a large quantity of retinene (664 m $\mu$  chromogen).

The second set of five retinas was bleached and left for an hour at room temperature before being extracted with benzine. During this period the visual yellow faded to colourlessness ('visual white'). The extract yielded the upper right curve of the figure. Retinene liberated by light is eventually converted quantitatively to vitamin A.

Köttgen and Abelsdorff<sup>2</sup> found the absorption spectrum of visual purple from eight species of fresh-water fishes to have a maximum at about 540 m $\mu$ ; while that from amphibia, owls and mammals was of the same general form, but displaced so that the maximum occurred at about 500 m $\mu$ . This spectral peculiarity, if general, might have made an examination of fish retinal processes of special interest. However, the absorption spectra of visual purple from the species used in the present experiments are practically identical with that from frogs, the maxima

falling in every case at about 500 m $\mu$ . The nature of the possible disagreement between these and previous data<sup>2</sup> is being investigated.

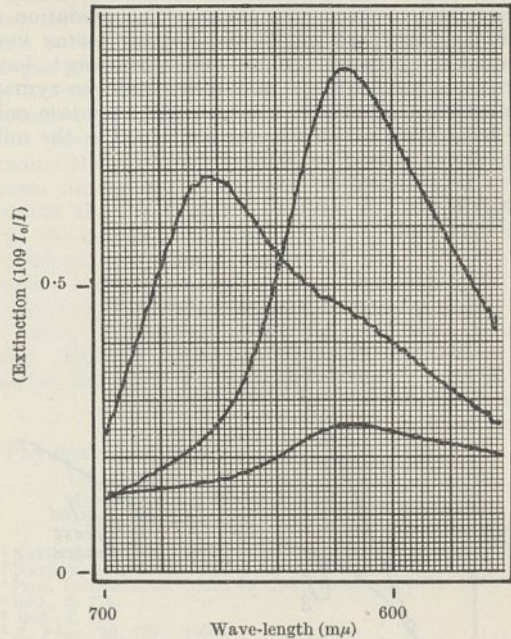


FIG. 1. Spectra of antimony chloride reactions with scup retinas, recorded automatically with a photoelectric spectrophotometer at the Massachusetts Institute of Technology (Hardy, A. C., *J. Opt. Soc. Amer.*, **25**, 305; 1935).

The combined pigment epithelium and choroid layer of these eyes contain vitamin A, an unidentified xanthophyll and flavine.

Details of this work will appear in the *Journal of General Physiology*.

GEORGE WALD.

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(Contribution No. 89),  
and  
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<sup>1</sup> G. Wald, *NATURE*, **134**, 65; 1934; **136**, 832, Nov. 23, 1935; *J. Gen. Physiol.*, **19**, 1935-36, in press.  
<sup>2</sup> E. Köttgen and G. Abelsdorff, *Z. Psych.*, **12**, 161; 1896.

Oxidative Inactivation of Co-enzyme with Schardinger Enzyme Preparations

IN continuation of experiments showing that a reversible oxidative inactivation of glycolysis or fermentation (Pasteur reaction) may take place<sup>1</sup>, the action of Schardinger enzyme (xanthine oxidase) on fermentation was tried. Schardinger enzyme was prepared from milk by the method described by M. Dixon and Kodama<sup>2</sup> or that due to Toyama<sup>3</sup>. In a mixture of such a milk preparation and yeast macerate (Lebedew) a considerable inhibition of fermentation appears after shaking with oxygen for about 1-1½ hours. In the absence of oxygen, no appreciable inhibition appears in this time.

Fig. 1 shows the results of an experiment in which, before the addition of glucose, the mixture was shaken for 1½ hours with oxygen and nitrogen

respectively. Removal of the oxygen did not restore fermentation. Fermentation recommenced, however, upon addition of a small amount of boiled yeast macerate, or of highly purified co-zymase, for which I am indebted to Prof. von Euler. The oxidation of the nucleotide part of the co-zymase seems very improbable, because Dixon and Lemberg<sup>4</sup> have shown that nucleotides, and also crude co-zymase preparations, are attacked by xanthine oxidase only after hydrolysis by an enzyme contained in the milk

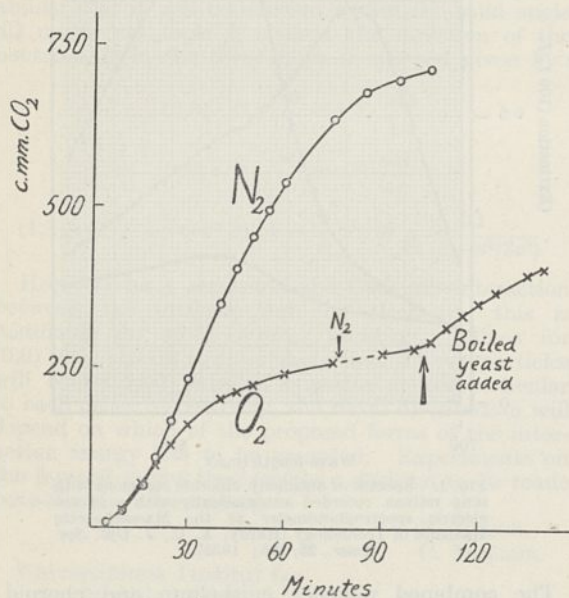


FIG. 1.

preparations. Although the real nature of the oxidative inactivation of co-zymase is not clear, the catalysis of the process by an enzymatic system appears to be of interest in connexion with the mechanism of the Pasteur reaction.

The present report of results, in this stage, is due to the very recent appearance of a publication by B. Andersson<sup>5</sup> from Prof. von Euler's laboratory, also dealing with the action of Schardinger enzyme on co-zymase.

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Biological Institute,  
Carlsberg Foundation,  
Copenhagen.

<sup>1</sup> F. Lipmann, *Biochem. Z.*, **265**, 133; 1933. **268**, 205, 274, 412; 1934.

<sup>2</sup> M. Dixon and K. Kodama, *Biochem. J.*, **20**, 1104; 1926.

<sup>3</sup> I. Toyama, *J. Biochem.*, **17**, 131; 1933.

<sup>4</sup> M. Dixon and Lemberg, *Biochem. J.*, **28**, 2065; 1934.

<sup>5</sup> B. Andersson, *Z. physiol. Chem.*, **235**, 217; 1935.

#### Adsorption of Grass and Butter Carotenes on Alumina

WE have recently reported that the petrol-phasic carotenoid fraction of butter unsaponifiable matter, when subjected to chromatographic adsorption on alumina, separates readily into two coloured zones, the upper red-brown, the lower yellow<sup>1</sup>. The appearance and location of the zones, and the absorption spectra of the elutriated pigments, are consistent with the presence of appreciable quantities of  $\alpha$ -carotene in butter. The  $\alpha$ -isomer has since been independently

detected in butter<sup>2</sup>, using magnesium oxide as adsorbent.

A re-examination, however, of the adsorption of butter carotene on each of these two adsorbents shows that alumina gives an apparent  $\alpha$ -carotene content much greater than does magnesium oxide.

In studying these anomalous results, we carried out adsorption experiments on pure  $\beta$ -carotene itself, the specimen used (*ex* cocksfoot grass; m.p. 180°–182°; rotation nil) being made available through the kindness of Prof. A. C. Chibnall. When this material is submitted to adsorption on alumina (Brockmann's, *ex* Merck, diluted 1 in 3 with inactive alumina), petroleum ether (b.p. 70°–80°) being used as solvent, the adsorbed pigment appears to be homogeneous. If, however, the carotene is washed off the adsorbent with petrol (or elutriated with methyl alcohol), recovered, and readsorbed, it separates clearly into two zones of pigment, the absorption maxima of which, on elutriation, are as follows:

Upper zone	483	452 $\mu\mu$	} in petroleum ether (b.p. 70°–80°);
Lower zone	477	447 $\mu\mu$	

that is, identical with those of  $\beta$ - and  $\alpha$ -carotene respectively. The lower zone thus contains a pigment formed during the adsorption process, and moreover, elutriation and readsorption of either of the two zones gives another separation into two zones with properties as before, on each subsequent adsorption, the process thus being reversible and never complete.

Calcium hydroxide, which separates  $\alpha$ - and  $\beta$ -carotenes<sup>3</sup>, also converts pure  $\beta$ -carotene into this yellow substance, but not so readily as does alumina. Magnesium oxide, also used for separating  $\alpha$ - and  $\beta$ -carotenes<sup>4</sup>, gives no evidence of separation of pure  $\beta$ -carotene into two zones even after four adsorptions. Further, carotene made separable by alumina or calcium hydroxide adsorption is apparently homogeneous when adsorbed on magnesium oxide.

The change has been obtained with pure crystalline  $\beta$ -carotene from both grass and carrots and also with the petrol-phasic carotenoid fractions of butter<sup>1</sup> and blood serum<sup>2</sup>. In the last two cases the pigment separated readily with one adsorption, whilst with the purified pigments a preliminary adsorption was necessary before the separation was evident.

Genuine  $\alpha$ -carotene *ex* palm oil<sup>6</sup> has also been examined. Repeated adsorption on alumina changes this pigment also, giving two zones which, on elutriation, exhibit absorption maxima as follows:

Upper zone ( $\alpha$ -carotene ?)	477	447.5 $\mu\mu$	} in petrol (b.p. 70°–80°).
Lower zone	469	440 $\mu\mu$	

This second substance on readsorption suffers partial reversion, again giving two zones of pigment with absorption maxima as just stated. The absorption maxima characteristic of the lower zone are closely comparable with those already reported, for a yellow substance occurring in small quantity at the bottom of the column, when  $\alpha$ - and  $\beta$ -carotene mixtures are adsorbed on calcium hydroxide<sup>3</sup>.

It might appear that on repeated adsorption  $\beta$ -carotene undergoes a reversible change into the  $\alpha$  form, but the observation that genuine  $\alpha$ -carotene changes into a substance with absorption maxima at shorter instead of longer wave-lengths makes this unlikely.

