NATURE

SATURDAY, MARCH 9, 1935

No. 3410 Vol. 135

CONTENTS

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number: WHITEHALL 8831
Telegraphic Address: PHUSIS, LESQUARE, LONDON

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4
Telephone Number: City 4211

Rationalisation of Scientific Publication

THE social aspects of scientific research, and the view that men of science should take a much more prominent part in spreading a scientific outlook and approach to social and other general problems of the community, have been eloquently urged in recent months. Despite these new opportunities and the greater disposition to listen to the contribution he can offer in these matters, the scientific worker often remains his own worst enemy. The lack of progress, for example, with all attempts to rationalise the publication and abstracting of scientific literature, or towards effective co-operation between scientific societies, continues to demonstrate an inability of the scientific worker to set his own house in order, if indeed it does not expose him to the charge of fiddling while Rome burns. Conservatism can be preserved from inertia and ineptitude only by wise judgment and the assimilation, not the rejection, of new ideas.

There are, of course, conspicuous exceptions. The Oil and Colour Chemists' Association, for example, has recently appointed a research and development correspondent whose special task is to assist in the interpretation of the results of the latest research work in a form which is easily assimilated by the industry or by the public. This is a welcome sign of the recognition of the need for expositors or interpreters of science if industry and society are to utilise to any wide extent the scientific knowledge which is already available for them, apart altogether from the penetration of science into the new fields of social research. The laxity of scientific men generally in regard to the exposition of their results, the widespread use of jargon, the inability of many scientific workers to express themselves in concise and accurate English, are serious obstacles to the spread of scientific knowledge into the sphere of political action. Even in industry, startling examples are often encountered of the indifference of the research worker to the reporting of his results in terms intelligible either to other scientific workers or those responsible for management. The industrial worker often remains ignorant of, and amazingly indifferent to, the contrast between the meticulous accuracy of his experimental work and the careless and ambiguous manner in which he presents his results. He does not appear to realise that lack of care at this point may vitiate his work as effectively as inaccuracy in the laboratory.

In consequence of this neglect, besides the difficulty placed in the way of the assimilation of scientific investigations into industrial or social practice, the scientific worker adds to the burden of publications of which he is often the first to complain. Looseness of thought, and indifference to the accurate and correct use of words, are a prime cause of the redundancy noticeable in many scientific papers. Dr. H. Moore was undoubtedly justified in stressing this point in his presidential address last year to the Institute of Metals. There are few papers indeed which would not have gained both from a scientific and from a literary point of view by careful revision, the exclusion of all irrelevant matter and the choice of the simplest and fewest words to express the author's meaning. As Dr. Moore pointed out, a clear idea of what he is doing and why he is doing it is as essential to the research worker in writing his paper or report as it is in the conduct of his experiments. A command of terse pregnant English is a valuable possession to the writer of a scientific paper, and is worth much trouble and patience to acquire. One of the merits of abstracting work as carried out in the past under the Bureau of Chemical Abstracts and elsewhere has been the discipline it imposes on the abstractors in regard to conciseness and clarity. Apart from the knowledge the abstractor acquires of his science, it enforces precision of language which should be a great asset in the writing of papers in subsequent life, and should exemplify, to him at least, the way in which force and clarity are related to brevity.

Dr. Moore estimates that the length of a scientific paper might well be reduced by about twenty per cent in this way, with advantages both in clarity and in diminished printing and publishing costs; and this reasonable estimate is sufficiently large to indicate that the matter is one well worth close attention by scientific societies. One of the difficulties is, however, the lack of perspective which sometimes characterises scientific writers—a failure to see their topic in its true relation to the science as a whole, and a tendency to claim, for the normal or average, the fuller and more detailed treatment which should be the privilege of those few papers which describe some really outstanding achievement or advance.

This question of values cannot be evaded. It is essential in the investigator alike in planning, executing and describing his work. It is equally essential when we confront the large question of the rational treatment of the mass of scientific literature to-day and the most efficient distribution of the burden. To its absence must be attributed the duplication of abstracting work which still persists, in regard to chemical literature, despite the example of co-operation afforded by the Society of Chemical Industry and the Chemical Society for nearly ten years. That it is difficult to avoid overlap between different fields such as chemistry, entomology, physiology, physics and engineering, etc., is obvious, though even here co-operation is less difficult than is imagined by the superficial. The duplication within any one field such as is provided by the abstracts of the Society of Public Analysts or the Society of Dyers and Colourists, to cite only two examples, which merely re-issue in varied form and at a later date the substance of abstracts provided for the whole science or profession by the Bureau of Chemical Abstracts, is surely remediable. Powerful arguments might be addressed in favour of the State contributing towards the cost of scientific publications, but support is unlikely to be given before men of science themselves eliminate the duplication of effort to which we have referred.

The waste and duplication are not confined, however, to abstracting publications. The same confusion of thought is to be found in regard to other types of publication as a result of the sectionalism and excessive specialisation in which such a profession as chemistry abounds. Each group pursues its own interests and special requirements without regard to those fundamental needs which must be served if its own specialisation is even to be possible. The net result is an intolerable burden on the parent and more comprehensive societies, such as the Chemical Society, which is appreciably enhanced by the marked reluctance of the younger members of the profession to support such societies by actual membership as compared with a couple of decades or so ago.

Chemists are probably neither better nor worse than other scientific workers in these matters, but if they and other men of science tend to lament rather too freely the burden which membership of numerous societies or the cost of publications places upon them, they should remember that the remedy is largely within their own hands. The setting of their own house in order would be a sure way of establishing the confidence of the community in the capacity of scientific workers for the wider fields of social service now opening before them.

Two Historical Notes

By PROF. E. N. DA C. ANDRADE, University College, London

HUMPHRY DAVY'S EXPERIMENTS ON THE FRICTIONAL DEVELOPMENT OF HEAT

IN practically all textbooks on heat, certain experiments of Humphry Davy are cited as constituting early experimental proof of the dynamical theory of heat, and they are generally said, either directly or by implication, to be of major importance. There is a certain amount of variety in the description of what these experiments were: several authors (for example, Poynting and Thomson, Grimsehl, Loeb and Adams and Hoare) say that he rubbed the pieces of ice together in a vacuum, while others (for example, Edser and Preston) say that he performed the experiment in air, and afterwards carried it out *in vacuo*. Now any physicist who contemplates repeating the experiment will, I think, at once be struck with the difficulty, if not impossibility, of carrying it out in such a way as to produce anything in the nature of a convincing result. If the ice is covered with a film of water, the friction is so small that scarcely any work is done, while if it is really dry it is liable to stick. In any case, to make the frictional heat appreciable, it is necessary to have a normal force holding the two surfaces together, and then one gets the well-known lowering of freezing point and consequent melting, if the surroundings are at the ice point, with all the possible dangers of regelation at the edges. Again, the amount of work required to melt 1 gm. of ice is very large: the criterion is an extraordinarily insensitive one. All these difficulties are, perhaps, sufficiently summarised in the fact that nobody, apparently, has ever tried to repeat the experiment, and I, for one, would not care to undertake it.

It is, then, perhaps worth while pausing a moment to inquire just what Davy did, and in what circumstances. The account of these and certain other experiments was the author's first contribution to science, and was published (in "Contributions to Physical and Medical Knowledge, principally from the West of England", edited by Thomas Beddoes, father of the poet Thomas Lovell Beddoes) early in 1799, when he was twenty years old. The work was, then, presumably carried out when he was nineteen. The first experiment described is directed to show that light is not an effect of heat; he held that he had proved experimentally that particles of iron can be heated to the melting point without giving out light! The second and third are the celebrated ice experiments.

In the first of these, described in less than three hundred words, without any detail, Davy says that he fastened two pieces of ice by wires to two iron bars and that "by a peculiar mechanism" the ice was kept in violent friction for some minutes. The pieces of ice "were almost entirely converted into water" which, strangely enough, was found to be at 35° "after remaining in an atmosphere at a lower temperature for some minutes", or, in other words, the friction of ice can raise water many degrees above the melting point! Even supposing that the stroke of the 'engine' was 5 cm., and that it executed 100 strokes a minute, and that the coefficient of friction was 0·5, this would mean, if for "some minutes" we read "ten minutes", that the force pressing the pieces of ice together would have to be equivalent to an additional pressure of about 4 atmospheres. The whole experiment is fantastic. This is said in no disrespect to Davy: how could one expect an untrained boy in 1799 to carry out an experiment which even to-day would tax an experienced physicist, to say the least? No doubt the whole effect observed by Davy was due to conduction.

The second experiment, the one in a vacuum, was not concerned with ice at all, but with the melting of wax. The wax was apparently attached to a metal plate, against which rubbed a clockwork-driven wheel. The clockwork stood on a piece of ice in which was cut a channel containing water, and the whole was under an exhausted bell-jar. The argument was that if the heat required to melt the wax had passed from the ice to the clockwork, the water would have frozen. As, however, the heat required to produce the rise of temperature observed in the clockwork amounted to but 12 calories, only 0·15 c.c. of water would have frozen in any event, which actually could not be observed by eye in a rough channel cut in a piece of ice. The experiment proves nothing at all.

I may be held to have spent too much time on a point which some may say is of historical interest only. I hold, however, that it is very inadvisable that students should be taught to attach a fundamental importance, not to experiments crudely carried out, which were afterwards improved, but to experiments of which one probably cannot be carried out at all, while the other is so ill-designed as to prove nothing. I am no denigrator; I do not think that it detracts from the greatness of Davy to point out that his first experiments, carried out when he was a country lad, were uncritical and lacked all quantitative basis. It is time, however, that they ceased to be ranked with such convincing demonstrations

as those of Rumford, and disappeared from the textbooks. Or, if they are quoted, do let us have instructions as to how to melt two pieces of ice by rubbing them together in a vacuum.

Newton's Early Notebook

In the Isaac Newton Memorial Volume, produced in 1927 to commemorate the two hundredth anniversary of Newton's death, there was published for the first time the contents of an early notebook, compiled by Newton as a boy or young man. The first part consists of a collection of rules and hints relating to drawing and painting (how to shade, how to enlarge a picture, to make a russet colour and so on); of receipts for cements, baits and other odd things; of cures for certain troubles; and of tricks. Prof. David Eugene Smith, who edited this matter, attributes it to some time within the period 1655–58 and apparently takes it to have been compiled by Newton. Prof. Louis Trenchard More, in his life of Isaac Newton, published last year, comments: "The most interesting, perhaps, of the items in this book, are those referring to drawing and the making of pigments, as they show the great interest he took in the art, and to the chemical and medicinal recipes which he jotted down".

This part of the notebook is, however, no collection of Newton's own, but is copied out from a book of receipts popular at the time, namely, John Bate's "The Mysteries of Nature and Art", of which the first edition was printed in 1634, and the third and last edition (a copy of which is in my possession) in 1654, shortly before the period to which we must attribute the part of the notebook in question. With this edition I have checked off all Newton's rules for drawing and painting, and many of his odd receipts—in fact, everything down to and including "To ingrave on a flint" in Prof. David Eugene Smith's reprint. The small remainder of this part of Newton's notebook consists of a few medical prescriptions and conjuror's tricks, which he may have picked up while lodging with Mr. Clark, the apothecary. I have not been able to trace them.

Another point of interest in Bate's book is that it contains full directions for making a water clock, which correspond to the account which Dr. Stukeley* gives of the water clock undoubtedly made by Newton. There is no doubt, then, that the "Mysteries of Nature and Art" was a book which young Newton freely consulted, and I conjecture that profounder historians than myself will find that it well repays study.

I may add that I find it a little difficult to accept Prof. Smith's attribution of date, 1655–58, for the first part of the notebook. On the first page of the book is the inscription:

ISAAC NEWTON HUNC LIBRUM
POSSIDET.
TESTE
EDVARDO SECKER.
PRET: 2^{d} OB.
1659.

Now, while a boy might write his name in a notebook, with his signature witnessed, as a schoolboy joke, some time after purchase, he is very unlikely to put the price, in this particular instance 2½*d*., except at the date of purchase. We know that Newton was very careful in his accounts of expenditure. I think we must take it that this inscription was inserted when the notebook was bought, and gives the date of the first entries.

* See Brewster's "Life of Sir Isaac Newton", vol. 1, p. 9. Louis Trenchard More, "Isaac Newton", p. 12.

Centenaries of Newcomb and Schiaparelli

SIMON NEWCOMB and Giovanni Virginio Schiaparelli were born within two days of one another, the former at Wallace, Nova Scotia, on March 12, 1835, and the latter at Savigliano, Piedmont, on March 14, and they died within a year of one another, Newcomb passing away on July 11, 1909, and Schiaparelli on July 4, 1910. Counting among their most distinguished contemporaries Lockyer, Huggins, Gill, Janssen, Loewy, Otto Struve, Auwers, Asaph Hall, Langley and Young, Schiaparelli was long regarded as the foremost of Italian astronomers, while Newcomb became to be recognised as the most eminent man of science in the United States.

They devoted themselves to widely differing branches of astronomy. Newcomb, as a member of the staff of the Naval Observatory, Washington, and as head of the "American Ephemeris and Nautical Almanac", during the course of forty years, contributed greatly to the advancement of gravitational astronomy, while Schiaparelli added immensely to the knowledge of meteors, comets and the planets. Honours were bestowed on them by many societies and institutions; both were associates and medallists of the Royal Astronomical Society, both were foreign members of the Royal Society and foreign associates of the Paris Academy of Sciences, while Newcomb's connexion with the United States Navy was recognised by Congress granting him the rank of a rear-admiral.

Of Newcomb, many appreciations were written after his death in 1909, but the most fascinating

record of his life is his own "Reminiscences of an Astronomer", published when he was sixty-eight years of age. In this, when speaking of Cayley the mathematician, he said, "His life was that of a man moved to investigation by an uncontrollable impulse; the only sort of man whose work is destined to be imperishable". The remark might well apply to Newcomb himself, for when at the age of twenty-two years, after an unusual start in life—which had included two years' service under a quack doctor—he entered his own "world of sweetness and light" as a computer in the office of the "Nautical Almanac" at Cambridge, Mass., his genius found the avenue which was to lead him to the highest distinction.

Of his work, his travels and his friendships of the years 1857–77, Newcomb gave an account in the early chapters in his "Reminiscences": "On September 15, 1877," he went on to say, "I took charge of the Nautical Almanac Office. The change was one of the happiest in my life. I was now in a position of recognised responsibility, where my recommendations met with the respect due to that responsibility, where I could make plans with the assurance of being able to carry them out. . . ." He was editor of the "American Ephemeris and Nautical Almanac" for twenty years, and his most valuable work for science was done in connexion with it. It was this work which led to his being awarded the Copley Medal in 1890, and being elected a foreign associate of the Paris Academy of Sciences in 1895, in succession to Helmholtz.

A devoted public servant and an indefatigable worker, Newcomb set an inspiring example to all with whom he came in contact, while, said Sir Robert Ball, "His habitual loftiness of thought, nobility of character, dignified courtesy and ever-ready helpfulness endeared him to his many friends on both sides of the Atlantic".

Schiaparelli was far more fortunate than Newcomb in his early environment, and at the age of nineteen years graduated from the University of Turin in engineering and architecture. For a year or two he taught mathematics, but astronomy had already laid its hold upon him, and in the year that Newcomb began his work at Cambridge, Schiaparelli was able to enter the Berlin Observatory, then directed by Encke, and two years later secured a post at Pulkovo under the Struves. Recalled to Italy in 1860 to become assistant to Carlini at the Brera Observatory, Milan, in September 1862 on the death of Carlini he was made director of the Observatory and this post he held for thirty-eight years.

Schiaparelli's first year at Milan was marked by his discovery of the asteroid Hesperia. Four years after becoming the director, he announced his discovery of the connexion between meteors and comets, and in 1873 he published his "Le Stelle Cadenti", declared by Lockyer to be one of the greatest contributions to the astronomical literature of the nineteenth century. In 1877 he commenced his observations of Mars, in 1882 began the study of Mercury and Venus and between 1875 and 1899 made 11,000 measures of double stars. Failing sight brought an end to his observations, and in 1900 he retired. Among his later work was his book on the astronomy of the Old Testament, in the preparation of which he had examined the dates of 2,764 Babylonian documents which had been translated.

Schiaparelli's views on the so-called 'canals' on Mars led to much controversy, and it is worth recalling that it was this which reawakened Lowell's interest in astronomy and led him to erect the Lowell Observatory, at Flagstaff, Arizona, where just five years ago the planet Pluto was discovered.

Modern Plastics

SOME criticism has been made of the word 'plastics' as applied to the industry which goes under this name to-day. The word 'plastics' is usually associated with clay, putty or similar materials which can be worked and shaped by hand. But 'plastics' has not, even in the past, been limited to materials which retain their plasticity. Clay, having been moulded into shape while in a plastic condition, takes permanent form after baking, but the article in its permanent form is still classified in the 'plastics' group. The bulk of the products of the plastics industry in its modern form may similarly be characterised—initially plastic, they are converted by heat and pressure into permanent forms.

Bayer in 1872 first announced that phenols would react chemically with formaldehyde, but beyond this fact little further attention was paid by him to the product. Other workers investigated the reaction later, and Kleeberg in 1890 first discovered that it was not a pure product that was obtained, but a sticky viscous material. Then technical men more commercially minded came into the field and started investigations. One of the early patents was taken out by Luft in 1902, who described a horn-like material which could be turned and shaped into various articles. He described it as artificial horn. Others followed, but none of them appears to have made a material which was commercially useful, since they found

no means of controlling the reaction or arriving at a reliable or satisfactory end-product.

Certain firms in Great Britain and in the United States began to develop the condensation product in liquid form for varnish purposes, but not until Dr. Baekeland turned his attention to this reaction was progress made. Dr. Baekeland announced his new discovery in 1908, and applied for patents in most countries in the world. The basis of his invention consisted in the use of relatively small proportions of ammonia as an accelerator in the reaction between phenol and formaldehyde, as against large amounts of acid or alkali used hitherto. He found that by the use of a small amount of alkali, the reaction could be controlled and checked at a convenient point during its progress, this resulting in an intermediate product between the raw materials and the final end-product obtained previously, which was hard, brittle and non-plastic.

All previous workers on this product had obtained a crystalline product or a hardened mass which was of little value. Dr. Baekeland succeeded in producing a material which could be used commercially. It could be readily handled, being a resin-like solid which could be ground, powdered, softened or dissolved in solvents. This he termed Bakelite 'A'. This product was chemically changed on the application of heat by polymerisation into a permanently hard amber-like solid which would no longer soften by heat, had good insulating properties and was termed Bakelite 'C'. When mixed with fillers in a powdered state, it could he introduced into steel moulds, subjected to heat and pressure in hydraulic presses, and, by continued application of heat, it set solid and assumed the shape or the contour of the mould into which it had been pressed, and could be discharged permanently solid. This process is the basis of the modern plastic moulding industry to-day.

The early material of Dr. Baekeland's invention was somewhat variable in quality and slow in its rate of hardening in the mould to the 'C' stage, and consequently the moulding industry made slow headway. It was in a very elementary stage, and it was not until towards the end of the War that practical advancement in the technique of manufacture of what are now termed the resinoid moulding powders, showed any progress in Great Britain. The last fifteen years has brought about considerable change in the industry and its technique. Where twenty-five years ago the moulding materials consisted of the resin A, ground to powder and mixed with dye and wood-meal, of which the rate of hardening was 5–15 minutes for an article of relatively small size, to-day similar articles are turned out from complex moulding mixtures at the rate of 1–1½ minutes in multiple impression moulds having as many as 50–75 impressions ; so that where one article was produced in five minutes, we have to-day 200–250 of the same articles turned out in the same time.

The production of mouldings has been referred to as illustrating the advancement of one side of the resinoid plastics industry. Dr. Baekeland's invention led to the production of other useful materials, apart from mouldings for the electrical and allied industries. It was found that, when this Bakelite Resinoid A was dissolved in solvents, and paper sheets were impregnated with it and then dried and pressed together in a hydraulic press between steam-heated platens, the resinoid hardened and made a compact mass consisting of laminations of paper sealed together by the hardened resinoid ; the product was 'Bakelite laminated sheets'. This material was found to be very hard and tough, yet it could be machined and had excellent insulating properties. It found a ready application in the electrical industry. The advancement in this branch of the industry has been less spectacular than in the moulding section, but advances have been made. The methods employed in production to-day are very much the same as when this material was originally introduced, apart from minor improvements in plant, but I feel sure we can look for great advances in methods of production, cheapening in costs and widening its applications.

Until the last year or two, the production of mouldings had been confined to small articles chiefly for the electrical industry, such as switch cover plates, distributor heads for car ignition sets and picnic set requisites and many similar products. With the introduction of radio sets at a price to attract the masses, the question of the production of cabinets to house the sets was considered by those concerns which turned their attention to the production of such sets in large quantities in standard and uniform design. It then became evident that a case or housing for such sets could be produced in plastics more fitting in design to meet modern requirements at prices to compete with those constructed of wood. This led to the production of the moulded radio cabinet, of which there are many examples to be seen to-day. The production of these cabinets called for the installation of very large and expensive hydraulic presses and moulds costing several thousands of pounds. The very existence of these presses will, no doubt, have the effect of leading the industry into the production of larger mouldings. The general tendency will be towards the production of still larger articles in moulded plastics, each moulding requiring many pounds of powder, thus gradually supplanting many articles and parts of articles at present made in wood or metal by plastic

moulded articles made on mass production lines. When this comes about, it is obvious that designs will have to change to meet the modern technique of production.

Very serious artistic thought should be given to the designs for the future, in order that such production may not only be practical from a mass production point of view, but also both restful and pleasing to the eye in outline and colour. In that way they will establish for themselves a permanent future and not be just a 'five minute wonder' to die out for lack of permanent artistic foundation. This is a point to which the industry should pay attention if it desires to establish itself as one of the main industries of the future.

The laminated material referred to above is at present relatively new compared with the moulding industry. Its chief applications have been industrial, in so far that it has formed a part in a main assembly, that is, in its use for insulation purposes in electrical equipment. Now, however, the material can be produced in sheets of larger sizes and in various colours and finishes, and it is already finding a use in industries that cater for domestic requirements. The laminated sheet material has some valuable features as it is resistant to heat, not readily marked or scratched, unaffected by alcohol and other solvents, and can be highly polished. Such properties are of value for many domestic applications. It is used for tops of tables in cafés, for dressing-table tops in hotels. In the United States it has been tried out as panelling for ships, state-rooms, cocktail bars; and similar applications are under trial in Great Britain. There are many uses for this material not yet developed, as it is difficult to find any other class of product which exhibits similar properties. There is no doubt that we shall see large developments in its use during the next few years. When sheets of this product are available in pleasing soft colours, they are likely to find favour for room decoration, for which, in many ways, they are ideal.

Future designs will require careful thought and planning. Present ideas do not entirely fit in with production of this type of material, and a new art and technique will have to be developed to meet these new products. Many articles which were previously made by hand, in many cases elaborately decorated by the craftsman, will in the future be produced in mass by this new process of moulding and fashioning. For a time, the craftsman's hand on the finished article will disappear until the industry has so advanced its technique that present difficulties of production have disappeared; then, there will be room for the craftsman to exercise his art—not on the finished article or on its construction, but in the steel or other material forming the master model from which such articles will be produced, and by engraving into it pleasing designs and artistic ideas which will be effectively and correctly reproduced in detail on the moulded articles. By these modern processes, such articles will be manufactured in quantities which will enable them to be sold at prices within the purchasing capacity of the majority.

H. V. POTTER.

Obituary

DR. R. C. KNIGHT

SCIENTIFIC horticulture has suffered a heavy loss by the death on January 28 of Dr. R. C. Knight, assistant director of the East Malling Research Station. He was born in 1891 and was educated at Sexey's School, Bruton, Somerset, and at the University of Bristol, where he took a degree in botany. He obtained a Board of Agriculture research scholarship in plant physiology in 1916, which he held at the Imperial College of Science and Technology, and in 1919 he was appointed to the staff of the Research Institute of Plant Physiology of that College. His association with East Malling Research Station began in 1920, when the demonstration of striking examples of rootstock influence upon the scion opened up a promising field for physiological investigations. At first Dr. Knight merely visited the Station for short periods to familiarise himself with his problems and to collect the necessary material. By 1922 it became obvious that in order to push forward with the work he must live on the spot with his material, and he was seconded for duty at the East Malling Station, where he worked until his death.

So wide were Knight's interests that he rapidly became familiar with the horticultural problems being investigated around him, and although he often said that these early years were "spent in closing doors by obtaining negative results rather than in opening them", this was an essential preliminary exploration, and he was all the time evolving in his mind and discussing with his colleagues those 'physio-pomological' methods which he used so much in later years. While he did much careful work in determining the optimum conditions for raising hard-wood and soft-wood cuttings, his outstanding contribution was concerned with the practice of layering. Here he emphasised and elucidated the all-important part played by the etiolation of the base of the shoot in encouraging adventitious rooting. By directing attention to this aspect he made it possible to reproduce with much greater certainty clonal races of a far wider range of plants than had been possible heretofore.

Knight's contribution to horticultural science, however, is in no way measured by the twenty or more published reports standing under his name. He exercised

a profoundly stimulating influence not only upon his immediate colleagues, but also upon the large number of graduate workers and investigators on leave from overseas who visited the Research Station for long or short periods.

Much of Knight's thought and care is built into the structure and equipment of the laboratories and library, but after these are forgotten his informal methods of evoking stimulating discussion, his unobtrusive readiness to give good counsel and frank criticism, and his gift for inspiring confidence will long be remembered by his colleagues.

Dr. Herbert Weld

We regret to record the death at the age of eighty-three years of Dr. Herbert Weld, geographer and archæologist, which took place at Lulworth Castle, Dorset, on February 4.

Dr. Weld was best known as an authority on the history and geography of Abyssinia, parts of which country he was the first to map. Of recent years, however, his name has more frequently been before the public in connexion with the exploration of Kish in Iraq by the Oxford University Expedition under Prof. S. Langdon, for which he was responsible, obtaining the concession at Tell Aheimar while in Iraq in 1922, and financing the expedition, which began operations in the following year. In addition to a large number of antiquities and an invaluable store of archæological data going back to the earliest stages of human occupation of the country, the expedition acquired some thousands of inscribed tablets. These, with such of the antiquities as were allotted to the expedition, were presented to the Ashmolean Museum at Oxford.

Herbert Weld (formerly Weld-Blundell) was the son of Thomas Weld-Blundell of Ince Blundell, and was educated at Stonyhurst and Queen's College, Oxford, from which university he afterwards received the honorary degree of D.Lit. in recognition of his work in connexion with the expedition to Kish. Before his exploratory work in Abyssinia he had already travelled in Persia (1891), Libya (1894), where he visited all the oases in turn, and Cyrenaica (1895). While in Persia he visited Persepolis and took a number of moulds of the reliefs, which he presented to the British Museum and the Louvre. He also prepared a scheme of restoration which was eventually utilised. His first visit to Abyssinia took place in 1898–99, when he travelled from Somaliland to the Sudan, bringing back a large collection of birds, including seventeen new species, which he presented to the British Museum (Natural History). In 1905, after the interruption of the South African war, where he was present as a newspaper correspondent, he was again in Abyssinia, continuing his work of mapping and collecting. On this occasion he covered the previously unmapped course of the Blue Nile from Tsana to the Sudan. He had already been a contributor to the *Geographical Journal*, the "Annual" of the British School at Athens and the *Journal of the African Society*, when in 1923 his Abyssinian studies bore further fruit in a highly valued volume, "The Royal Chronicle of Abyssinia, 1760–1840", of which the text, in translation from the "Ethiopic Chronicle" in the British Museum, was accompanied by learned and informative appendixes.

Prof. R. A. Robertson

Robert Alexander Robertson, born in Rattray, Perthshire, in 1873, was a graduate in arts and in science of the University of Edinburgh. Going to the University of St. Andrews in 1889, he was appointed lecturer in botany in 1891, his status being raised to that of reader in 1915. In 1929 a chair of botany was instituted and Prof. Robertson became its first occupant. He retired in September 1934, and died on January 15 last.

Robertson was a great teacher. Not only had he the power of imparting knowledge, but he also developed initiative and created enthusiasm. In his early years at St. Andrews he provided many examples from the vegetable kingdom to illustrate the then new conception of 'functional inertia' advanced by Fraser Harris. In those days, too, recognition of timbers by their microscopic structure was pioneer work when illustrated by microphotographs.

Prof. Robertson was a fellow of the Royal Society of Edinburgh and of the Linnean Society. He was a fellow of the Botanical Society of Edinburgh and its president in 1915. He was elected to the committee of management of the Imperial Bureau of Mycology from its inception in 1922. Prof. Robertson commanded the St. Andrews contingent of the O.T.C. from 1912 until 1922.

A man of great sympathy and of high principle, Prof. Robertson strove in all things to do that which was best. In this creed he gave forty-four years of strenuous service to his adopted University, and devoted a life to the advancement of botany in Scotland.

Prof. Basil Hall Chamberlain, emeritus professor of Japanese and philology in the University of Tokyo, died at Geneva on February 15 at the age of eighty-four years. At the time of his retirement from the University of Tokyo in 1905, he was widely recognised as one of the first authorities on the life and culture of the Japanese, avoiding the sentimentality and false idealisation which characterised most writers on the country of his day.

We regret to announce the following deaths:

Sir Leslie Mackenzie, medical member of the Scottish Board of Health from 1919 until 1928, and president of the Geographical Association in 1931–32, on February 28, aged seventy-two years.

Sir William Morris, superintendent of the Ordnance Survey of the Transvaal and Orange River Colony in 1902–7, on February 26, aged eighty-eight years.

News and Views

New Fellows of the Royal Society

THE Council of the Royal Society has agreed to recommend for election into the Society the following seventeen candidates: Dr. N. K. Adam, research chemist, University College, London; Prof. E. N. da C. Andrade, Quain professor of physics, University of London; Sir Frederick Banting, professor of medical research, University of Toronto; Prof. S. P. Bedson, Goldsmiths' Company's professor of bacteriology, London Hospital Medical School; Mr. E. J. Bowen, fellow of University College, Oxford; Mr. G. E. Briggs, lecturer in plant physiology, University of Cambridge; Prof. H. Graham Cannon, professor of zoology, University of Manchester; Prof. W. E. le Gros Clark, Dr. Lee's professor of anatomy, University of Oxford; Prof. J. S. Foster, professor of physics, McGill University, Montreal; Dr. A. L. Hall, lately assistant director of the Geological Survey of the Union of South Africa; Dr. W. H. Hatfield, Brown-Firth Research Laboratory, Sheffield; Dr. J. de Graaff Hunter, lately of the Survey of India; Dr. B. A. Keen, Rothamsted Experimental Station; Prof. R. A. Peters, Whitley professor of biochemistry, University of Oxford; Prof. J. Read, professor of chemistry, University of St. Andrews; Dr. R. N. Salaman, director of the Potato Virus Research Station, Cambridge; Dr. R. Stoneley, lecturer in mathematics, University of Cambridge.