Whatever the explanation of the foregoing observations, which we are now investigating further, it is

clear that, following the usual procedure for the chromatographic technique, carotene undergoes change into another pigment when repeatedly adsorbed on alumina, even when oxygen is rigorously excluded.

In view of the widespread and successful use of chromatographic methods<sup>7</sup> in the carotenoid field, it is important that the possibility should be recognised that changes can occasionally be brought about by the process itself.

A. E. GILLAM.  
M. S. EL RIDI.

Chemistry Department,  
University, Manchester.  
Nov. 5.

<sup>1</sup> Gillam and Heilbron, *Biochem. J.*, **29**, 834; 1935.

<sup>2</sup> Strain, *J. Biol. Chem.*, **111**, 85; 1935.

<sup>3</sup> Karrer and Walker, *Helv. Chim. Acta*, **16**, 641; 1933.

<sup>4</sup> Strain, *J. Biol. Chem.*, **105**, 525; 1934.

<sup>5</sup> Gillam and El Ridi, *Biochem. J.* (in press).

<sup>6</sup> Kuhn and Brockmann, *Z. physiol. Chem.*, **200**, 255; 1931.

<sup>7</sup> Kuhn and Brockmann, *Z. physiol. Chem.*, **206**, 41; 1932. Cf. also Winterstein, "Klein's Handbuch der Pflanzen-Analyse", **4**, 1403; 1933.

### Plasticity of Bismuth

IN an earlier letter<sup>1</sup> one of us (W. F. B.) tried to explain the discrepancies which exist concerning the plasticity of bismuth. It was confirmed that crystals obtained by different methods behave quite differently; for example, that soft crystals, that is, crystals which slip in tensile tests at room temperature, occur among those made in air (Czocharlski method), whereas only hard crystals are obtained *in vacuo* (Bridgman method). Since the crystals made under atmospheric pressure were found to contain some gas, it was suggested that the gas was responsible for their softness. Hard crystals made *in vacuo* were found to slip in compression tests at room temperature and in tensile tests at higher temperatures<sup>2</sup>. Experiments by Gough<sup>3</sup> and by Andrade and Roscoe<sup>4</sup> seem to support these findings.

Since the difference mentioned above is not the only one in making the crystals, it was desirable to apply a method which would allow the crystals to be grown *in vacuo* or under pressure while keeping all other factors constant. A method devised by Andrade and Roscoe<sup>4</sup> has been found suitable for this purpose. In it a furnace travels horizontally along a wide glass tube, in which lies a thin piece of wire to be made into a single crystal. The glass tube can be evacuated or filled with gas. By this method it is easy to get crystals of any desired orientation by using a seed crystal.

The wires used were 1–2 mm. in diameter and were obtained by casting *in vacuo*, to be sure that they were free of gas. The material was (1) that used in the earlier experiments, (2) Hilger's spectroscopically pure Bi No. 9506, the same material, we understand, as used by Andrade and Roscoe<sup>5</sup>. Crystals were grown from (1) *in vacuo*, and in nitrogen, hydrogen, carbon dioxide; from (2) *in vacuo* only. The rate of growth was 1.6 mm./min.

Under all conditions some of the crystals obtained were soft. So far as the experiments on crystals grown under atmospheric pressure are concerned, these results are a qualitative confirmation of those of Georgieff and Schmid<sup>6</sup>, since their crystals, obtained by the Czocharlski method, contained gas. We consider the fact that crystals grown *in vacuo* show a similar behaviour, goes beyond their results, and it also seems at variance with the results of Andrade and Roscoe<sup>5</sup>. It remains to be seen whether

the conformity of the crystals grown in gas and *in vacuo* is a quantitative one. We believe that the crystals made in vacuum exhibit the 'true behaviour' of bismuth, because the Andrade method seems the least objectionable of all. Any hard crystals found could be explained by unsuitable orientation<sup>6</sup>. Thus the gas content seems to have little influence, and another explanation has to be found to show why bismuth crystals grown by Bridgman's method are hard. Here the material is cast into glass tubes and remains there while solidifying. Owing to the well-known anomalous behaviour of bismuth, it seems possible that it becomes subject to heavy stresses from the surrounding glass while cooling under such conditions. We have confirmed the fact, already stated by Gough and Cox<sup>7</sup>, that one seldom finds a bismuth crystal obtained by this method which does not show mechanical twinning. It thus appears likely that the hardness of such crystals is but another example of strain hardening.

W. F. BERG.  
L. SANDLER.

Physical Laboratories,  
University,  
Manchester.

Oct. 17.

<sup>1</sup> NATURE, **133**, 831; 1934.

<sup>2</sup> NATURE, **134**, 143; 1934.

<sup>3</sup> Proc. International Conference on Physics, **2**, 180; 1934.

<sup>4</sup> *Ibid.*, **2**, 176.

<sup>5</sup> *Ibid.*, **2**, 176.

<sup>6</sup> *Z. Phys.*, **36**, 759; 1926.

<sup>7</sup> *J. Inst. Metals*, **48**, 227; 1932.

DR. BERG has invited me to comment in print upon an earlier version of the above letter. In view of the somewhat contradictory nature of the findings communicated in his last two letters on the subject, I think that any attempt to estimate how far he has gone beyond Georgieff and Schmid may well await his final results, which will, no doubt, be shortly published with due circumstance in one of the technical journals. I have been unsuccessful in a private attempt to make Dr. Berg understand what I consider to be the significance of our results on bismuth, and I do not think that it would be profitable to renew the attempt in public. The letter does, however, contain one fact, previously unknown to me, which I note with interest, namely, that Dr. Berg has found useful our technique for growing strain-free single crystals\*, which we had the pleasure of demonstrating to him in detail when he paid a personal visit to our laboratory last year.

E. N. DA C. ANDRADE.

University College,  
London, W.C.1.

\* Unpublished, except for a three-line reference in "Proceedings of the International Conference on Physics", 1934, p. 173.

### Coalescence in Stages between Two Drops of a Liquid

IN a letter in NATURE of August 3<sup>1</sup>, Ian W. Wark and Alwyn B. Cox record their observation that "Small drops directed obliquely on to the surface of tap water do not immediately coalesce with it", and they suggest that the reason for this lies in the contamination of the surface by a thin film of grease or dust.

So far as one can see from this short description, the phenomenon seems to be identical with, or similar

to, that which I described a few years ago<sup>2</sup>. If a fine jet of water issuing from a fine nozzle with a moderate velocity reaches the surface of tap or distilled water in its instability range, it is resolved into many floating drops which last about three seconds. I noticed that the chief condition for the success of the experiment was the freshness and cleanness of the water used. Even the least trace of grease, for example, the very touch of the surface with the fingers, lessened the range and life of the drops, or even made success impossible. In so far as the same phenomenon is in question, the interpretation of the above-mentioned authors is opposed to these observations of mine.

M. KATALINIĆ.

Physics Institute,  
University of Zagreb,  
Yugoslavia.  
Oct. 16.

<sup>1</sup> I. W. Wark and A. B. Cox, *NATURE*, **136**, 182, August 3, 1935.  
<sup>2</sup> M. Katalinić, *NATURE*, **127**, 627, April 25, 1931.

### Cytoplasmic Bodies in the Oogenesis of *Lumbricus*

By those<sup>1</sup> who have worked on the oogenesis of *Lumbricus* or allied forms, the vitellogenesis is believed to be one of the simplest known, though there is no general agreement.

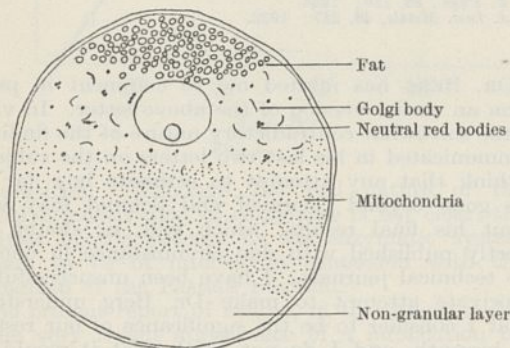


FIG. 1.

We have recently used the Beams' ultra-centrifuge on these eggs, and our findings are as follow. The cytoplasmic granules form a number of layers, consisting of fat granules above, Golgi elements below and in the region of the nucleus, mitochondria lower still, and the lowermost layer formed of a homogeneous and non-granular substance, as shown in the semi-diagrammatic reproduction (Fig. 1). The mitochondria are granular, not filamentous. No protein yolk could be found, and the larger granules to be seen so clearly in the living eggs are fat, not Golgi bodies; when previously stained supra-vitally in neutral red, before centrifuging, the globules so produced take up a position mainly between the fat and the mitochondria, that is the region where the dictyosomes of the Golgi apparatus come to lie.

GERTRUDE NORMINTON.  
J. BRONTË GATENBY.

Dept. Zoology,  
Trinity College, Dublin.  
Nov. 2.

<sup>1</sup> Harvey, *Quart. J. Micr. Sci.*, **74**: 1931. Gatenby and Nath, *Quart. J. Micr. Sci.*, **70**: 1926. Nath, *Quart. J. Micr. Sci.*, **73**: 1930. Weiner, *Z. mikr. anat. Forsch.*, **20**: 1930.

### Age of the Universe

SIR JAMES JEANS has recently pointed out<sup>1</sup> that observations of binary stars indicate  $10^{13}$  years as the order of age of the universe, while the recession of the nebulae, indicated by their spectral shift, suggests an age of the order of  $10^{10}$  years.

In a recent publication<sup>2</sup>, however, we have shown how the spectral shifts may be accounted for by a variation with time of certain electrical and quantum quantities; this allows a way out of the difficulty. In order to measure times over long periods, one must define a standard for measuring time intervals at different epochs; such a standard might depend either on gravitational or electrical measurements, and the two systems, though by definition agreeing now, might differ in the results for a period of time in the past. Thus the age of the universe might well be  $10^{13}$  years when measured in terms of a gravitational definition of the year, and at the same time  $10^{10}$  years when measured in terms of an electrical definition of the year. The apparent discrepancy now becomes a way of determining the relative values of electrical and gravitational phenomena in the past.

J. A. CHALMERS.

The University,  
Durham.

BRUCE CHALMERS.

Sir John Cass Technical Institute,  
London.

<sup>1</sup> J. H. Jeans, *NATURE*, **136**, 432, Sept. 14, 1935.

<sup>2</sup> J. A. Chalmers and B. Chalmers, *Phil. Mag.*, **19**, 436; 1935.

### The Spectrum of $\gamma$ Cassiopeiae

ON and since October 7, a very strong and very sharp absorption line, the strongest and sharpest absorption line in the whole spectrum, suddenly appeared in the spectrum of  $\gamma$  Cassiopeiae. This line is nearly coincident in position with that which should be occupied by the bright violet component of H $\zeta$ . On receiving this information, Prof. A. Fowler has suggested that it is probably the neutral line of helium ( $\lambda$  3888.646) intensity 10, this line being the strongest line of the principal series of the triplet system. The next line in this series is at  $\lambda$  3187.743 (intensity 8), but this falls outside the region photographed at Sidmouth, so its presence cannot be ascertained.

In view of the other important changes in the spectrum to which I have recently directed attention, the spectrum evidently needs careful watching for further variations.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,  
Sidmouth.  
Nov. 24.

### Fossil Human Occipital Bone from Thames Gravels

UNDER "News and Views" in *NATURE* of October 19, page 638, the discovery at Swanscombe of a human skull fragment by Mr. Marsden is recorded and the note says, *inter alia*, "The bone was associated with Acheulean flint implements". We should like to put on record that in our experience the middle gravel of the 100-ft. terrace, in which the bone was found, contains, in addition to Acheulean hand-axes and flake tools, artefacts of Clacton III type closely resembling those of High Lodge, and also a few flakes exhibiting a Levalloisian technique.



Both of us have been privileged to examine the actual spot where the skull fragment was found, and we can record that at the horizon in question unbraided Clactonian flakes and tools are almost as common as Acheulean ones.

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### Recrystallisation accompanying an Allotropic Change

DR. W. G. BURGERS and Dr. van Amstel are to be congratulated on their success in obtaining a cinematograph record of the  $\alpha \rightleftharpoons \gamma$  change in iron by the very beautiful method they describe in NATURE of November 2 (136, 721). Their photographs show

that recrystallisation at an allotropic change point is similar to that occurring on heating coldworked metal. Some years ago, in order to settle this same point, I examined a number of salts which undergo allotropic changes of a similar character. Ammonium, potassium and silver nitrates are particularly suitable as they can be melted on a slide and, if crossed Nicol prisms are used, the whole process can be studied. In every case the change began at the crystal boundaries or round an inclusion or blow-hole, by the appearance of new crystal nuclei which rapidly spread across the field. I then found that the rate of change could be slowed down by the presence of a cover-slip and by regulating the thickness of the fused salt, and obtained a series of photographs—some of them in colour—illustrating the change over.

C. F. ELAM.

Engineering Laboratories,  
Cambridge.

### Points from Foregoing Letters

Mass spectrograms of platinum and platinum-iridium alloy obtained by means of a high-frequency spark are submitted by Prof. A. J. Dempster. They confirm the existence of two iridium isotopes of mass numbers 191 and 193, the existence of which was recently deduced by Venkatesachar and Sibaiya from the arc spectrum of iridium. These two isotopes fill the only gaps in the mass number scale in this region.

Prof. M. W. Travers discusses the processes involved in the thermal decomposition of acetaldehyde and of ethylene oxide, concerning the mechanism of which a divergence of opinion exists. Prof. Travers claims that additional experiments support his view that the reactions depend upon the surface of the system and that they involve a 'chain' mechanism.

The detection by Dr. J. Bell of small amounts of methyl alcohol (0.13 per cent) and of formaldehyde (0.03 per cent) in the suddenly cooled products of the explosion of a methane-oxygen mixture is reported by Prof. W. A. Bone.

The radioactivity of oil-waters from Czechoslovakia has been measured by Prof. F. Běhounek, V. Santholzer and Prof. F. Ulrich. The highest content of radium found is  $7.25 \times 10^{-10}$  gm. in one litre of water, from a depth of 262 metres. This is much lower than the radioactivity reported by Vernadsky from oil-waters in the Northern Caucasus ( $1.46 \times 10^{-7}$  gm. per litre).

In order to account for the production of electrons of different energies by radioactive elements, some physicists have been led to postulate the simultaneous emission of neutrinos, which are uncharged particles of mass comparable with that of the electron. Drs. F. Bloch and C. Möller discuss the probable relation between the direction of emission of the electron and that of the neutrino.

The electrolytic separation coefficient for the isotopes of oxygen is found by Geoffrey Ogden to lie between 0.86 and 1.0, depending on the width and height of the energy barrier, and taking into account the possibility of 'tunnelling' of the barrier by the  $O^{16}H$  or  $O^{18}H$  complex. This range of values is in good agreement with the available experimental results.

Further experiments on the chemical changes taking place in the retina, connected with the visual purple system, are reported by G. Wald. He finds that in the retina of fishes, as in that of frogs, the

following cycle occurs: visual purple  $\rightarrow$  retinene  $\rightarrow$  vitamin A  $\rightarrow$  visual purple.

In connexion with processes that may affect the glycogen  $\rightarrow$  lactic acid fermentation (Pasteur reaction), Dr. F. Lipmann reports that an inhibition of fermentation takes place when yeast macerate is mixed with a milk preparation containing xanthine oxidase (Schardinger enzyme), in the presence of oxygen. Fermentation recommences upon addition of boiled yeast macerate or purified co-zyzyme.

A. E. Gillam and M. S. El Ridi present evidence to show that, when pure  $\beta$ -carotene from grass is twice adsorbed on alumina, it changes partially into a substance similar to  $\alpha$ -carotene. The process is reversible, as this substance on reabsorption reverts in part to the original  $\beta$  form. Genuine  $\alpha$ -carotene is also changed under these conditions, and it is therefore important to recognise that surface adsorption can itself change certain pigments as well as separate them (chromatographic adsorption).

Applying the method of Andrade and Roscoe for growing metal crystals under atmospheric pressure or *in vacuo*, leaving all other factors constant, Dr. W. F. Berg and L. Sandler show that bismuth crystals, which slip in tensile tests at room temperature, can be obtained in gas and *in vacuo*. The hypothesis that gas was responsible for the softness of bismuth crystals, put forward by Dr. Berg in an earlier letter, is now withdrawn. The hardness of bismuth crystals obtained by Bridgman's method is tentatively explained as strain hardening.

A diagram showing the order in which the various constituents of the egg of the earthworm (*Lumbricus*) arrange themselves under the influence of a strong centrifugal force is given by Miss Gertrude Norminton and Prof. J. Brontë Gatenby. No protein yolk could be found, though yolk formation is believed by some to be one of the simplest of life processes.

Dr. J. A. and Mr. B. Chalmers claim that the discrepancy between the age of the universe deduced from the 'reddening' of the light from nebulae ( $10^{10}$  years) and that computed from observations of binary stars (which indicate a period a thousand times greater) may be simply explained by a change in the time standard at different epochs, since the standard may depend upon gravitational and electrical factors.

## Research Items

### Alaskan Archæology

DR. ALEŠ HRDLIČKA, the Smithsonian Institution of Washington, D.C., reports, has recently returned from his fourth successive season of excavation on a habitation site on Kodiak Island, off the coast of Alaska. He is more than ever convinced that this is one of the key sites of North American archæology. It covers four acres, and in places the deposits are more than sixteen feet in depth. At least one more season is required to complete the excavation; and judging from the manner in which new and disturbing factors have occurred unexpectedly in the exploration of previous years, Dr. Hrdlička regards it as unsafe at present to draw anything but the most tentative conclusions in the interpretation of the evidence. As the result, however, of a personal examination of the prehistoric evidence from British Columbia, he is convinced that the peoples of Kodiak and the British Columbia coastal area are identical in physique and culture. The Kodiak culture in its earliest phase is dated at approximately two thousand years ago. Only shortly before did the island become inhabitable, owing to the shrinkage of glaciers. The glacial period was followed by a deposit of loess on the glacial till, and it was on this loess that the first settlement took place. The first settlement was of brief duration, the people possibly migrating to the north-west coast. A further deposit of four or five inches of loess was succeeded by a period of pluviation, which covered the island with vegetation; and from this time forward, it was inhabited continuously until about the time of the coming of the Russians, when it was abandoned. For about the last fifth of this occupation the island was inhabited by people of Aleut type who had massacred the older inhabitants. In all the periods of the older occupation there was a relatively high type of culture, the oldest being in some respects the most advanced. It was in this earliest period that carving in wood, bone and ivory flourished, most characteristic being a realistic form of portraiture, in which one specimen shows the feature, rare among North American indigenes, of a chin beard.

### Elasmobranchs from Puget Sound

WHILST collecting on the shrimp trawler *Audrey*, Allan C. DeLacy and Wilbert M. Chapman captured some interesting adult elasmobranchs and egg-cases (*Copeia*, No. 2, 1935). Egg-cases of *Apristurus brunneus* were taken from the female, and others were found attached by their tendrils to a sea-whip, *Stylatula*. The adult is little known, but twenty-two specimens were taken by the *Audrey* in Saratoga Passage and along the east side of Camano Island. Other egg-cases described are those of *Raja rhina*, taken abundantly off Everett and a few from the San Juan Islands, and *Raja binoculata* from the latter locality, taken commonly throughout the summer. Two young skates of *R. binoculata* measured shortly after they had hatched from an egg-case in an aquarium were 194 mm. and 197 mm. in total length respectively. Egg-cases of the ratfish, *Hydrolagus collicii*, were also common, the length ranging from 114 mm. to 140 mm. A tendril 120 mm. long was

seen on one freshly deposited case. The cases were always empty, or contained undeveloped eggs. In one instance, the trawl brought up a female ratfish to which the egg-cases were still attached by their long anterior filament. Embryos of *Squalus neckleyi* were examined, and here the eggs in the Müllerian duct are enclosed in a long tubular case, transparent, flexible and entirely smooth, which ends in a single horn bearing a tendril which in one specimen was 70 mm. long. When the embryos have developed to a size not exactly known, the egg-case is resorbed or sloughed off, and the embryos continue their development in the Müllerian duct, which is abundantly supplied with large blood vessels and has, dependent from the inner side, innumerable small platelets also liberally supplied with blood vessels. When the yolk has been completely absorbed, the young dogfish are born alive. 1-4 eggs may be enclosed in one case.