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 4, the following ordinary fellows were elected: Dr. J. L. Brownlie, chief medical officer, Department of Health for Scotland; Dr. R. S. Clark, scientific superintendent, Fishery Board for Scotland; Lieut.-Col. S. H. Cowan, lecturer in forestry engineering, University of Edinburgh; Mr. C. F. Davidson, geologist, H.M. Geological Survey of Great Britain; Mr. Maxwell Davidson, lecturer in heat engines and thermodynamics, University of Edinburgh; Dr. B. N. Desai, assistant meteorologist, Government of India; Dr. R. Grant, demonstrator, Zoology Department, University of Leeds; Dr. A. M. M. Grierson, senior assistant medical officer of health, Manchester; Dr. A. C. W. Hutchinson, dean of the Edinburgh Dental Hospital and School; Dr. J. H. Kenneth, assistant, Imperial Bureau of Animal Genetics, University of Edinburgh; Prof. Peter MacCallum, Pathology Department, University of Melbourne, Australia; Dr. W. A. Mozley, Walter Rathbone Bacon scholar, Smithsonian Institution, 1931–34, Department of Zoology, University of Edinburgh; Mr. J. Munnoch, formerly controller, General Post Office, Edinburgh; Dr. B. Narayana, lecturer in physiology, University of Patna, India; Mr. C. S. Pichamuthu, assistant professor of geology, University of Mysore, India; Mr. T. Rowatt, director, Royal Scottish Museum, Edinburgh; Prof. M. G. Say, Department of Electrical Engineering, Heriot-Watt College, Edinburgh; Mr. Eric Stevenson, lecturer in Engineering, University of Edinburgh; Dr. J. D. Sutherland, lecturer in psychology, University of Edinburgh; Mr. J. E. Touche, Edinburgh; Sir William Whyte, solicitor, Uddingston.

Sir C. V. Boys, F.R.S.

ON Thursday next, March 14, Sir C. V. Boys—more familiarly known as Prof. Boys, though the honour of knighthood was conferred upon him by H.M. The King at the beginning of this year—will be eighty years of age; and his friends everywhere will, we are sure, be glad to associate themselves with us in offering him a tribute of esteem and congratulation on this event. The Royal Society Club, of which Boys is the senior member, is to celebrate the occasion with a festival dinner, at which he will be presented with an album containing the autographs of members of the Club. The Club consists of a group of fellows of the Royal Society who dine together on the days of the ordinary meetings. It was formed so long ago as 1743, and its history has been related in a substantial volume by Sir Archibald Geikie entitled "Annals of the Royal Society Club", published in 1917. Benjamin Franklin was very frequently among the visitors in the latter half of the eighteenth century; and it is particularly appropriate to recall this association with the Club of the discoverer of the nature of lightning, and the recent work of Boys in the same field.

SINCE 1752, when Franklin proved that lightning was an electrical discharge, and concluded that "for the most part, in thunderstrokes it is the earth that strikes into the clouds, and not the clouds that strike into the earth", practically no experimental work on the subject had been done until our new Franklin devised his rotating lens camera for the study of the propagation of the discharge. Boys gave the first description of this ingenious instrument in an article entitled "Progressive Lightning" in NATURE of November 20, 1926 (**118**, 749), and its use in South Africa by Dr. E. C. Halliday, Dr. B. J. F. Schonland and Mr. H. Collens has shown that the majority of the lightning strokes examined consist of a dart-like downward-moving leader stroke, which may be described as an electron avalanche, followed immediately upon arrival at the ground by a more intense upward moving main stroke along thermally ionised channels. The device by which this new knowledge has been secured represents, like Boys's gas calorimeter, the production and use of quartz fibres for the determination of the gravitational constant and other purposes, the photography of rifle bullets and the study of soap bubbles, the application of most original conceptions to experimental inquiry. It may be trite to say that whatever subject Boys has touched he has adorned, but it is certainly true that his contributions to classical experimental physics will go down in the history of science among the highest achievements of a brilliant period.

T. O. Bergman (1735–84)

TORBERN OLOF BERGMAN was born at Katrineberg, Vestergotland, on March 10, 1735. Educated at Uppsala, he first taught mathematics and physics at the University there, before becoming professor of chemistry and mineralogy in 1767. He greatly improved upon the early technique of blowpipe and 'wet' methods of analysis. His most important contribution to theoretical chemistry was his "Essay on Elective Attractions", that is, on chemical affinity. For many years he endeavoured to determine the numerical values for the relative affinities of the elements, bases and acids, but his results were of little significance, since no account was taken of such factors as mass action and the volatility, insolubility, etc. of some of the products of chemical reactions. In the course of his investigations, Bergman discovered the elements molybdenum and tungsten, but it was said of him that "his greatest discovery was Scheele".

Medal Awards of the Institution of Chemical Engineers

AT the thirteenth annual corporate meeting of the Institution of Chemical Engineers held on February 22, the Moulton Medal, the Junior Moulton Medal and Prize of books, and the Osborne Reynolds Medal were presented. These awards were instituted in 1929. The Moulton Medal, which commemorates the chemical engineering work of the late Lord Moulton at the Department of Explosives Supply, is in gold and bears on the obverse a portrait of Lord Moulton, and on the reverse, the seal of the Institution. It is awarded for the best paper of each year presented before the Institution. Papers by non-members are eligible for this Medal. The award for 1934 was made for a paper by Mr. J. Davidson Pratt and Mr. G. S. W. Marlow, entitled "Legal Pitfalls for the Chemical Engineer". The Junior Moulton Medal is in silver, and is a duplicate of the senior award. It is given for the best paper of the year read before the Graduates' and Students' Section of the Institution. Only papers by graduates and students of the Institution are eligible for this Medal and Prize. The 1934 award was made for the paper "Determination of the Efficiency of a Multi-Stage Washer", by Mr. D. Gordon Bagg. The Osborne Reynolds Medal, in silver, commemorates the fundamental investigations of the late Prof. Osborne Reynolds, and is the gift to the Institution of Mr. F. A. Greene, the honorary treasurer. It bears on the obverse the seal of the Institution, and is awarded for meritorious service for the advancement of the Institution. For 1934 the award was made to Mr. H. J. Pooley, in recognition of his work as honorary director of the Appointments Bureau of the Institution since the inception of this office in 1925.

New President of the Society of Chemical Industry

MR. W. A. S. CALDER, delegate director of the General Chemicals Group of Imperial Chemical Industries, Ltd., has been elected president of the Society of Chemical Industry for the year 1935–36. Mr. Calder's lifelong association with the chemical industry commenced after he left the Royal College of Science and joined the staff of Messrs. F. C. Hills and Co., of Deptford. In 1899 he became head chemist and manager of Messrs. Chance and Hunt at Oldbury, of which firm (now part of Imperial Chemical Industries, Ltd.) he became managing director in 1917. When the works were taken over by the Ministry of Munitions during the War, in addition to an increased output of acids and heavy chemicals, an important installation for the manufacture of T.N.T. was developed under Mr. Calder's direction. Mr. Calder is a former president of the Institution of Chemical Engineers, and has always taken an active part in the administration of that organisation and is a member of the executive board of the Chemical and Allied Employers Federation. He is the co-inventor with Dr. C. C. Fox of the Calder-Fox scrubber for the removal of liquid and solid particles from gases.

Malthus Commemoration

THOMAS ROBERT MALTHUS, the economist, author of the "Essay on the Principle of Population", died a hundred years ago on December 23, 1834, and the centenary was celebrated in Cambridge on March 2. Many distinguished economists and statisticians met in King's College, along with a few biologists who came to mark the influence of Malthus upon Darwin and his 'struggle for existence'. Prof. A. C. Pigou presided, and addresses were delivered by Mr. C. R. Fay, Mr. J. M. Keynes, and by Dr. James Bonar, whose book on "Malthus and his Work", written just fifty years ago, remains our chief authority. The same company met again at dinner in Jesus College, of which Malthus was undergraduate and fellow. The Master, Mr. Arthur Gray, spoke to the memory of Malthus, and beside him sat the one surviving kinsman of the philosopher. Dr. Gray coupled the toast with Dr. James Bonar's name, and charmed all his hearers with a simple, intimate account of Malthus and his friends, of the influence which Malthus exercised, and the events and circumstances which influenced him. Malthus became professor of political economy at Haileybury, and was the first of all professors of that science; he was one of the early members of the Political Economy Club, together with Tooke, Ricardo and James Mill; and at the very end of his life he was one of the founders of the Statistical Society. Mr. Gray had many interesting things to say of David Hartley the philosopher, also a member of his College, whose "Observations on Man" and other writings had great influence on the political philosophy of the latter half of the eighteenth century. Malthus and Coleridge (yet another Jesus man), both born after Hartley died, were in their several ways both deeply indebted to him. Coleridge wrote of him as "Hartley, of mortal kind Wisest", and called his son after his name. Hartley Coleridge was born all but fifty years after David Hartley died, and just two years before the "Essay on Population" appeared. Samuel Taylor Coleridge and Thomas Robert Malthus died in the same year, 1834.

The Pace of Progress

IN his Rede lecture at Cambridge on March 4, Sir Daniel Hall discussed the way in which State control is tending to retard the rate of material progress based upon science, and the effect of this tendency on scientific life and thought. From the re-birth of science at the Renaissance, the time-span of social and technical progress has steadily diminished. The two centuries between the invention of printing and the foundation of the Royal Society; the hundred and forty years from that time to the close of the eighteenth century; the first ninety years of the nineteenth century; and the last forty years can be regarded as a series of diminishing time-spans of approximately equal material advance. Material progress which formerly was spread over several generations now occurs within a single lifetime, and our social economy is correspondingly disturbed. This disturbance is the greater because of the persistence of a social structure developed when agriculture was the dominant as well as the primary industry of mankind. Agriculture is at present the outstanding example of an industry brought to an economic standstill because of our inability to handle the enhanced powers of production due to science. The theory of over-production, however, postulates a static society and an inelastic demand, and the disturbing effect of science in the form of invention and discovery is enhanced by greater efficiency, made possible through advances in the technique of organisation.

SIR DANIEL HALL suggested that the difficulty of adjusting the pace of increased production to the social structure first became apparent in agriculture, and that the failure of peasant farming to stand up to the competition of mechanised farming in America and the newer countries was the fundamental factor in determining the shift of fiscal policies in Europe from 1870 onwards. The initial aim of these policies in Europe was to preserve the fundamental peasant basis of each State and to check the rate of material change. The policy of national self-sufficiency pursued by such different methods, for example, as in the Irish Free State and in Italy or Germany, has essentially the same object, and commences by lowering the standard of living as the inevitable consequence of excluding imported goods. In contrast to countries which are content to forego material advantages promised by scientific progress and to accept a low standard of living as the price of national unity and sufficiency, the equally isolated Russian State embraces science as the means of creating real wealth which can be shared among all its population and definitely seeks to raise the standard of living. This system also presupposes a closed autocracy in which it is doubtful whether science can continue to grow or be required, and Sir Daniel suggests that the Marketing Boards now being tried in Great Britain, while an alternative to these two types of autocracy, equally eliminate individual enterprise and threaten to damp the fire of research. Science is an extinguishable response to man's inherent curiosity and its course needs to be broadened not arrested, so that science serves the majority and not merely the interests of a few.

Scientific Developments and Defence Against Air Attacks

THE Under-Secretary of State for Air, Sir Philip Sassoon, announced in the House of Commons recently that a special committee has been set up to investigate the possibilities of countering air attacks by utilising recent progress in scientific invention. The committee, which is already at work, consists of Mr. H. T. Tizard, rector of the Imperial College of Science and Technology (chairman), Prof. A. V. Hill, Foulerton research professor of the Royal Society, Prof. P. M. S. Blackett, professor of physics at Birkbeck College, University of London, and Mr. H. E. Wimperis, Director of Scientific Research, Air Ministry. It will be seen that, with the exception of the last named, the committee's composition is non-official, and Sir Philip paid tribute to the public spirit which has induced these gentlemen to give their services. He also stated that while the body has been kept small to facilitate rapid progress, it is intended to invite other distinguished men of science to contribute to its investigations, and that its actual membership may be enlarged if and when it appears necessary. Prof. F. A. Lindemann, professor of experimental philosophy in the University of Oxford, has already been invited to assist, in view of the attention that he has given to the subject. It is intended to bring the committee's report before the Committee of Imperial Defence in due course.

Radcliffe Telescope for University of London Observatory

OXFORD, both University and the City, is witnessing now the first results of the legal decision upholding the rights of the Radcliffe Trustees to act in the best interests of Urania. This duty led them in the most obvious way possible to a happier clime, where clear skies with steady seeing occur with far more frequency than in Oxford. Quite soon the quaint but beautiful Radcliffe Observatory will cease to adorn the Woodstock Road, and Pretoria will glory in its opportunity to cherish the Radcliffe 72-inch reflector now under construction at Newcastle-on-Tyne. Of late, the Trustees have been engaged in finding new domiciles for such instruments as are not required in South Africa, and to this end offered to the University of London as a free gift the most valuable of the telescopes. This is one of the finest examples of the skill of the late Sir Howard Grubb. It comprises a photographic refractor 24 inches in diameter and 270 inches in focal length, with a visual refractor 18 inches in diameter and 270 inches in focal length. The Senate of the University of London has accepted this magnificent gift for its observatory at Mill Hill, where for the last five years in a conspicuous building of attractive design an enthusiastic group has worked. This notable addition to the facilities of the Observatory is a fitting reward for much labour, in that it will provide further and extended opportunities for investigation which will no doubt be fully utilised.

Birth of a Chimpanzee at the London Zoo

THE birth of a chimpanzee, at the Gardens of the Zoological Society of London on February 15, is an event worthy of record ; and it shows, in no uncertain way, how carefully the well-being of the great apes is studied at the Gardens. The mother, and her daughter, we are told, are doing well. Dr. Wyatt, of St. Thomas's Hospital, and Dr. G. M. Vevers, a member of the staff of the Society, missed no opportunity of studying all the phases of pregnancy, from the time that it was detected until the birth took place. The period of gestation was 250 days. The period of labour Dr. Wyatt describes as precisely similar to that of the human being. A detailed account of the birth is to be given in the next issue of the *Proceedings* of the Society. A deficiency of calcium being suspected, the prospective mother was given regular supplies of 'Micklefield irradiated milk'. This is prepared by passing fresh milk, in a thin film, under ultra-violet rays ; a process which results in an increase of the vitamin D content of the milk ; thus making the lime-salts in it more easily assimilated.

Fertility of the Earth

IN his Research and Development Lecture delivered under the auspices of the Royal Institution and the British Science Guild at the Royal Institution on March 6, Sir Frederick Keeble spoke on the fertility of the earth. Soil-fertility is a product—a by-product—of the bacteria and other microscopic forms of life that teem in incredible numbers in the soil. The crops grown in field and meadow serve mankind in two ways. On one hand, they supply substance for making blood, bone, flesh and sinew and for providing energy for the work of life. On the other hand, they supply substances which stir up the body to activity so that it can use the foods for building purposes and for supplies of energy. Therefore the most important task that agricultural science can accomplish is to discover and learn to control the conditions in which soil and crop provide both the necessary body-building and energy-yielding food materials and also those that stir up growth and activity in the animal and human body. Much is known of the conditions necessary for the production of the first kinds of food. But little is known about the conditions under which crops provide the growth- and activity-provoking foods. When this is understood, foods will be judged by a new and higher standard than they are at present ; and with foods conforming to that standard, human strength will increase and health will improve.

Maiden Castle, Dorchester

DR. R. E. MORTIMER WHEELER'S account of his excavations at Maiden Castle, Dorchester, presented to the Society of Antiquaries of London on February 28, and his report in *The Times* of March 1, make possible a judicial estimate of the importance of this remarkable site in the prehistory of south-western Britain on more assured evidence than size alone, impressive though this may be. As Dr. Wheeler points out, Maiden Castle stands at the centre of an area noteworthy for the number of its sites of prehistoric occupation. It is clear that its history must be that of a pivotal point in cultural and social development. On the evidence afforded by the first season's exploration, four periods of occupation have been differentiated. Of these the earliest, surprisingly enough, was found to date back to the stone age—an occupation by a neolithic people, pastoralists, keeping sheep, pigs and a large breed of ox which had become extinct by historic times. They were pit-dwellers and makers of pottery of the 'Windmill Hill' type. This settlement is dated tentatively at 2,000 B.C. Of the later occupations two are pre- and one late-Roman. In the early Iron Age, towards its end, possibly about the fourth century B.C., a site of about fifteen acres was enclosed by ditch, rampart and palisade. The extension of the area to its present size of about a hundred acres, with its complicated series of defences, is perhaps to be attributed to the next period of settlement, but this is not yet clear. It was in this period in the second century B.C. that peoples from Brittany, with their Celtic craftsmanship, spread over the Somerset plain, reaching Glastonbury and Meare. At Maiden Castle, however, Dr. Wheeler has as yet discerned no fundamental change in the character of the population. Towards the close of the period of Roman occupation the site, which for a time had been left derelict while the neighbouring Roman town of Dorchester was flourishing, was reoccupied and the building took place of the now famous Romano-British temple which Dr. Wheeler has rediscovered.

Kalevala Centenary

ON February 28, the Finnish people celebrated the centenary of the completion by Elias Lönnrott of the first edition of the *Kalevala*, the Finnish national folk-epic. The celebrations culminated in a great gathering in the recently completed Fair Hall at Helsingfors, at which a large number of scholars and delegates from foreign countries were present. Great Britain was represented by Mr. Robert Nichols, Dr. Margaret Murray (Royal Anthropological Institute) and Miss Agnes Dawson (Folk-Lore Society). It was at one time the fashion to compare the *Kalevala* with the Homeric poems ; but in fact this great collection of the legends and folk-lore of Finland is unique in European literature, both as a picture on an enormous canvas of a very primitive stage of society and as a mosaic of pagan magic, pagan religious belief and heroic legend. In this respect it surpasses anything that can be found in the pagan element of Germanic or Scandinavian saga. It consists of a large number of ballads which Lönnrott collected among the peasantry of Karelia, the eastern province of Finland, and wove into a composite whole. It has played an important part in fostering Finnish national aspirations, and has been a fertile source of inspiration in literature, art and music. Since Lönnrott's day much further material of a similar character has been collected. The esteem in which this body of literature is held as a national possession was marked in the

present celebrations by a special session of the Diet at which a sum of approximately £9,000 was voted for the further study of the ancient history, culture and literature of the Finnish people, and by the presence of more than 4,000 people when M. Mamtere, Minister of Education, opened an exhibition, at which a large collection of pictures by Gallen Kalicia, Finland's greatest painter of Kalevala subjects, was the centre of attraction.

Training the Industrial Chemist

THE important subject of the training of an industrial chemist was discussed by Mr. Thomas Donaldson in his address as chairman of the Glasgow Section of the Society of Chemical Industry at a meeting held jointly with the Glasgow Section of the Institute of Chemistry in the Royal Technical College, Glasgow, on March 1. Mr. Donaldson is general technical manager of the Explosives Group of Imperial Chemical Industries, Ltd., and though he made it clear that he was expressing his own personal opinions, his long industrial experience and his position as a governor of the Royal Technical College give him an opportunity of forming an unbiased opinion by being able to look at the problem from both sides. His chief criticism of the present system is that the training usually considered necessary to equip a man for chemical industry is too long. In Scottish universities a student of chemistry takes an honours degree requiring four years study and then normally pursues research leading to a doctorate. This research period extends over three years for a Ph.D. and then, at the age of about twenty-four years, the man endeavours to obtain an industrial position. Once in industry, it requires a further two years training before the man can be considered to be a thoroughly efficient member of his profession, since the university training has scarcely touched on industrial chemistry. Mr. Donaldson suggested that instead of the present system a man should take a three years pass degree, and he could then decide whether he would continue to pursue a technical career. If not, then, by two years training on the commercial side, he could become a thoroughly efficient technical salesman. If he decided to remain on the technical side he had two alternatives. He could complete his honours degree and do one year's post-graduate research, or he could take a two years course in applied chemistry. On this matter of starting research, Mr. Donaldson said that it is far more important that students should be trained in the methods of research rather than that they should solve any particular problem.

Annual General Meeting of the Institute of Chemistry

AT the fifty-seventh annual general meeting of the Institute of Chemistry held on March 1, Prof. Jocelyn Thorpe (president), in moving the adoption of the annual report, said that the register of the Institute now contains the names of 6,285 fellows and associates and more than 800 registered students. The Institute is in a strong position financially, and has co-operated with many other organisations in matters of public importance during the year. Negotiations are on foot for closer co-operation with other societies devoted to chemistry, particularly the Chemical Society and the Society of Chemical Industry. Continuing, Prof. Thorpe dealt with the importance of individualism in professional scientific life. Having regard to the bearing of the subject on the development of team work in research, he emphasised especially the desirability of giving due credit to the individual worker who initiated and developed ideas. He contrasted the present conditions for research work with those existing some forty years ago in the big German factories, where there was little or no intercourse between the members of the research section, who never seemed to talk to one another, being fearful lest they should communicate to their fellow-workers something of the investigations on which they had been engaged, and thus lose the credit due to themselves. This competitive method has now practically died out. The following were elected officers of the Institute for the ensuing year: *President*, Prof. Jocelyn Thorpe; *Vice-Presidents*, Mr. W. J. A. Butterfield, Sir George Clayton, Dr. A. E. Dunstan, Mr. F. G. Edmed, Dr. H. H. Hodgson, Mr. W. H. Roberts; *Hon. Treasurer*, Mr. P. H. Kirkaldy.

Training in Food Technology

IN NATURE of February 23, we summarised the proceedings at a meeting held under the auspices of the Food Group of the Society of Chemical Industry, to discuss a paper on this subject by Dr. H. B. Cronshaw, editor of *Food Manufacture*, the *Manufacturing Chemist* (*not* the *Industrial Chemist*, as erroneously stated in the notice), the *Food Industries Weekly*, etc. Dr. Cronshaw writes to us to make clear that he was advocating an extension, rather than a restriction, of the food chemist's general scientific training, particularly in pre-graduate days, in the direction of physical chemistry and of biology (including bacteriology); this is not in any way inconsistent with increased technological facilities, both in teaching and in research, at the post-graduate stage. He is in agreement with his fellow-members of the Food Group that the food technologist must be a scientific worker first and foremost.

German Physical Congress

THE *Physikalische Zeitschrift* of December 1, 1934, contains the communications and discussions made to the German Conference of Physics held in Pyrmont last September. The section on low temperatures includes reports on the magnetic method for attaining low temperatures, on supra-conductivity, on the calorimetric behaviour of metals at low temperatures, on reflection of light and photo-electric effect at low temperatures, etc. The other section on atomic and nuclear physics includes communications on absorption lines, discharge tubes, molecular oscillations in sound-wave phenomena, positrons, cosmic particles, and electron optics, etc.

European Bison in Poland

A RECENT Quarterly Information Bulletin concerning the protection of Nature in Poland records that the herd of bisons living in the forest of Bialowicza has now reached the number of fourteen individuals, of which nine belong to the pure race. These are two adult males, two young males, two adult females and three young ones. The remaining five are hybrids—the fourth generation of a cross between an American bison cow and a European bison bull. Of the present stock, five individuals were bought in 1929, and the remainder were born in Bialowicza, as well as an additional young bull now in the zoological garden at Warsaw.

Announcements

SIR LANCELOT GRAHAM, Secretary to the Government of India Legislative Department since 1924; Mr. F. W. Ogilvie, president and vice-chancellor of the Queen's University of Belfast; and Prof. G. G. Turner, professor of surgery in the University of London and director of the Surgical Unit at the British Postgraduate Medical School, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

SIR GEORGE NEWMAN, who has been the chief medical officer of the Board of Education since 1907, and of the Ministry of Health since 1919, will retire on March 31. Dr. Arthur Salusbury MacNalty, a senior medical officer of the Ministry and Deputy to the Chief Medical Officer, has been appointed to succeed Sir George, and Mr. Thomas Carnwath has been appointed deputy to the chief medical officer in succession to Dr. MacNalty.

AT the annual general meeting of the Geological Society of London held on February 15 the following officers were elected: *President*, Mr. J. F. Norman Green; *Vice-Presidents*, Prof. P. G. H. Boswell, Prof. W. S. Boulton, Prof. H. L. Hawkins, Sir Thomas Holland; *Secretaries*, Prof. W. T. Gordon, Dr. Leonard Hawkes; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft; *New Members of Council*, Mr. A. J. Bull, Dr. R. G. S. Hudson, Prof. H. H. Read, Prof. H. H. Swinnerton, Prof. W. W. Watts.

MR. A. COULSTON EVANS, assistant plant pathologist at the Long Ashton Research Station, University of Bristol, has been appointed assistant entomologist at the Rothamsted Experimental Station. Mr. Evans received his training at the Royal College of Science under Profs. Balfour-Browne and J. W. Munro; also at University College, London, under Prof. J. C. Drummond, and the London School of Hygiene and Tropical Medicine under Prof. P. A. Buxton. For about eighteen months, he was in France studying sheep blow-fly under Dr. F. G. Holdaway, Council for Scientific and Industrial Research, Commonwealth of Australia, and since August 1934 has been studying fruit pests at the Long Ashton Research Station.

THE portrait of Lord Rutherford, which is Lord Bledisloe's parting gift to New Zealand, was formally presented to the trustees of the New Zealand National Art Gallery at a reception in Wellington on March 1. The Prime Minister of the Dominion as chairman accepted the gift, and in his address paid eloquent tribute to Lord Rutherford. In referring to this portrait in NATURE of March 2 (p. 334), it was stated that Mr. Oswald Birley's original painting is in the Royal Institution. This is not correct; the portrait hangs in the meeting room of the Royal Society.

WRITING with reference to the article in NATURE of February 23 on "Solid Carbon Dioxide" the general manager of the Carbon Dioxide Company, Ltd., Union Marine Buildings, 11 Dale Street, Liverpool, 2, states that this firm also manufactures solid carbon dioxide, and was, indeed, the first to produce it in Great Britain on a commercial basis. The firm's trade name is 'Cardice'.

THE Technical Press, Ltd., of 5 Ave Maria Lane, London, E.C.4, has issued a useful classified catalogue of the technical, scientific and industrial books which it publishes. The titles of technical books on practically all branches of engineering are given. The firm also publishes books on trades and manufactures, arts and handicrafts, and agriculture.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant entomologist in the Advisory Department (Sugar Beet Pests) of the Department of Agriculture, University of Cambridge—The Secretary (March 13). A lecturer in pathology in the University of Liverpool—The George Holt Professor of Pathology (March 15). An assistant botanist in the Ceylon Rubber Research Scheme—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (March 16). Two women lecturers in geography and in mathematics at Norwich Training College—The Principal (March 16). A principal of the Municipal College of Technology, Belfast—The Director of Education, Education Office, Victoria Street, Belfast (March 20). Two junior scientific officers at the Torry Research Station, Aberdeen—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (March 22). Assistant laboratory worker in the Plant Pathology Departments of the Royal Horticultural Society's Laboratories at Wisley—The Director, Royal Horticultural Society, Wisley, Ripley, Surrey (March 23). A junior research officer at the Veterinary Laboratory, New Haw, Weybridge, Surrey—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (March 25). A scientific assistant in the Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge—The Deputy Director (March 31). An assistant mycologist in the Midland Agricultural College, Sutton Bonnington, Loughborough—The Acting Principal. A senior assistant engineer in the Research Department of Electric and Musical Industries, Ltd.—The Employment Department.

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. 398.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Remains from Kanam and Kanjera, Kenya Colony

THANKS to facilities afforded by the Royal Society and to the courtesy of Dr. L. S. B. Leakey, I have recently had an opportunity of spending about six weeks with the East African Archæological Expedition in the Kendu district of Kenya. The chief object of my visit was to study the geology of the deposits from which the Kanam mandible and the Kanjera No. 3 skull fragments were obtained, for Dr. Leakey had come to the important conclusion that these remains of *Homo sapiens* type occurred *in situ* in beds of Lower Pleistocene and Middle Pleistocene age, respectively. Unfortunately, it has not proved possible to find the exact site of either discovery, since the earlier expedition (of 1931–32) neither marked the localities on the ground nor recorded the sites on a map. Moreover, the photograph of the site where the mandible was found, exhibited with the jaw fragment at the Royal College of Surgeons, was, through some error, that of a different locality ; and the deposits (said to be clays) are in fact of entirely different rocks (volcanic agglomerate). Further confusion seems to have arisen over the photograph labelled as the horizon from which the Kanjera No. 3 skull fragments were obtained, this proving to be a cliff of volcanic ash situated some distance away. As the 1931–32 expedition spent three months in the area after the discovery of the mandible at Kanam (its activities being described in Dr. Leakey's field-reports circulated at the time), it is regrettable that the records are not more precise.

The excavations made by the 1934–35 expedition at sites which, one hoped, were close to those of the original finds, revealed the fact that the clayey beds found there had frequently suffered much disturbance by slumping. The date of entombment of human remains found in such beds would be inherently doubtful, and careful investigation of the deposits by an experienced geologist at the time of discovery would therefore be essential. Thus, in view of the uncertain location of the Kanam and Kanjera sites, and in view also of the doubt as to the stratigraphical horizons from which the remains were obtained and the possibility of disturbance of the beds, I hold the opinion that the geological age of the mandible and skull fragments is uncertain.

It will be recalled that on March 18–19, 1933, the Royal Anthropological Institute convened a conference at Cambridge to discuss the evidence of these early human remains[1]. It would appear, from the circumstances just mentioned, that the evidence placed before the conference was unintentionally misleading. The Geological Committee at the conference prefaced its conclusion as to the stratigraphical age of the remains with the phrases "From the evidence supplied by Dr. Leakey, the Committee can see no escape from the conclusion. . . ." It seems likely that if the facts now brought forward had been available to the Committee, a different report would have been submitted.

There still remains for consideration the state of mineralisation of the bones, and the succession of implements from the Kendu area. The degree of mineralisation is undoubtedly high, but such a feature can be used only comparatively and with due caution[2]. I am satisfied, however, that the human remains in question are much more highly mineralised than are those excavated from shell-mounds in the district, believed to be Mesolithic, which are the only other human bones we have for comparison. The implements actually found in undisturbed deposits in the district are not numerous ; they include a few pebble tools from the Kanam area, and a few Chellian tools from the Kanjera area four miles away. These occurrences appear to me to be far too meagre to constitute a succession of types similar to that at Oldoway, in Tanganyika[3].

It is disappointing, after the failure to establish any considerable geological age for Oldoway man (of *Homo sapiens* type)[4] that uncertain conditions of discovery should also force me to place Kanam and Kanjera man in a 'suspense account'.

Finally, it is a pleasure to record that, during the last week of my work in the Kendu area, I had the benefit of the wide experience and sound judgment of Mr. E. J. Wayland, director of the Geological Survey of Uganda. Without committing Mr. Wayland in matters of detail, I am able to say that he agrees with the main conclusions I have expressed above.

P. G. H. BOSWELL.

Imperial College of Science
and Technology,
London, S.W.7.
Feb. 21.

[1] NATURE, **131**, 477 ; 1933.
[2] See, for example, Andrews, C. W., *Geol. Mag.*, p. 110, 1912.
[3] *ibid.*, Cambridge Conference, Archæological Committee's Report. "At Kanam and Kanjera, stratified deposits include a similar series of industries. . . ." (that is, similar to Oldoway).
[4] *ibid.*, **131**, 397 ; 1933.

Cosmic Rays and Novæ

PROF. W. KOLHÖRSTER[1] has recently described some fluctuations in the observed intensity of cosmic rays in December last, which he suggests may possibly be connected with the appearing of Nova Herculis at that time. Without venturing to judge of the reality of this particular correlation, one may inquire whether it is in general possible that nova outbursts could supply energy sufficient to maintain the supply of cosmic radiation, or a large fraction of it.