### Japanese Freshwater Cladocera

DR. MASUZO UÉNO, following his first paper (1927, in the same periodical), continues his study of the freshwater Branchiopoda of Japan in three further papers (*Mem. Coll. Sci., Kyoto Imp. Univ.*, B, 8, No. 3, 1933; 9, No. 4, 1934). Many lakes and ponds have been investigated in various localities. Only eighteen species of *Cladocera* have been found in the waters round Hokkaidô, *Daphnia longispina* and *Bosmina coregoni* showing the widest range of distribution. The second paper deals with *Daphnia pulex* and *D. longispina*; the latter in a small oligotrophic pond in Kyoto was observed for two years, with the result that two maxima occurred in each year, a conspicuous one in April, and a weak one in autumn. Such a type of seasonal succession in the genus has never been observed in European waters. The rate of growth is greatest in early spring, falling towards summer, and again increasing markedly in autumn. Accordingly the animals are small in size during the summer months, though there was seen no distinct seasonal change in shape from spring to winter. The population was dicyclic in the first year and monocyclic in the second year. The production of males or ephippial females were conspicuously scarce, and the number of parthenogenetic eggs markedly decreases before the commencement of sexual periods, the males always occurring shortly after an extreme maximum of the population. In the third paper it is shown that the local variation of this species is greater than in the other species, its external appearance differing much from lake to lake.

### Abdominal Mechanisms of a Grasshopper

UNDER the foregoing title, Mr. R. E. Snodgrass, of the U.S. Bureau of Entomology, has written a memoir which forms a natural sequence to his earlier study entitled "The Thoracic Mechanism of a Grasshopper". The present contribution forms No. 6, vol. 94 of the Smithsonian Miscellaneous Collections (Sept., 1935). The primary object of the work has been to arrive at an understanding of the mechanisms of copulation and oviposition in the family Acridiidae.

which presents various peculiar features. It is, in fact, a study in functional morphology, and consequently very full consideration is given to the musculature of the abdomen and its associated organs. Following this, the ovipositor and its related parts are treated in detail and likewise the male genitalia. The general title of the paper is, perhaps, too restricted in its implication since it comprises a survey of abdominal organs in the main groups of the Acridiidae. Like all Mr. Snodgrass's contributions, the work is the result of its author's first-hand study, and is illustrated by numerous excellent text-figures. Space does not admit of any discussion of the author's conclusions and theories; it will serve here to direct the attention of morphologists to a contribution of major importance.

#### Bombay Grasses

SINCE the publication of the "Flora of Bombay" (1903), many additions have been made to the grass flora of the Presidency, and there have been many changes in generic concepts. In a recent volume (Imp. Council Agric. Research; Scientific Monograph No. 5, 1935) Blatter and McCann have brought up to date the systematic account of the Gramineae of this area. More than three hundred species belonging to 110 genera are described, and many are illustrated. In the definition and sequence of the tribes, the authors have followed Stapf. Full descriptions of the species are supplemented by vernacular names, notes on etymology, ecology, economic uses and distribution. Keys are given for the genera and species.

#### The Ranges of Eastern Siberia

MUCH new light on the Yablonovi and Stanovoi and associated ranges of eastern Siberia has been shed in recent years by the work of Russian travellers. This is expounded by Prof. V. A. Obruchev in an article in the *Geographical Journal* of November. Most older maps showed these ranges as marking a continuous divide between the Arctic and Pacific drainage from Mongolia to Bering Strait. Kropotkin, however, separated the two and made the Stanovoi a continuation of the Great Khingan Range. It would now appear that the Yablonovi, which is in the main a faulted horst of crystalline and metamorphic rocks, consists of more than one range, and only in its middle part takes the form of a step between the higher plateau to the west and the lower to the east. On the south it begins about the Chikoi River and on the north it seems to end about the Olekma River. The Stanovoi, on the other hand, is a much longer range beginning at Lake Baikal in the south but not forming a main drainage divide between Arctic and Pacific north of about lat. 60° N. It then curves inland to the north and north-west and cuts off the distinctive north-west and south-east ranges of the extreme east of Siberia. In structure, the Stanovoi is complicated, but the present relief is due mainly to faulting in metamorphic and other ancient rocks, and the formation of a series of horsts and troughs, the former dissected into numerous peaks.

#### Tokyo Earthquakes in 1934

IN four *Seismometrical Reports* issued by the Earthquake Research Institute, lists are given of the earthquakes felt in Tokyo during the year 1934. Within about eighty miles of the capital, there is a network of fourteen stations, the records at which

enable the position of a focus to be determined. During the year, 64 earthquakes were sensible in Tokyo, a number slightly above the annual average, none of them of destructive intensity and one only (in the Idu peninsula) strong enough to throw down vases, etc. Most of the epicentres lie on land to the north of Tokyo Bay, but 2 are under Sagami Bay and 14 beneath the Pacific Ocean and within 45 miles from the coast. In 56 of the earthquakes, the depth of the focus is estimated, ranging from 2½ to 50 miles, with an average of 30 miles.

#### Turbulence of the Lower Atmosphere

*Geophysical Memoir* No. 65 of the Meteorological Office is an account of valuable experiments made in 1931-33 on various aspects of turbulence in the layer of atmosphere nearest to the ground, by A. C. Best, under the title "Transfer of Heat and Momentum in the Lowest Layers of the Atmosphere". The experiments were carried out on a ridge of high ground on the south-eastern edge of Salisbury Plain. The instrumental equipment included apparatus for determining the difference of temperature over various height intervals, the lowest layer extending from 2.5 cm. to 30 cm. and the highest from 7.1 metres to 17.1 metres. Thermo-electric couples were used for the lower intervals; these were housed inside concentric tubular nickel-plated brass radiation shields provided with aspiration pipes leading to an electric fan. For the study of the vertical gradient of wind velocity near the ground, air meters of the conventional vane type were used, also special low-speed meters calibrated for velocities as low as 0.3 metres per sec., and a hot wire anemometer that was specially designed for this investigation in order that wind measurements could be made 2.5 cm. above the ground. To those unfamiliar with conditions very near to the ground in clear weather, some of the figures are likely to prove startling, as for example, those giving the absolute extremes of temperature difference between heights of 2.5 cm. and 30 cm., which include a lapse of 10.8° F. on a sunny morning in May and an inversion of 11° F. between the same heights during a night of clear sky in March. The former figure is about 2,000 times the dry adiabatic gradient, a rather larger ratio than has been deduced by D. Brunt as the maximum possible for stable conditions, but Brunt's formula was well supported by the rather lower extremes obtained for hourly means of temperature difference.

#### Combined Alternating Stresses

A PAPER entitled "The Strength of Metals under Combined Alternating Stresses" was read to the Institution of Mechanical Engineers by Dr. H. J. Gough and Mr. H. V. Pollard, of the Engineering Department, National Physical Laboratory, on November 1. It describes a research, by means of a specially designed high-speed testing machine, into the resistance of metals under combined alternating plane flexural and torsional stresses. A comprehensive study was made of three materials—a normalised 0.1 per cent carbon steel, a heat-treated 3.5 per cent nickel-chromium steel and a silicon cast iron—which were subjected to plane bending stress, torsional stress and five combinations of these. The results showed a simple relation

$$f^2/f_1^2 + q^2/q_1^2 = 1$$

to exist, where  $f$  and  $q$  represent the bending and

torsional stresses at the fatigue limit due to the applied load, while  $f_1$  and  $q_1$  denote the fatigue limits of stress under simple bending and torsion respectively. It is proposed to apply similar tests to a wide range of steels but, meantime, the authors are of the opinion that "until data for other metals become available it appears unlikely that any serious error would be involved in estimating the fatigue resistance of ductile metals to combined stresses by the use of this equation and the experimentally determined values of  $f_1$  and  $q_1$ ". The specimens of ductile steel yielded no data regarding the plane on which failure first occurs, whereas the cast iron specimens exhibited close agreement between the fracture plane and that of greatest principal stress.

#### X-Ray Study of Substituted Edingtonites

IN a paper read before the Mineralogical Society on November 14, W. H. Taylor described an X-ray examination of substituted edingtonites. X-ray investigations of base-exchange products of analcime and natrolite have shown that a monovalent ion like silver takes up the exact position previously occupied by the sodium ion which it replaces. Each divalent barium ion of edingtonite  $Ba_2Al_4Si_6O_{20} \cdot 8H_2O$  is replaced, however, by two monovalent ions. X-ray work on the thallium compound  $Tl_4Al_4Si_6O_{20} \cdot 8H_2O$  shows that there is no essential change in the framework of  $(SiO_4)$  and  $(AlO_4)$  tetrahedron-chains lying parallel to the  $c$ -axis. The four thallium ions are, however, distributed uniformly among six possible positions made up of a two-fold group and a four-fold group. Of the six possible positions, two are near the positions occupied by barium ions in the mineral edingtonite, the remaining four (one half occupied) are as far distant as possible from other positive ions—thallium, silicon and aluminium. A study of potassium edingtonite yields an almost identical distribution for the potassium ions; small differences in distribution are probably due to incomplete replacement of the barium ions. The observed arrangement of cations satisfies the condition of a uniform distribution of residual valency.

#### Concentration Cell in Quantitative Analysis

A RAPID and accurate electrometric technique for the determination of small amounts of substances which may occur in salts has been worked out by N. H. Furman and G. W. Low (*J. Amer. Chem. Soc.*, 57, 1585; 1935) and applied to the determination of small amounts of chloride. It depends on the use of a concentration cell with silver-silver chloride electrodes. The cell is very simple in construction and the results are comparable in accuracy with those obtained by the nephelometer, with the advantage that foreign salts do not cause difficulties as they do in the use of the nephelometer. Traces of chloride so low as 0.00035 gm. per litre were accurately measured. In a second paper the authors compare five different methods for chloride determination, three electrometric and two nephelometric. A new photronic nephelometer is described. The general result is that the electrometric methods are more accurate, easier to perform and less time-consuming. The general experience with nephelometers, that the chief difficulty lies in the reproducibility of the suspensions, was confirmed.

#### Determination of Iodine in Biological Substances

IODINE plays an important part in the metabolism of the body, since it is present in the molecule of thyroxine, the hormone of the thyroid gland; the normal level of metabolism in warm-blooded animals is only maintained when this gland secretes into the blood-stream for distribution throughout the body adequate amounts of thyroxine. The removal of the iodine atoms from thyroxine leaves a compound which has none of the specific activity of the former substance. Iodine is therefore an important constituent of the diet, but the amounts found in natural sources are exceedingly small and difficult to estimate. The need of a reliable method of estimation is shown by the facts that the incidence of goitre in different regions is related to the iodine content of foodstuffs and the water supply, and that in the converse condition of hyperthyroidism, the blood content of iodine is much greater than normal. C. O. Harvey has recently published the results of an investigation, carried out under the auspices of the Medical Research Council, into methods of estimating minute amounts of iodine, together with a description of a standardised reliable method, based on Hurlley's modification of Von Fellenberg's procedure (Special Report Series, No. 201. London: H.M. Stationery Office, 1935. 1s. 0d. net). Briefly, the method consists in the digestion of the material with caustic potash, followed by ignition in a nickel dish and extraction of the alkaline mass from the carbon with water. The iodide is extracted with alcohol, oxidised to iodate with bromine water, and the iodine, liberated by addition of potassium iodide, titrated in the usual manner with sodium thiosulphate. Nitrite is destroyed by addition of sodium azide before the oxidation with bromine. Harvey gives full details for carrying out the process, including the methods of preparing the reagents. By his method the iodine in 50 ml. milk, 5 gm. dried vegetable material or 10 ml. blood can be determined, the amounts present being of the order of 1 gamma. With strict attention to all the details of the process, the method has given comparable results in the hands of different workers.

#### Intensities of Fraunhofer Lines

IN the *Memoirs of the Commonwealth Solar Observatory*, No. 5, Parts 1 and 2, Dr. C. W. Allen discusses the measurement of the intensities of Fraunhofer lines in the spectral region 4036 Å.-6600 Å. This is the most extensive series of observations which has as yet appeared. The author has used the standard methods of photographic photometry, and his results agree largely with those of other observers who have worked on more limited regions of the spectrum; but the general standard of agreement between one observer and another using this method is not very high. Two observations of the same line, made at different observatories, differing by five per cent between themselves, would count as substantial agreement under present conditions. Dr. Allen confirms the well-known result that solar multiplet intensities can only be reconciled with laboratory and theoretical intensities if a damping constant ten times that given by Lorentz on the classical electromagnetic theory is used in computing the correction for Doppler effect. He is able to show a connexion between the sharpness of the line and the excitation potential of the lower state, and to deduce values for the abundance of the elements in the sun which are in substantial agreement with Russell's values.

## Anniversary Meeting of the Royal Society

ON St. Andrew's Day, November 30, the customary anniversary meeting of the Royal Society was held, and Sir Frederick Gowland Hopkins delivered his presidential address. In the course of the address, he referred to the work of the fourteen fellows and four foreign members of the Society who have died since the last anniversary meeting. Speaking of the Report of Council, he stated that a gift of £10,000 has been recently received at the instance of Prof. P. E. Newberry and Mrs. Newberry from the trustees of the late William Johnston, of Liverpool, for the foundation of a fellowship or studentship for research on problems of health. He also said that, in the last ten years, both the *Philosophical Transactions* and *Proceedings* of the Society have doubled in bulk, while the Society's present expenditure on research is nearly ten times that of twenty-five years ago.

At the conclusion of his presidential address, parts of which are printed in this issue (p. 893), Sir Frederick presented the medals for 1935; extracts from his remarks in making the presentations are given below.

### PRESENTATION OF MEDALS

Copley Medal, awarded to Prof. C. T. R. Wilson

Prof. Charles Thomson Rees Wilson is awarded the Copley Medal for his contributions to the progress of modern physics by his work on the use of clouds in advancing our knowledge of atoms and their properties. How wide the field of his work has been can be seen from the following summary of his researches. He studied the phenomena of condensation of vapour to form drops by the use of expansion apparatus—which he designed. He discovered the existence of 'rainlike' and 'cloudlike' condensation of water vapour, and measured the corresponding supersaturations and critical expansions. He also measured the supersaturations requisite to produce condensation of water vapour on ions of both signs produced in various ways. He devised and constructed various types of electrometers, and with them and with his cloud apparatus demonstrated the so-called natural ionisation of air and other gases. With a new form of expansion apparatus, he photographed the tracks of ionising particles and radiations traversing gases.

Prof. Wilson next developed methods of measurement which he applied to the study of thunderstorm electricity. In this work the main phenomena relating to the electric field changes produced by lightning discharges were observed for the first time, studied quantitatively, and the principles of their interpretation outlined.

Prof. Wilson further extended the use of the cloud-chamber method. Stereoscopic methods of photographing ionisation tracks in the cloud chamber were applied successfully to the investigation of the properties of photo-electrons and Compton recoil electrons, including their ranges. In recent years, he has continued to make numerous and important contributions to the study of atmospheric electricity and, by introducing important improvements and modifications into his cloud-chambers, he has greatly extended their use.

A Royal Medal, awarded to Prof. C. G. Darwin

A Royal Medal is awarded to Prof. Charles Galton Darwin for his researches in mathematical physics, especially in quantum-mechanics, optics and statistical mechanics. His papers on the reflection of X-rays are now regarded as the fundamental researches on the subject.

In a series of papers on statistical mechanics, written in collaboration with R. H. Fowler, he published a new mathematical technique by which the relation of thermodynamics to statistics was placed on a satisfactory basis, and the way was opened for extensive subsequent developments.

Perhaps the most original and influential of Darwin's papers have been those concerned with quantum-mechanics. The quantum theory of the motion of an electron in an electromagnetic field, as it had been developed before 1925, gave results not in accordance with experiment. To obviate this, in 1925, the assumption was introduced that the electron has a mechanical angular momentum and a magnetic moment; but this conception did not admit of the application of wave-theory, since the waves corresponding directly to such an electron would be in space of six dimensions. It was Darwin who in February 1927 put forward the idea which led ultimately to the solution of these difficulties; he assumed that, just as there are two independent polarised components in a wave of light, so there are two independent components in the wave of an electron. He then constructed a pair of equations to represent the fine structure of the hydrogen spectrum, obtaining all the levels correctly except the *s*-levels, and showed how the equations could be expressed in vectorial form, so that, as he expressed it, the electron was a vector wave.

Among the quantum papers is also numbered the celebrated memoir on "Free Motion in Wave Mechanics", in which he took up the general question of aperiodic phenomena and dealt with it in masterly fashion, the principles of description and interpretation which are now universally accepted being formulated and applied to the free motion of electrons and atoms in various types of field.

A Royal Medal, awarded to Dr. A. Harker

A Royal Medal is awarded to Dr. Alfred Harker as the greatest British petrologist since that subject became a science. In 1886 he published a paper on slaty cleavage, which added considerably to the better understanding of the nature and laws of cleavage phenomena. His next important contribution was the Sedgwick Prize Essay of 1889 on the Bala Volcanic Series of Carnarvonshire. In collaboration with his colleague, J. E. Marr, he published a notable work on the Shap granite and associated rocks.

It is probably true to say that Harker's greatest achievement is the geological mapping of the island of Skye in 1895–1901, the results of which were published as a memoir of the Geological Survey in 1904. This monumental work has had a very wide influence upon the science of petrology: in this memoir and in the subsequent memoir on the Smaller

Islands of the Inner Hebrides, Harker set a high standard of work both in the field and in the laboratory. His book on the "Natural History of Igneous Rocks", published in 1909, has been described as "a work which has had a greater effect than any geological publication in the last fifty years". He has also made contributions of great value to the subject of differentiation of rock magmas, etc. His latest book on "Metamorphism", published in 1932, is the best contribution to the subject written in any language.

#### Davy Medal, awarded to Prof. A. Harden

Prof. Arthur Harden is awarded the Davy Medal in recognition of his distinguished work in biochemistry and especially of his fundamental discoveries in the chemistry of alcoholic fermentation. In 1904, in collaboration with his colleague W. J. Young, he showed that the alcoholic ferment of active cell-free yeast juice, the preparation of which had been achieved a few years earlier by E. and H. Buchner, could be separated into two components, a thermolabile non-dialysable enzyme complex and a thermostable dialysable co-enzyme, both of these being essential for the fermentation of sugar. They observed that the fermentation of sugars by this yeast juice was profoundly affected by an addition of inorganic phosphate, and followed up this discovery by a detailed and systematic investigation of the carbon balance, from which they showed that, for each hexose molecule broken down to carbon dioxide and alcohol, another molecule became esterified with phosphoric acid. From the fermentation products, hexosediphosphoric and hexosemonophosphoric esters were afterwards isolated by Harden and his colleagues. These discoveries have been the foundation upon which much of our present knowledge of the intermediate changes in the enzymic breakdown of carbohydrate has been established.

Harden has made important contributions to our knowledge of chemical reactions effected by bacterial enzymes, especially those concerned in carbohydrate metabolism. He has also taken an active part in the development of vitamin research in Great Britain, while as editor of the *Biochemical Journal* since 1911 he has influenced deeply the development of this branch of chemistry.

#### Hughes Medal, awarded to Dr. C. J. Davisson

A Hughes Medal is awarded to Dr. Clinton Joseph Davisson for his discovery that electrons are diffracted like waves of light. Like many other discoveries, this one disclosed itself gradually; but its origin can certainly be traced to some experiments on the scattering of electrons by nickel made by Davisson and Kunsman in 1921. Davisson recognised at the time that the observed effects did not harmonise with the existing theories of matter and electrons. Owing to the polycrystalline nature of the metals investigated, the correct interpretation to be put upon the results was not at all clear. Davisson fully recognised the importance of this discrepancy, and this he and his assistants proceeded to investigate with great pertinacity and skill.