Let us suppose there is an average total liberation of cosmic ray energy E in a single nova outburst. The number of such outbursts in the galactic system is not known, but it has been estimated (Bailey) that there are one or two novæ per year of apparent

magnitude at maximum less than 6. The mean absolute magnitude at maximum appears to be about − 5, which gives apparent magnitude 6 at 5,166 light years distance. Hence we should certainly not underestimate E if we suppose there is one nova per year at distance $r = 5{,}000$ light years, and that this one is solely responsible for the cosmic rays in our neighbourhood. This would give an average energy flux $F = E/4\pi r^2 Y$ per cm.^{2} per sec. outside the earth's atmosphere, where $Y = 3{\cdot}156 \times 10^7$ sec. = 1 year. This does not imply that a nova outburst lasts on the average just one year; it gives merely an estimate of the rate of supply of cosmic ray energy if one nova appears per year at distance r. Further, Regener[2] has estimated the flux of cosmic ray energy outside the atmosphere to be $3{\cdot}53 \times 10^{-3}$ erg./cm.^{2}/sec. Setting F equal to this value, we find $E \sim 3 \times 10^{49}$ ergs. This should be an upper bound; and it should be safe to conclude that if a single nova is capable of liberating energy of this order, then, so far as energy considerations go, such processes could maintain the observed intensity of cosmic rays.

Now Milne[3] takes a typical nova outburst to be one in which a star of initial effective temperature $T_0 \sim 8{,}000°$ collapses to a state of final effective temperature $T \sim 40{,}000°$. Also he takes the total luminosity as about the same before and after collapse, so that $R_0 T_0^2 = RT^2$, where R_0, R are the initial and final radii. If then we take a star having initially solar dimensions, its initial negative gravitational energy is on Eddington's model $5{\cdot}66 \times 10^{48}$ ergs. This quantity is inversely proportional to the radius, so that if the radius changes in the ratio $(R_0/R) = (T/T_0)^2 = 25$, then its final value is $1{\cdot}42 \times 10^{50}$ ergs. Hence the total gravitational energy liberated in the collapse is $\sim 10^{50}$ ergs. This estimate was first given by Milne[4], and is independent of any theory of what happens during the actual outburst. Nevertheless, he does not consider that such a large energy liberation can in fact take place, for on his stellar models the mass is much more concentrated towards the centre than in Eddington's, so the potential energy change corresponding to a given radius change is smaller. Hence it appears that if stars are built on Eddington's model, then it may be possible that nova outbursts are adequate to supply the energy of cosmic rays. Whether the gravitational energy is liberated in the form of cosmic rays or not, is of course another question. If, however, the stars have much higher central densities, then apparently the energy supply from this source would not suffice.

A more definite verdict can at present scarcely be given. One needs to know more about the structure of a star just before and just after the nova phase, and more about the distribution of novæ in space. In regard to the latter, it may however be pointed out that Kolhörster tentatively connects a 2 per cent increase in cosmic ray intensity with Nova Herculis. Since estimates of the total number of novæ in the galaxy give 20–30 per year, he considers this fraction not unreasonable if novæ have the importance suggested. However, almost all these novæ are much fainter than Nova Herculis, which should therefore make a much *larger* percentage difference.

Finally, it need scarcely be said that if the origin of cosmic rays is to be traced to novæ, then their liberation of energy in this form must vastly surpass that in the form of light. For Regener's estimate gives a cosmic ray intensity almost equal to the total intensity of starlight. The latter is equivalent to the light from about 2,000 first magnitude stars, while a nova rarely reaches first magnitude, and so makes but little difference to the total light intensity. Actually, Unsöld has evaluated the total light emitted in a typical nova outburst as 6×10^{44} ergs, a quantity small compared with the order of 10^{49} ergs seen to be necessary for cosmic rays.

W. H. McCrea.
Imperial College of Science and Technology.
Feb. 7.

[1] *Z. Phys.*, **93**, 429; 1935.
[2] *ibid.*, **80**, 666; 1933.
[3] *Observatory*, **54**, 126; 1931.
[4] *ibid.*, p. 144.

Ratio of the Magnetic Moment of the Proton to the Magnetic Moment of the Deuteron

In a previous paper[1] it was shown that it is possible to estimate the ratio of the magnetic moment of the proton to the magnetic moment of the deuteron (μ_H/μ_D) by comparing the rates of the reactions

$$\text{ortho-}H_2 + O_2 \rightleftarrows \text{para-}H_2 + O_2 \qquad (1)$$
$$\text{ortho-}D_2 + O_2 \rightleftarrows \text{para-}D_2 + O_2 \qquad (2).$$

The ortho-para transitions occur in the reactions (1) and (2) under the influence of the inhomogeneous magnetic field during the collisions with oxygen molecules[2].

Since the theory of the paramagnetic ortho-para-hydrogen conversion[3] has recently been investigated in some detail[4], and in addition more heavy hydrogen has become available, the ratio μ_H/μ_D has been re-determined. The results obtained are given below.

Temperature T (° K)	$k_{H_2}^{(2T)} / k_{D_2}^{(T)}$	μ_H/μ_D
83	12·5	3·85
193	14·5	4·03
293	14·8	4·07

$k_{H_2}^{(2T)}$ and $k_{D_2}^{(T)}$ denote the velocity constants for the reaction (1) at the temperature $2T$ and that for the reaction (2) at the temperature T respectively. The ratio μ_H/μ_D is calculated according to the formula given by Kalckar and Teller[4].

$$(\mu_H/\mu_D)^2 = a.k_{H_2}^{(2T)} / k_{D_2}^{(T)}$$

where $a = 9/8 = 1{\cdot}12$ for $T > 120°$ K. and $a = 1{\cdot}18$ for $T = 83°$ K. The variation of the ratio μ_H/μ_D with temperature is within the limits of experimental error, which is less than 5 per cent.

The present ratio is in agreement with the values for μ_H and μ_D obtained by the magnetic deflection method[5,6]. It should be mentioned, however, that the ratio μ_H/μ_D as determined by the deflection method is not very certain owing to the great limit of error in the measurement of the absolute values for μ_H and μ_D.

L. Farkas.
A. Farkas.
Laboratory of Colloid Science,
University of Cambridge.
Feb. 14.

[1] Farkas, Farkas and Harteck, *Proc. Roy. Soc.*, A, **144**, 481; 1934.
[2] Farkas and Sachsse, *Z. phys. Chemie*, B, **23**, 1, 19; 1933.
[3] Wigner, *Z. phys. Chemie*, B, **23**, 28; 1933.
[4] Kalckar and Teller, NATURE, **134**, 180; 1934.
[5] Estermann and Stern, NATURE, **133**, 911; 1934. *Phys. Rev.*, **45**, 761; 1934.
[6] Rabi, Kellogg and Zacharias, *Phys. Rev.*, **45**, 769; **46**, 157, 163; 1934.

(*Continued on p.* 393.)

Supplement to NATURE

No. 3410 MARCH 9, 1935

Reviews

An Encyclopædia of Natural Science

Handwörterbuch der Naturwissenschaften. Zweite Auflage. Herausgegeben von R. Dittler, G. Joos, E. Korschelt, G. Linck, F. Oltmanns, K. Schaum. Band 1: *Abbau—Blut.* Pp. x+1078. 56 gold marks. Band 2: *Blütenpflanzen—Dutrochet.* Pp. viii+1172. 61 gold marks. Band 3: *Echinoderida—Fette.* Pp. vii+1230. 67 gold marks. Band 4: *Fische—Geuther.* Pp. viii+1270. 67 gold marks. Band 5: *Gewebe—Kützing.* Pp. viii+1286. 67 gold marks. Band 6: *Lacaze-Duthiers—Morison, Robert.* Pp. viii+1134. 61 gold marks. Band 7: *Morphologie der Pflanzen—Poisson.* Pp. viii+1140. 61 gold marks. Band 8: *Polarlicht—Siemens.* Pp. viii+1248. 67 gold marks. Band 9: *Silikate—Transformatoren.* Pp. viii+1158. 61 gold marks. Band 10: *Transplantation bei Tieren—Zwillinge und Zwillingsforschung.* Pp. viii+1090. Dazu *Sachregister und Systematische Inhaltsübersicht.* Pp. 242+16. 73 gold marks. (Jena: Gustav Fischer, 1931–1935.)

THE attempt to compress into an encyclopædia of ten volumes our present knowledge of the main facts and theories of the natural sciences is an undertaking ambitious enough to daunt even the most courageous of authors and publishers. The volumes here before us, however, cannot but be received with unstinted praise. They owe their origin to the enterprise of the founder and original proprietor of the publishing house of Gustav Fischer, Jena, who felt that increasing specialisation in the sciences during the last decades had made it difficult for all except those directly connected with university institutions to keep in touch with subjects not involved in their ordinary activities. Moreover, there was the danger that science was tending to be regarded as a heterogeneous sum of unconnected spheres of knowledge and not as a harmonious whole, the *gestaltetes Wissen* which is so aptly expressed in the German word *Wissenschaft*. Our interest in the individual leaf must not extinguish our desire to see the whole tree.

Some four hundred scientific workers were therefore invited to collaborate in producing an authoritative and comprehensive work which, it was hoped, would be worthy to become the standard work of reference for the natural sciences. This hope has been fully realised. The second edition which lies before us is remarkably up-to-date in the information it gives. Three of the original editors (H. Th. Simon, M. Verworn, E. Teichmann) have died since the appearance of the first edition, and the present editors are: R. Dittler (Physiology), G. Joos (Physics), E. Korschelt (Zoology), G. Linck (Mineralogy and Zoology), F. Oltmanns (Botany) and K. Schaum (Chemistry). At the beginning of each volume there is a list of contents, giving the heading and the author of each article in alphabetical order as in the actual text. This preliminary index is particularly convenient for quick reference and also for finding out under what headings subjects are to be found.

Chemical elements are treated in groups in accordance with the periodic classification. For example, we find under the heading *Berylliumgruppe* a detailed account, covering 58 pages, of the discovery, occurrence, preparation, application, electrochemistry, analytical chemistry, thermochemistry, photo-chemistry and colloid chemistry of the elements beryllium, magnesium, calcium, strontium, barium, radium, zinc, cadmium, mercury and their compounds. Many interesting observations are contained in this article; for example, that beryllium is seventeen times more transparent to X-rays than aluminium and has therefore been recommended for windows in X-ray apparatus, and that in 1927 one gram of beryllium metal cost 200 marks whereas in 1930 one kilogram cost less than 1,000 marks. It is significant that, of the four references given for beryllium, one is to the scientific publications of the *Siemenskonzern*, by whom a special issue dealing only with beryllium was issued in 1929, and one is to a publication of the Canadian Department of Mines. It is doubtful whether sufficient attention has been directed in Great Britain to the great industrial possibilities of this very light metal.

If we wish to refer to the atom we find four headings: *Atombau* (Estermann), *Atomkernstruktur*

(Kirsch), *Atomlehre* (Drucker), *Atom-* und *Molekular-strahlen* (Estermann). These articles occupy nearly fifty pages and, although highly condensed, contain everything of importance and much that will be new to many readers. In a set of volumes of such wide scope it is impossible to attain uniform excellence of treatment, and although the standard throughout is maintained at a high level, a certain unevenness is manifested in the number and quality of the bibliographical references. In some cases references to German sources only are given; in others the most important non-German books are extensively quoted. It would be a great help to the English and American reader if a little more space could be given in the next edition to the outstanding English treatises in some of the subjects. A good example is set in the splendid article on the theory of elasticity (Th. v. Kármán) which refers to three French, four English and six German works.

The subjects concerned with the different aspects of electricity occupy 383 pages in the third volume alone; there are additional articles in other volumes (for example, transformers). Concerning properties of matter there is an attractive article on surface tension (*Oberflächenspannung*) by Auerbach, copiously illustrated by diagrams taken largely from vol. 7 of the "Handbuch der Mechanik". The theories of Lipmann, Helmholtz, Nernst and Krüger are briefly but lucidly described and there is also a note on electro-capillarity, the capillary telephone of Bréguet and Livén and the electro-capillary motor of Lipmann. Attention may also be directed to the following among many excellent articles: radiometer effects (Gerlach), northern lights (Angenheister), science of aviation (Everling), statistical physics (von Laue), stellar spectra (Siedentopf), scattering of light (Pringsheim), all of which are well illustrated.

Of the biological contributions, it may be said that, on the whole, the longer articles appear to attain a higher standard than the shorter ones. More than 150 pages are devoted to the propagation of plants, no less than ten writers having contributed to the various sections. We note with pleasure that Prof. F. O. Bower (Ripon, formerly of the University of Glasgow) is the author of two of these, dealing with Archegionata. Lundegårdh (Stockholm) has written the article on cyclic changes of substances in the organic world; the lengthy and elaborate article on the geography of plants is by Firbas (Göttingen) and Rikli, Rübel and Schröter, all of Zurich. An article on the nerve system seems rather old compared with most of the other contributions; very few references are to works later than 1911 and that to Sherrington bears the date 1906. The same criticism applies in a lesser degree to the article on breathing, in which J. S. Haldane's work is inadequately represented. These two articles might well be re-written or at any rate extended when there is a call for another edition. In contrast with these, the article on the sense of touch has been excellently written and illustrated by von Skramlik (Jena). Biochemists will find a rare feast in the article on fermentation, among the contributors of which are Neuberg, Luers and Windisch. Nor must we omit to mention the masterly survey given under the heading "System and Nomenclature of Chemical Substances".

Biographical notes on the life and work of eminent scientific workers of the past are also contained in these volumes; most of them have been written by Emilie Drude of Göttingen. Living scientists are, rightly, not included. These notes give the main essentials as regards dates and important discoveries, and also arresting details of the personal life of the savant in question. We learn, for example, that Joseph von Fraunhofer, born in 1787 near Munich, was the son of a master glazier and had not yet learned to read or write when at the age of twelve he became an orphan. King Max of Baden happened to have his attention directed to the boy and gave him money to buy books. The youth, although entirely self-taught, became in 1818 the director of an important optical firm in Benediktbeuren, which later established itself in Munich. In 1823 he was elected to the Academy of Sciences and appointed professor of physics at Munich, and a year later he was knighted. His discovery of the dark lines in the solar spectrum was made in 1814; three years of further work led him to the construction of the first diffraction grating. He died in 1826.

The short sketch of Johannes Kepler's life is also characterised by some personal touches. On one occasion, just after he had discovered his Third Law, he had to interrupt his work at Linz and hasten home to the help of his mother, who was in danger of being burnt as a witch. He was never free from financial worries, for his patron, Kaiser Rudolf II, rarely paid him his salary in full, and his attempts to enlist the help of Wallenstein were unsuccessful. When at last he went to Ratisbon to apply to the Reichstag for the balance of his salary, he was attacked by fever and died.

The biographical notes thus reflect interesting sidelights on the private lives of the earlier men of science, and have been written with commendable taste and discrimination.

The supplementary index volume (*Sachregister*) contains not only an alphabetical list of the technical references, in which the proper names and the headings of the articles are made prominent

by being printed in heavy type, but also a systematic table of the articles (with the names of their authors) under their respective headings. For example, the articles dealing with botany are collected together and subdivided into nine sections, each of which contains a list of all the articles concerned with the subject-matter of that section. This index and classified list considerably enhance the usefulness of the "Handwörterbuch".

The volumes have been handsomely produced in the manner of Abderhalden's "Handbücher" and the numerous diagrams (more than 9,000 in the ten volumes) have been excellently drawn. We are, indeed, accustomed to sets of volumes of this kind coming from Germany, a country where it appears comparatively easy to persuade scientific workers, no matter how fully occupied in routine work, to write their contributions without delay, and to find publishers who can get the volumes out in relatively few months. Until the speed of working is accelerated in other countries, we are unlikely to find similar sets of handbooks on science produced in other languages.

As it is desirable and in many cases even essential that these series of "Handbücher" (Physik, Experimentalphysik, Kosmische Physik, Technische Physik—to mention only the volumes on physics) should be intelligible to science students generally, the question naturally arises whether the amount of German taught in English schools meets the requirements of those who will later be engaged in scientific pursuits, whether academic or industrial. No research worker can nowadays afford to be without at least a sound reading knowledge of German ; and many teachers, too, would find it a boon to be able to keep in touch with the progress and methods of education in a country which has played such a pioneer part. Is it too much to hope that German will soon be introduced into our schools as a compulsory subject for the great number of boys whose ultimate goal is a scientific profession ? It is true that the many translations from the German which have appeared in recent years have been a valuable aid to study in various fields, but translations rarely appear until a considerable time has elapsed after the publication of the original work, and their usefulness and freshness is therefore much reduced. Moreover, in the case of research papers complete translations are, of course, out of the question.

In other ways, too, the increased study of German would have its advantages in bringing the youth of England into closer contact with a great country, for which many of us have a deep and lasting affection and from which no man of science can fail to draw inspiration.

HENRY L. BROSE.

The Analysis of Mind

Manual Skill : its Organization and Development. By Dr. J. W. Cox. (Cambridge Psychological Library.) Pp. xx+247+1 plate. (Cambridge : At the University Press, 1934.) 16*s.* net.

IN 1904 Prof. C. Spearman began that long series of papers, culminating in 1927 in his book "The Abilities of Man", which gave to psychology a new method of attack upon the problem of mental constitution. This method combined two techniques which were then coming into use in psychology, those of correlation and of mental testing. It made possible the analysis of a concrete function such as addition. It was possible to determine not only how many factors were involved but also which of them were general, that is, common to all abilities, which were group factors, that is, common to some but not all abilities, and which specific to the ability in question. It was even possible to estimate the relative importance in that ability of the various factors.

It was clear that only very extensive investigation could realise the full value of the Spearman method. Dr. J. W. Cox is one of those who are bringing this realisation nearer. In 1928 he published what is still perhaps the best account of the investigation of a group factor ("Mechanical Aptitude". Methuen, 1928). He showed that efficiency in a 'mechanical' function, for example, the solution of an engineering problem, depends partly upon a general factor—the Spearman g or general intelligence, partly upon a factor specific to that function, and partly upon a group factor co-extensive with the field of 'mechanical' or engineering functions—the mechanical factor m. From the point of view of vocational selection and guidance, the demonstration of this mechanical group factor was especially important.

The present work is both a continuation of the earlier work and a breaking of fresh ground. It applies the same method to manipulative functions, chiefly to the assembling and stripping of an electrical lampholder. Assembly was split into five operations which constituted five 'assembling tests'. These were used in two ways. When first applied, the mode of assembly being still a problem, they were 'mechanical assembling tests'. After familiarisation, they were 'routine assembling tests'. The four 'stripping tests' were used only as 'routine tests'.

These tests, along with tests of intelligence and of mechanical ability, were applied to groups of school children. Analysis showed that the mechanical assembling tests involved the general factor g, the group factor m and specific factors,

whilst the routine assembling tests involved not only g, m and specific factors, but also a group factor especially associated with routine manual work. The application of other manipulative tests showed that the manual factor was of wider scope than lampholder operations. It is to be noted, however, that both m and g tend to be negligible in simple manual functions, and m in the stripping tests as well. Furthermore, whilst the manual factor is common to routine and manual assembling and to simple manual operations, it tends to disappear in favour of specific factors in operations calling for speed rather than the careful adjustment of parts, such as stripping. It is clear that if the manual factor is to be measured precisely in individuals, operations of the assembling rather than the stripping type, and complex rather than simple, are called for. But precise individual measurement of the manual factor is further in the future than of the mechanical factor.

The demonstration of a new group factor is enough in itself to make Dr. Cox's book important. It contains, however, many other important findings. Of these it is possible to mention only that relating to the transfer effects of practice and training.

Woodrow showed in 1927 that training, that is, instruction in suitable methods of memorisation together with practice in memorising one kind of material, improves efficiency in memorising certain other kinds of material, although practice without instruction lacks this beneficial effect. Dr. Cox has found not only that this is true of motor functions but also that the improvability of the functions showing transfer is increased. It is to be noted, however, that the spread of the transfer thus far demonstrated is far narrower than the general transfer claimed by the old 'faculty' psychologists and some modern educationists.

Research among Primitive Peoples

Essays presented to C. G. Seligman. Edited by E. E. Evans-Pritchard, Raymond Firth, Bronislaw Malinowski and Isaac Schapera. Pp. ix + 385 + 19 plates. (London: Kegan Paul and Co., Ltd., 1934.) 21*s.* net.

IT will, no doubt, be the pleasing duty of some future historian of the progress of science in the first third of the twentieth century to trace in the development of anthropological studies the influence of the Cambridge Expedition which set out for the Torres Straits in 1898 under the leadership of Dr. A. C. Haddon. It was as a result of what he saw on that expedition that the late W. H. R. Rivers took up the serious pursuit of ethnology, while on the same expedition Prof. C. G. Seligman, to whom this volume of essays is presented by his friends and former pupils, was inspired with that enthusiasm for research in the field among primitive peoples, which has been the dominating influence in his life-work. How much of this was due to the leader of the expedition, who contributes the foreword to this volume, it is unnecessary to inquire; but the influence, whatever its source, was decisive.

Prof. Seligman, as the earlier entries in the bibliography published here will show, clearly had before him a choice of distinction in more than one branch of scientific research; and his selection of anthropology as his main interest and subject of study has never been allowed to restrict unduly the play of his versatility. This has given his work a flexibility and freshness of outlook, which is exemplified in his published work by his readiness to consider the bearing of advances in cognate subjects of inquiry on the methods of his own branch of investigation. Thus in the wide range of topics covered by the thirty-nine contributors to this presentation volume, some perhaps almost on the fringe, rather than actually within the bounds of the science, there is none to which Prof. Seligman himself has not made some more or less substantial contribution.

In turn he has inspired or interested others. It is in no sense invidious to suggest that much is due to his influence in, let us say, selecting almost at random, the essays by Prof. E. E. Evans-Pritchard on "Zande Therapeutics", the Princess Marie Bonaparte on "Psycho-Analysis and Ethnography", with its stress on the importance of the investigation of primitive peoples before it is too late, Dr. Raymond Firth on "The Meaning of Dreams in Tikopia", or the "Anthropological Approach to Ethnogenics" by Capt. Pitt-Rivers emphasising the practical aspects of anthropology, of which Prof. Seligman has always been an ardent champion. To his example too, no doubt, must be attributed Prof. Malinowski's divagation to an antiquarian topic, upon which he forbears to enlarge, in a description of stone implements from eastern New Guinea.

Where so much is of interest, it is difficult to select any special papers for mention. The reader's preference, whether for material culture, psychology, magic, law or religion, will scarcely fail to find satisfaction somewhere in this long list of contributions. Mr. J. Layard, for example, studies beliefs relating to the journey of the dead in the New Hebrides; Dr. G. Róheim, psycho-analytic methods in the study of character development and the ontogenetic theory of culture; Mr. Henry Balfour describes the peculiar Tandu industry of Northern Nigeria, by which an animal membrane is made into boxes and flasks; and Prof. J. L. Myres

puts forward a theory of the creation of the Tribunes of the Roman Plebs, while Dr. R. R. Marett re-examines the old problem of food rites and their relation to totemism, sacrament and sacrifice.

Even where so much is excellent or attractive, one paper stands out, not only on its intrinsic merits, but also for its critical attitude towards traditional anthropological method. This is by Dr. A. Hrdlička on "The Anthropological Value of the Skull". He traces the history of this character as an element in the study of man and in racial classification, and shows how it came by degrees to overshadow all other characters in the methods of physical anthropology. While he does not deny that it has a real value in anthropological research, he maintains that it must be put in proper perspective and its study carried on critically. Dr. Hrdlička considers that the human body, including the skull, is still plastic and that great changes are going on now, for example, in the Eskimo and the American Indian. The latter, indeed, has often so changed under altered conditions as to be almost worthless for type study. Coming from so great, and on the whole conservative, an authority, this opinion should give pause to the too ready formulation and acceptance of racial theories.

Of this volume as a whole it remains to be said that in form and contents it is worthy of its recipient, and than this there could perhaps be no higher praise. The editors have earned thanks and congratulations.

A Modern Naturalist

Confessions of a Scientist. By Dr. Raymond L. Ditmars. Pp. xiii+241+23 plates. (New York: The Macmillan Co., 1934.) 15*s.* net.

DR. DITMARS has charge of the reptiles in the New York Zoo, but, as he tells us, he is a kind of chaperone for all its beasts, with a special liking for the more primitive and delicate forms. We tend to think we can buy everything in the way of beasts, living and dead, whereas New York seems to do much of its own collecting. This means a personal knowledge on the part of its officers of the beasts in Nature, and, practically in gardens and scientifically in laboratories and museums, this is invaluable.

The assets of a keeper are observation, humour and pluck, and all these the author has to a marked degree. His writings are charming and fresh, deservedly meriting their wide clientèle. For pluck, read how he made a motion picture of a mamba, the quickest and most deadly of all snakes. The studio was decorated with a young hornbeam, on the spreading branches of which the mamba was induced to lie under the necessary vapour lights. Here was the stimulating spring sunshine, rich in ultra-violet, that wakes the mamba—and it is surprising that the author lived to tell his tale, as the reader may see. All this work and danger to secure a film! What folly? But a film may reveal movements and a play of features, unseen by the eye, and these tell us of the psychology which is as much part of a beast as his anatomy. Evidently, the belief is that the film is to become part of the technique of the lecturer in zoology and to this we agree, expecting that in twenty years' time lecture rooms without cinema will be anomalies. In Great Britain, the films as yet do not exist, but we look to the Zoological Society of London to give us them. It is a society possessed of vision, and it has means. It will soon want fresh fields to conquer, and here is one well worthy of its enterprise.

To return to our text, the "Episode of the Twenty-Four Tarantulas" must be read. The vampire next! She found her quarters in the Zoo, learning to feed on defibrinated blood which was diluted somewhat for her babes. It required time to break her in, but films finally were secured when she approached her dish and fed. Her thumb served as a foot and "there was no semblance of a bat, but a weird stalking thing, of the softest gait. . . . Bending over the dish, she darted her tongue into the sanguineous meal . . . 4 darts a second. . . . Her wings spread like a flash . . . and she hooked a hind claw overhead and was hanging, head down. . . . Gorged and inverted". More knowledge here than acquired in three hundred years of study. Who would have guessed that the vampire alone among bats has the double habits of running and flight? Is there not something wrong with the scientific worker? Indeed, how many know that the range of temperature for snakes is only 32°–115° F., and that the parental care of the marmoset father for his children is to secure food for them, despite an always greedy mother.

Of course, the author cannot leave the Loch Ness monster alone. Who can! It was one of the biggest items in the world's news in 1933–34 and it lasted longest. It is not a reptile, since there is not a reptile living that could exist in the chilly waters of the Loch—and hence it must be a warm-blooded beast, namely, a mammal. Like the salmon we caught last month, it doubtless has continued to grow, and hence it might well have been a seal, which, swimming in the surface waters, produces a long wake.

Lastly, we may refer to the use of cobra venom, which has nerve toxins, for the amelioration of malignant growths. It all started with the observation that a marked improvement was shown by

a leper after being accidentally bitten by a tarantula. Then Dr. Ditmars came in as a purveyor of poison, and the results are to be seen in the published accounts of the work of Dr. Monae-Lesser showing that the use of cobra venom on cases of tumour, benign or malignant, always relieves pain, often stabilises the growth for a period and even in cases obtains regressions. Most snake venom, however, is of a different type, attacking the blood and destroying the red corpuscles and breaking down the walls of the blood vessels. Here injections were also tried and were found to produce a surprising effect; they inhibited the bleeding and are thus potentially of considerable use in medicine. We wonder what will come next! The last discovery was made on injecting the venom into a rabbit to make its skin more sensitive to the bleeding reaction, while the effects proved exactly the reverse.

Cytology and Genetics

Introduction to Cytology. By Lester W. Sharp. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Third edition. Pp. xiv+567. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30*s*. net.

THE development of cytology in its relation to genetics is a chapter of more than usual interest in the history of biology. Cytology in the modern sense developed during the last quarter of the nineteenth century as a purely observational science. The general nature and behaviour of cells, nuclei and chromosomes were worked out during that period, although the cell theory, of course, originated much earlier. The rediscovery of Mendelism and the announcement of mutation at the turn of the present century marked a new epoch in biology, and soon gave abundant meaning to the observations regarding chromosomes which the cytologists had already accumulated. Henceforth cytology and the young science of genetics mutually influenced each other, and each derived increasing strength from the observations of the other.

For a time, genetics or breeding experiments were naturally regarded as the dominant member in this remarkable partnership. But the early discovery of mutations with different chromosome numbers, of the relation between genetic linkage and the chromosomes, and of polyploidy or chromosome multiples in many plant genera, not to mention the sex chromosome mechanism in animals and its relation to sex-linked inheritance, soon made it clear that cytology would play a fundamental rôle in the future development of genetic research. Nevertheless, many geneticists were slow to realise that the cytologists had provided them with the only mechanism by which their results could be adequately explained. The practical breeders, in particular, failed to sense the necessity of calling cytology to their aid in connexion with the improvement of such important world crops as wheat and cotton, until the essential results regarding the chromosomes in these plants had been placed before them by the cytologists. This was no doubt partly because cytology requires a special equipment and an exacting technique which some investigators never fully achieve.

That geneticists now universally recognise the fundamental importance of cytology for breeding work, even in its most practical aspects, is due to the striking mass of results regarding the chromosomes and their behaviour which cytology has achieved. From being the handmaiden of genetics, cytology has become an equal partner; and to change the metaphor, it has become clear that cytology must continue to provide the foundations on which the superstructure of genetics can be built. To judge from the large proportion of genetical papers in which cytological results are reported, it might even be contended that cytology has already reached the dominant position. In a recent number of the *Journal of Genetics*, for example, six of the nine papers either reported new cytological results or were based upon cytological facts already known, while in two of the remaining three papers special facts regarding the chromosomes were involved in the interpretation. This situation is not surprising, since cytology is recognised as an essential part of the training of the younger generation of geneticists. Indeed, the term cytogenetics, now in frequent use, marks the fusion of these two sciences into one, and indicates that cytology will play an essential part in all future development of the subject. Genetics without cytology would be like the play without Hamlet.

The book before us is a useful introduction to cytology, particularly as regards plants, and much of it is devoted to the cytological foundations on which the structure of modern genetics is reared. Its usefulness is attested by the fact that it is the third edition of a work first published in 1921. Large alterations and additions have been made in the present edition, which is much improved thereby, and nearly all the relevant recent work has been included.

The work now consists of twenty-six chapters: the first seven deal with such topics as the cell, protoplasm, nucleus, plastids, Golgi material, chondriosomes and ergastic substances. The next six chapters are concerned with mitosis, chromosome structure and related subjects; the three

following, with sporogenesis, syngamy and meiosis, the phenomena in all groups of plants being compared. The remaining ten chapters, except the last which gives a historical sketch of cytology, are devoted to modern work on chromosomes and heredity, chromosome fragmentation, heteroploidy, cytogenetics of hybrids and related phenomena.

While there are points in which the reviewer would differ from the author in conclusions or treatment, yet it must be recognised that the work is a carefully collated and dispassionately presented account of advances in this wide field. Didactic considerations have not been forgotten, and there is sufficient explanation and comparison with conditions in animal cells to make the book serviceable also to zoologists. Accounts of various phenomena of general interest, such as spermatogenesis and artificial parthenogenesis in animals and endomixis in *Paramecium*, find a place. The extensive references to literature have been mostly relegated to footnotes. The condensed bibliography at the end runs to more than eighty pages, a feature which investigators will find of much value.

The recent developments in the cytogenetics of maize, *Œnothera*, *Datura* and *Crepis* are considered at length, and the chromosome maps of *Drosophila* receive attention. Evidence is presented for the new conception of the nucleolus as a body produced by a particular region of one chromosome pair. The phenomena of synapsis and crossing-over are discussed, the various views being presented without dogmatic adherence to one—a very desirable feature in any work on so intricate a subject. Finally, it may be mentioned that the results of microdissection work and similar studies of the living cell are incorporated.

No doubt the author will be rewarded with the appreciation of cytologists and geneticists for the production of this new and up-to-date edition, which marks the merging of these two sciences in their cognate aspects into one.

R. Ruggles Gates.

Proper Motions of 25,000 Stars

The Radcliffe Catalogue of Proper Motions in the Selected Areas 1 to 115. Compiled by Dr. H. Knox-Shaw and H. G. Scott Barrett. Published by Order of the Radcliffe Trustees. Pp. xlviii + 352. (London : Oxford University Press, 1934.) n.p.

In 1906 Kapteyn published his "Plan of Selected Areas" to bring together the various observational elements necessary for a more complete knowledge of the structure of the system of the stars. To obtain data for the fainter stars (position, proper motion, magnitude, spectrum, radial velocity, and so on), he proposed that samples of 206 areas uniformly distributed over the sky should be completely investigated, and work was apportioned to different observatories. Rambaut undertook the determination of the proper motions over fields of $40' \times 40'$, $50' \times 50'$, $60' \times 60'$, depending on galactic latitude, for the 115 areas from the equator to the north pole. Kapteyn's proposal was that exposures should be made sufficient to obtain stars to a definite magnitude, the plates carefully stored, and re-exposed ten years later with their centres displaced slightly. This method has the disadvantage that at the second exposure, if clouds came up, the necessary limit of magnitude might not be reached. The plan was modified by taking the second exposure on a separate plate, *through the glass*, and measuring the displacements by placing the plates face to face. Rambaut carried on the work from 1907 until 1923, and it has been completed under his successor's direction. The difficulties attending long exposures in the climate of Great Britain are considerable, and although the aggregate exposure time on which the proper motions depend has been only 450 hours, "it has taken 24 years of unremitting effort to achieve this modest score".

The handsome volume published by the Radcliffe Trustees, compiled by Dr. Knox-Shaw and Mr. Barrett, gives the proper motions for 25,000 stars. The average limit of magnitude is 15·2 m.; only in ten fields is it below 14·5 m. In addition to the proper motions, magnitudes are determined with a probable error of $\pm 0{\cdot}108$ m. Owing to an adjustment of the telescope in March 1914 by which the tilt of the crown and flint lenses was altered by 1′, the centre of density of the images of the brighter stars was altered relatively to that of the fainter stars, thus introducing a magnitude equation. The effect of this has been successfully eliminated.

The proper motions as printed are relative, as there are insufficient stars of known proper motion to serve as a zero, and it has been considered inadvisable to apply somewhat uncertain corrections for parallactic motion and solar rotation to stars of these faint magnitudes. The probable errors for different areas range from $\pm 0{\cdot}0025''$ to $\pm 0{\cdot}0060''$. By applying the parallactic motion, the apex of the solar motion, and the vertex and axes of the Schwarzschild ellipsoid, have been found for stars 9·0–14·0 m. and those fainter than 14·1 m. It is pointed out that the vertex of Schwarzschild's ellipsoid is the only one of these quantities which can be satisfactorily derived from the relative motions of these faint stars.

The average values of the proper motions for stars at different galactic latitudes are next given

and range from 0·010″ on the galactic equator to 0·024″ near the pole for stars of magnitude 9·0 m.–14·0 m., and from 0·010″ to 0·019″ for magnitude 14·1 m.–15·0 m.

The stars of proper motion less than 0·1″ are collected and their distribution per square degree given for different galactic latitudes. The number of variable stars found is very small, being no more than one star in 2,900.

The Radcliffe Observer and his staff are to be heartily congratulated on the conclusion of this laborious and useful piece of work.

F. W. D.

Rapid Physics

Experimental Physics : a Selection of Experiments. By Dr. G. F. C. Searle. Pp. xiv+363. (Cambridge : At the University Press, 1934.) 16*s.* net.

NON cuivis homini contingit adire Corinthum ; and those of us who have not been fortunate enough to have come directly under the influence of Searle's inspiring personality, owe him a heavy debt of gratitude for leaving us some record—incomplete though it may be—of the methods which he has practised with such eminent success for nigh fifty years.

It is an impressive record ; all the more so in that this, his latest, although we hope not his last, volume shows all the vigour and energy and enthusiasm—and thank Heaven, the prejudices—that have ever characterised his work. It has been called an "Odds and Ends Book", and never has there been a volume to which the term could be applied with less justification—singleness of purpose and outlook inform and penetrate every page.

Skill in design ; an uncanny aptitude for hitting on an experiment which will illustrate half a dozen physical principles ; a remembrance of the saying that small corrections are the fun of physics ; a consequent hunt for the fourth or fifth significant figure even when, Dulong-wise (or is it Petit-wise ?), the third may be now and then in doubt ; the aptitude of an accomplished craftsman for making the utmost use of simple mathematics ; a violent dislike for tobacco—all the characteristics that we know and love are there.

The topics handled—do they really matter ? Still, it is usually considered to be the reviewer's first task to give his readers some inkling of the contents of the book, and we have here a record of some thirty-four experiments, four or five being devoted to dynamics, six to elasticity, thirteen to surface tension and viscosity, five to heat, and five to sound. Each of the main sections is prefaced by a chapter dealing with the mathematical principles involved.

There is but one serious criticism to put forward, and that is concerned with a section of the preface which states that the author has "abandoned a former project of writing a manual on *Experimental Electricity and Magnetism*". We trust that the author will, in the comparative leisure that will fall to him after September 30, 1935, reconsider this decision. We have heard old Triton blow his wreathéd horn, and, after revelling in the heartening blasts which he has sounded, we love not the descent to the electrical-and-magnetic bleatings of more orthodox volumes. May he be persuaded to wind another strain, this time to the theme of electricity and magnetism ! A. F.

Reaction Kinetics

The Reaction between Hydrogen and Oxygen. By C. N. Hinshelwood and Dr. A. T. Williamson. Pp. v+108. (Oxford : Clarendon Press ; London : Oxford University Press, 1934.) 8*s.* 6*d.* net.

WITH the rapid development of science, it is very convenient to have in one's hand from time to time a critical and authoritative up-to-date monograph on the present status of some important phases in scientific development. Such an account is given by Mr. Hinshelwood and Dr. Williamson on the reaction between hydrogen and oxygen.

The more general implications of the chain mechanism advanced by Nernst to interpret the hydrogen chlorine reaction were pointed out and developed by Semenov, who, in his famous paper of 1927 on the phosphorus – oxygen reaction, not only referred to the hydrogen – oxygen reaction, but also indicated and afterwards investigated with his collaborators the phenomena of homogeneous slow combustion, rapid combustion, degenerate and true explosions, and interpreted the phenomena of upper and lower limits of explosion. The view that such reactions are chain reactions entails an inquiry into the mechanism of the starting, propagation, reflection, branching and cessation of the chains as well as the factors operative in limiting the explosion both at the upper and lower limit. These reactions form not only an important connecting link between surface or heterogeneous catalytic actions and true homogeneous reactions, but also provide us with a means for obtaining, admittedly in small concentration, new and reactive chemical entities, the chain carriers.

It is generally admitted that the hypothesis of simple atomic links such as obtain in the reactions investigated by Polanyi is not adequate to interpret the experimental data in chain reactions such

as that of hydrogen and oxygen, likewise the concept of the 'hot molecule' or energy rich molecular species such as $H_2\overset{\times}{O}$ is falling more and more into disfavour. Interest is being centred more on unstable radicals which act as links and diffuse through the gas.

It may be observed as first suggested by Melville that an idea as to the nature of the carrier might be obtained from its diffusion coefficient. This is discussed on pp. 60–61 of the present volume; in the equation given, the symbol D does not actually represent the reciprocal of the diffusion coefficient, but is only proportional to it for a given inert gas pressure. Such explosive limits as are found are sometimes governed by an asymmetrical relationship between the products of the reacting gases, but this symmetry can be disturbed very considerably if the collision efficiencies for reaction of the two chain carriers are very different. In this connexion it is interesting to note that there appear to be many points of similarity between the radicals of the type $XH.$, for example, $O_2H.$, $CH_2H.$, $CH_3.CH.H$. At the same time, the old idea that radiation and ionisation play an important part in the wave front of a propagated explosion appears to be entering on a new lease of life.

All those who are interested in the question of reaction kinetics must thank these authors for a well-documented monograph written with the clarity and in the style that we are accustomed to find in the communications from the Oxford laboratory. E. K. R.

Television Systems

(1) *Television: To-day and To-morrow.* By Sydney A. Moseley and H. J. Barton Chapple. Fourth edition. Pp. xxxi+208+71 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1934.) 7*s.* 6*d.* net.

(2) *Television: Theory and Practice.* By J. H. Reyner. Pp. xi+196+12 plates. (London: Chapman and Hall, Ltd., 1934.) 12*s.* 6*d.* net.

THERE is not yet a really good book in English on television. Schröter's excellent "Handbuch" was an admirable German model to which to work, although it is now happily out-of-date despite its completeness at the date of publication and its comparative youth. Neither of the present works reaches Schröter's level, although Reyner's survey is the best that has yet appeared in English.

(1) Moseley and Chapple have been noticed in earlier editions; they might well have taken the opportunity offered by a fourth edition to lop off much dead wood. The main criticism even of this new edition is that it contains much more television of yesterday than of to-day or to-morrow. Now that the Television Committee has administered the *coup de grâce* to that low-definition television which was an experimental triumph and an entertainment travesty, the authors would do well to condense into a brief single chapter the story of television before 1930, and to expand their treatment of the newer high-definition systems. They might at the same time judiciously excise from Mr. Moseley's preface his curious reference to "the adoption of the cathode ray system after it had been practically flung on the scrap heap". Whoever flung it on the scrap heap was a singularly wrong-headed individual sinning against the light, for there has always been a very strong body of expert opinion pressing towards that cathode ray system which has now, after an unnecessary delay and at a remarkable ultimate speed, been brought to a stage the merits of which are attested by the recommendations of the Television Committee. A decent veil might well be drawn, in preface and book, over this major error of judgment.

The most interesting chapters of the new edition are xiii and xiv, which attempt to compress into some thirty pages the basis of cathode ray systems, the utilisation of ultra-short waves, and the intermediate-film process. If the fifth edition devotes 175 pages to these subjects, and relegates to 25 pages the matter which now occupies these 175, the book will be vastly improved.

(2) Mr. Reyner can view the subject from a greater distance, and the improved perspective of this tele-vision results in a much better book. At an epoch when even weeks are of importance in the history of the subject, it is fair to record that the author's preface is dated March, 1934. For that date the book is remarkably up-to-date, giving a whole chapter to velocity-modulation, and brief but clear accounts of the Zworykin iconoscope and the Farnsworth image dissector, important competitors in the field of true television as opposed to the more highly developed methods which may be unambiguously if inelegantly labelled 'telefilm'.

After good comprehensive surveys in the two opening chapters, the first in general terms, the second detailing the instrumental arrangements, the author passes to physiological optics in Chap. iii, to the optical elements of mechanical television systems in Chap. iv, and thence to a very useful chapter on the technical characteristics of photo-electric cells. In satisfactory contrast to Moseley and Chapple, Reyner then devotes three chapters to the essentials of cathode ray television. These chapters may be specially commended as very fairly representative of the material published up

to the middle of 1934. Indeed this commendation may, as has already been suggested, fairly be extended to all the seventeen chapters of the book.

We may hope that the author and his publishers may be moved to produce, in the next few months, a new edition including the wealth of material which is now being released as a result of the Television Committee's report. Such a work would be assured of a wide circulation in the autumn; meanwhile, the present edition is a very well-balanced and accurate introduction to a subject which has now definitely climbed from mere curiosity value to real entertainment value.

Progress and Economics

The Economic Consequences of Progress. By Roy Glenday. Pp. xv+302. (London: George Routledge and Sons, Ltd., 1934.) 12*s.* 6*d.* net.

THERE must be progress—even in the desert the camel is giving way to the motor-car; it is not an accident but a necessity. It has far-reaching economic consequences which have proved to be unequal in their incidence on different peoples and on different strata of society. Applied science is affecting the daily life of everyone to an ever-increasing degree. Its supposed advantages appear sometimes to conflict with the existing state of affairs, but they are none the less real, and nothing can stop the progress of science or deprive the people of the new benefits which they are to receive by science.

Nearly a hundred years ago, we in England were in the "hungry forties"—words then pregnant with real meaning of scarcity, even starvation. It is stated that at the beginning of the eighteenth century, approximately one third of the population of these isles was unable to live honestly, while another third was living close to the margin of subsistence. To-day there is an over-production of the essential foodstuffs which is directly due to the application of science; thus the yield of grain per acre has been increased five-fold, the average yield of milk from dairy cows is more than doubled and could be doubled again, whilst the egg yield from hens has been doubled during the last twenty-five years. The world over, the price of food has fallen in consequence and the farmer is hard put to it to make a living, particularly when he is burdened with a mortgage at a high rate of interest. It is clear, moreover, that the cost of production of many foodstuffs will continue to fall. Further, the invention of cold-storage and quick long-distance transport has made the surplus food supplies of the world available in Great Britain.

The standard of living, according to Sir Josiah Stamp, has increased by more than four times during the past century. The economists tell us that it was not until man learned how to increase food supplies more rapidly than the rate of growth of the population that he was really able to make progress in wealth.

The economic consequences of progress as we find them in 1935 are so diverse, and can be viewed from so many angles, that the business man is inclined to distrust economics as a science, and to believe that his practical experience is nearer the truth than the theories of the academic economist. It may be that progress follows a series of cycles of growth and decay or, as we term them, prosperity and depression; but it should not be beyond the wit of man to flatten the curves. Before this can be attempted with any possibility of success, it is obviously necessary to have a full understanding of the problems such as the book before us seeks to provide.

Mr. Glenday's close touch with the business community enables him to write from an angle which the business man understands. In the first half of his book he traces the laws of growth and structure which have in fact controlled progress; in the second he deals with the future with a prophecy of what must be done to prevent disaster. His final attitude is in effect that we should abandon the economic struggle for increasing wealth and seek happiness and cultural progress by other means, involving a largely planned civilisation and controlled population: we must learn to control our numbers and their output of goods.

The fundamental changes in this direction which the great combines and the men in charge of them are bringing about are stressed by Mr. Glenday. It is significant to find him recording that many of them "are tending less and less to regard their undertakings as mere profit-making machines for absentee shareholders and more and more to behave as the leaders of the armies of industrial advance".

The new science of 'scientific management', on which there is to be an International Congress in London this year, deals essentially with the "art of generating, utilising and controlling educational forces within industry and without, so that the human industrial team can continually be equipping itself for performing its task with a degree of efficiency ever on the upgrade". We quote this definition of management from a letter in *The Times* of January 2, 1933, signed by thirty-one leaders of industry, commerce and finance.

The author has given us a readable book, erudite and enthusiastic; we commend it warmly to all interested in these problems, which concern each one of us deeply. E. F. A.

Short Notices

Archæology and Ethnology

The Annual of the British School at Athens. No. 32 : *Session 1931–1932.* Pp. viii+310+42 plates. (London : Macmillan and Co., Ltd., 1934.) 63*s.* net.

THE "Annual of the British School of Archæology at Athens" has established a reputation for a high standard of accuracy and scholarship in the presentation of the work of its members and students from year to year. The present volume, which covers the session 1931–32, in this respect in no way falls short of the achievement of its predecessors. These qualities indeed are the more noticeable from the fact that at present no operations of the first magnitude by the School fall to be chronicled. It must not, therefore, be assumed that the contents of the present volume show any failing in interest. This is far from being the case. Mr. N. G. L. Hammond, for example, in his "Prehistoric Epirus and the Invasion of the Dorians", presents the archæological and historical argument in a manner as skilful as its subject is intriguing. Miss Winifred Lamb's account of her excavations at Antissa have carried on a piece of work essential in duration to her previous excavations, and Mr. S. Benton's report on a tour of the Ionian Islands, combining a certain amount of rapid field-work with material from museum collections and other sources, would be found more than suggestive, if only money and opportunity were available for further research. Among the remaining papers, Mr. R. P. Austin reports on his excavations at Haliartos on the site of a sanctuary dating from 550 B.C., Mr. J. D. Beazley describes groups of mid-sixth century Black Figure ware and Mr. R. J. N. Jenkins some archaic Argive terra-cotta figurines. The illustrations, as usual, are liberal and excellently reproduced.

The Greatness and Decline of the Celts. By the late Henri Hubert. Edited and brought up to date by Prof. Marcel Mauss, Raymond Lantier and Jean Marx. Translated from the French by M. R. Dobie. (The History of Civilization Series.) Pp. xvi+314. (London : Kegan Paul and Co., Ltd., 1934.) 16*s.* net.

IN this volume, which forms the second instalment of the late M. Henri Hubert's study of the Celts, the author is no longer entirely dependent on the indirect evidence of archæology. He has had at his disposal the statements of classical historians and geographers, and in the later periods a mass of material of a miscellaneous character and varying degree of authority drawn from traditions, annals and other forms of literary record. Taking the middle of the first millennium B.C. as his starting point, he traces the expansion of the Celts from their home in Central Europe into Italy, Spain, Gaul, the British Isles and eastward to their point of farthest penetration in the Ægean and Asia Minor. M. Hubert then follows their decline in the struggle with Rome and the Germanic peoples, until in the modern world Ireland alone remains as their sole independent and national representative in a political sense.

M. Hubert has reconstructed a picture of Celtic society and culture out of the reports of classical historians and geographers and the material afforded by the heroic traditions and other literary remains of the Celts themselves. It suffers from the necessary limitation that it applies primarily to the Celts of Gaul and Britain only, and is not chronologically homogeneous ; but the author argues with some considerable effect for its general applicability.

Creation and Evolution in Primitive Cosmogonies, and other Pieces. By Sir James George Frazer. Pp. xi+151. (London : Macmillan and Co., Ltd., 1935.) 8*s.* 6*d.* net.

SIR JAMES FRAZER has here reprinted a number of 'pieces', of which the title-piece of the volume is the most substantial. It appeared originally in the Darwin memorial volume, published in 1909. It brings together a number of instances to show that both the concept of a special act of creation and something in the nature of the evolutionary theory are found in primitive cosmogonies. Among the subsequent essays are the Zaharoff Lecture on Condorcet delivered in Oxford in 1933, biographical sketches of Sir Baldwin Spencer and the Rev. John Roscoe, some reminiscences of the author's early life in Glasgow in a speech of thanks when the freedom of his native city was conferred upon him, and some memories of his parents. Each of these pieces, it is scarcely necessary to say, bears the hall-mark of the author's charm and finished style.

Biology

The Myxomycetes : a Descriptive List of the known Species with special reference to those occurring in North America. By Thomas H. Macbride and G. W. Martin. Pp. x+339+21 plates. (New York : The Macmillan Co., 1934.) 25*s.* net.

THE slime moulds are found in decaying organic matter in every country of the world, and they are probably inhabitants of all soils. So far as is known, they have no economic importance and in consequence of this they are neglected. Their formation of hard fructifications, in which the spores lie, gives structure upon which a classification may be based, but their systematy is of peculiar difficulty on account of an obvious responsiveness to environment while their fructifications are forming. How many thousands of species of these animals or plants, whichever they be, exist in the world we do not know, but the work before us represents six years labour on the part of Dr. Macbride and his research assistants. About 400 species are described in this monograph, but it occurs to us how much more

interesting and stimulating it would be, had it been preceded by a full well-illustrated account of the biology of these organisms. The 573 figures, so careful for form but tiny and uncoloured, cannot tell their exquisite story and are of little use to recruit future workers; they will be the better understood if used in connexion with Arthur Lister's coloured plates in his monograph of 1911.

Taxonomy is not an end in itself. Indeed, it is merely a convenient method of cataloguing, and something apart from modern conceptions of science. To the reviewer it is by itself analogous to stamp collecting and cataloguing—quite a good amusement but leading nowhere. It becomes interesting when the stamps are studied in relation to the histories of countries, as these Myxomycetes might well be if described in relation to their environment.

Insect Physiology. By Dr. V. B. Wigglesworth. (Methuen's Monographs on Biological Subjects.) Pp. x+134. (London: Methuen and Co., Ltd., 1934.) 3*s.* 6*d.* net.

ENTOMOLOGISTS have seldom concerned themselves with problems of insect physiology. The study of structure, habits and taxonomy in so vast a class has monopolised the field. What is known of insect physiology has, for the most part, resulted as a side-line or by-product of other investigations, rather than as the outcome of the study of insects as such. In the last ten years or so, entomologists have come to realise the necessity for exact knowledge of the functions of insect organs and tissues, especially in regard to the problems of insect control. It is in the latter connexion, perhaps more than any other, that our ignorance of physiology has revealed itself most.

In writing this handbook, Dr. Wigglesworth imparts to his subject a freshness of outlook which only comes to a writer who has acquired first-hand knowledge. His own researches into the physiological make-up of insects have broken new ground, and are always suggestive and productive of ideas. The results of these studies find their place in the book but, at the same time, the author has explored the literature on insect physiology with admirable thoroughness (as the bibliography will testify) and subjected it to critical selection. In a sense, the book is quite unique since it has no competitors: the only previous survey of the subject at all comparable is that of Marchal, published in 1911. It needs no further recommendation, and every entomologist and zoologist should possess it. A. D. I.

The Familiar Trees of Hopei. By Hang-Fan Chow. (Fan Memorial Institute of Biology, Peiping, Handbook No. 4.) Pp. xiv+370. (Peiping: The French Bookstore, 1934.) Cloth, 3 dollars; paper, 2.40 dollars.

THE publication of an English edition of this book simultaneously with the Chinese text will be welcome to many foreign botanists and others interested in the trees of the district around Peiping. The author claims to include only the more common species occurring in the Province of Hopei, and this object has been fully attained. The Englerian system of classification is adopted. Useful keys to the families, genera and species respectively are supplied. From these, in conjunction with the descriptions, the student should in most cases have little difficulty in naming the trees met with in this part of China. Taxonomic works published in China in recent years have been noted for the high standard of illustrations from line drawings, and in the present work Mr. C. R. Feng has maintained this high standard in illustrating practically all the species which Mr. Chow describes here. The distribution of each species is given and under the heading "Use" are, in many cases, a number of interesting notes. The book is clearly printed, but there is no index. C. V. B. M.

Chemistry

Theoretische Grundlagen der organischen Chemie. Von Prof. Walther Hückel. Band 1. Zweite Auflage. Pp. xii+475. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 19.80 gold marks.

A LITTLE more than three years ago the first edition of Prof. W. Hückel's "Theoretical Outlines of Organic Chemistry" was published (NATURE, **129**, 41; 1932) and now we have the second edition of the first volume of that work.

The present edition keeps generally to the original plan, but there have been minor and justifiable rearrangements. Prof. Hückel's critical survey of some modern work is stimulating, but stated so didactically may, and does, meet with many criticisms. The really disappointing feature of the present work is the omission of references to advances in organic chemistry which have been made during the last three years; these advances have been described, if only—and necessarily—briefly in the excellent "Annual Reports of the Progress of Chemistry" published by the Chemical Society, with a reasonably full bibliography. Incidentally, it is worth while recording that the cost of this new edition of Prof. Hückel's book is rather more than six times the cost of any one volume of the "Annual Reports".

The appearance of finality which the written word is apt to convey is not in keeping with the publication of new editions of such works at very short intervals. Provided that the first or original edition is well planned, and this is certainly true in the case of Prof. Hückel's book, it is suggested that such rapid republication is unnecessary and it is certainly to be deprecated. C. S. G.

Conductometric Analysis: Principles, Technique, Applications. By Dr. Hubert T. S. Britton. (Monographs on Applied Chemistry, Vol. 8.) Pp. xi+178. (London: Chapman and Hall, Ltd., 1934.) 12*s.* 6*d.* net.

THIS book is a smaller and more specialised companion to the author's volume on "Hydrogen Ions", published in the same series. After two short introductory chapters on the nature and significance of

electrical conductivity, apparatus and methods are described in chapters iii and iv. The rest of the volume is devoted to various applications of conductometric titration.

Since the author maintains that "the conductivity of solutions can often supply useful information which cannot always be easily obtained by other means", it may be anticipated that this clear and well-produced exposition of the subject will have an extensive circulation. If it be maintained that the methods advocated are suitable only for "pure research", it may be recalled that exactly the same remarks were probably made about *p*H determinations some twenty years ago. The determination of hydrogen ion concentration is, however, at least as frequently carried out to-day in industrial as in academic laboratories, and Dr. Britton's book should do much to bring about a similar extension of use for conductometric analysis. A. L. B.

(1) *Introductory Colloid Chemistry.* Pp. xiv+198. 15*s.* 6*d.* net. (2) *Laboratory Manual of Colloid Chemistry.* Third edition, rewritten and reset. Pp. xvii+229. 20*s.* net. By Prof. Harry N. Holmes. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.)

THE author's introductory text fulfils its claim to be a "short, clear, yet moderately comprehensive statement of the fundamentals of colloid chemistry". In fairly brief compass he has discussed the preparation and fundamental properties of various colloid systems, coagulation, froths and films, emulsions, gels and jellies, soaps, proteins, soils and clays, adsorption and catalysis. The value of the work is enhanced by a series of well-selected references.

The companion laboratory volume has now reached its third edition—a fact which testifies sufficiently well to its usefulness.

Laboratory manual and textbook are developed on closely parallel lines, and the manual is also enriched by a large number of references to the original literature.

The author has preserved his enthusiasms, and his presentation of his subject shows an admirable combination of freshness and conciseness. A. F.

Engineering

Elements of Water Supply Engineering. By Prof. E. L. Waterman. Pp. xv+302. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21*s.* 6*d.* net.

THIS work is stated by its author, who is professor of sanitary engineering in the State University of Iowa, to be a textbook for students beginning their study of water supply engineering; he disclaims that it is in any sense a treatise or a handbook. He has based it on lectures which he himself delivers and it is designed to suit the particular need of his students. Viewed from this angle, the book fills a definite purpose in regard to which the author is naturally sole arbiter, and so, although the science of hydraulics is an essential element of water supply engineering, the theoretical side of the subject, with its fundamental laws, is excluded from consideration, as being adequately treated elsewhere, and, in the case of the author's students, being taken in a concurrent course.

Subject to these limitations, the volume forms a very useful introductory survey of American practice in water supply. In addition to the purely technical features (reservoirs, pipes, channels, intakes, pumps and pumping plant), the communal, sanitary, chemical and financial aspects of the matter are dealt with. As the purview of the work is confined to the North American continent, it contains certain things which present some degree of strangeness and novelty to English engineers. For example, the *per capita* consumption of water in the leading cities of the United States is startling when compared with the standards of Great Britain. One wonders what it can be used for and whether there is not excessive waste. Whatever be the explanation, it is certainly instructive to have the practice of other nationalities displayed for comparison and study, and English engineering students will find the book very helpful in this respect, as in others of a more general character. B. C.

The Blue Book 1935: the Directory and Handbook of the Electrical and Allied Industries. 53rd edition. Pp. xxviii+1436. (London: Benn Brothers, Ltd., 1935.) 25*s.* net.

THE fifty-third annual edition (1935) of the electrical trades directory and handbook will prove of value to everyone who wants to have the latest information about the activities of the electrical engineering profession and industry. In this edition more societies, associations and technical schools and colleges are included. Many physical constants connected with industry are given, and we were interested in an instructive page on telephone transmission units. The difference between the American standard line of cable and the English standard line is clearly explained and the decibel and neper are defined. Useful particulars are given about the Bureau of the International Communication Union. The grid scheme of the Central Electricity Board was completed last year, and grid tariffs for the whole of Great Britain, except south Scotland and north-east England, are in operation. In the manufacturing industry a fairly general and sustained improvement occurred during 1934. The output of electricity by supply undertakings increased 14 per cent compared with the previous year. The use of broadcasting and telephony has also greatly increased.

Wireless for the Man-in-the-Moon: Perhaps a Fairy Tale, Perhaps a Textbook, Perhaps Neither. By Coulombus and Decibel. Pp. 128. (London: George Newnes, Ltd., 1934.) 2*s.* 6*d.* net.

JOHN PERRY was wont to say that Euclid was fit reading only for the very learned. This work of 'Coulombus' and 'Decibel' falls, not necessarily for the same reasons, into the same category. If the man-in-the-moon is very learned he will take no

harm from the reading, and may contrive a rare wan smile, but he will learn little or nothing. He will certainly wonder whether life is made notably easier by the simple device of calling an electron a duckling. If, on the other hand, he is the simple soul at or to whom the "wit and humour of the book" (guaranteed by the publishers) are directed, he may be deluded into feeling that he has "unconsciously acquired a real insight into the basic principles and practice of Wireless".

Mathematics

Differential and Integral Calculus, By R. Courant. Translated by E. F. McShane. Vol. 1. Pp. xiii+568. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1934.) 20*s*. net.

THIS volume is an English edition of the author's original work in German on the calculus which was briefly reviewed in 1928. Although the title-page announces it to be a translation, yet it is much more than this. Dr. McShane, in co-operation with the author, has considerably modified the treatment in order to adapt the book to the needs of English and American students. Among the principal divergencies from the original text, this edition contains (i) a sketch of the differentiation and integration of functions of several variables, and (ii) a collection of classified examples. Although the preface claims that a large number of exercises has been added, yet, compared with English textbooks, this number is somewhat small.

The course is intended for those who wish to pursue the study of the calculus and its applications as beginners. Much of the rigour demanded in establishing some of the more difficult fundamental theorems has therefore been taken out of the main discussion and given later in appendixes to the chapters. In this way, not only is the student enabled to pass rapidly to the practical applications, but also the presentation of the subject has been greatly enhanced, for too much rigour to a beginner is undoubtedly repellent.

The book is thoroughly well printed and the text is of a clarity which is not always possible in a purely literal translation. F. G. W. B.

Higher Mathematics: for Engineers and Physicists. By Prof. Ivan S. Sokolnikoff and Dr. Elizabeth S. Sokolnikoff. Pp. xiii+482. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net.

THE text of this volume is based upon courses of lectures given annually to engineering students in the University of Wisconsin. The aim of the authors is to provide a textbook which may not only appeal to students of applied science, but may also serve as a stepping-stone to more advanced mathematical treatises. A wholly rigorous and purely formal presentation has therefore not been attempted, since, as the authors wisely point out, such a course of detailed analysis would tend to bewilder many practical students and thus stifle their interest in mathematics.

The calculus, beginning with elliptic integrals and leading on to those ordinary and partial differential equations most frequently met with, is thoughtfully developed. This is followed by some very practical chapters on vector analysis, probability and empirical formulæ, whilst the final chapter incorporates an interesting lecture on conformal representation by Dr. Warren Weaver. Examples are provided at the end of each chapter, and these are to be regarded as an integral part of the text, since they embody extensions and further developments of the subject matter.