Towards the end of 1926, Davisson and Germer succeeded in making similar experiments with a single metallic crystal surface, so that the results were simple enough to be interpreted easily. It was then at once seen that the electrons were diffracted like waves of light of the wave-length required by the theory which had in the meanwhile been put forward by M. de Broglie towards the end of 1924. The first announcement of Davisson and Germer's results was published in *NATURE* of April 16, 1927. This publication was the first clear experimental proof of the wave character of the electron.

Davisson has also made important contributions to thermionics.

## Thixotropic Colloids

A PUBLIC lecture on some recent developments of colloid science was delivered at Queen Mary College, London, on November 29 by Prof. H. Freundlich.

Prof. Freundlich pointed out that, whilst it has long been known that a solid gel, such as a gelatin gel, may be liquefied to a sol on heating, and that it returns reversibly to the state of a gel on cooling, investigators in colloid science scarcely realised until recently that an isothermal, reversible, sol-gel transformation is also very frequent. Many gels may be liquefied by shaking or stirring and set to a gel again, in a definite time, when left to themselves. This phenomenon is called thixotropy. It is found not only in true sols and gels (of oxides like  $Al_2O_3$ ,  $Fe_2O_3$ , of gelatin, etc.), but also in concentrated suspensions of coarser particles (of clays, bentonite, etc.). In many cases, thixotropy may be regarded as a first, reversible stage of coagulation, causing the whole sol to unite to one large flake, so to say, which is able to enclose all the liquid present.

Under suitable conditions, some thixotropic sols may be solidified much more rapidly by a gentle, regular movement, a phenomenon called rheopexy. Thus there is a distinct difference between the

liquefying action of strong and irregular movement and the solidifying influence of regular, weak vibrations and similar kinds of movement.

Thixotropy generally, perhaps always, involves a loose packing of the particles. The plastic behaviour of such masses also depends upon their loose packing. Hence thixotropy and plasticity are in opposition to Osborne Reynolds's dilatancy, which involves close packing; moist, pure quartz sand shows dilatancy, becoming hard and dry when displaced by an external force, and returning to its original, moist state when this force ceases to act. Foreign substances, such as clay, etc., when added to the sand, form water-binding layers round the particles, thus causing loose packing and thixotropy. A case of quicksand was found the thixotropic behaviour of which was caused by the presence of a fine, clay-like substance; this may be a fairly frequent occurrence. Moulding sands are also plastic and thixotropic because they contain clay and iron compounds.

In many other technical processes (plastics, paints, drilling fluids in the petroleum industry, etc.) thixotropy turns out to be an important factor. Proto-plasm is frequently thixotropic, or may readily become so in the course of biological processes.

## Educational Topics and Events

CAMBRIDGE.—Trinity College announces the usual offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October 1936 as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year. The studentship is open this year only to men who have not reached the age of twenty-six years before May 1, 1936. Applicants shall ordinarily be nominated by the authorities of their universities. Applications must reach the Senior Tutor not later than May 1, 1936. The same College offers, as usual, Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go 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. Candidates must apply through the principal authority of their University, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by May 1, 1936.

OXFORD.—In Congregation on December 3, it was proposed to make statutory the decree governing the relations between the committee of the Museum of the History of Science and those bodies which use part of the Old Ashmolean building where the Museum is housed. A concordat was recently arrived at in which the Museum obtains the whole building in "1942 or earlier". By making the decree statutory, the proposers hoped to get this vague phrase interpreted as "early as possible". The motion was defeated by 75 votes to 46. The speakers against it were all sympathetic to the objects of the Museum but they pointed out that until the new extension of the Bodleian library is available, the work in the large room required by the Museum could not be conveniently removed elsewhere. It was stated that probably by 1941 the whole of the building could be given to the Museum.

READING.—Following the installation of Sir Austen Chamberlain as Chancellor of the University on December 2, the honorary degree of D.Sc. was conferred on Sir Rowland Biffen, Sir Frederick Gowland Hopkins, Lord Rutherford and Sir J. J. Thomson.

Later in the day, Sir Austen announced that the installation of the new Chancellor is being commemorated by the gift from Mr. Reginald Marden of the freehold of Shipley Court Farm, a fine property of more than 300 acres, representing a value of £10,000—£15,000.

DR. ERNEST RENAUX has been nominated successor to Prof. Jules Bordet in the chair of bacteriology in the University of Brussels.

The annual Conference of the Geographical Association will be held in the London School of Economics on January 1-3. On January 1, Mr. J. Fairgrieve will deliver his presidential address entitled "Can we Teach Geography Better?" On January 2, a symposium on "Soils in Geography" will be held, when the speakers will be Dr. W. G. Ogg, Dr. S. W. Wooldridge and Dr. L. Dudley Stamp. On the same day, Dr. E. B. Worthington will deliver a lecture on "A Biologist Looks at Africa", and a discussion on "The Use of the Epidiascope in the

Teaching of Geography in Schools" will be opened by Mr. L. S. Suggate. On January 3 there will be two discussions, namely, "Higher Certificate Courses in Geography", to be opened by Mr. L. B. Cundall and Mr. H. W. Ogden, and "A Geography Course in Senior Schools", to be opened by Mr. A. E. Moody; and a lecture by Dr. H. J. Wood on aspects of irrigation development in the western United States. On January 4, there will be a demonstration of films for use in the teaching of geography in the Gaumont-British Theatre, Film House, Wardour Street, W.1. This will be followed by a discussion. Further information can be obtained from the Secretary, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

## Science News a Century Ago

### Faraday and Lord Melbourne

PRIOR to 1835, several men of science had received the honour of knighthood, and during the first administration of Sir Robert Peel, which lasted from December 16, 1834, until April 18, 1835, Civil List pensions were bestowed on Mrs. Somerville and Prof. Airy. Faraday's name had also been put forward in connexion with the award of pensions. After at first refusing to acquiesce in the proposal, Faraday had his memorable interview with Peel's successor, Lord Melbourne, which led Faraday afterwards to write to his Lordship: "The conversation with which your lordship honoured me this afternoon, including as it did your Lordship's opinion of the general character of the pensions given of late to scientific persons, induces me respectfully to decline the favour which I believe your Lordship intends for me. . . ."

An article afterwards appeared in *Fraser's Magazine* entitled "Tory and Whig Patronage to Science and Literature", which purported to give an account of the interview. Comments on the article appeared in the Press, and on November 28, 1835, *The Times* gave a long extract from it. On December 7, Faraday wrote to the editor of *The Times* saying, "neither directly nor indirectly did I communicate to the Editor of *Fraser's Magazine*, the information on which that article was founded, or further, either directly or indirectly, any information to or for any publication whatsoever." The letter was published on December 8.

### Airy Declines a Knighthood

In his autobiography, Airy noted under the year 1835: "On Dec. 8th Mr. Spring Rice and Lord John Russell offered me knighthood, but I declined it." At that time, Lord Melbourne was Prime Minister, Spring Rice Chancellor of the Exchequer, and Lord John Russell Home Secretary. Airy's letter to Spring Rice declining the honour was written from the Observatory, Cambridge, on December 10, just before he left for Greenwich.

In the course of his letter, Airy said: "The unalterable custom of this country has attached a certain degree of light consideration to titles of honour which are not supported by considerable fortune; or at least, it calls for the display of such an establishment as may not be conveniently supported by even a comfortable income. The provision attached to

my official situation, and the liberality of the King towards one of the members of my family, have placed me in a position of great comfort. These circumstances however have bound me to consider myself as the devoted servant of the country, and to debar myself from efforts to increase my fortune which might otherwise have been open to me. I do not look forward therefore to any material increase of income, and that which I enjoy at present is hardly sufficient, in my opinion, to support respectably the honour which you and Lord John Russell have proposed to confer upon me. . . ."

#### Sir Charles Bell and his Edinburgh Professorship

ON December 8, 1835, when Sir Charles Bell was about to succeed to the chair of surgery at Edinburgh, he wrote from London to his brother George: "I have seen enough to satisfy me of what the world can offer to a man—I mean this great world; and were you to look back to my letters, you would find the opinion, uniformly expressed, that the place of a professor who *fills his place* is the most respectable in life. My hands are better for operation than any I have seen at work, but an operating surgeon's life has no equivalent rewards in this world; I must be the teacher and consulting surgeon to be happy. Do you remember this is the fifth offer I have had to return to lecturing?" The same day his brother wrote from Edinburgh: "You are now an adopted member of this University, and with the unanimous assent and acclamation of a Town Council composed of persons of all parties, chosen by the several wards of this intellectual city. And surely never was an offer more honourable to an individual, for I do assure you it has the approbation of all ranks and classes of men, and of none more than the Professors of the University and the whole medical profession."

#### Electrostatics: a Cold Night on the Roof

"It may be a question," wrote Faraday on December 10, 1835, "whether every case of electric residence on the surface of conductors in our atmosphere is not a case of induction"; and proceeded to try experiments to see if a metallic surface could retain any charge if there was no other surface or object opposite to it. A large concave mirror was insulated on the lecture room table, its curved surface facing upwards to the ceiling, and charged electrically. When the distribution of charge was examined, it was found to correspond with that in earlier experiments. The intensity was greatest at the edges; no electricity could be obtained from the lowest central part. The topmost point only of a ball rested at the centre showed a feeble charge.

But these effects might be due to inductive action of the ceiling, thought Faraday, although it was far above the lecture table; and so: "Then removed all this apparatus to the roof of the house, into a situation where a straight line drawn from the upper point of the 3 inch ball in the mirror, and passing by the edges of the mirror, could reach no external object except the starry sky. The sky was clear; the stars bright; the cold great, being about 27° or 28° and freezing fast at the time. Then repeating the experiments as within the house as nearly as possible, the same electrical effects were produced. Hence electricity can exist upon surfaces which are not inductively related to other surfaces of conducting matter".