A Shorter Trigonometry. By W. G. Borchardt and the Rev. A. D. Perrott. Pp. viii+238+xxxii+xxxi. (London: G. Bell and Sons, Ltd., 1934.) 4*s*.; without Tables, 3*s*. 6*d*.

As the title suggests, all the trigonometry for the several school certificate examinations is here contained in a single volume. The authors have divided the text into two parts: the first is introductory and therefore mainly numerical, the second deals with the more formal trigonometry. The whole treatment is thoroughly sound, and every chapter contains a large number of exercises which are well designed to stimulate the pupil's interest and are not too difficult.

Objection might be taken to the statements on p. 86, where confusion is likely to arise in identifying cosA and sinA, previously defined as ratios, with the *lengths* of OM and PM respectively. In spite of this small defect, however, the book may be confidently recommended, for the authors have carried out their purpose excellently. F. G. W. B.

Miscellany

Three Philosophers (*Lavoisier, Priestley and Cavendish*). By W. R. Aykroyd. Pp. xi+227+8 plates. (London: William Heinemann (Medical Books), Ltd., 1935.) 10*s*. 6*d*. net.

THIS is a rather charmingly written study: not too deep, not heavy, not coldly ordered, and humane. With the central figure Lavoisier are portrayed (with sound art in passing to and fro between the characters) Priestley and Cavendish, as complements and foils. Cavendish, by birth noble, by inheritance wealthy, by genius a metrical hermit; and Priestley, the very opposite in each point, in whom an intolerable fluency in doctrine was joined with the happiest success in qualitative experimenting: these two men are quite indispensable to science, yet both humanly and scientifically they stand at antipodes. That third indispensable, Lavoisier, was equipped with a supremely lucid and systematising brain, and he commanded much of Cavendish's type of metrical skill, coupled (for scientific purposes) with Priestley's missionary instinct *minus* its naïvety. Hence, though he lacked their peculiar gifts for discovery *per se*, he was able with this triple combination of abilities to rise to a summit higher than either of theirs.

Mr. Aykroyd does not hide Lavoisier's "grabbiness" (as he calls it) in adding to his considerable wealth, and in the familiar points of scientific priority. But he shows well that Lavoisier toiled greatly for the material civilising of a dirty and misgoverned nation; and that this public service came to take far more of his energy and time than did his scientific researches. Nevertheless in the end it failed, as they did, to save him in '94 from the inevitable fate of the ci-devant tax-farmers. The latter years of Lavoisier's life are especially well told, and the mounting crises of the time; and the author's pleasant humour enlivens his sketch of Mme. Lavoisier's essay in second marriage with Count Rumford.

It is not to this work that chemists and physiologists would turn for authoritative history of their sciences, for that is scarcely the author's intention; but it will appeal to them, and no less to lay readers, because it shows well the diversity of the human agents through whom scientific discovery grows.

IRVINE MASSON.

Hutchinson's Technical and Scientific Encyclopædia: Terms, Processes, Data, in Pure and Applied Science, Construction and Engineering, the Principal Manufacturing Industries, the Skilled Trades: with a Working Bibliography. Edited by C. F. Tweney and I. P. Shirshov. In 3 vols. Vol. 1: *A to Direction-Finding.* Pp. viii+672. (London: Hutchinson and Co. (Publishers), Ltd., n.d.) 28*s.*

A DYSPEPTIC reviewer once grudgingly concluded his notice of a book with the words, "We have not detected any errors, but no doubt there are some". In a work of the comprehensive range of this "Encyclopædia", it is almost inevitable that there should be sins of omission or of commission, but our attitude towards such an enterprise is one of admiration for what has been so well done rather than of finding faults in it. The work is, however, not so much an encyclopædia as an encyclopædic dictionary. Though a fair number of the articles may rightly be described as encyclopædic in character, most of the entries are of the nature of definitions or explanatory paragraphs relating to words and terms which make up the vocabulary of science and technology.

The editors, with the assistance of about eighty principal contributors, have been successful in their treatment of a very wide field, and few points appropriate to the survey have escaped notice, even if they have only recently emerged. Thus, we find definitions or explanations of such subjects as bel and decibel, ascorbic acid and carotene as vitamins, Cepheid variables, and cosmic radiation. We miss cytology; and though chromosphere is included we do not find chromosome; also deuterium and diplogen occur but not diplon, and dingo but not dinosaur. These, however, are but minor points, and we have no hesitation in saying that the editors and the publishers deserve the thanks of all who are engaged in scientific or industrial occupations for this handy and helpful work of ready reference. We trust the two further volumes will maintain the same high standard.

Scrambles in Japan and Formosa. By the Rev. W. H. Murray Walton. Pp. 304+26 plates. (London: Edward Arnold and Co., 1934.) 18*s.* net.

BOOKS on Formosa are relatively few, and this one treats of the little-known mountainous part of that island, much of which is still only nominally under Japanese control. The hill tribes were left alone by the Chinese, but are gradually being subdued by the Japanese. There is a brief sketch of the habits of these 'head hunters', and a great deal about the rugged peaks of the island, including Niitaka, which rises to well over twelve thousand feet. After the ascent of these and other lofty peaks, Mr. Walton returned to Japan and climbed in the Japanese Alps. There is an interesting chapter about the island of Yakushima and its forests and people. It is, however, in respect of the attention it gives to Formosa that this book has its chief value. There are useful maps and many photographs.

Alpine Pilgrimage, By Dr. Julius Kugy. Translated by H. E. G. Tyndale. Pp. xxii+374+20 plates. (London: John Murray, 1934.) 12*s.* net.

IN this volume a well-known mountaineer summarises the work of forty-five years, mainly in the Carnic and Julian Alps. It is a book that should delight not only climbers but also all who care for mountain scenery and alpine pastures, for Dr. Kugy writes with equal charm of the hills, the flowers and the animal life. The technique of climbing interests him little and he claims to have written neither a climber's guide nor a book of sport. Achievements, though he could claim many, do not impress him. To him the charm of mountaineering lies in the solitude and beauty, and he abhors the dedication of Alpine heights to record breakers, and tourists with provisioned huts and inns and mountain railways. There are many fine photographs and a useful map. The book should delight all mountaineers.

Philosophy and Psychology

The Family: its Sociology and Social Psychiatry. By Prof. J. K. Folsom. (Wiley Social Science Series.) Pp. xiii+604. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 25*s.* net.

THE development of modern society in the post-War period has been denounced as thoroughly immoral and degenerate; it has been justified as an expansion of the opportunity for self-expression. Dr. Folsom studies the function of the family as an integral part of society and, without expressing an ethical judgment, diagnoses the changes in the circumstances and conditions affecting it as part of this development, according as they conduce to or hinder the proper performance of its function in a healthy community. Conduct which in the ethical judgment would be regarded as immoral, that is, not in accordance with the conventions of modern civilised society, is classified as a maladjustment.

Dr. Folsom has here made a very thorough study of his subject. The family is examined first as a means of satisfaction for certain human needs; it is then surveyed as a working system, and the differences in the family of the savage and the civilised man are contrasted with the view of showing what the function of the family may be in differing circumstances. The changes which are taking place in romantic love, courtship, sexual relations, married life, divorce, irregular unions, the relations of parents and children and so forth, are then surveyed in the light of the data which have been collected both in Europe and in the United States. Much of this material is familiar in a general way, even to those who have not made a special study of the subject; but it is here set forth in convenient form and discussed quite impartially by the author. A considerable part of the book is devoted to a practical application of the conclusions which the author has reached, with the view of alleviating or remedying certain of the maladjustments which experience shows now enter into the social problem.

Science and Monism. By Dr. W. P. D. Wightman. (History of Science Library.) Pp. 416. (London: George Allen and Unwin, Ltd., 1934.) 15*s.* net.

Dr. Wightman makes a rapid survey of philosophical speculations concerning the character of the universe as a whole from Thales to Whitehead and of their interaction with physical theory. Biological theory too he takes in his stride. It is a little breathless and too much of it merely summarising other people's summaries; but he is always clear and obviously has the capacity to seize on the essentials. His comments, where he allows himself any, are pertinent and pointedly expressed. Where he is dealing with thinkers he understands thoroughly, as Spinoza, he is an excellent exponent and critic.

At the end, however, it is difficult to suppress certain doubts. We may take monism in a loose sense as meaning no more than that there is a wholeness of things within which events happen with some recognisable order, or in other words that though we may expect some surprises we are not always being surprised. In this sense, monism has always been the principle inspiring scientific investigation and speculation. But if this were all, there would be no need to write a book about it. Monism evidently means more than this for Dr. Wightman, as it has for everybody, and it is doubtful whether any strict kind of monism is compatible with empirical science. If the universe is really in any way compact and homogeneous, then we cannot know anything truly about any part until we know about the whole, and if we know anything at all, in principle at least, we know everything. Consequently scientific procedure, which consists in finding out about the parts without troubling about the whole, is fallacious and unnecessary, as Hegel and some of his followers appear to have thought. Perhaps Dr. Wightman will next consider whether some kind of dualism or pluralism is not an essential postulate of science.

Philosophical Studies. By the late Dr. J. McT. Ellis McTaggart. Edited, with an Introduction, by Dr. S. V. Keeling. Pp. 292. (London: Edward Arnold and Co., 1934.) 12*s.* 6*d.* net.

The day has gone when a book of philosophical studies, even though its author was distinguished only as a metaphysician, is to be regarded as necessarily outside the province of a scientific journal. The frontiers between science and metaphysics are no longer so rigidly drawn as they were a generation ago. Science may shade off into metaphysics, and metaphysics may be informed with the scientific spirit. McTaggart, for example, insisted that there is only one way of getting at the truth, and that is by proving it. He would have nothing to say to the doctrine that a thing must be true because we want it to be, except that such doctrine is "false and rather cowardly". There spoke the man of science, though not of physical or biological science. Again, he was lucid and definite in his broad demarcation between the aims of metaphysic and of science. The former is concerned with the ultimate nature of reality; the latter is also concerned with reality, but not with its ultimate nature—a definition which is something to go on with, but perhaps not to be maintained to the end.

The papers collected in this volume, under the extremely able editorship of Dr. Keeling, give an interesting summary of McTaggart's philosophical method and conclusions; and would serve as a good introduction to the study of his chief published works. We quite agree with the editor that the paper entitled "An Introduction to the Study of Philosophy" is an outstanding example of philosophical summarising. It is well worth the careful attention of all who are interested in the borderland between science and philosophy, as well as of those whose main interest is in philosophy.

Must Philosophers Disagree? and other Essays in Popular Philosophy. By Prof. F. C. S. Schiller. Pp. xi+359. (London: Macmillan and Co., Ltd., 1934.) 12*s.* 6*d.* net.

The essays in this collection, like all Dr. Schiller's work, are amusing and provocative, and sometimes more than this. The three essays on William James and his work, coming from a fervent admirer, are interesting and valuable. Many who do not agree with James's philosophy would yet agree with Dr. Schiller that he is one of the creative thinkers of modern times. Perhaps the most interesting part of the book are the four connected essays called "A Philosophical Survey"; the last of which is on "Man's Future on the Earth". The author makes the useful point that at any moment there are some factors making for improvement and others for deterioration; so that a survey of present conditions, with the future unknown, provides equally good arguments for optimists and pessimists. There has been progress, but not always, or in straight lines, and it is always precarious.

Your Mind and Mine: an Account of Psychology for the Inquiring Layman and the Prospective Student. By Dr. Raymond B. Cattell. Pp. 314. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1934.) 7*s.* 6*d.* net.

Dr. Raymond Cattell, who is psychologist to the Leicester City Education Committee, provides us in "Your Mind and Mine" with a very sensible account of psychological problems of to-day. The book is charmingly written, easy to read, and will appeal to those who have to read without being in possession of technical knowledge. The epoch-making work of Spearman and Burt receives full consideration.

We doubt the wisdom of illustrating stigmata of degeneration, having stated in the text that they are practically as common in the general population as among criminals. A little knowledge is indeed a dangerous thing, and the public are very quick to air their little knowledge on so many occasions.

Physics

Newton and the Origin of Colours: a Study of one of the Earliest Examples of Scientific Method. By Michael Roberts and E. R. Thomas. (Classics of Scientific Method.) Pp. viii+133+8 plates. (London: G. Bell and Sons, Ltd., 1934.) 3*s.* 6*d.* net.

It is something of a reproach to physical science that very little has heretofore been accomplished in the matter of historical teaching. Chemistry, to its great benefit, has adopted another course, and systematic lectures on the history of the science have been a commonplace for generations. More than ever to-day, when the foundations of physics are being laid anew, is it necessary to approach our science historically, and thus to realise something of what the builders of the older structure thought of its permanence and its value. To attempt a valuation of some one portion of the whole fascinating story in anything like a compact volume is perhaps even more difficult than to tell the full tale. A full and accurate survey of the documents involved may leave one without a picture, and it is above all essential that the characters should be set against the background of their times, and that those little details—*ce superflu, si nécessaire*—should be sketched in, which make all the difference between the vivid and the dull outlook.

The authors of "Newton and the Origin of Colours" must be held to have succeeded in this by no means easy task. They have told us something of Newton, of his predecessors and contemporaries—of Robert Hooke "of middling stature something crooked, pale faced, and his face but little below, but his head is lardge; his eie full and popping, but not quick; a grey eie". They have given us an outline of the state of optics in 1660, of Newton's contributions to optical science, of the controversies with Hooke and with Linus, and of the developments of optics since Newton. They have accomplished this feat in a well-written octavo of some one hundred and thirty pages. The volume is a notable contribution to an excellent series. A. F.

Ions, Electrons and Ionizing Radiations. By Prof. J. A. Crowther. Sixth edition. Pp. xi+340+4 plates. (London: Edward Arnold and Co., 1934.) 12*s.* 6*d.* net.

This is a sixth edition of the well-known textbook so familiar to university students of physics, and in the preface the author explains the reasons for the new edition and the manner in which it differs from its predecessor.

The limitations set on the subject matter are generally indicated in the title, but as Prof. Crowther points out, the very rapid advances within the last few years have necessitated much rewriting and also considerable change in the balance between the older and the newer knowledge. The reader familiar with an older edition will at once recognise such main sections as those on the charge on an ion, photo-electricity, X-rays, and so on. He will also be pleased to note new sections on neutrons, positrons, cosmic radiation, artificial disintegration and structure of the nucleus.

These sections are of course written in the author's usual lucid style, and the selection of subject matter is admirably suited to his chosen scope and object, namely, the introduction of students grounded in physics to the more recent developments.

In consonance with this aim, there has been no attempt to give more than general references at the end of each chapter—a wise provision which makes it easier for the student to follow up selected topics. The book cannot be said to be overloaded with theory—the subjects being treated, on the whole, in that broad manner likely to be acceptable to science students generally.

Certainly the student who works through Prof. Crowther's excellent book will attain to a sound general knowledge of the experimental bases of modern physics.

The Physical Basis of Things. By Prof. John A. Eldridge. (International Series in Physics.) Pp. xiv+407. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 22*s.* 6*d.* net.

The author has given, in an interesting style, a vivid account of the physics of to-day. As he says, the book is not primarily intended for the specialist in physics but rather to give the student an appreciation of modern physics. The atom takes, of course, the main position, and relativity a subsidiary one. After opening with relativity, a large section on the kinetic theory of matter follows. This is particularly good in showing how the statistical method runs through the whole subject. The quantum theory and its pre-spectrum applications follow. The spectrum is described in more detail than any other phenomenon. This is perhaps justified, but the reader will find that the style of interesting narrative has at this stage become lost in a catalogue of spectrum series, energy levels and electron spin, to be regained, however, when nuclear physics is reached. Here the transformation of atoms is described, along with the discoveries of the deutron, neutron and positron. In view of the importance of these discoveries, they

might have been described at greater length. The new mechanics is not treated with the same wealth of detail as the earlier subjects. This is reasonable, as the book is in no sense a mathematical treatise. The table of relationships between the atomic and the C.G.S. units is useful, and the student can exercise himself and at the same time revise his knowledge by working through the set of some 150 questions at the end of the book.

Elementary Dynamics : for Students of Science and Engineering. By Dr. R. C. Gray. Pp. xi+211. (London : Macmillan and Co., Ltd., 1934.) 5*s*.

THIS little volume has been specially written for students beginning a university course in engineering or applied science. It aims, therefore, at giving a useful introduction to the principles of applied dynamics. The subject matter is divided into two main sections : one dealing with the particle, and the other with rigid bodies. The latter ends with a very valuable chapter on gyroscopes. The whole course is not only well arranged, but also abounds in practical applications, which are clearly explained and quite interesting.

The mathematical side has only been dealt with so far as is necessary in the discussion of the principles underlying applied science. The author points out that no calculus has been used as few students have previously studied it. The book is well supplied with suitable exercises of a practical nature, and these are chiefly arithmetical. Although the mathematical treatment is slender—and not without some very faulty statements—the course is quite a good one and admirably suited to the needs of the students for whom it was written.

The Kinetic Theory of Gases : being a Text and Reference Book whose Purpose is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator. By Prof. Leonard B. Loeb. Second edition. Pp. xx+687. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1934.) 36*s*. net.

STUDENTS of the generation which fared dryly on such treatises as Watson's would scarcely recognise their subject in the new edition of Prof. Loeb's treatise. The classical developments are all there for the nourishment of the student of the elements, but due regard has been taken of the astonishing changes which we associate with the name of quantum mechanics. At least a third of the original text has been rewritten, and the sections which deal with specific heats, with equations of state, with dielectric constants and with magnetism, have suffered radical changes.

The book needs no description or recommendation to students of kinetic theory, and it is sufficient to say that, in its revised form, it amply fulfils its claim to be a "Text and Reference Book whose Purpose is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator". A. F.

Lumineszenz-Analyse im filtrierten Ultravioletten Licht : ein Hilfsbuch beim Arbeiten mit den Analysen-Lampen. Von Prof. Dr. P. W. Danckwortt. Dritte, erweiterte Auflage, mit einem Beitrag von Dr. J. Eisenbrand über "Quantitative Messungen". Pp. viii+190+16 plates. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1934.) 8.50 gold marks.

THE first edition of Prof. Danckwortt's book appeared in 1928, and the third is mainly distinguished from its predecessor by the addition of an entirely new section on the quantitative measurement of fluorescent radiation emitted by bodies when exposed to ultra-violet light, contributed by Dr. J. Eisenbrand, and a further list of references to original work. The apparatus and technique for qualitative observations, photography, microscopy and photomicrography are fully described. The excellent set of plates included in the book bears witness to the wide range of usefulness of ultra-violet light examinations, and the thousand or so references to original papers emphasise the need of a guide such as this book provides.

Technology

Photo-Engraving. By A. J. Bull. Pp. viii+100+15 plates. (London : Edward Arnold and Co., 1934.) 9*s*. net.

THIS is an excellent little book. It has been written with the object of providing a concise but accurate account of the various methods of photo-engraving. It is intended for students ; for those who are in the printing trade and may be familiar with one branch it will serve to provide a general survey of their craft, and for a wider class of students it will teach the outlines of the various methods so that their own work may be more fruitful. The latter group will include advertisers, commercial artists and others who must use photo-engraving as a means to their particular ends. The author's experience, both as a teacher and a research worker, has enabled him to make the book a model of clarity. To the general reader, not the least interesting part is the historical outline of the application of photography to printing.

The Kingdom of the Camera. By T. Thorne Baker. Pp. xvii+209+64 plates. (London : G. Bell and Sons, Ltd., 1934.) 7*s*. 6*d*. net.

THE applications of photography to general science and industry have now become so numerous that few people, even among those who use photography in their daily work, have any idea of the vast variety of its possibilities. For many years Mr. Thorne Baker has been associated with photographic inventors and their work ; moreover, he can write a good story about things he has met with in his wide experience. In this exuberant book he gives a short survey of most of the outstanding applications of photography. Profusely illustrated with good half-tone plates, it provides a very interesting, though necessarily very brief, account of the subject.

Forthcoming Books of Science

Agriculture, Forestry and Horticulture

Doubleday, Doran and Co., Inc.—Herbs and the Earth, H. Beston; Color and Succession of Bloom in the Flower Border, H. S. Ortloff and H. B. Raymore.

English Universities Press.—The New Garden, R. Sudell.

George G. Harrap and Co., Ltd.—English Earth, Marjorie H. Tiltman.

Macmillan and Co., Ltd.—Tropical Planting and Gardening, H. F. Macmillan; Garden Flowers in Color, G. A. Stevens.

Putnam and Co., Ltd.—Hardy Bulbs, Lieut.-Col. C. H. Grey; The Cool Greenhouse, Noel Sutton.

Anthropology and Archæology

A. and C. Black, Ltd.—The Progress of Early Man, Stuart Piggott.

Lovat Dickson and Thompson, Ltd.—Tell-el-Amarna, J. Pendlebury; The Indus Civilization, Dr. E. Mackay; Ancient Rome, Prof. Guido Calza.

Faber and Faber, Ltd.—African Dances, G. Gorer; The Development of Sumerian Art, Dr. C. L. Woolley; Healing Ritual, Phyllis Kemp; The Cassubian Civilization, Dr. F. Lorentz, Dr. A. Fischer and Dr. T. Lehr-Splawinski.

Hodder and Stoughton, Ltd.—The Conquest of Cannibal Tanna, A. K. Langridge.

John Lane, The Bodley Head, Ltd.—The Black Races, J. H. Driberg.

Macmillan and Co., Ltd.—The Palace of Minos, vol. 4, Sir Arthur Evans; The Idea of Salvation in the World's Religions, Dr. J. W. Parker.

Methuen and Co., Ltd.—The Primordial Ocean, W. J. Perry; Ancient Ireland, Prof. R. A. S. Macalister; Stonehenge and its Date, R. H. Cunnington.

Oxford University Press.—Roman Mines in Europe, Oliver Davies; Romanesque Architecture in Western Europe, A. W. Clapham; Byzantine Art, D. Talbot Rice; The Tressé Iron-Age Megalithic Monument, Miss V. C. C. Collum; Tomb Development, G. A. Reisner; Tibetan *Yoga* and Secret Doctrines, W. Y. Evans-Wentz; Applied Anthropology, G. Gordon Brown and A. McD. Bruce Hutt.

Kegan Paul and Co., Ltd.—Early Buddhist Scriptures, Dr. E. J. Thomas; Yogic and Vedic Culture, Dr. R. Mulbagala; Men and Gods in Mongolia, H. Haslund.

Stanley Paul and Co., Ltd.—In Quest of Sheba's Mines, F. E. Hayter; Cannibal Cousins, Capt. J. H. Craige.

Biology

George Allen and Unwin, Ltd.—The Principles of Genetics, C. H. Waddington; How Animals Develop, C. H. Waddington.

D. Appleton-Century Co., Inc.—Wild Birds at Home, F. H. Herrick; A Guide to Bird Songs, A. A. Saunders.

Edward Arnold and Co.—The Hake, C. F. Hickling; The Arachnida, T. H. Savory.

Cambridge University Press.—Heredity and the Ascent of Man, C. C. Hurst; British Stem- and Leaf-Fungi (Coelomycetes), W. B. Grove.

J. and A. Churchill.—An Introduction to Zoology, F. G. Sarel Whitfield and A. H. Wood; A Textbook of Plant Physiology, Meirion Thomas; Human Physiology, Dr. F. R. Winton and Dr. L. E. Bayliss.

Victor Gollancz, Ltd.—The World of Nature, H. C. Knapp-Fisher.

John Lane, The Bodley Head, Ltd.—Half Mile Down, Dr. William Beebe.

H. K. Lewis and Co., Ltd.—Unfit Houses, H. G. Clinch and R. G. Bannington.

Longmans, Green and Co., Ltd.—Adventures with Animals and Men, Cherry Kearton.

Macmillan and Co., Ltd.—Botany for Medical Students, L. J. F. Brimble; Introductory Biology, E. Stenhouse; Wild Flowers of the Great Dominions of the British Empire, Lady Rockley.

Oxford University Press.—The Growth of the Surface Area of the Human Body, Edith Boyd; The Algae and their Life Relations, Josephine E. Tilden; Familiar Birds of the Pacific South-west, Florence F. V. Dickey.

Sir Isaac Pitman and Sons, Ltd.—A Short Course in Biology, W. B. Little; Some Aspects of Child Hygiene, Dr. Mary G. Cardwell.

Religious Tract Society.—Our Heritage of Wild Flowers, Hilda M. Coley; Birds of the Homestead, R. Hallett.

George Routledge and Sons, Ltd.—Fishes and their Ways of Life, Prof. Louis Roule; The School of Biology, Curt Thesing; A Really Healthy Nation, Dr. Drummond Shiels.

University of London Press, Ltd.—Biological Drawings: (2) Plant Studies, C. von Wyss.

University Tutorial Press, Ltd.—Textbook of Biology, Dr. F. R. Spratt and A. V. Spratt.

Frederick Warne and Co., Ltd.—The Spiders and Allied Orders of the British Isles, T. H. Savory.

Williams and Norgate, Ltd.—Succulent Plants, H. Jacobsen, translated by Vera Higgins; Epidemics and Crowd Diseases, Prof. Major Greenwood; Nature's Way of Birth Control, Dr. V. C. Pedersen.

Chemistry

Edward Arnold and Co.—The Chemistry of Cement and Concrete, F. M. Lea and C. H. Desch.

Eyre and Spottiswoode, Ltd.—The New Modern Gasworks Practice, vol. 2, Alwyne Meade; Dictionary of Organic Compounds, vol. 2, edited by Prof. I. M. Heilbron.

Charles Griffin and Co., Ltd.—A Text-Book of Physical Chemistry, vol. 2, Dr. J. Newton Friend.

Longmans, Green and Co., Ltd.—Origin and Development of Applied Chemistry, Prof. J. R. Partington; Thorpe's Dictionary of Applied Chemistry Supplement: vol. 2, N–Z, Prof. J. F. Thorpe and Prof. M. A. Whiteley; A Comprehensive Treatise on Inorganic and Theoretical Chemistry, vol. 14, Prof. J. W. Mellor; Optical Rotatory Power, Prof. T. M. Lowry.

Macmillan and Co., Ltd.—Physical Principles and Applications of Magnetochemistry, Prof. S. S. Bhatnagar and Dr. K. N. Mathur.

Oxford University Press.—Organic Solvents, A. Weissberger and Eric Proskauer; The Chemistry of the Aliphatic Free Radicals, F. O. Rice.

Sir Isaac Pitman and Sons, Ltd.—Shellac, E. J. Parry.

Engineering

Chapman and Hall, Ltd.—Electrical Water Heating, D. J. Bolton, P. C. Honey and N. S. Richardson; Photo-Electric and Selenium Cells, T. J. Fielding; The Low Voltage Cathode Ray Tube and its Application, G. Parr; Modern Surveying for Civil Engineers, H. F. Birchal; A Symposium on Illumination, C. J. Webber Grieveson.

Doubleday, Doran and Co., Inc.—Our Wings Grow Faster, Grover Loening.

English Universities Press.—Aerodynamics, Dr. N. A. V. Piercy; The Transmission and Distribution of Electrical Energy, Prof. H. Cotton; The Electrification of Agriculture and Rural Industries, E. W. Golding; The Rectification of Alternating Current, H. Rissik; The Utilisation of Electrical Energy, E. Openshaw Taylor.

Charles Griffin and Co., Ltd.—The Operation of Motorship Auxiliary Machinery, vol. 2, J. Lamb; Concrete Engineering, vol. 2, J. Singleton-Green.

Sir Isaac Pitman and Sons, Ltd.—Aviation Encyclopædia; Problems of Radio Engineering, E. T. A. Rapson; Modern Radio Communication, vol. 2, J. H. Reyner; Definitions and Formulæ for Students—Radio, Dr. A. T. Starr; Telephotography, C. F. Lars-Davies, fourth edition by H. A. Carter.

George Routledge and Sons, Ltd.—The Power Behind the Microphone, P. P. Eckersley.

Technical Press, Ltd.—Engineering Geology, Dr. C. S. Fox; Electrical Horology, H. R. Langman; Elements of Practical Flying, P. W. F. Mills.

Geography and Geology

D. Appleton-Century Co., Inc.—The Geographic Pattern of Mankind, J. E. Pomfret.

Edward Arnold and Co.—Round Mystery Mountain: a Ski Adventure, Sir Norman Watson.

Ernest Benn, Ltd.—New Zealand, Dr. W. P. Morell.

Cambridge University Press.—The World in Outline.

Jonathan Cape, Ltd.—North-West by North, Dora Birtles; Afghan Journey, Ben James.

Faber and Faber, Ltd.—Young Men in the Arctic, A. R. Glen.

Hodder and Stoughton, Ltd.—Libyan Sands, R. A. Bagnold; Such is the Antarctic, Lars Christensen.

Jarrolds, Ltd.—The Two Roads of Papua, Evelyn Cheesman; The Pageant of Cuba, Hudson Strode.

Macmillan and Co., Ltd.—Highways and Byways of the West Highlands, Seton Gordon.

Methuen and Co., Ltd.—Speak to the Earth, Vivienne de Watteville; The Magic Gate of the Sahara, Angelo Piccioli; The Glories of Hindustan, Dr. A. Nawrath; A Historical Geography of Europe, Gordon East.

Thomas Murby and Co., Ltd.—The Dorset Coast: a Geological Guide, G. M. Davies; Tertiary Faunas, vol. 1, Prof. A. Morley Davies.

John Murray. Forest Life in India, Hon. James Best; Canoe Errant, Major R. Raven-Hart.

Stanley Paul and Co., Ltd.—Canada To-day and To-morrow, B. Fuller; Far East, Madeleine C. Munday.

George Philip and Sons, Ltd.—Philip's Centenary Mercantile Marine Atlas of the World; The Changing Sea Level, Prof. Henri Baulig; Europe—A Pictorial Geography, Dr. E. M. Saunders; Human Geography of the Pacific Lands, J. Fairgrieve and E. Young; Life Overseas, "Newfoundland", E. Young and S. C. Gilmour.

Putnam and Co., Ltd.—The Traveller's Russia, B. Holmes.

Seeley, Service and Co., Ltd.—Recollections of a Geographer, E. A. Reeves.

University of London Press, Ltd.—Senior Practical Geography, E. J. Orford; Regions of the World in Pictures: (1) Northern Africa, G. J. Cons; A Systematic Regional Geography: (1) The British Isles, Prof. J. F. Unstead.

Mathematics and Physical Sciences

Edward Arnold and Co.—The Discovery of Specific and Latent Heats, D. McKie and N. H. de V. Heathcote.

G. Bell and Sons, Ltd.—Hydromechanics, A. S. Ramsey.

Blackie and Son, Ltd.—Atomic Physics, Dr. Max Born; Differential and Integral Calculus, vol. 2, R. Courant.

Cambridge University Press.—The Theory of Atomic Spectra, E. U. Condon and G. H. Shortley; Cambridge School Certificate Mathematics: Algebra, part 2, H. J. Larcombe and J. K. Fletcher.

Chapman and Hall, Ltd.—Electrical Measurements, H. Cobden Turner and E. H. W. Banner.

English Universities Press.—Worlds without End, Dr. H. Spencer Jones; Experimental Electricity, M. M. Das.

Charles Griffin and Co., Ltd.—A Manual of the Principles of Meteorology, R. M. Deeley.

Macmillan and Co., Ltd.—Intrinsic Geometry of Ideal Space, Prof. A. R. Forsyth; The Measurement of Inductance, Capacitance and Frequency, A. Campbell and Dr. E. C. Childs.

Methuen and Co., Ltd.—Fine Structure in Line Spectra and Nuclear Spin, Dr. S. Tolansky.

John Murray.—Through my Telescope, Will Hay.

Oxford University Press.—Relativity, Gravitation, and World Structure, Prof. E. A. Milne; The Principles of Quantum Mechanics, Prof. P. A. M. Dirac; The Differential Calculus, T. Chaundy.

Kegan Paul and Co., Ltd.—This English, Sir Richard Paget.

Sir Isaac Pitman and Sons, Ltd.—Everyday Life Arithmetic, W. G. Bate; Common Sense Practical Mathematics, F. F. Potter; Elementary Practical Mathematics, book 3, E. W. Golding and H. G. Green.

Technical Press, Ltd.—A Treatise on Practical Mechanics, J. M. Lacey.

University of London Press.—Fundamental Geometry, Dr. P. B. Ballard and E. R. Hamilton; Rational Mechanics, A. H. G. Palmer and K. S. Snell.

University Tutorial Press, Ltd.—Revision and Mental Tests in Arithmetic, Algebra and Trigonometry, R. J. Fulford; Mechanics (Elementary), G. F. Peaher; Light and Sound, H. G. Lambert and P. E. Andrews.

Metallurgy

D. Appleton-Century Co., Inc.—Romantic Copper, J. B. Joralemon.

Charles Griffin and Co., Ltd.—Electric Melting Practice, A. G. Robiette.

Miscellany

D. Appleton-Century Co., Inc.—Research, T. A. Boyd.

G. Bell and Sons, Ltd.—The Road to Modern Science, H. A. Reason.

Cambridge University Press.—General Science for Senior Schools, H. Webb and M. A. Grigg.

Chatto and Windus.—A Diary of Thomas Henry Huxley, edited by Julian Huxley.

Lovat Dickson and Thompson, Ltd.—Science in Wonderland, Prof. A. M. Low.

Thomas Nelson and Sons, Ltd.—Science: a New Outline, J. W. N. Sullivan; Speed, Space and Time, V. Sommerfield.

Ivor Nicholson and Watson, Ltd.—Scientific Progress in Recent Times, G. P. Bailey.

George Routledge and Sons, Ltd.—British Scientists of the Nineteenth Century, J. G. Crowther; Man and the Machine, H. Williams.

Philosophy and Psychology

George Allen and Unwin, Ltd.—Science and Religion N. Bishop Harman; Science and the Human Temperament, E. Schrödinger, translated and edited by J. Murphy.

D. Appleton-Century Co., Inc.—The New Field of Psychology, Dr. M. Bentley; Wish and Wisdom, J. Justrow; Early Philosophers of Greece, M. T. McClure.

Cambridge University Press.—The Visual Perception of Space, A. H. El Koussy; "Intelligence", Concrete and Abstract, W. P. Alexander.

Chapman and Hall, Ltd.—The Challenge of Childhood, J. Wickstead.

Victor Gollancz, Ltd.—Play in Childhood, Dr. Margaret Lowenfeld.

Hodder and Stoughton, Ltd.—Psychology and Life, L. D. Weatherhead.

Hogarth Press.—Æsthetics and Psychology, Charles Mauron, translated by Roger Fry and A. B.

Macmillan and Co., Ltd.—Ability and Knowledge, F. C. Thomas.

Methuen and Co., Ltd.—On Dreams, edited by T. Besterman; An Anthology of Mysticism and Mystical Philosophy, W. Kingsland; Psychology, Prof. R. S. Woodworth.

Oxford University Press.—The Man in the Street and the New Psychology, R. A. Howden; Psychology, Prof. Cyril Burt; Neo-Realism, B. N. Roy.

Kegan Paul and Co., Ltd.—The World of Colour, Prof. David Katz; Imagination in Children, Ruth Griffiths; Principles of Gestalt Psychology, K. Koffka.

Technology

Chapman and Hall, Ltd.—Hydrogenation of Coal and Oil, Dr. D. A. Howes.

Charles Griffin and Co., Ltd.—Controlled Humidity in Practice, Dr. M. C. Marsh.

Sir Isaac Pitman and Sons, Ltd.—Science for Craftsmen and Technical Students: (1) Mechanics, Physics and Chemistry, A. F. Collins and H. H. Wynn, (2) Heat, Light and Sound, H. H. Wynn, (3) Electricity, A. Green, (4) Chemistry, W. V. Waddoup.

Technical Press, Ltd.—Liquid Fuels, H. Moore.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

Experimental Evidence regarding the Field of the Deuteron

A METHOD for determining the field surrounding nuclei is to scatter charged particles by the nuclei in question. If the field were of the Coulomb type, the yield of nuclei projected in a given direction under the bombardment of α-particles would be proportional to $1/V^4$, where V is the velocity of the incident α-particles. Any deviation from the Coulomb field will manifest itself in a deviation from this relation. The experiments of Chadwick and Bieler[1] have shown that such anomalous scattering is very clearly evident in collisions between α-particles and protons for α-particle velocities corresponding to ranges greater than about 2 cm.

We have made similar experiments to determine the range at which anomalous scattering begins for α-particle impacts (1) with protons, (2) with deuterons. Our results for protons confirm the work of Chadwick and Bieler and show detectable anomalous scattering at 1·7 cm. α-particle range for head-on collisions; experiments at a greater angle showed that the anomaly occurs at a larger range but for the same distance of closest approach. The yield curves for deuterons are of the same form as for protons, as suggested by Rutherford and Kempton[2], but the anomaly begins at a lower α-particle range, namely, 1·45 cm. for head-on collisions.

If one calculates the distance of closest approach for the two cases, taking account of the different masses of the projected particles, one finds that the deviation from the Coulomb field occurs at $4{\cdot}6 \times 10^{-13}$ cm. for protons and $3{\cdot}1 \times 10^{-13}$ cm. for deuterons. It is of interest that the attractive nuclear field extends farther in the case of the proton than it does in the case of the deuteron. If known corresponding radii for higher elements are plotted against Z, then it is the proton which lies off the extrapolated curve, the deuteron being more nearly regular.

E. POLLARD.
H. MARGENAU.
Yale University.
Feb. 1.

[1] J. Chadwick and H. Bieler, *Phil. Mag.*, **42**, 923; 1921.
[2] Rutherford and Kempton, *Proc. Roy. Soc.*, A, **143**, 724; 1934.

β-Spectra of Some Radioactive Elements

WE have investigated the β-spectra of radioactive elements that are obtained by bombarding chlorine, bromine and iodine with neutrons. As E. Fermi, E. Amaldi, O. D'Agostino, E. Rasetti and E. Segrè[1] have shown, in all these cases radioactive isotopes of the bombarded elements are formed.

A glass tube containing beryllium and 200 millicuries of radon was used as the source of neutrons. Surrounding the source with substances rich in hydrogen[2] highly increases in the case of bromine and iodine the probability of formation of the radioactive nuclei, and in the case of chlorine gives a marked effect[3]. Therefore we immersed the source, together with the sample to be irradiated, in a container filled with water.

Radioactive chlorine was observed by using carbon tetrachloride, and radioactive bromine and iodine were obtained from ethyl bromide and methyl iodide, the active atoms being separated from the irradiated substance, as suggested by Szilard and Chalmers[4], in the form of a thin layer of the corresponding silver compound.

The energy distribution of the electrons emitted was measured by the magnetic analysis method with two Geiger-Müller counters already described[5]. The results obtained are shown in the last two columns of the following table:

Irradiated substance	Radioactive substance	Period	Limit of the spectrum	Maximum of the spectrum
Chlorine	Cl^{36}	50 min.	2,050 ± 100 kv.	—
Bromine	Br^{80}	30 min.	2,100 ± 100 kv.	~ 500 kv.
Bromine	Br^{82}	6 hr.	2,100 ± 100 kv.	< 300 kv.
Iodine	I^{128}	30 min.	2,100 ± 100 kv.	~ 500 kv.

So far as the accuracy of our measurements goes, all the elements investigated have the same spectral limits. Furthermore, Br^{80} and I^{128} have not only the same periods and spectral limits, but also the same shape of the spectral curve, analogous to that of radium E. By comparing the spectral limits obtained here with the masses of the nuclei involved in the nuclear reactions, emission of hard γ-rays is to be expected.

A. I. ALICHANOW.
A. I. ALICHANIAN.
B. S. DŽELEPOW.
Physical Technical Institute,
Leningrad.
Jan. 22.

[1] E. Fermi, E. Amaldi, O. D'Agostino, E. Rasetti and E. Segrè, *Proc. Roy. Soc.*, A, **146**, 483; 1934.
[2] E. Fermi, E. Amaldi, B. Pontecorvo, E. Rasetti and E. Segrè, *La Ricerca Scientifica*, V, 2; 1934.
[3] E. Amaldi, O. D'Agostino, E. Segrè, *La Ricerca Scientifica*, V, 2; 1934.
[4] Szilard and Chalmers, NATURE, **134**, 462; 1934.
[5] A. J. Alichanow, A. I. Alichanian and B. S. Dželepow, NATURE, **133**, 950; 1934.

Ionosphere Measurements during the Partial Eclipse of the Sun of February 3, 1935

PULSE measurements were made at Deal, N.J., during the solar eclipse of February 3, 1935. This eclipse began at 10.28 a.m. and ended at 12.32 p.m. with a maximum effect at the ground at Deal of approximately 40 per cent magnitude at 11.30 a.m. (E.S.T.).

The critical ionisation frequencies for the E, M^1 and F_2 regions were measured on the day of the eclipse from 8.30 a.m. to 2.00 p.m. as well as on the two following days.

Our results show that the eclipse was accompanied by a decrease in the maximum ionic density of 20–25 per cent in all three regions, and that the minimum ionisation occurred at or very shortly after the eclipse maximum. The percentage decrease was progressively greater from the lowest to the highest region, being approximately 20 per cent for the E region, 22 per cent for the M region and 25 per cent for the F_2 region. A progressive increase of this order is to be expected from the fact that the eclipse had a magnitude of 40 per cent at the ground and approximately 43 per cent in the F_2 region (250 km. over Deal). These magnitudes are in terms of the sun's diameter, which for this eclipse means an eclipsed area of 29 and 31 per cent, respectively.

This decrease in ionic density may be compared to a 50–60 per cent decrease in the E region ionisation during the eclipse of August 31, 1932, when the eclipse magnitude was 95–100 per cent.

A number of observers[2] who made measurements during the 1932 eclipse agreed that while there may have been an eclipse effect in the F_2 region, it could not be definitely attributed to the eclipse in view of

the variable nature of this layer on days before and after the eclipse and because the effect which was found was not coincident with the solar effect but was considerably later.

The present measurements seem to give a more definite correlation between the eclipse occurrence and the time of decrease in ionic density of the F_2 region, in that the decrease began within a few minutes after the first contact, with a minimum shortly after the maximum of the eclipse and a recovery to a more or less constant higher value a few minutes after the last contact. At no time during these measurements on the eclipse day or the days after was there any other variation of a comparable magnitude.

It must be remembered, however, that the F_2 region is of a very variable nature and it will take many eclipses before we are absolutely sure of the effect produced upon it.

These results, together with the results of the August 31, 1932, eclipse, indicate that ultra-violet light is an important ionising agency in the E, M, F_1 and F_2 regions.

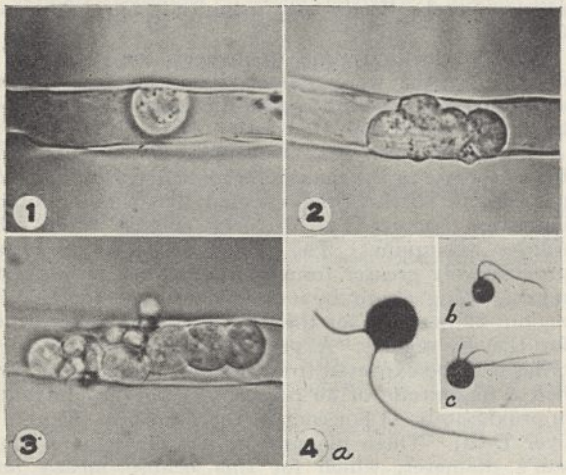
J. P. SCHAFER.
W. M. GOODALL.

Bell Telephone Laboratories,
Deal, N.J.
Feb. 6.

[1] This is the intermediate region, see Schafer and Goodall, NATURE, 131, 804; 1933.
[2] Kirby, Berkner, Gilliland and Norton, *Proc. I.R.E.*, Feb., 1934. Henderson, *Canadian J. Research*, January, 1933. Schafer and Goodall, *Science*, Nov. 11, 1932.

Occurrence of Zoosporangia in *Spongospora subterranea*, (Wallroth) Lagerheim

ALTHOUGH powdery scab disease of potatoes has been known and studied for nearly one hundred years, zoosporangia have never been described in the life-history of the causal organism, *Spongospora*



FIGS. 1–4. *Spongospora subterranea*. Fig. 1. Early stage in zoosporangial formation in root hair of tomato; × 1,000. Fig. 2. Zoospore discharge about to begin. Note swelling on cell-wall of root hair; × 1,000. Fig. 3. Zoospores being discharged; × 1,000. Fig. 4. Stained zoospores; *a*, × 2,200; *b*, × 1,000; *c* (zygote ?), × 1,000.

subterranea. Zoosporangia have, however, been observed in other genera of the Plasmodiophorales by Cook[1] and by me[2]. It therefore seemed probable that they might be found in *Spongospora*, especially if microscopic examinations of the roots of the host were made early in the course of the disease.

Tomato and potato seedlings were planted in soil which, after steam sterilisation, had been inoculated with spore balls from diseased tubers. At 65° F. heavy infection was obtained in two weeks in the root hairs of both hosts. All stages of development from amœbæ which had just penetrated the host to mature zoosporangia were observed. Sometimes single zoosporangia were present in root hairs or epidermal root cells (Fig. 1). More often they lay in rows or clusters (Figs. 2 and 3), sometimes of a dozen or more, nearly filling the host cell. Development of a single zoosporangium to form a cluster appears to take place by a process of budding.

Zoospore discharge is not accomplished through exit tubes but through a rupture in the host cell-wall resulting from pressure from a swelling which develops at one point in the zoosporangium (Fig. 2).

Zoospores from zoosporangia are similar to swarm-spores from germinating spore balls in size, shape, ciliation and manner of swimming. It is of interest to note that the occurrence of two cilia of unequal length confirms former observations on ciliation of zoospores in the Plasmodiophorales[3]. The presence of occasional binucleate spores with four cilia (Fig. 4*c*) suggests a possible fusion of gametes. Further studies are being made on the origin and subsequent development of these.

G. A. LEDINGHAM.

National Research Laboratories,
Ottawa, Canada.

[1] *Trans. British Myc. Soc.*, 11, 196–213; 1926; and *Proc. Roy. Soc.*, B, 218, 283–314; 1930.
[2] *Phytopathology*, 23, 20; 1933 (Abstract).
[3] NATURE, 133, 534; 1934.

An Abnormality in the *Boyau Calicial* (Female Accessory Glands) of the Desert Locust, *Schistocerca gregaria*, Forsk.

WHILE dissecting out the ovaries of the desert locust, *Schistocerca gregaria*, some time ago, I came across an abnormality in the accessory glands which is worth recording.

Normally, the *boyau calicial* in *Schistocerca gregaria*, as in all other Acridiidæ (vide Fedorov[1], Fenard[2] and Uvarov[3]), consist of a pair of unbranched forward prolongations of the two egg-calyces anterior to the base of the first ovariole. Each *boyau* is a much-coiled structure and usually bends inwards to touch its fellow of the other side. As Fenard[2] had observed long ago, these glands acquire their maximum development shortly before oviposition and "secrete a substance which is destined to be extruded at the same time as the eggs". This substance is the material which forms the basis of the egg-pod, and also forms a protective 'froth' over the eggs. In the uncoiled condition the glands are about 3 mm. long in a freshly emerged female and 8–12 mm. long in a female about to lay eggs.

The abnormality of the glands in the present case consists in the fact that the right gland shows an extra diverticulum arising from its outer side at a point about one third the length of the gland from its anterior tip. It reaches forward beyond the latter. The length of the main gland is about 4·8 mm. and that of the diverticulum 3 mm. The latter has exactly the same appearance as the main gland and

shows similar folds. The left gland of this female is normal. The female in which this abnormality has been found is a young one, as is evident from the small size of the ovarioles and of the accessory glands.

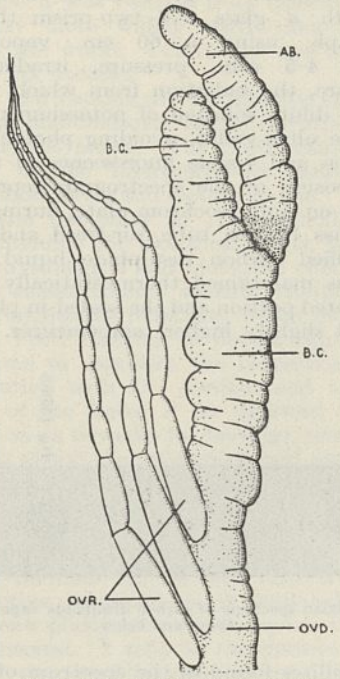


FIG. 1. The right female accessory gland of *Schistocerca gregaria* Forsk., showing the abnormal outgrowth. Camera lucida drawing. × 12. *AB*, abnormal outgrowth of the gland. *BC*, female accessory gland. *OVD*, egg-calyx; *OVR*, ovarioles.

I had previously dissected more than a hundred females of this species but never encountered any abnormality in the accessory glands; nor, so far as my knowledge goes, has such an abnormality been recorded in any other Acridiid.

M. L. ROONWAL.

Zoological Laboratory,
Cambridge.

[1] *Trans. Ent. Soc. Lond.*, **75**; 1927.
[2] *C.R. Acad. Sci.*, **22**; 1896.
[3] "Locusts and Grasshoppers". London, 1928.

Crown Rot of Sugar Beet a Boron Deficiency

CROWN rot of sugar beet and mangel is an unsatisfactory disease to account for, and some doubt has always attended the attribution of it to the fungus *Phoma betæ*, Frank. It was not entirely surprising, therefore, that Brandenburg[1] has recently shown in Holland that the disease is caused by boron deficiency, and can be cured by the addition of this element, in the entire absence of the fungus. This has now been confirmed in Ireland.

In the first of the present experiments, ten sugar beet seedlings were grown in Crone's solution (*p*H 6·2–6·5) without boron, and 20 with the addition of 1 mgm. of boric acid per litre. The former developed crown rot rapidly and to such an extent that, after 30 days, three of them were dead and seven seriously diseased, while the latter grew normally and much more vigorously. At this stage the experiment was reversed, boric acid being supplied to the seven seriously diseased plants and withheld from ten of the twenty healthy ones. The effect was immediate, for the former began to grow and produced secondary crowns, as in field attacks of the disease, while the latter developed crown rot. The ten plants receiving boron throughout continued to grow well to the end. Similar results were obtained using Tollens' and Knop's solutions. There was no parasitic fungus associated with the disease.

Confirmatory results were secured in two field experiments in Carlow where the disease is very severe locally. The yield and value of the crop were about doubled in one case (where the attack was exceptional) and increased by one half in the other, the sugar content being raised by 1–3 per cent, by applications of 12–20 lb. of borax per acre. Heavier applications did not appear to give proportionate increases, but the disease is very unevenly distributed and the optimum rate of application has not yet been determined. Brandenburg used about 18 lb. per acre.

The discovery has much economic importance. Thirty per cent of the beet area of Leinster is said to be subject to crown rot, and as a result of this work the incorporation of borax with the fertilisers is being considered. The addition of borax where the disease was absent showed no apparent effect, beneficial or otherwise.

W. HUGHES.
PAUL A. MURPHY.

Department of Plant Pathology,
Albert Agricultural College,
Glasnevin,
Dublin.

[1] Brandenburg, E., *Phytopath. Z.*, **3**, 499: 1931.

Nomenclature of Vitamin B_2

PERHAPS it is useful to direct attention to the above subject before confusion gets worse confounded. It was pointed out in 1931 that the use of the terms vitamin B_2 and anti-dermatitis (anti-pellagra ?) factor interchangeably was already causing difficulties[1]. The discovery by Kuhn and his co-workers that lactoflavine is able to supplement a vitamin B_2-deficient diet for the growth of rats constitutes a great advance, but the anti-dermatitis factor (the so-called *Haut-faktor* of the Heidelberg workers) does not appear to be identical with it. Again, we have observed[2] that concentrates of renoflavine (obtained from ox-kidney extracts) have their growth-promoting effect considerably enhanced by the addition of a relatively heat- and alkali-stable substance present in ox-kidney extracts, which is not so well adsorbed by fuller's earth in acid solution as the flavine. The tests were carried out with 'vitamin B'-deficient rats receiving vitamins B_1 and B_2.

The same heat-stable factor in ox-kidney extracts, which is obviously different from vitamins B_1, B_4 and the flavine, has been found also to supplement the growth-promoting power of a pure preparation of lactoflavine, very kindly supplied by Prof. R. Kuhn. Apparently similar results obtained in biological experiments with lactoflavine have already been reported by Chick and Copping[3]; and Booher, Blogett and Page[4]. Elvehjem and Koehn[5] now report that flavines cannot prevent 'pellagraic' symptoms in chicks, maintained on a ration low in vitamin B_2-content. That there is some factor missing in the usual vitamin B_2-deficient diet, that causes cataract in rats, is indicated by the work of Langston and Day[6]. We have ourselves met with cases of cataract

among vitamin B_2-deficient rats, but not on an extensive scale.

The above would indicate in outline the complexity of what is called 'vitamin B_2'. At least four factors appear to be involved—the flavine, the heat-stable factor, the anti-dermatitis factor and the anti-cataract factor, though it is not improbable that two or more of them may be identical. We would suggest that provisionally the term 'vitamin B_2' be reserved for the entire complex, which supplements the usual vitamin B_2-deficient diet for the promotion of good growth in rats. The other factors may be indicated by their special characteristics or methods of assay—for example, flavine, anti-dermatitis factor, anti-cataract factor, etc.

We shall, perhaps, know then where we are.

B. C. GUHA.

Biochemical Laboratory,
Bengal Chemical and Pharmaceutical Works Ltd.,
Calcutta.
Feb. 4.

[1] Guha, *Brit. Med. J.*, **2**, 53; 1931.
[2] Guha and Biswas, *Current Science*, **3**, 300; 1935. *Ber. deutsch. chem. Gesell.*, in press.
[3] Chick and Copping, *Chemistry and Industry*, **53**, 874; 1934.
[4] Booher, Blodgett and Page, *J. Biol. Chem.*, **107**, 599; 1934.
[5] Elvehjem and Koehn, NATURE, **134**, Dec. 29, 1934.
[6] Langston and Day, *Southern Med. J.*, **26**, 128; 1933.

Reproduction and Cancer

PROF. E. C. DODDS and Dr. J. W. Cook[1] have published much information regarding the chemical and pharmacological relationship between the sex hormones such as œstrin and certain carcinogenic hydrocarbons. They have established in those respects an interesting connexion between the growth changes of the uterus and those observed in certain types of cancer.

There are other interesting facts concerning the two processes. Thus carbon monoxide gas renders mice sterile[2], when breathed in concentrations (0·25 per cent) which do not interfere with the general growth of the body of mice acclimatised gradually; in the same concentration the gas retards both rate of growth of mouse carcinoma No. 63 (Bashford's tumour) and development of tar cancer[3].

Again, embryonic skin of mouse is—equally with placental tissue—the most potent agent in rendering mice immune to transplantable and spontaneous tumours[4]; it is possible that this epithelium manufactures 'immune bodies' as the result of œstrogenic and uterine activity. The interesting question is why these 'immune bodies' should be most concentrated in the embryonic skin as compared with other embryonic tissues; it may be due to the origin of the skin from ectoderm which in the early stages lies nearest to the uterine decidua, a tissue influenced by œstrin.

If œstrin is responsible, directly or indirectly, for production of natural immunity, then we should expect cancer to be most prevalent when the production of œstrin ceases. This is the case, at any rate in the female, since cancer is most prevalent after the menopause.

J. ARGYLL CAMPBELL.

National Institute for Medical Research,
N.W.3.
Feb. 12.

[1] Ann. Rep. Brit. Emp. Cancer Campaign, **11**, 12; 1934.
[2] *Quart. J. Exp. Physiol.*, **24**, 271; 1934.
[3] *J. Path. Bact.*, **35**, 379; 1932. *ibid.*, **36**, 243; 1933.
[4] Murphy, J. B., Bull. Johns Hopkins Hosp., **56**, 1; 1935.

Raman Spectrum of Gaseous Carbon Disulphide

The $\Delta\nu = 655$ cm.$^{-1}$ Raman band of carbon disulphide was photographed, the substance being in the state of vapour. Fig. 1 shows a spectrogram taken with a glass $F/6$ two-prism thermostated spectrograph, using a 60 cm. vapour column at about 4·5 atm. pressure, irradiated by a mercury arc, the radiation from which was filtered through a dilute solution of potassium chromate to cut off the ultra-violet, avoiding photochemical decomposition and visible fluorescence of the vapour.

The exposure of the spectrogram reproduced was 100 hours on Agfa Isochrom plate, during which the 'Telex' glass Raman tube, air-freed and containing some purified carbon disulphide liquid in its tail annex, was maintained thermostatically at 100° C., the irradiated portion and the sealed-in plane-parallel window at slightly higher temperatures.

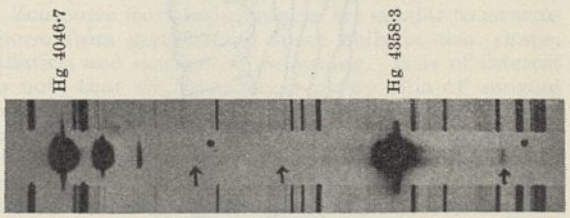


FIG. 1. Raman spectrum of carbon disulphide vapour. Copper arc above and below.

The satellites found in the spectrum of the liquid[1] and interpreted as due to transitions from excited vibrational states are not resolved, even if present, on our plates, with a linear dispersion 20 A. per mm. at λ4358 and a large slit width, 0·1 mm. According to the most recent and accurate data for the liquid[2] the centre of gravity of the two stronger component bands is shifted by 655·0 cm.$^{-1}$ from the exciting frequency.

The shift of the intensity maximum in the gaseous spectrum was observed as two Stokes lines of mercury λλ4047 and 4358, and an anti-Stokes line of the latter as marked by an arrow in Fig. 1. The measured value from the two Stokes lines on the best plate (reproduced) is 655 ± 1 cm.$^{-1}$, and is the same as the liquid shift. The negligible influence of the change of state upon the molecular vibration frequency of carbon disulphide may be expected from the smallness of dipole moment of the substance.

The intensity ratio of the $\Delta\nu = 796$ cm.$^{-1}$ band to that of $\Delta\nu = 655$ cm.$^{-1}$ appears to be much lower in the spectrum of the gas than in that of the liquid. Excepting a very faint and doubtful blackening, no measurable trace of the former band has been recorded above background level up to 125 hours exposure (dotted parts in Fig. 1); whereas with the liquid, as high as 1 : 3 is reported for the above intensity ratio under ordinary conditions of observation[2]. It is intended to measure photometrically the value of it on a denser and sharper plate in the near future.

SUNAO IMANISHI.

Institute of Physical and
Chemical Research,
Komagome, Hongo, Tokyo.
Nov. 30.

[1] P. Krishnamurti and others. See literature in (2).
[2] A. Langseth, J. U. Sørensen and J. R. Nielsen, *J. Chem. Phys.*, **2**, 402; 1934.

Ring Method for Measuring Surface Tension

A GREAT deal has been written about the ring method since it was rescued from oblivion in 1919. It is to-day more widely used than any other throughout the world. Let us try and analyse the reasons for its success.

The first two reasons are its rapidity and facility. Whoever has laboured over any of the other methods must admit this much. The third reason was the ruggedness of the instrument—a great asset in students' laboratories and lecture rooms. The fourth reason is the reliability of the method. It was primarily intended for biological fluids, and for the first time physiologists and biological chemists could check their measurements without trouble, rapidly. It was its remarkable reliability which induced such workers as Prof. Harkins to devote much of their valuable time to establish the correction formulæ, in collaboration with Dr. Jordan, and to compute the values of the factor F for different dimensions of the ring, so as to make its readings more rigorous. A. Ferguson stated that of twenty odd methods only three were reliable: the ring method was one.

Its accuracy and reliability being established, its rapidity and ease of handling being well known, I still believe that the greatest reason for the success of the ring method was the fact that it proved to be constructive, inasmuch as it disclosed a certain number of new phenomena which were not altogether devoid of interest. I refer to the discovery that, in a solution, the establishment of equilibrium—the only conditions in which the Gibbs-Thomson thermodynamic equation is valid—is a slow process capable of being followed step by step; to the discovery of the factors governing the surface tension of protein and other solutions; of the recovery after lowering of the surface tension of such solutions by surface active substances, due to a mutual adsorption; of the existence of absolute minima; of a method for determining the surface of adsorption of materials such as charcoal, graphite, platinum black, etc.; of a method for following the process of immunity; of a photo-capillary effect in plant sap; of a method for detecting structural changes in serum proteins following inactivation; of a method for detecting alterations in transformer oil after use; of a method for ascertaining the lubricating value of oils; and so on.

Now all these phenomena do not depend on absolute but on relative values. They were found because the method was very rapid, simple, reliable, and because it was possible to take into account the time factor. Relative methods are often more fruitful than absolute ones, as absolute values are of no particular interest except when dealing with pure substances. But I think everybody will agree, particularly the biologists, that solutions offer a broader field of investigation than pure liquids. As a matter of fact, the physical chemist and the physicist use comparatively few absolute methods.

Freud and Freud, however, succeeded in developing a brilliant new theory which led them to accept the ring method as absolute, and this, in addition to the collection of new facts overlooked so far, and difficult, if not impossible, to study with another method, is another important reason why the ring method, in its modern form, has been so widely adopted in research as well as in industrial laboratories.

LECOMTE DU NOÜY.

Institut Pasteur, Paris.

Oxidation of Silane

IN view of a reference by Semenoff[1] to some results recently obtained by Schantarowitsch on the upper and lower critical explosion limits in the oxidation of silane, it is of interest to record similar observations which we have made during the last six months.

We have found that pure silane when mixed with oxygen is not explosive at atmospheric pressure, but that when the pressure of the mixture is reduced, ignition occurs at a well-defined limit, which is higher the higher the temperature. The effect of two typical oxidation inhibitors (chloroform and ethyl iodide) has been examined. In small concentrations they lower the upper limit and in larger amounts prevent ignition altogether. This inhibiting action may be counteracted by increasing the temperature. Even a mixture containing the spontaneously inflammable higher hydrides of silicon may be rendered non-inflammable by small amounts of either of these inhibitors, and doubtless other substances will be found to have a similar action.

The lower oxidation limit of silane – oxygen mixtures has been examined in tubes of varying diameter, the walls of which were coated with a film of concentrated sulphuric acid. The following typical results in a cylindrical tube of 1·25 cm. diameter show the order of magnitude of this lower pressure and the relation between the pressure of the separate gases at the limit:

p_{SiH_4} (mm.)	0·837	0·605	0·368	0·272	0·241	0·198
p_{O_2} (mm.)	0·040	0·049	0·067	0·093	0·105	0·159

Under the conditions so far studied, the lower critical oxidation pressure shows a direct proportionality to a power of the vessel diameter slightly greater than unity, and not to the square of the diameter, as in the case worked out theoretically by Semenoff for deactivation on the vessel walls. On dry glass surfaces the lower limit is higher, but consistent results have not yet been obtained.