## Societies and Academies

### DUBLIN

Royal Irish Academy, November 11. W. B. MORTON: Settlement from a suspension flowing through a tube of circular section. The rate of precipitation is examined on the two limiting assumptions of steady Poiseuille flow and of a distribution of particles maintained in uniformity across the section of the tube by eddies. J. J. NOLAN and V. H. GUERRINI: The diffusion coefficients and velocities of fall in air of atmospheric condensation nuclei. Methods for determining these quantities are described. The values found for nuclei in Dublin air are  $D = 18 \times 10^{-6}$  and  $V_g = 7.5 \times 10^{-5}$ . From these values the mass of the nucleus is deduced to be  $1.68 \times 10^{-16}$  gm. and its radius  $2.85 \times 10^{-6}$  cm. As the concentration of nuclei in air falls off with time, the nuclei are found to be of larger size. The bearing of this variation in size on the part played by the nuclei in the equilibrium of atmospheric ionisation is pointed out.

### PARIS

Academy of Sciences, November 4 (*C.R.*, 201, 801-860). LUCIEN DANIEL: The heredity of monstrosities in the descendants of the Jerusalem artichoke grafted on the annual sunflower to the eighth sexual generation. JEAN LE ROUX: Non-Euclidian distances. NICOLAS LUSIN: The choice of a perfect ensemble distinguished in an arbitrary analytical complement having non-enumerable constituents. G. DRINFELD: Integral invariants. N. ARONSZAJN: The metric characterisation of Hilbert space, of vectorial spaces and of certain metric groups. ANTOINE APPERT: New remark on the maximum of semi-continuous functionals. MAX SERRUYS: A rational scale of classification of fuel for internal combustion engines. The fuel is used in a motor under closely defined conditions of working, and compared with a fuel composed of a definite mixture of heptane and *iso*-octane. MARCEL CHÂTELET and FRANÇOIS KERTÉSZ: The activity of the chlorine ions in some solutions of complex chlorides of cobalt and chromium. ALBERT PORTEVIN and MICHEL CYMBOLISTE: Study of electrolytic baths. JEAN SWYNGEDAUF: The phenomena of electro-filtration in the electrolysis of gels. LÉON BLOCH, EUGÈNE BLOCH and CHOONG SHIN-PIAW: The emission spectrum of the selenium oxide, SeO. The fundamental vibration frequencies of the molecule SeO in the normal and excited state are 908.9 cm.<sup>-1</sup> and 533.4 cm.<sup>-1</sup>. The energy of dissociation of the molecule in the normal state was found to be 5.31 volts. FRÉDÉRIC JOLIOT, ANDRÉ LAZARD and PIERRE SAVEL: The synthesis of radio-elements by deuterons accelerated by means of an impulse generator. ALBERT MICHEL-LÉVY and ANDRÉ MURAOUR: The variation of detonation spectra with the nature of the surrounding gas. A mixture of tetranitromethane and toluene was detonated in different gases, argon, krypton, carbon dioxide, nitrogen, air, helium, hydrogen and chlorine. Reproductions of the spectrographs obtained are given. The results support the hypothesis attributing the observed luminosities to the stimulation by the shock waves of the gas molecules surrounding the explosive. WILFRIED HELLER: The distances between the colloidal particles in the bright layers of certain iron oxide sols. The author has found a method of preparing artificially the bright layers discovered by



Zocher: the method is based on the slow hydrolysis of solutions of ferric chloride. An outline of the theory of the phenomena is given. JEAN SAVARD: The Raman spectra of methyl-diethylcarbinol, dimethylbenzylcarbinol and the corresponding ethylene hydrocarbons. Frequencies due to the phenyl group, and the C.H and C=C linkages are given: tentative frequencies for other groups are suggested, but require confirmation by further work. All compounds containing the ethyl group give an intense line of frequency about 720. ARAKEL TCHAKIRIAN and MICHEL LEWINSOHN: Preparations of alkyl trihalogenides or of phenyl germanium of the type  $RGeX_3$  and of methylene germanium hexachloride. ANDRÉ CORNILLOT and RENÉ ALQUIER: The reaction of acetylene with acetyl chloride. In the presence of aluminium chloride, acetylene and acetyl chloride give methyl- $\beta$ -chlorovinylketone,  $CH_3.CO.CH=CHCl$ . This is very unstable: treated with boiling alcoholic soda, besides much tarry matter, this compound gives 20-25 per cent of triacetylbenzene. JACQUES BOURCART: The Quaternary of the coast of Rabat (Morocco). S. DEB: The discovery of an Orbitoid in the Annot (Alpes-Maritimes) grits. JACQUES FROMAGET: New observations on the upper Trias of western Tonkin and on the Norian age of the *Myophora napengensis* layers. FERNAND OBATON: A method for the rapid determination of the quantity of water contained in the soil. The method is based on the determination of the electrical resistance of a column of soil under a fixed pressure. The conversion of electrical resistance into moisture content is based on a curve reproduced. RENÉ SALGUES: The erythrocytes, hæmoglobin and the globulin value in the bird. JACQUES PELLEGRIN: The buccal variations in the barbel of the Kivu region. ROBERT WEILL: The working of the colloblasts. MAURICE CAULLERY: Remarks on the preceding communication. J. TIMON-DAVID and G. CERESOLA: The influence of sex on the lipids of some marine molluscs. JEAN COURTOIS: The action of various chemical compounds on the plant phosphatases. MME. PAULETTE CHAIX: The action of some compounds containing sulphur on the fermentation of glucose by propionic bacteria (*Propionibacterium*). WACLAW MOYCHO: Do bacteria secrete protease? Oppenheimer and Emler hold that living bacteria have not the power of secreting proteolytic enzymes, the latter only being liberated after the death of the cell. This view has not been proved experimentally, and has been adversely criticised. The author describes experiments with *B. prodigiosum* which he regards as clearly proving that the enzymes are only liberated after the death of the bacterium.

## WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 561-585, Oct. 15). C. P. HASKINS: A determination of the magnitude of the cell 'sensitive volume' associated with the white-eye mutation in X-rayed *Drosophila*. The results of exposure for different periods to the same source of X-rays suggest that passage of a single electron through this locus is sufficient to cause a mutation. Assuming that every electron causes a mutation, the minimum volume of the white loci in the X-chromosomes of all cells of the optic *anlage* at the time of treatment is  $37.06 \times 10^{-18}$  c.c. TH. DOBZHANSKY and A. H. STURTEVANT: Further data on maternal effects

in *Drosophila pseudo-obscura* hybrids. CHESTER STOCK and FRANCIS D. BODE: Occurrence of Lower Oligocene mammal-bearing beds near Death Valley, California. This is the first time these fossils have been recorded in the Great Basin Province, which is far from previously known areas of occurrence. A definite age determination has been made for the lowermost formational unit in the Tertiary rock sequence of the Grapevine and Funeral Mountains forming the north-east wall of Death Valley. Geological sections are given. ARTHUR E. KENNELLY: Adoption of the metre-kilogram-mass-second (M.K.S.) absolute system of practical units by the International Electrotechnical Commission (I.E.C.), Brussels, June 1935. An account of the history of electrical units and a list of sixty-one quantities with their symbols, M.K.S. and C.G.S. units. BERTIL HANSTRÖM: Preliminary report on the probable connexion between the blood gland and the chromatophore activator in decapod crustacea. Extracts from the eyestalks of most of the crustaceans examined cause concentration of pigment within the skin chromatophores. The active regions on microscopic examination are found to contain the blood gland and the X-organ, both of which receive nerves from a part of the brain connected with the optic paths. It is believed that the blood gland is the source of the chromatophore activator, though the X-organ may also be concerned with the colour changes of crustaceans.

## Forthcoming Events

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

## Sunday, December 8

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".\*

## Monday, December 9

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—C. Musters: "Some Zoological Collecting Trips".\*

SWINEY LECTURES ON GEOLOGY, at 5.30.—(at the Imperial College of Science, Exhibition Road, South Kensington, S.W.7).—Dr. Frederick Walker: "The Formation of British Coast Lines" (succeeding lectures on December 11, 13, 16, 18, 20, January 1, 3, 6, 8, 10 and 13).\*

## Tuesday, December 10

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. P. Hartley: "International Biological Standards for Drugs and Therapeutic Substances".

## Thursday, December 12

ROYAL ASIATIC SOCIETY, at 4.30.—Mme. Gabrielle M. Vassal: "The Temples of Yunnan".

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. Cecil Wall: "The Surgeons' Company, 1745-1800" (Thomas Vicary Lecture).\*

## Friday, December 13

ROYAL SOCIETY OF ARTS, at 4.30.—Khan Bahadur Sheikh Sir Abdul Qadir: "The Cultural Influences of Islam in India" (Sir George Birdwood Memorial Lecture).

ROYAL INSTITUTION, at 9.—Sir Richard Paget: "Sign Language as a Form of Speech".

Saturday, December 14

ROYAL INSTITUTION, at 3.—Dr. W. Percival Yetts: "Chinese Bronzes".