These results, which will be published in greater detail later, are in general accord with those of Schantarowitsch, as described by Semenoff, and show that the oxidation of silane resembles very closely that of phosphine rather than that of methane.

H. J. EMELÉUS.
K. STEWART.

Imperial College of Science,
London, S.W.7.
Feb. 5.

[1] "Chemical Kinetics and Chain Reactions", 1935, p. 376.

Reactivity of Carbon

X-RAY examination[1] indicates the presence of graphite in specimens of 'amorphous' carbon. Y. Oshima and Y. Fukuda[2] conclude that coke and charcoal consist of minute particles of graphite contaminated by and cemented together with hydrocarbon complexes. The so-called 'amorphous' forms of carbon generally show a chemical activity much greater than that displayed by graphite. It is, therefore, of interest to report a reaction in which the reverse is the case. During some systematic investigations of the reactivity of various types of cokes it was discovered that graded (60–100 I.M.M. mesh sieves), hard, metallurgical coke is oxidised at 100° by excess of a mixture of chromic and

phosphoric acids, much more rapidly than gas and low temperature cokes. Further investigation showed that graphite and highly graphitised forms of carbon are oxidised by this mixture approximately 20–25 times more rapidly than sugar charcoal.

The following figures give the weights of carbon dioxide (the amount of carbon monoxide was negligibly small) evolved from 1·0 gm. of graded samples in 2½ hours at 100°.

Electrode carbon	1,043 mgm.
Graphite (natural)	823 ,,
Wood charcoal	328 ,,
Metallurgical cokes	100–200 ,,
Gas cokes	87–135 ,,
Low temperature coke	75–100 ,,
Sugar charcoal	42 ,,

The anomalous position of wood charcoal in the above series is readily accounted for by its porous nature. The effect of this can be reduced by fine grinding; and it was found that when more finely powdered specimens were employed the order of the above series remained the same, except in the case of wood charcoal, which fell to the position of sugar charcoal.

These results indicate that, when it is possible to eliminate the effect of pore structure by employing a finely graded sample, the above reaction offers a simple method of estimating the amount of graphitised carbon in the various forms of 'amorphous' carbon.

H. L. RILEY.
H. E. BLAYDEN.

The Laboratory of the Northern
Coke Research Committee,
Armstrong College,
Newcastle-upon-Tyne.

[1] Debye and Scherrer, *Phys. Z.*, **18**, 291; 1917.
[2] *J. Fac. Eng. Tokyo Imp. Univ.*, **18**, 125; 1929.

Points from Foregoing Letters

IN 1932, Dr. Leakey claimed that he had discovered remains of *Homo sapiens* type *in situ* in ancient geological deposits in Kenya. The deposits were older than those containing the more primitive types of man elsewhere in the world. After a recent visit to the area where the remains were found, Prof. P. G. H. Boswell records that the exact sites could not be found, that errors had arisen in connexion with the photographs of the beds and that the deposits in the area had frequently been disturbed by slipping. Consequently Prof. Boswell regards the geological age of the remains as non-proven.

Prof. Kolhörster observed an increase of 1–2 per cent in cosmic ray activity during last December, and he has suggested that it may be connected with the appearance of Nova Herculis. Prof. W. H. McCrea calculates the energy available when a nova is formed, that is, when (according to Prof. Milne) a star collapses from a state of large volume and low temperature to one of small volume and high temperature. He concludes that this energy might be sufficient to account for the cosmic rays detected, if the star is entirely gaseous previous to the collapse, as assumed by Eddington's theory, but not if the mass of the star is already concentrated towards the centre.

The nuclei of ordinary and heavy hydrogen differ in several physical and chemical properties. Drs. L. and A. Farkas calculate the magnetic moment of the proton and deuteron from the rate of chemical reaction of their *para* and *ortho* varieties. The value calculated agrees with that obtained by means of the more direct but less accurate method of magnetic deflection.

The nuclear field of attraction of the proton extends farther than that of the deuteron, according to Mr. E. Pollard and Prof. H. Margenau. They arrive at this conclusion from the scattering effect produced by the two nuclei upon the α-particles of radium, from which the distance of closest approach may be calculated.

The range of velocity in the electrons (β-rays) emitted by chlorine, bromine and iodine, after neutron bombardment, has been determined by Messrs. A. I. Alichanow, A. I. Alichanian and B. S. Dželepow. From mass-energy considerations, the authors are led to expect that hard γ-rays are also emitted during the nuclear reactions involved.

Experiments on the reflection of radio 'pulses', made by Messrs. J. P. Schafer and W. M. Goodall during the solar eclipse of February 3, showed a decrease in the electrical conductivity of various layers or regions of the upper atmosphere. The results, though not conclusive, support the view that ultra-violet light is an important factor in producing ionisation in those regions.

E. Brandenberg, in Holland, has found that the crown rot of sugar beet is due to boron deficiency, and not to a fungus disease. Mr. W. Hughes and Prof. P. A. Murphy submit further experimental proof and state that the addition of 12–20 lb. of borax per acre improves considerably the yield of beet in areas affected by crown rot.

Dr. B. C. Guha suggests that the term vitamin B_2 be used for the whole complex found by biological assay to be necessary to promote good growth in rats grown upon a special diet. He advocates that the specific terms, anti-dermatitis factor, anti-cataract factor, etc., be used when special tests are applied involving the appearance of those diseases.

Experiments with the sex hormone (œstrin) have led to the opinion that its presence in certain circumstances may produce cancerous tissue. Mr. J. Argyll Campbell brings forward observations suggesting that under normal conditions œstrin may be responsible for providing immunity from cancer.

Dr. H. J. Emeléus and Mr. K. Stewart find that chloroform and ethyl iodide inhibit the ignition of a mixture of silane (SiH_4) and oxygen. The authors have determined the pressure at which silane becomes oxidised and find it approximately directly proportional to the diameter of the vessel used; they state that in general the oxidisation of silane resembles that of phosphine rather than that of methane.

Many instances are known in which charcoal appears to be chemically more reactive than graphite, especially when absorption is involved. Prof. H. L. Riley and Mr. H. E. Blayden now find that graphite oxidises 20–25 times more rapidly with a chromic-phosphoric acid mixture, at 100°, than sugar charcoal. The reaction offers a means of estimating the amount of graphite in 'amorphous' carbon.

Research Items

Serbian Gypsies. In the course of studying the life of Serbian peasants, Mr. Alexander Petrovič has collected data relating to the Serbian gypsies, and has published the first of a series of observations (*J. Gypsylore Soc.*, 3, 14, pt. 1), in which he deals with practices relating to theft. The gypsies recognise two forms of stealing, of which the first is from a Serb, when all keep silence, and the second from another gypsy, which is considered most disgraceful, and is followed by a vociferous lamentation on the part of the injured party, similar to the lamentation over the dead. It is only considered a sin to steal when what is taken is already in the house and is not needed. The gypsies perform spells for successful theft. On Christmas Eve, straw is obtained from the peasants and three twigs—of oak, beech and ash—are placed under the eaves of the house. At dusk, straw is scattered on the floor of the house and food, nuts, etc.—everything there is in the house except food containing animal fat—is placed on the table. Before supper, nuts are thrown in the four corners of the room. After the supper the housewife perambulates the house thrice, followed by the children, imitating the cries of hen and chickens. At dark all disperse to steal something in the neighbourhood, usually of no value, such as twigs or branches. Whatever is stolen is brought back and thrown in the fire, with the saying, "May it never be known what I have been stealing to-night", and then as it burns, "As this fire burns brightly, so may I steal quickly and cleverly". If a gypsy is caught in his theft, he is made fun of and not allowed to steal in the coming year.

Artificial Incubation of Pheasant Eggs. Heat and moisture are important factors in the development of birds' eggs, and the development of artificial incubation of game birds' eggs, especially in the United States, has suggested that an analysis of these factors may be of great service in reducing uncertainty in hatching and inferior quality of stock due to improper handling during incubation. The most efficient temperature for the incubation of pheasant eggs, when other physical conditions were kept constant, was 102° F. for the first period (to the end of the seventh day), 101° F. for the second period (days, 8–16), and 100° F. for the third period (up to hatching on 24th day). During the third period the incubation temperature may be considerably lowered with benefit to the embryo. As regards humidity, pheasant eggs require higher at the beginning and lower at the end of incubation, a gradient from about 75 per cent relative humidity down to about 65 per cent (Alexis L. Romanoff, Bull. 616, Cornell Univ. Agr. Exp. Stn., Ithaca, Nov. 1934). It is to be noted that temperature and moisture demands are specific, so that the needs of the quail (*Colinus virginianus*) fluctuate within a much closer range of temperature (101° F. throughout), and require a somewhat lower humidity at the beginning and higher at the end of incubation (rising from about 65–75 per cent relative humidity). The treatment of eggs of various game-birds in the same incubator is likely therefore to lead to poor results.

Australian Acarina or Mites. Mr. H. Womersley has recently published a revision of the mites belonging to the families Erythræidæ and Trombidiidæ in Australia (*Rec. South Australian Mus.*, 5, No. 2). Species of the first-mentioned family are parasites of the early stages of insects, while the Trombidiidæ are well known to be of economic importance since their larvæ are irritating pests of man. Apart from larval forms, 32 species and 2 varieties of Trombidiidæ were previously known from Australia, and 9 species of Erythræidæ. Comparatively little work has been done on this section of the fauna, only four workers having written on the subject previously. In the present paper, 46 species and 4 varieties of Trombidiidæ are listed, of which 2 genera, 14 species and one variety are new, together with two new species only known as larvæ. Of the Erythræidæ, 24 species of adults are listed, of which one genera and 14 species are new. Nine new species of larval forms of this family are described and, it may be added, no larvæ have been previously recorded from Australia. The paper is accompanied by numerous illustrations of a diagnostic character, together with a bibliography.

Ganglion Cells in the Hearts of Invertebrates. Three papers have been published by Senji Suzuki on this subject: "On the Ganglion Cells of the Heart of the Pearl Oyster *Pinctada martensi* Dunker", "On the Innervation of the Heart of Limpets" and "Ganglion Cells in the Heart of *Ligia exotica* (Roux)" (*Sci. Rep. Tôhoku Imp. Univ.*, Fourth Series (Biology) Sendai, 4, Nos. 2 and 3; 1934). Ganglion cells were found in the heart of all these animals. In the pearl oyster the heart is not traversed by the rectum, the muscles being better developed in the ventricle than in the auricle. It was found that ganglion cells were more numerous in the auricle, especially just before its junction with the ventricle. The limpets *Cellena nigrolineata* and *C. eucosmia* were alike in having the heart supplied by a nerve from the visceral ganglion and having several ganglion cells in the heart of large size and easily stainable, there being more in the ventricle than in the auricle. In the isopod *Ligia exotica*, there is a nerve fibre bundle with six ganglion cells along the dorso-median line of the heart.

Moulting and Metamorphosis in *Rhodnius*. Dr. V. B. Wigglesworth (*Quart. J. Micro. Sci.*, 77, Pt. 2, Dec. 1934) shows that in the blood-sucking bug *Rhodnius prolixus* the number of moults is absolutely fixed; no departure from the normal five nymphal stages has been observed among hundreds of these insects reared in the laboratory. The five nymphal stages are more or less alike; the adult differs markedly from the nymphs. There are thus two phenomena to be considered—simple moulting and moulting coupled with metamorphosis. Moulting occurs at a definite interval after feeding, only one meal being necessary in each case. There is a 'critical period' in the moulting cycle, about 7 days after feeding in the fifth nymph, about 4 days in the earlier nymphs, and removal of the head before this period prevents moulting. Insects sharing the same blood moult simultaneously, hence the process of growth must be co-ordinated by chemical factors presumably produced by the growing cells. If fourth or even first nymphs of *Rhodnius*, decapitated soon after feeding, receive blood from moulting fifth nymphs they undergo a precocious metamorphosis and develop adult characters. Metamorphosis is therefore brought

about by chemical differences in the blood. If fifth nymphs, decapitated soon after feeding, receive blood from moulting fourth nymphs, they also moult, showing that the moulting factor is the same at all stages. The absence of metamorphosis in normal nymphs before the fifth stage must therefore be due to some inhibitory factor or hormone in the blood. The head is necessary for the secretion of this inhibitory hormone.

Cytology of Variation in Apomictic Genera. Various theories have been put forward to explain the origin of polymorphic groups of species in genera with apomictic reproduction, such as *Taraxacum*, *Hieracium* and *Antennaria*. It has been supposed that they are partly sexual and have thus given rise to a swarm of forms through crossing, and it has been assumed that, even with apomictic development, gene mutations might occur which would give rise to new biotypes. In a cytological study of these conditions in *Taraxacum*, Dr. A. Gustafsson (*Hereditas*, **19**, 259) concludes that partial fertility does not occur in these dandelions and that new biotypes cannot be formed by the above methods. He finds, however, in the megaspore mother cell, what is described as a pseudohomotypic mitosis occasionally occurring, in which the chromosomes of the heterotypic metaphase do not pair but arrange themselves in a single plane and divide. It may happen that both daughter halves of a particular chromosome pass to the same pole. The normal pairing of chromosomes may also lead to crossing-over. In both of these ways it is possible that new biotypes ('pseudomutations') may arise in forms which are totally apomictic. The fact that in *Antennaria alpina* males arise from females although the latter are totally parthenogenetic and show various grades of intersexuality, is explained by the hypothesis that the X and Y chromosomes undergo crossing-over in prophase and may also undergo irregular distributions in the pseudohomotypic division.

Fungi in the Air over Orchards. When apples are gathered late in the season in several districts, they fall a prey to numerous fungi which cause unsightly 'spots' to appear during storage. Horne and Nitimargi have shown that the air above an orchard contains the spores of many fungi which produce such disfiguration, whilst Mr. F. M. Carter, of the Imperial College of Science and Technology, has recently published the results of a continuation of this work (*Trans. Brit. Mycol. Soc.*, **19**, No. 2, 145–153, Jan. 1935). Plates of nutrient media were exposed in orchards at East Malling, Swanley and Belfast, and the fungi which appeared were cultured and identified. An extensive list of species is given, and it is rather significant that most of them are known to occur in apple 'spots'. The majority of organisms isolated from diseased apple tissue are also represented in the list. Some species, such as *Sporotrichum roseum* and *Verticillium lateritium*, have not previously been obtained from diseased apples, but are shown by the present account to produce rotting when inoculated artificially. Particular attention has been paid to *Pleospora herbarum*, and several new forms of the genus *Polyopeus* have been noted.

A Pliocene Flora from Shansi Province. In the *Bulletin of the Geological Society of China* (**12**, No. 2; 1933) R. W. Chaney describes a flora comprising eight species from lake deposits near Taiku, Shansi Province, which have been referred to the upper Pliocene on the basis of stratigraphical relations and faunal evidence. The modern equivalents of the Taiku flora are found for the most part in the cool, semi-arid provinces of northern China, and a climate of this type appears to have characterised this part of China during the late Pliocene. All the fossil species are described as new, but they show a general resemblance to the Pliocene flora of western North America. The more humid and somewhat warmer type of climate indicated by the middle Tertiary floras of north-eastern Asia suggests that there has been a progressive trend towards cooling and aridity in this region since the Oligocene, which corresponds to similar climatic changes already noted in western North America during the Tertiary.

Nevada Earthquake of December 20, 1932. The Cedar Mountain (Nevada) earthquake, which ranks as one of the strongest of recent earthquakes in the United States, is described in a valuable paper by Messrs. V. P. Gianella and E. Callaghan (*Amer. Seis. Soc. Bull.*, **24**, 345–377; 1934). Though it caused but little damage and no loss of life—the central area is thinly populated—the shock was definitely felt over an area of 400,000 square miles. The principal shock occurred at 10.10 p.m., Pac. St. Time, and its epicentre lay in lat. 38° 7′ N., long. 117° 8′ W. One fore-shock was felt at 9.32 p.m. and thousands of after-shocks occurred within the next year with their epicentres lying along a belt nearly 100 miles long from north to south. The most interesting feature of the earthquake was the formation of about sixty rifts in the epicentral area. These rifts differ from the secondary fissures formed in alluvium with every great earthquake, for they were caused by actual shifts of adjoining rock-masses and can be traced across ridges of rock. They vary in length from a few hundred feet to about four miles, and in width from less than an inch to 400 feet. They occupy a belt about 38 miles long from north-west to south-east and 4–9 miles wide, and occur in a general echelon pattern. With one possible exception, all are essentially vertical, and nearly all the larger rifts show a vertical displacement, usually down the slope. In a few rifts, positive evidence of horizontal movement was detected, in one place amounting to 34 inches. In all of them, the east side was shifted relatively to the south, and this is also indicated by the echelon pattern of the rifts. The authors notice the agreement of this direction with that during the Owen's Valley earthquake of 1872 and the Californian earthquake of 1906.

Ultra-Violet Glasses. The December 1934 issue of the *Journal of Research* of the National Bureau of Standards contains a research paper on ultra-violet transmission changes in glass as a function of the wave-length of the transmission stimulus, by Drs. W. W. Coblentz and R. Stair of the Bureau. It constitutes an important addition to the series of papers which have issued from the Bureau dealing with the properties of these glasses. The object of these investigations is to determine what are the particular wave-lengths in sunlight which cause deterioration of the transmission of such glasses, for what wave-lengths this deterioration is most marked and what is the constituent of the glass which is accountable for the changes. So far, it seems the deterioration is due mainly to wave-lengths shorter than 3000×10^{-8} cm. and the greatest reduction in

transparency is for wave-lengths of this type. For 3050 the reduction is to about 40 per cent of the initial transparency after six weeks exposure to sunlight in May and June, and it remains near that figure for a considerable period. By exposing the glass to light between λ 3300 and λ 4050, the transparency for λ 3000 light may be increased about 10 per cent. As this rejuvenating light is present in sunlight, both deterioration and improvement of transparency are going on during daily exposure. The overall deterioration for the whole of sunlight is to about 80–85 per cent of the transmission of freshly made glass. In soda-lime glasses the soda appears to be the sensitive constituent.

Surface and Interfacial Tension of Mercury. Recent values for the surface tension of mercury range from 400 to 500 dynes/cm., and those for the interfacial tension between mercury and water from 370 to 427 dynes/cm., the greatest disagreement existing in the values found by the sessile drop method. H. Brown (*J. Amer. Chem. Soc.*, **56**, 2564; 1934) has modified this method and finds that the results obtained with large flat drops and with small ones agree with those obtained with the drop weight method. The interfacial tension against water was found to be 374·3 dynes/cm. at 25°, and the surface tensions in dry air and in a vacuum are the same to within 0·3 per cent, namely, 473 at 25°. Thermodynamic considerations show that the surface tension of mercury in a vacuum must be at least 447 at 25°, which excludes some previous values. On the assumption that a mercury surface oxidises in air only in the presence of water vapour, some puzzling results can be explained, such as irreversible adsorption effects and the different results sometimes obtained with a static and a dynamic method. The fact, first observed by Quincke, that water spreads on a fresh clean mercury surface, affords an excellent criterion of the cleanliness of a mercury surface.

Emission Spectra of Alkali Halides. H. Hamada has recently discussed the emission spectra of the vapours of the chlorides, bromides and iodides of sodium and potassium (*Phil. Mag.*, Dec. 1934). The spectra were obtained by heating the salts in the hollow cathode of a discharge tube. With sodium salts, the *D* lines are intensely excited and there is a nearly continuous spectrum extending to the long wave side of these lines. Near the lines some band structure is observed. There is a faint apparently continuous spectrum on the short wave side of the *D* lines. Similar results are obtained with the potassium salts. The results are correlated with the Franck-Condon theory of molecular excitation. Most of the molecules excited by electron impact go into an unstable state which dissociates into a normal halogen atom and an excited sodium atom. The latter atoms emit the *D* lines. In an alternative process, however, the electronically excited molecule may be set in vibration without dissociating, and it then gives rise to the band spectrum observed.

Down-coming Radio Waves. D. F. Martyn and A. L. Green (*Proc. Roy. Soc.*, A, Jan.) have studied the wireless waves reflected from the upper atmosphere, using a receiving system containing a vertical wire aerial and two vertical loops at right angles. Each of these aerials was connected to a separate receiver and recording galvanometer. The results obtained show that the down-coming, elliptically polarised ray is often deviated laterally out of the plane of propagation. This phenomenon is probably responsible for the inconsistent results obtained by other methods in measuring the angle of incidence of down-coming waves. The present method enables the authors to calculate the position of the ionospheric reflecting centres responsible for the down-coming ray—these centres move about rather rapidly. The angles of incidence observed correspond approximately to symmetrical reflection in the ionosphere, and the polarisation of the down-coming wave is normally, but not always, approximately circular.

Pure Calcium Chromate. When calcium chromate is prepared by mixing solutions of calcium chloride and potassium chromate, the precipitated calcium chromate is always contaminated with adsorbed potassium and chloride ions. Prof. J. Milbauer and Dr. J. Doškař have now discovered a method which overcomes this difficulty and have published their results in the *Proceedings of the Masaryk Academy of Work* at Prague. These authors have worked out the exact conditions for the precipitation of calcium chromate by mixing solutions of calcium chloride and sodium chromate. The best results were obtained by adding a solution containing 400–450 gm. of calcium chloride per litre to a saturated solution of sodium chromate so that the former was in excess, namely, 1·6 times the amount required according to the equation:

$$Na_2CrO_4 + CaCl_2 = 2\,NaCl + CaCrO_4.$$

The best temperature for the reaction was between the limits 18° and 27° C. The precipitate of calcium chromate so obtained was readily freed from any adhering salt or excess of calcium chloride, and is said to be particularly pure.

Fatigue Research and Engine Design. The failure of revolving shafts in engines and machinery has occurred so frequently that it has led to much investigation. Ships have been lost through the breakage of propeller shafts and many motorists have been delayed by the fracture of rear-axles. In a booklet published by the Society of Motor Manufacturers and Traders in 1932, it was stated that, of all the breakdowns in motor-vehicles, the breaking of rear-axle shafts accounted for 13·6 per cent. In most cases such failures result in nothing but expense and delay, but when shafts in ships break, the consequences may be disastrous. Ever since the screw propeller was adopted, shafts have broken; anything that can explain the causes is of value to the designer. A good deal of light is thrown upon the subject in a paper read on January 25 to the North East Coast Institution of Engineers and Shipbuilders entitled "The Relation of Fatigue to Modern Engine Design". In this paper, Mr. R. A. Macgregor treated it from the aspect of the manufacturer of steel forgings, Mr. W. S. Burn dealt with it as an engine designer while Prof. F. Bacon referred to some results of researches in the laboratory. In Mr. Burn's view, researches on fatigue endurance by scientific engineers were "sufficient to prove that it can be rendered quite a harmless germ if the correct antidote is administered. The antidote is simply the avoidance of stress concentration or notch effect". He gave some interesting examples of the improvements effected in engine parts by the application of this maxim. The paper contains a bibliography of more than two hundred books and papers published on the subject of fatigue in this and other countries.

Measurement of Geological Time*

THE report of the Committee on the Measurement of Geologic Time for the year ending April 28, 1934, prepared by the chairman, Prof. A. C. Lane, contains an imposing record of the progress achieved and gives some account of the varied and far-reaching character of the researches now being carried out. Prof. Lane contributes an article dealing with the history of the subject. He also directs attention to his proposal that the isotopes of uranium from which the various series originate should be distinguished as Ur-radium, Ur-actinium, Ur-thorium and (if needed) Ur-virginium.

The more important of the new age determinations are listed in the accompanying table. All are calculated from lead-ratios except those for the Triassic and Keweenawan basalts, which are based on helium determinations. As helium is liable to escape, the highest figure for the Keweenawan is most likely to be correct. From the radium contents of the travertine deposits of the Mammoth Hot Springs, Yellowstone Park, H. Schlundt finds various ages up to 14,000 years. A purely geological method is applied by F. J. Pack to the measurement of post-Miocene time. He has determined the rate of recession of the wall of Bryce Canyon at two feet per century. The wall has receded a hundred miles since the Miocene, corresponding to a period of the order 26 million years. This corresponds well with the age of 28 million years found for the Cleveland Dyke in Co. Durham.

Geological Age.	Material and Locality.	Investigators.	Age in Millions of Years.
Triassic.	Basalt, New Haven.	W. D. Urry.	170
Permian.	Pitchblende, Wölsendorf.	F. Hecht and Edith Kroupa.	205
Permian.	Thorite, Langesundfjord.	A. von Grosse.	226
Devonian.	Uraninite, Glastonbury.	C. N. Fenner.	296
Late Ordovician.	Uraninite, Fitchburg.	F. Hecht and Edith Kroupa.	336
Late Cambrian.	Kolm, Sweden.	W. R. Bennett.	444
Keweenawan.	Basalt, Calumet and Hecla.	W. D. Urry.	302–610
Pre-Witwatersrand.	Uraninite, Gordonia.	A. Holmes and F. Hecht.	925
Laurentian.	Uraninite, Quebec.	H. V. Ellsworth.	1040
Pre-Laurentian.	Pitchblende, Great Bear Lake.	J. P. Marble.	1260
Pre-Laurentian.	Monazite, Manitoba.	Edith Kroupa.	1725

New methods for the determination of radium have been devised by R. D. Evans and for thorium by W. D. Urry. Work on the actinium series has been carried out by A. von Grosse and A. E. Ruark. A. F. Kovarik has found that the half-period of thorium is close to $1{\cdot}3 \times 10^{10}$ years, a result that agrees with independent measurements by Heimann and by Fesefeldt and confirms the value adopted by Kovarik and Holmes in the "Age of the Earth" (*Bull.* 80, Nat. Res. Coun., 1931). Determinations of the atomic weight of lead from radioactive minerals have been made by O. Hönigschmid, J. P. Marble, C. M. Alter and A. D. Bliss.

The extremely sensitive magneto-optic methods of F. Allison have now been brought into use. C. S. Piggot, of the Geophysical Laboratory, has co-operated with Allison in detecting the isotopes of lead in various minerals, particularly those of the Great Bear Lake pitchblende deposits. Sixteen isotopes of lead are now known and eight of uranium. The programme of research on the disintegration of potassium and the accumulation of Ca^{41} in rocks and minerals during geological time, announced by Holmes at the York meeting of the British Association, is being carried out systematically in collaboration with Allison, who has so far determined Ca^{41} in about a hundred analysed materials. The results, which it is hoped will soon be published, not only throw much-needed light on the vexed question of the origin of igneous rocks, but also serve in the case of appropriate rocks and minerals to determine the period at which consolidation took place.

Prof. Lane and his Committee and the active team of associated workers are to be congratulated on the spectacular acceleration of progress that the last few years have witnessed.

* National Research Council: Division of Geology and Geography. Report of the Committee on the Measurement of Geologic Time, presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, April 28, 1934. Pp. ii+86. (Washington, D.C.: National Research Council, 1934.)

The Pre-Crag People of Suffolk

ON February 19, Mr. Reid Moir spoke at the Royal Anthropological Institute on "The Age of the Sub-Crag Flint Implements". It is now twenty-five years since the first traces of man were found in the Suffolk Bone Bed beneath the Red Crag. The Bone Bed is of very considerable geological antiquity, and predates those deposits containing the earliest palæolithic implements.

Mr. Reid Moir has carried out many excavations in the Suffolk Bone Bed, and after a very searching examination of a large number of artefacts from this deposit, concludes that these can be divided into five groups which show marked differences from each other. These differences make themselves manifest in colour and condition, and in the types and flaking of the various specimens. The characteristics mentioned serve to differentiate the groups, which moreover contain artefacts which exhibit reflaking. Such specimens, which are well-known in later prehistoric cultures, represent those which were flaked by one man, and then patinated and stained, to be found afterwards and reflaked by another and later man. The later flaking shows usually a different colour from the earlier, and clearly cuts through the more ancient surface. Further, the colour of the more recent flaking can be matched with that of another group, and so on, thus establishing the fact that below the Red Crag there exist five periods of human flaking upon the flints there assembled. Mr. Reid Moir has carried out an exhaustive series of measurements of the specimens in each group and this supports the conclusions based upon colour and condition, as to the reality of the presence of the five groups mentioned.

The Suffolk Bone Bed is a typical residual deposit made up largely of the wreckage of strata at one

time existing in East Anglia, and broken up by the irruption of the sea into the area in Crag times. At Bawdsey, on the Suffolk coast, the sea is to-day attacking a cliff composed of London clay, Red Crag, Glacial Gravel and surface material. As these various beds are washed away, the heavier contents collect at low tide mark, and are forming a deposit similar in some respects to the Suffolk Bone Bed. It is indeed highly probable that this was accumulated under analogous conditions, and it is possible that the mammalian remains of different ages in the Bone Bed, together with the flint implements, at one time occupied their respective geological horizons in the now vanished land of Suffolk.

The mammalian bones and teeth in the Suffolk Bone Bed range from Upper Miocene to late Pliocene times, when this deposit was laid down. It is possible that the earliest group of the sub-crag flint implements may date back to the earlier part of the Pliocene, or even to more ancient times, but this is not yet established. The specimens of the earliest group, though exhibiting many archaic characteristics, cannot however be looked upon as the type of artefact likely to be made by the earliest representatives of the human race; but this group is obviously of an extreme antiquity, and its existence points to a much greater age for the human race than has hitherto been supposed. It has long been recognised and accepted that man was present in East Anglia before the deposition of the Red Crag some 500,000 years ago, but it now appears that this period of time must be greatly extended to include the earliest group of the pre-Crag artefacts.

The excavations which over a number of years have been conducted by Mr. Reid Moir in the Suffolk Bone Bed, have been made possible by the invaluable financial help of the Royal Society, the Percy Sladen Memorial Fund and Mr. T. R. Parkington of Ipswich.

Artificial Production of the Hormone of the Corpus Luteum

THE transformations of cholesterol into the male sex hormone (androsterone) and of stigmasterol into a crude product having the biological activity of the corpus luteum hormone[1] have been rapidly followed by further important developments in this field of investigation of the sex hormones, and the corpus luteum hormone has now been prepared in a chemically pure state from stigmasterol and also from pregnandiol.

The conversion of pregnandiol into the hormone was achieved by Butenandt and Schmidt[2] in a strikingly simple manner. Having first shown that by partial hydrolysis of pregnandiol diacetate the nuclear acetoxy group was hydrolysed, they converted the monoacetate by a series of stages into the hormone, and showed thereby that the hormone was the $\Delta^{1:2}$ or $\Delta^{4:5}$ unsaturated diketone corresponding with pregnandiol. These authors then found that pregnandiol could be transformed into the pure hormone by three simple stages, namely, oxidation to pregnandione, monobromination, and subsequent elimination of hydrogen bromide by heating with pyridine. As pregnandiol may be isolated from the urine of pregnancy without difficulty, there is no doubt that considerable supplies of the artificial hormone will be manufactured by this method.

The isolation of the pure hormone from the degradation products of stigmasterol has been recorded by Fernholz[3] and by Butenandt and Westphal[4]. As Fernholz and Chakravorty[5] have also shown that both cholesterol and stigmasterol may be degraded to the same 3-hydroxy-*nor-allo*cholanic acid, this conversion of stigmasterol into the corpus luteum hormone establishes the positions 3 and 20 for the two keto groups of the hormone. The $\Delta^{4:5}$ position of the double bond is also regarded by Butenandt and Westphal as established by the formation of the hormone from stigmasterol, but since the position of the double bond of stigmasterol is based only on analogy with cholesterol[6] it is better to admit that the $\Delta^{1:2}$ position for the double bond of the hormone has not been rigorously excluded.

Butenandt and Mamoli[7] have directed attention to the fact that pregnandiol is therefore a hydrogenation product of the hormone, and in the light of this conception it is easy to understand the presence of large quantities of pregnandiol in the urine during pregnancy, for the diol is thus seen to be the form in which the hormone is excreted, just as cholesterol is excreted in the form of its hydrogenation product, coprosterol.

The artificial hormone, like that prepared from corpus luteum extracts, exists in two polymorphous forms, one of which is readily converted into the other[8].

[1] NATURE, **134**, 758; 1934.
[2] *Ber.*, **67**, 1893, 1901; 1934.
[3] *ibid.*, p. 1855, 2027; 1934.
[4] *ibid.*, p. 2085.
[5] *ibid.*, p. 2021.
[6] Fernholz, *Annalen*, **507**, 128; 1933.
[7] *Ber.*, **67**, 1899; 1934.
[8] See Butenandt and Schmidt, *Ber.*, **67**, 2088; 1934.

Temperatures of the Stars

IN a lecture before the Newcastle-on-Tyne Astronomical Society on December 12, Mr. W. M. H. Greaves described the way in which stellar temperatures are derived from a study of the spectra of stars.

All information regarding temperatures of the stars is derived from their light and its analysis. In heating a metal, while at first the radiation is almost entirely limited to the infra-red, with increase of temperature it includes wave-lengths in the visible part of the spectrum, and the proportion of blue to red light emitted increases as the temperature rises. But we cannot generally find temperature from colour, since the emissivity of bodies varies. Nevertheless, our knowledge of the temperature of stars is derived from measures of the colour of star light, the source of which is the outer layers of the star.

The 'black body', which theoretically absorbs all radiation falling on it and which, when heated, emits radiation of all kinds, is taken as a standard of reference. For such a body the proportions of emitted light at different wave-lengths are connected with temperature by Planck's formulæ. Observation shows that, so far as measurement made between spectral lines is concerned, stars are emitting radiation in a

similar manner to black bodies, although they are actually 'grey body' radiators. This being so, the continuous spectrum of a star can be matched in colour with black body radiation corresponding to some temperature, and this temperature is called the 'colour temperature' of the star.

The light from a star consists of radiation from its surface and, to some extent, radiation from its lower layers which has only been partly absorbed on its way to the surface. Theoretical investigation shows that, subject to certain hypotheses, the colour temperature of a star is about twenty-five per cent greater than the actual temperature of the surface. A comparison is made between the light emitted by the star and a laboratory source the colour temperature of which is known, and it is necessary to measure the ratios of the radiations from the star and the laboratory source at two separate wave-lengths. Applying Planck's formula for the ratio of the radiations from the latter at the two wave-lengths, the measured ratios make it possible to derive the ratio of the radiations from the star at these wave-lengths. We then have the data to give the colour temperature.

For measurement, the spectra from the star and laboratory source are photographed on the same plate and the photo-chemical properties of the emulsion are utilised, since there is a relationship between the optical density or degree of blackening of the negative and the amount of light which caused it. By an additional series of exposures of the plate to sources of light the relative intensities of which are known, spectral images are formed which enable a calibration curve to be made for any particular wave-length, and from this, differences in optical density can be converted into ratios of light. The data obtained yield a quantity known as the 'colour function', which is related to colour temperature by a formula derived from Planck's formula, and thence the colour temperature of the star is obtained.

Star light is reddened in passing through the earth's atmosphere and the observations have to be corrected for this effect. Use is made of a system of stars the differences of colour function of which have been measured by a set of comparisons in pairs at equal altitudes above the horizon. Pairs of stars chosen from this system are now photographed at unequal altitudes, and each such comparison yields a quantity, part of which is due to difference in colour function and part to the atmospheric effect. As the difference of colour functions has been already obtained, atmospheric reddening can be determined and applied to comparisons between stars and the laboratory source used for comparison.

Well-determined colour temperatures for a number of stars are now available as a result of the work at different observatories, and in the study of the relationship between temperature and other effects a striking correlation of temperature with spectral type has been found.

Reorganisation of the University of Durham

THE University of Durham entered upon the second century of its existence three years ago with prospects somewhat clouded by controversies relating to medical education. The Royal Commission appointed in March 1934 to report on the University's organisation and work found the constitution of the College of Medicine, which, together with Armstrong College, forms the Newcastle Division of the University, and also the University statutes, to be radically unsound in many respects and more particularly in their failure to confer on the University any control over the fate of one of its own professors.

The recommendations of the Commission, embodied in the report just published (London : H.M. Stationery Office, Cmd. 4815. 1*s*. 6*d*. net) provide for the reconstitution of the Newcastle Division as a single unit by the amalgamation of its two colleges under a head, to be appointed, in the first instance, by the Crown. For the guidance of the organisation and development of medical education and the maintenance of close relations between the College and the associated hospitals, responsibility would be vested in a dean of medicine, to be *ex-officio* a member of the Court and Senate of the University and of the Council and Academic Board of the College and chairman of the Board of the Faculty of Medicine and of the Medical Studies Committee of the Academic Board.

Of the two schools of thought with regard to the place and treatment of chemistry and biology regarded as part of the medical curriculum proper, the Commission has ranged itself emphatically on the side of the champions of the closest collaboration between the medical departments and the science departments in a university, the precise allocation of the teaching of the various frontier subjects being left to be determined in the light of the whole of the teaching power which is available, rather than by mere departmental considerations : granted the desirability of relating the teaching of chemistry and biology to human physiology and anatomy and to medical problems generally, the one thing to avoid, in the interests of the teachers themselves as well as of the students, is a divorce of this specialised teaching from the university departments devoted to chemistry and biology.

Medical education in Newcastle has been somewhat hampered for many years by inadequate premises. Land for new buildings adjoining Armstrong College and opposite the Royal Victoria Infirmary has been acquired, however, and an extensive scheme involving the sale of the present site of the College of Medicine has for some time been under consideration. Among the recommendations of the Royal Commission on the affairs of the University is one for the constitution of a temporary board of five persons, four appointed by the College of Medicine and one appointed by Armstrong College, to sell the existing premises and generally to arrange for the finance of the new building, to control the proceeds of sale and the greater part of the capital funds at present vested in the College, to assume control of the new site and supervise the erection of the new buildings and ultimately to transfer the premises together with any funds in its hands to the proposed new University College to be formed by amalgamation of Armstrong College with the College of Medicine. A time limit not exceeding seven years would be fixed within which the Board would have to complete its activities.

The Durham Observatory, which was opened in 1841, is at present vested in the Council of the Durham Colleges, and is managed by a large body of curators, of whom some are teachers in Newcastle.

In the general debacle which overtook the teaching of science in the University of Durham in the eighteen-sixties, the study of astronomy survived and at times the astronomical work has been of considerable importance. A seismograph was installed in 1929. Among the Royal Commission's recommendations for the future government of the University is a proposal that the Observatory should be transferred from the Council of the Durham Colleges to the University. It is pointed out that, there being science departments in both the Durham and the Newcastle Divisions, the work of the Observatory should be regarded as a central university activity.

University and Educational Intelligence

CAMBRIDGE.—The General Board has issued a report on the future organisation of teaching and research in crystallography. The following recommendations are made. (1) The Crystallographic Laboratory shall be under the control of the Cavendish professor of experimental physics. (2) All teaching of crystallography for Part I of the Natural Sciences Tripos shall be given in the Department of Mineralogy and Petrology. All teaching of crystallography for Part II of the Natural Sciences Tripos shall be given in the Crystallographic Laboratory. (3) The research facilities of the Crystallographic Laboratory shall be available for use by the staff of the Department of Mineralogy and Petrology and the research facilities of the Department of Mineralogy and Petrology shall be available in a similar manner for use by the staff of the Crystallographic Laboratory. (4) There shall be an assistant director of research in crystallography who shall be responsible to the Cavendish professor for advanced teaching and direction of research in crystallography. (5) There shall be an assistant in experimental research in crystallography whose duty shall be to help the assistant director of research. He shall be appointed by the Cavendish professor, subject to confirmation by the General Board. It is recommended further that Mr. J. D. Bernal, of Emmanuel College, be appointed assistant director of research in crystallography from October 1, 1934, with a pensionable stipend of £500 a year.

OXFORD.—The contributions to science by the early members of Wadham College formed the subject of a public lecture in the Hall of the College on March 2. The speaker, Dr. R. T. Gunther, stated that but for a most lamentable accident the lecture would have been delivered by the late Dr. F. A. Dixey, whose unrivalled knowledge of the connexion of the early fellows of the College with the foundation of the Royal Society had delighted many audiences in that hall. Portraits of John Wilkins, Sprat, Seth Ward and Wren hang on its walls. Sydenham and Mayow were among its members. Less well-known was the botanical work of Walter Stonehouse (1597–1655) and of Richard Warner (1713–75).

THE Royal University of Pisa is offering a research scholarship for the year 1935–36 under the Galileo Galilei Foundation. The scholarship is open to all and, if a candidate is not Italian, he will be expected to carry out scientific research in an Italian institute during the tenure of the scholarship. Further information can be obtained from the Rector of the University of Pisa.

THE first Regional British Isles Conference of the New Education Fellowship will be held at the University of St. Andrews on August 13–22, under the presidency of Dr. A. D. Lindsay, Master of Balliol College, Oxford. The theme of the Conference will be "Education and Leisure: How to Create a Democratic Culture". Two problems will be discussed, namely, education for leisure at schools and the provision of facilities and training for adolescents and adults so that they may be able to make use of their leisure after school life is over. The subject of Dr. Lindsay's address will be "Unemployment and Education". Further information can be obtained from the New Education Fellowship, 29 Tavistock Square, London, W.C.1.

Science News a Century Ago

A Description of Upper California

At a meeting of the Royal Geographical Society on March 9, 1835, a communication was read from Dr. Coulter describing Upper California, in which he had resided for two years. The only portion of the country which was settled was mainly along the coast, the chief settlers being the Catholic missionaries, who sought to collect around their stations an Indian population, whom they taught, in a rude way, to till the ground and rear domestic cattle, while they compelled them to conform to their religious observances. The great article of produce was black cattle. In 1827 the missions possessed 210,000 branded cattle, and it was supposed not less than 300,000 unbranded. The number of white inhabitants in Upper California was estimated by Dr. Coulter at 6,000, and they were rapidly increasing, while the Indian population was decreasing. The prospects for settlers in the north were good, the district being highly fertile, well wooded and watered. The Tuli Lakes, although shallow in the dry season, furnished good facilities for the transport of wood, hides, etc. Gold had been found in a stream falling into the Southern Tuli.

Colliery Explosion near Wigan

According to the *Annual Register* for 1835, an explosion of firedamp in a coal mine near Wigan on March 9, 1835, caused the death of three women working in the mine. There were only six persons working in the pit, which was a small one, but the pit was known always to contain a great quantity of inflammable gas. Owing to this, a piece of cloth had been placed at the bottom of the pit to assist in ventilating it, but on the day of the accident this was not in place. On a workman, Peter Tabernier, going into the colliery with a naked light, he noticed symptoms of an approaching explosion and hastened to get out of the pit, calling the others also to do so. Unfortunately, before they could get out, the explosion took place, burning two men badly, and killing another man and three sisters aged respectively nineteen, seventeen and fourteen years. "Had Tabernier," said the *Annual Register*, "taken the precaution of using Davy's safety lamp, instead of approaching with an unguarded light, which as soon as it approached, set fire to the explosive fluid, this accident in all probability would not have happened. He had one of the lamps at home but out of repair, and through the extreme poverty to which he was reduced, he could not afford to get it repaired."

Egyptian Chronology

On March 12, 1835, Henry Hallam, the historian, wrote to Mrs. Somerville directing her attention to an error she had made in her "Connexion of the Physical Sciences". On p. 104 of this work Mrs. Somerville had written: "The Egyptians estimated the year at 365 d. 6 h., by which they lost one year in every 14,601, their Sothiac period. They determined the length of their year by the heliacal rising of Sirius, 2,782 years before the Christian era, which is the earliest epoch of Egyptian chronology." After pointing out that the Egyptian civil year was of 365 days only and the Sothiac period was 1461 years, not 14,601, Hallam said: "I do not see how the heliacal rising of Sirius in any one year could help them to determine its length. By comparing two successive years they could of course have got at a sidereal year; but this is what they did not do; hence the irregularity which produced the canicular cycle. The commencement of that cycle is placed by ancient chronologers in 1322 A.C. It seems not correct to call 2782 A.C. 'the earliest epoch of Egyptian chronology', for we have none of their chronology nearly so old, and in fact no chronology, properly so called, has yet been made out by our Egyptian researches. . . . Certainly, 2782 A.C. is a more remote era than we are hitherto warranted to assume for any astronomical observation."

A History of British Fishes

Among its short notices of new books, the *Athenaeum* for March 14, 1835, referred to "A History of British Fishes" by William Yarrell. "Here is the first number," it said, "of a beautiful work, to be completed in fourteen monthly parts, illustrated by woodcuts of all the species, and numerous vignettes. The name of Mr. Yarrell is sufficient guarantee for the accuracy of the work; and we can assure our readers that the exquisite beauty of the illustrations leaves nothing to be desired. It promises, when complete, to be a worthy companion to Bewick's 'Birds'—and we know not that we could say more in its praise." Yarrell, who was born in 1784 and died in 1856, was a successful business man and head of a newspaper agency. Devoted alike to sport and natural history, he belonged to the Linnean, Zoological and Entomological Societies. His collections of fishes and birds were purchased for the British Museum.

Chemistry at Oxford

In the Lent Term, 1835, Dr. Daubeny began a course of chemical lectures in the basement of the Old Ashmolean Building at Oxford to an audience, some of whom rose to great distinction. Among them were Archibald Campbell Tait, F.R.S., then a newly elected fellow of Balliol, who afterwards became headmaster of Rugby, 1842–60, Bishop of London, 1856–68 and Archbishop of Canterbury, 1868–82; William Dudley Ryder, afterwards arbitrator in the Mixed Court of New York; Reginald Windsor West, seventh Earl Delawarr; and John Bennett Lawes, who had matriculated at Brasenose College in 1833, and who founded the Rothamsted Agricultural Experiment Station ten years later. In those days, it was quite usual for persons intending to take holy orders to attend scientific lectures.

Societies and Academies

LONDON

Royal Society, February 28. J. MELLANBY: The supposed coagulation of oxalate plasma by trypsin. The action is due to the conversion of prothrombase to thrombase by the ionised calcium contained in the trypsin solution. The quantity of calcium required to coagulate oxalate plasma is determined by the thrombokinase content of the plasma. Plasma containing $N/80$ potassium oxalate and an optimal quantity of kinase may be coagulated by the addition of $N/800$ calcium chloride. This fact indicates the avidity of kinase for securing the calcium ions to the prothrombase kinase system. Mammalian blood collected directly into a solution of potassium oxalate obtains kinase relatively slowly from the cells of the blood. The interval of time after leaving the blood vessels is greater than that required for the precipitation of 75 per cent of the total calcium of the blood by the potassium oxalate. G. SALT: Experimental studies in insect parasitism. (3) Host selection. Parasites attack only certain hosts, but why they choose some particular species and reject others is unknown. Two strains of the parasitoid *Trichogramma evanescens*, reared exclusively on *Sitotroga* and *Ephestia* respectively for 63 and 43 generations, developed no dependence on, or preference for, their respective hosts. Both strains preferred *Ephestia*, but the preference was not a specific one for *Ephestia* but a preference for *Ephestia* as the larger host. Ovipositing females of *Trichogramma* attacked a number of true hosts from which their progeny successfully emerged; several unsuitable hosts in which their progeny were unable to develop; and a variety of false hosts in which they were unable even to lay their eggs. The principal criterion used by ovipositing females of *Trichogramma* in the selection of their hosts is that of size. G. FRAENKEL: A hormone causing pupation in the blow-fly, *Calliphora erythrocephala*. This secretion is produced 16 hours before pupation (at 20° C.). The hormone-producing organ is either the ganglion or in its immediate neighbourhood. After the hormone has been discharged, pupation can be successfully accomplished without the co-operation of the ganglion. The atmospheric oxygen required for the darkening of the pupa is brought to the skin through the tracheal system.

PARIS

Academy of Sciences, January 21 (*C.R.*, **200**, 269–356). The president announced the death of Emanuele Paterno di Sessa, foreign associate. EMILE PICARD: Functions of one variable possessing a theorem of addition. L. LECORNU: The *retour éternel*. ERNEST ESCLANGON: A photograph with long exposure of Nova Herculis. Remarks on a peculiarity present in the photograph taken on January 11, and not appearing in photographs taken on January 7 and 12. MARCEL BRILLOUIN: A heterogeneous electromagnetic ether capable of producing a field of a quantic atomic force. HYACINTHE VINCENT and FRANÇOIS MOREL: The alexic deficit determined by experimental hyperthermy. LOUIS LUMIÈRE: An optical inverter. A modification of the Wollaston prism. CHARLES CAMICHEL, LÉOPOLD ESCANDE and PIERRE DUPIN. Indeterminations in the phenomenon of sudden enlargement (hydraulics): the influence of the initial conditions. ALEXANDRE GUILLIERMOND

was elected a member of the Section of Botany in succession to the late H. Lecomte. GÉRARD CORDONNIER: A new method of generation of right conoids. SILVIO MINETTI: The search for the exceptional values of a series of analytical functions and a new criterion of normality of a family of such functions. CHARLES SADRON: The determination *a priori* of the coefficients of turbulent friction for conduits and rough plates. PIERRE VERNOTTE: The damping of oscillations of real materials. L. GOLDSTEIN: The determination of the potentials of interaction of corpuscles. GASTON DUPOUY and RAYMOND JOUAUST: The absolute measurement of magnetic fields and the determination of the ampere in absolute value. Several authors who have made absolute measurements of magnetic fields by the two usual methods, the induction method and the electromagnetic method, have obtained results showing a systematic difference and this has been attributed to the difference between the absolute ampere (deduced from its electromagnetic definition) and the international ampere. The experiments described by the author show no such difference. The ratio of the international ampere to the absolute ampere deduced from the experiments described agrees within 1 in 10,000 with the value of H. L. Curtis and R. W. Curtis (U.S. Bureau of Standards). ALBERT TURPAIN and RAYMOND DE BONY DE LAVERGNE: Observations on the communication of M. Jacques Métadier relating to the action of the magnetic field on the Brownian motion. J. CAYREL: A method permitting the separate study of the rectification of the two contacts of a rectifier with rigorous elimination of the rectification of one of them. Application to the localisation of the β-rectification of copper sulphide detectors. PAUL GAUBERT: The anisotropy of liquids round gas bubbles. ALBERT ARNULF: The resolving power of visual optical instruments and its relations with the optical quality of the instrument. K. SITTE: Remarks on the theory of artificial radioactivity. WOLFGANG GENTNER: The disintegration of beryllium by the γ-rays. Absorption of the emitted neutrons. Effective section of the γ-rays. MORICE LETORT: The kinetics of the thermal decomposition of acetaldehyde vapour in the presence of traces of oxygen. PIERRE VALLET: The theoretical study of the decomposition of bodies with linearly increasing temperatures. MME. MARIE ELISA P. RUMPF: Pertitanates and pervanadates. Using the method of continuous variations, it was found that the per-compound formed corresponds to the action of one molecule of hydrogen peroxide on one molecule of titanium tetrachloride or of sodium vanadate. The equilibrium constants of these reactions were determined. ALBERT PORTEVIN and PIERRE CHEVENARD: The micromechanical study of welds. An application of the micro-machine recently described by Chevenard. Diagrams are given showing the results obtained with welds of chrome molybdenum steels. G. LEJEUNE: Some tartromanganic salts. JULES JARROUSSE: The hydrogenation of diphenylpyruvic acid. JEAN RUDIC: The quantity and the nature of the gases evolved under the action of heat and a vacuum by some fossil Rumanian coals. Contribution to the classification of these combustibles. E. AUBERT DE LA RÜE: The geological constitution of Wallis and Futuna Islands. GILBERT MATHIEU: The geological structure of the Vendean Bocage. EDMOND SAURIN: The presence of the Lias in the province of Phu Yen (South Annam) and on the age of the upper grits of south-east Indo-China. ALBERT F. DE LAPPARENT: The Tertiary basin of Eoulx, near Castellane (Haute-Provence). ADOLPHE LEPAPE: The origin of the helium of natural gases. Helium and ekacæsium (element No. 87). It is suggested that the presence of lithium and cæsium in springs exceptionally rich in helium are indicators of the original presence of the hypothetical alkaline radio-element No. 87, or ekacæsium, in the strata supplying the mineral matter for these springs. NORBERT CASTERET: The gulfs and caverns of the Taza region (Morocco). ROBERT DE LITARDIÈRE: Observations relating to the cycle of the nucleoles in somatic mitosis. JEAN CHAZE and ANDRÉ SARAZIN: Contribution to the study of the *môle*, a disease of mushroom beds. The internal morphology of species of *Psalliota* with parasites. PH. JOYET-LAVERGNE: Contribution to the search for vitamin A in animal and plant cells. MLLE. GERMAINE COUSIN: A case of gynandromorphism in a hybrid grasshopper, *Achaeta bimaculata-campestris*, *A. bimaculata*. EMILE F. TERROINE and ROBERT RAZAFIMAHERY: The distribution of the excrementitial forms of sulphur in the various aspects of metabolism. MLLE. PAULE LELU: The metabolism of imidazol.

AMSTERDAM

Royal Academy of Sciences (*Proc.*, **38**, No. 1, 1935). W. J. DE HAAS and J. M. CASIMIR-JONKER: Penetration of a magnetic field into supra-conductive alloys. Extends previous work on tin to Bi_5Tl_3 and a Pb–Tl alloy (64·8 per cent Tl). H. TER MEULEN and MISS H. J. RAVENSWAAY: The molybdenum content in leaves. The molybdenum content of the leaves of all the trees investigated except the horse-chestnut remained constant or increased between May and October. A. VAN ITTERBEEK and W. H. KEESOM: Measurements on the viscosity of oxygen gas at liquid oxygen temperatures. Determinations between 90·2° K. and 79·4° K. by the oscillating disc method. L. S. ORNSTEIN and J. W. MEYER: The velocity of alcoholic fermentation. A mathematical theory of the carbon dioxide evolution and sugar consumption in alcoholic fermentation is developed and checked on the authors' and other observers' experimental data. R. WEITZENBÖCK: On restricted semi-invariants of binary forms. A. A. NIJLAND: Mean light curves of long period variables. (21) *Z.* Cygni. The period of this star is 262 days and the amplitude 5·59 magnitudes. P. J. BOUMA: Outlines of a general theory of the colour metric (1). Extends and completes previous theories by Schrödinger and Thoden v. Velzen. JULIUS WOLFF: Demonstration of a theorem on the conservation of the angles in the conformal representation of a domain in the neighbourhood of a frontier point. KURT MAHLER: An arithmetical property of the Taylor coefficients of rational functions. H. BEHNKE and F. KORTE: Theory of functions of several complex variables. The boundary of the region of regularity. P. KOETS: Complex coacervation of amylophosphoric acid and proteins and its possible bearing on the problem of amylopectin. Viscosity measurements of mixtures of amylophosphoric acid and various proteins and possible interpretation. N. H. VAN DOORNINCK: The position of the Laki crevasse in Iceland. N. H. VAN DOORNINCK: The origin of the shield volcanoes and the volcanic table mountains of Iceland. GASTON ASTRE: Pericatalan beds of *Pseudotoucasia Catalaunica*. GASTON ASTRE: A preradiolite from the island of Ibiza. G. V. UBISCH: Influencing the signs of

heterostyly in *Oxalis stricta* by *Ustilago Oxalidis*. F. KRÜER: Contributions to the knowledge of oxygen respiration in *Ascaris suilla*. A. BIEMOND and PH. H. HARTZ: Hypogenitalism in a case of dystopia of the neurohypophysis with special reference to the rôle of the basophilic elements. It is concluded that if the gonadotropic hormone is produced by the basophilic elements, it must be transported by way of the pars posterior and hypophyseal stalk. W. HUREWIEZ: Contributions to the topology of deformations. (1) Higher dimensional homotopy groups. J. F. DREYER: A human skull from Florisbad, Orange Free State, with a note on the endocranial cast by C. U. Ariëns Kappers.

Forthcoming Events

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

Monday, March 11

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Miss C. E. Longfield: "A Naturalist in Brazil".*

VICTORIA INSTITUTE, at 4.30.—Dr. W. Bell Dawson: "Solar and Lunar Cycles implied in the Prophetic Numbers of the Book of Daniel".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. Brysson Cunningham: "An Inland Water Survey for Great Britain".

UNIVERSITY OF GLASGOW, at 8.30.—J. Anderson: "Progress in Shipbuilding".*

Tuesday, March 12

ILLUMINATING ENGINEERING SOCIETY (Joint Meeting with the ROYAL AERONAUTICAL SOCIETY), at 7.—H. N. Green: "Recent Developments in the Lighting of Airways and Aerodromes".

Wednesday, March 13

ROYAL SOCIETY OF ARTS, at 8.—S. A. Main: "Properties, Characteristics and Uses of Stainless Steel".

Thursday, March 14

ROYAL SOCIETY, at 4.30.—H. J. Taylor: "The Tracks of α-Particles and Protons in Photographic Emulsions".

M. L. E. Oliphant, A. E. Kempton and Lord Rutherford: "The Accurate Determination of the Energy Released in Certain Nuclear Transformations".

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Dr. V. B. Wigglesworth: "Observations on the Malaria Epidemic in Ceylon".*

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. C. D. Broad: "Time as a Metaphysical Problem".*

Friday, March 15

PHYSICAL SOCIETY, at 4.45—(at the Imperial College of Science, South Kensington, S.W.7).—Annual General Meeting.

KING'S COLLEGE, LONDON, at 5.30.—Maj.-Gen. Rowan-Robinson: "Iraq and her Neighbours".*

Saturday, March 16

MICROCHEMICAL CLUB, at 10.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Annual General Meeting.

Official Publications Received

GREAT BRITAIN AND IRELAND

Manual of Safety Requirements in Theatres and other Places of Public Entertainment. Issued by the Home Office, 1934. Pp. ii+106. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1933–1934. (Cmd. 4796.) Pp. 172. (London: H.M. Stationery Office.) 3*s*. net.

Sanatoria: List of Sanatoria and other Residential Institutions approved by the Minister of Health for the Treatment of Persons suffering from Tuberculosis and resident in England and Wales, with the names of the Administrative Counties and County Boroughs in which the Institutions are Situate. (List 10e.) Pp. 26. (London: H.M. Stationery Office.) 6*d*. net.

University of London: University College. Annual Report, February 1934–February 1935. Pp. ii+183. (London: Taylor and Francis.)

British Standards Institution. Handbook of Information and Indexed List of British Standard Specifications, (C.D. 5050.) Pp. 93+xxvi. (London: British Standards Institution.) 1*s*.

Empire Fibres for Marine Cordage: Tests of Tarred and Untarred Cordage made from East African Sisal; Report of Exposure Tests carried out by the Admiralty, 1933–34. Pp. 11. (London: Imperial Institute.) 1*s*.

Bulletin of the International Tin Research and Development Council, No. 1: Tinplate and Canning in Great Britain. Pp. 82. (London: International Tin Research and Development Council.) Free.

The Journal of the Royal Agricultural Society of England, including the Farmer's Guide to Agricultural Research. Vol. 95. Pp. 537+cxlvii. (London: John Murray.) 15*s*.

London Shellac Research Bureau. Technical Paper No. 1: Isolation of Pure Lac Resin. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 24. (London: London Shellac Research Bureau.)

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 3, 1934. Pp. iv+171. (London: Brompton Hospital for Consumption.) 2*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21, Nos. 19, 20 and 21: Pollination in *Saxegothæa*, by Joseph Doyle and Mary O'Leary; Pollination in *Pinus*, by Joseph Doyle and Mary O'Leary; Pollination in *Tsuga*, *Cedrus*, *Pseudotsuga* and *Larix*, by Joseph Doyle and Mary O'Leary. Pp. 175–204+plates 3–5. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 4*s*.

Technical Education Series. Pamphlet No. 3: Flour Quality; its Nature and Control. By Dr. E. A. Fisher. Second (revised) edition. Pp. 58. (London: National Joint Industrial Council for the Flour Milling Industry.) 6*d*. net.

Report for 1934 (No. 47) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Dr. R. J. Daniel. Pp. 36. (Liverpool: University Press of Liverpool.) 1*s*. 6*d*. net.

Institute for Research in Agricultural Engineering: University of Oxford. Farm Wiring. By C. A. Cameron Brown. Pp. 32+4 plates. 1*s*. Some Trends in Mechanised Farming, 2: Grass. By Dr. H. J. Denham. Pp. 8. (Oxford: Institute for Research in Agricultural Engineering.)

Royal Commission on the University of Durham. Report. (Cmd. 4815.) Pp. 94. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

OTHER COUNTRIES

Report of the Aeronautical Research Institute, Tôkyô Imperia University. No. 115: On a Motion of a Cylindrical Bubble in a Tube and its Application to the Measurement of the Surface Tension of a Liquid. By Sin-iti Hattori. Pp. 161–193. 30 sen. No. 116: Investigation of the Accident to the Flying-boat, J-BCDO, "Sirohato". (Report of the Accident Investigation Committee.) Pp. 194–437. 1.90 yen. (Tôkyô: Koseikai Publishing Office.)

The Mysore Tribes and Castes. Vol. 1, Chapter 1: The Position of Mysore in India's Racial History. By Dr. Baron von Eickstedt. Pp. 80+21 plates. (Bangalore: Government Press.)

Memoirs of the Geological Survey of India. Vol. 67, Part 1: The Baluchistan Earthquakes of August 25th and 27th, 1931. By W. D. West. Pp. v+82+vii+8 plates. (Calcutta: Geological Survey of India.) 3 rupees; 5*s*. 3*d*.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 93: Rapport Atlantique 1933 (Travaux du Comité du Plateau continental atlantique) (Atlantic Slope Committee). Publié avec l'aide de Dr. Ed. Le Danois et Rafaël De Buen. Pp. 36. (Copenhague: Andr. Fred. Høst et fils.) 1.50 kr.

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1928–1929. English Version, Part 2. Pp. xii+375+13 plates. (Cairo: Government Press.) 30 P.T.

Bergens Museum. Årsberetning, 1933–1934. Pp. 96. (Bergen: A/S John Griegs Boktrykkeri.)

Carnegie Institution of Washington. Year Book No. 33, July 1, 1933–June 30, 1934: with Administrative Reports through December 14, 1934. Pp. 405. (Washington, D.C.: Carnegie Institution.)

CATALOGUES

Minerals, Rocks, Fossils, Meteorites. Pp. 48. (London: Gregory, Bottley and Co.)

Radiography in the Erect. (Publication No. 34/09.) Pp. 12. (London: Newton and Wright, Ltd.)

Boots Special Medical Products. Pp. 32. (Nottingham: Boots Pure Drug Co., Ltd.)