EXHIBITION OF MICROSCOPES BY W. WATSON AND SONS, LTD., December 9-14.—To be held in the Central Hall, Westminster, S.W.1.\*

December 10, at 7.—T. H. Turner: "The Part the Microscope plays in the Scientific Control of the Railway".\*

December 11, at 7.—M. Duncan: "The Microscopist at the Seaside".\*

December 12, at 7.—H. C. Rands: "The Manufacture of Optical Glass".\*

## Official Publications Received

### Great Britain and Ireland

- The Registrar-General's Statistical Review of England and Wales for the Year 1934. (New Annual Series, No. 14.) Tables, Part 1, Medical. Pp. iv+409. (London: H.M. Stationery Office.) 6s. net. [1911
- British Empire Cancer Campaign. Twelfth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 25 November 1935. Pp. xxxi+247. (London: British Empire Cancer Campaign.) [2111
- Forestry Commission. Report of the National Forest Park Committee, 1935. Pp. 8. (London: H.M. Stationery Office.) 6d. net. [2211
- London and Cambridge Economic Service. Special Memorandum No. 40: The Effect of Present Trends in Fertility and Mortality upon the Future Population of England and Wales and upon its Age Composition. By Enid Charles. Pp. 20. (London: London and Cambridge Economic Service, c/o London School of Economics.) 5s. [2211
- The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1934-35. Pp. 40. (Aberdeen: North of Scotland College of Agriculture.) [2511
- Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 12: The Inheritance of Fuzz and Lintlessness and Associated Characters in Asiatic Cottons. By J. B. Hutchinson. Pp. 20. (London: Empire Cotton Growing Corporation.) 2s. 6d. [2511
- Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1935; with Report of the Director of Fuel Research. Pp. xi+188+11 plates. (London: H.M. Stationery Office.) 3s. 6d. net. [2711
- The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Twelfth Conference held at St. John's College, Cambridge, September 20th to 23rd, 1935. Pp. 126. (London: Association of Special Libraries and Information Bureaux.) 5s. [2711
- Sixth International Congress for Scientific Management, London, July 15th to July 20th, 1935. Proceedings. Pp. 234. (London: P. S. King and Son, Ltd.) [2811
- Thirty-third Annual Report, 1934-1935, of the Imperial Cancer Research Fund. Pp. 36. (London: Imperial Cancer Research Fund.) [2811
- Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-eighth Annual Report, 1934-35, presented by the Council to the Court of Governors on the 25th October 1935. Pp. 42. (Cardiff: National Museum of Wales.) [2811

### Other Countries

- Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Section. Bulletin No. 1: Some Hydrographic Data from the Suez Canal, 1928-29. By R. S. Wimpenny. Pp. 7+5 plates. 10 P.T. Notes and Memoirs, No. 8: The Fishery Grounds near Alexandria. 1: Preliminary Report. By Adolf Steuer. Pp. 18+6 plates. Notes and Memoirs, No. 9: The Fishery Grounds near Alexandria. 2: A Bottom Sample taken at Alexandria. By Aristocle Vatova. Pp. 3+1 plate. Notes and Memoirs, No. 10: The Fishery Grounds near Alexandria. 3: Cirripeds. By Hjalmar Broch. Pp. 5+1 plate. Notes and Memoirs, No. 11: The Fishery Grounds near Alexandria. 4: Some Marine Mites from Alexandria. By Dr. Karl Viets. Pp. 3+2 plates. Notes and Memoirs, No. 12: Die Fischerei-gründe vor Alexandrien. 5: Ostracoda. Von Walter Klie. Pp. 9+1 plate. (Cairo: Government Press.) [1911
- National Research Council. Transactions of the American Geophysical Union, April 25 and 26, 1935, Washington, D.C. Part 1: Reports and Papers, General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 364. 2 dollars. Part 2: Reports and Papers, Section of Hydrology. Pp. 365-530. 1.50 dollars. (Washington, D.C.: National Academy of Sciences.) [1911
- Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 7: Investigations on the Course of Growth in a Virgin, or Plant, Crop of Sugar Cane (Variety White Tanna). By Dr. H. Evans. Pp. 36+25 plates. (Port Louis: Government Printer.) [2011
- University of Illinois Bulletin. Vol. 32, No. 52: Development of the Pectoral Limb of *Necturus maculosus*. By Hsin Kuo Chen. (Illinois Biological Monographs, Vol. 14, No. 1.) Pp. 71. (Urbana, Ill.: University of Illinois Press.) 1 dollar. [2211
- Federated Malay States. Report on the Progress of Schemes for the Improvement and Extension of Rice Cultivation. Pp. 12+8 plates. (Kuala Lumpur: Government Printer.) 1 dollar; 2s. 4d. [2511

- Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1934. By Dr. W. Youngman. Pp. D200. (Colombo: Government Record Office.) 2 rupees. [2511
- University of Illinois: Engineering Experiment Station. Bulletin No. 278: Oscillations due to Corona Discharges on Wires subjected to Alternating Potentials. By Prof. J. Tykocinski Tykociner, Raymond E. Tarpley and Prof. Ellery B. Paine. Pp. 56. 60 cents. Bulletin No. 279: The Resistance of Mine Timbers to the Flow of Air, as determined by Models. By Prof. Cloyd E. Smith. Pp. 64. 65 cents. Bulletin No. 280: The Effect of Residual Longitudinal Stresses upon the Load-carrying Capacity of Steel Columns. By Prof. Wilbur M. Wilson and Rex L. Brown. Pp. 28. 30 cents. Circular No. 24: Simplified Computation of Vertical Pressures in Elastic Foundations. By Nathan M. Newmark. Pp. 19. 25 cents. (Urbana, Ill.: University of Illinois.) [2511
- Bulletin of the American Museum of Natural History. Vol. 86, Art. 8: Results of the Archbold Expeditions. No. 7: Summary of the 1933-1934 Papuan Expedition. By Richard Archbold and A. L. Rand. Pp. 527-579+plates 28-46. (New York: American Museum of Natural History.) [2511
- Sveriges Geologiska Undersökning. Ser. C, No. 390: Blockundersökningar; Historik och metodik. Av G. Lundquist. Zusammenfassung: Geschiebeuntersuchungen; Historik und Methodik. Pp. 45. 1.00 kr. Ser. C, No. 391: Gästrikländska forstrandlinjer och nivåförändringsproblemen. Av Bror Asklund. Pp. 119+3 plates. 3.00 kr. Ser. C, No. 392: On the Origin of late Magmatic Solutions containing Magnesia, Iron and Silica. By N. Sundius. Pp. 24. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [2511
- Society of Biological Chemists, India. Influence of Light on some Biochemical Processes. By Dr. N. R. Dhar. Pp. iv+73. (Bangalore: Society of Biological Chemists, Indian Institute of Science.) 1 rupee. [2511
- Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 151: A New Method of staining Mycobacterium Tuberculosis: a Scientific Microbiological Note. By Prof. Dr. Matteo Carpano. Translated to English by Dr. H. Fadel. Pp. 9+7 plates. (Cairo: Government Press.) 15 mills. [2511
- Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 21: Reports of the Research, Economic and Agricultural Education Branches for the Year 1934. Pp. iii+90. (Kuala Lumpur: Government Press.) 50 cents. [2511
- Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1934. By Dr. H. A. Tempany. Pp. iv+78. (Kuala Lumpur: Government Press.) 50 cents; 1s. 2d. [2511
- The Rockefeller Foundation. Annual Report, 1934. Pp. xiv+408. (New York: The Rockefeller Foundation.) [2711
- Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1934. (Publication 3305.) Pp. xiv+448+73 plates. (Washington, D.C.: Government Printing Office.) 1 dollar. [2711
- U.S. Department of Agriculture. Farmers' Bulletin No. 1755: Game Laws for the Season 1935-36; a Summary of Federal, State and Provincial Statutes. By H. P. Sheldon and Frank G. Grimes. Pp. ii+38. (Washington, D.C.: Government Printing Office.) 5 cents. [2711
- The Municipal Smoke Problem: a Brief Treatise on the Products of Combustion of Fuels and their Effects. By H. B. Meller and L. B. Sisson. Pp. ii+20. (Pittsburg, Pa.: Mellon Institute of Industrial Research.) Free. [2711
- State of Connecticut: State Geological and Natural History Survey. Bulletin No. 53: The Mammals of Connecticut. By George Gilbert Goodwin. Pp. 221+33 plates. 2 dollars. Bulletin No. 54: The Reptiles of Connecticut. By George Herbert Lamson. Pp. 35+12 plates. 50 cents. (Hartford, Conn.: State Librarian.) [2711
- U.S. Department of the Interior: Geological Survey. Bulletin 854: Geology and Ore Deposits of the Castro Quadrangle, Ohio. By Clyde P. Ross. Pp. vi+135+8 plates. 60 cents. Bulletin 859: Geology of the Santa Rita Mining Area, New Mexico. By A. C. Spencer and Sidney Paige. Pp. iv+78+6 plates. 40 cents. Bulletin 862: The Southern Alaska Range. By Stephen R. Capps. Pp. iv+101+8 plates. 70 cents. Professional Paper 180: The Minerals of Franklin and Sterling Hill, Sussex County, New Jersey. By Charles Palache. Pp. vi+135+19 plates. 30 cents. Professional Paper 184: Precambrian Rocks of the Lake Superior Region; a Review of Newly Discovered Geologic Features, with a revised Geologic Map. By C. K. Leith, Richard J. Lund and Andrew Leith. Pp. ii+34+1 plate. 60 cents. Water-Supply Paper 765: Surface Water Supply of the United States, 1934. Part 10: The Great Basin. Pp. v+95. 15 cents. (Washington, D.C.: Government Printing Office.) [2711
- Memorias del Consejo Oceanográfico Ibero-Americano. No. 16: El estado actual del problema de las ondas de marea interna. Por Francisco de P. Navarro. Pp. 18. Congreso Internacional de Oceanografía, Hidrografía, Marina e Hidrología continental, de Sevilla. Catálogo de los instrumentos y documentos expuestos. Pp. 49+10 plates. Consejo Oceanográfico Ibero-Americano. Primera Conferencia Oceanográfica Ibero-Americano, Madrid-Málaga, Abril 1935. Trabajos presentados, No. 1: Fauna ictiológica. Por Prof. Fernando de Buen. Pp. 89+20 plates. (Madrid: Consejo Oceanográfico Ibero-Americano.) [2811
- Oceanographical Charts of the Adjacent Seas of Työsen for the Year 1934. Pp. 88. (Husan: Fishery Experiment Station of the Government General of Työsen.) [2911

### Catalogues, etc.

- Bornkessel Burners. Pp. 2. (London: W. Edwards and Co.)
- Exhibition of Microscopes. December 9th to 14th inclusive. Pp. 20. (London: W. Watson and Sons, Ltd.)
- Wholesale Price List of Fine Chemicals. Pp. 72. (London: Harrington Brothers, Ltd.)
- Verzeichnis der Werke und Zeitschriften. Pp. 100. (Leipzig: Akademische Verlagsgesellschaft m.b.H.)
- Francis Edwards' General Catalogue, 1936. (Catalogue No. 594.) Pp. 102. (London: Francis Edwards, Ltd.)