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Research in Engineering.

ENGINEERING research may be said to have had its birth in the investigations of Smeaton on wind and water power and in the work of Watt on the steam-engine. Almost contemporary with their investigations we see in France the application of mathematical science to the forms and masting of ships, and the establishments of the École des Ponts et Chaussées and the École des Mines, the former having for its director the distinguished civil engineer Perronet. These various activities were among the firstfruits of the extension and application of the experimental sciences, and ever since there have been men, in increasing numbers, who have concerned themselves with the scientific principles underlying the work of the engineer and the adaptation of scientific discoveries for everyday needs. There can be no question that material progress in the past half-century has been principally due to this co-operation of science and industry, and it is in this direction hopes for the future lie. Huxley many years ago wrote: "As industry becomes more complicated and competition more keen, the sciences are dragged in one by one to take their part in the fray, and he who can best avail himself of their help is the man who will come out uppermost in the struggle for existence."

At first engineering research was but a sluggish stream confined within narrow channels, but with the coming of the steamship and the railway and all the great works they included, the sluggish stream was quickened into life, and it has now become a mighty river having tributaries in every branch of practical work. Watt, Smeaton, Perronet, and Réaumur were followed by Rennie, Barlow, Tredgold, and Navier, who in turn were succeeded by Carnot, Clapeyron, Wöhler, Tresca, Bauschinger, Froude, Hirn, and Rankine, whose names are known to every student and whose labours are the heritage of the engineering world. Then, too, institutions for mechanics, such as the Andersonian at Glasgow, paved the way for our technical schools and colleges, the leaders of engineering formed themselves into societies for the discussion of both theory and practice, engineering professorships and engineering laboratories were founded, organisations such as the British Association fostered research in engineering, eminent captains of industry invited the assistance of chemists and physicists in their undertakings. State departments also initiated original investigations, and governments, convinced by the ever-accumulating mass of evidence of the importance of research, established institutions such as our own National Physical Laboratory, while another landmark was passed when in 1915 the British Government created a new public office under the title of the Department of Scientific and

Industrial Research, which already has a budget of nearly half a million.

The total amount of research carried out in engineering all over the world to-day can best be gauged by a review of the innumerable periodicals and journals, the transactions of the engineering societies, blue books and reports, of which there is a never-ending succession. But in spite of this, just as the Romans called for roads and still more roads, so the insistent demand to-day is for research and still more research. Its methods, its scope, and its results are referred to in practically every presidential address, and the foremost engineering institutions make its energetic pursuit a part of their programme. Of recent addresses referring to this topic, mention may be made of the presidential address of Engineer Admiral Sir George Goodwin to the Institution of Engineers-in-Charge, of the autumn lecture to the Institute of Metals by Sir John Dewrance, the president-elect, and of the address of Mr. H. Kerr Thomas to the Institution of Automobile Engineers.

Mr. Thomas regards the automobile engineer as a man who adapts the ideas of the inventor and the theories of the man of science to the needs of the public. Just as it is essential for him to organise his factory, so he should organise both inventor and scientific investigator for the benefit of the community. Many automobile engineers have failed to do this; and Mr. Thomas gives it as his considered opinion that if the automobile engineer has been careless of the money of his patron, and occasionally has been apathetic towards the inventor, his attitude towards the man of science has been simply inexplicable. "I will go further," Mr. Thomas continued, "and say that if this attitude does not alter, and that speedily, although the statement may sound exaggerated, it is my belief that this industry, one of the largest in the country, will be found to have passed its zenith, and will more or less rapidly decline until it is faced with extinction."

Dealing with the questions as to who should carry out the research, and how to obtain the fullest value, Mr. Thomas declared that the whole training of the automobile engineer, whose work consists of manufacturing something to be sold, unfits him for the work of research. "It is no more possible for him to do his own research work than it is for him to make the tracings in his drawing office, or to operate his capstan lathes." But it is needful for him to organise the work of the research laboratory, and this implies the capacity of working with other people, "for in government laboratories, universities, and technical colleges all over the world, there are men concentrating on just the problems which daily confront the automobile engineer." Co-operation with other manufacturers is necessary also, for the old plan of secrecy is in the end impracticable, and it is happily coming to be regarded as more advantageous in the end to give away information than to withhold it.

In his final paragraphs, Mr. Thomas refers to the cost of research. Since 1920 there has been a Research Association under the Association of British Motor and Allied Manufacturers. The funds were provided by the motor industry, which disburses in wages some 30,000,000*l.* a year. But only about $\frac{1}{100}$th of 1 per cent. of this sum was set aside for communal research. If but $\frac{1}{10}$th of 1 per cent. were set aside, there would be a fund of 30,000*l.*, which, together with the help from the Department of Scientific and Industrial Research, would enable work to be attempted on a scale hitherto unknown. The American engineering institutions have formed an Engineering Foundation, a trust in which all participate. It has invested already 550,000 dollars, and now there is a serious proposal put forward by the president of the American Institution of Electrical Engineers to provide a community fund of 20,000,000 dollars. Engineering research should not be carried out in watertight compartments, and it is plain that if Great Britain were to pool its research the greatest economy could be achieved, but, says Mr. Thomas, "it would be necessary for the automobile engineers to accord to the joint research body their whole-hearted support."

The general recognition of the value of research in engineering has come about during the last thirty years. In the first James Forrest lecture to the Institution of Civil Engineers in 1893, Anderson, having for his subject "The Interdependence of Abstract Science and Engineering," remarked: "It seems to be the fate of peoples to attack social problems from the wrong end, to solve them by the painful and dilatory process of trial and error, rather than by means of investigations based on first principles, and this method is commonly applied to engineering problems. Random trials, as a rule, are the methods by which great results have been achieved, while the application of the scientific principles involved has been left to other heads, long after the results have been attained at much needless cost and by much unnecessary expenditure of labour and of time." These words were uttered when the motor industry was still in its cradle. Rolls did not import his first motor-car into England until 1895, and nearly ten years passed before Henry Ford offered his first car to the public. No one then dreamt that thirty years later the world would possess 20,000,000 motor vehicles or that a single factory would be able to turn out 8000 motor-cars a day. But such are the achievements of to-day, and they have been rendered possible only by the close co-operation of the chemist, the physicist, and the metallurgist, with the skilled engineer and the business man.

Greek Myths and Mycenæan Realities.

The Ring of Nestor: a Glimpse into the Minoan After-World and a Sepulchral Treasure of Gold Signet-Rings and Bead-Seals from Thisbe, Boeotia. By Sir Arthur Evans. Pp. ii + 75 + 5 plates. (London: Macmillan and Co., Ltd., 1925.) 12*s.* 6*d.* net.

TO-DAY even the most old-fashioned admirer of Hellenism has to admit that classical Greek civilisation was not only preceded by but also actually rooted in the Minoan culture of Crete and its continental daughter, the Mycenæan. The excavator of Minos' palace at Knossos, who so dramatically found the key to the riddle of pre-classical Greece, has himself taken the lead in tracing the influence of the Minoan civilisation on the classical; again and again he has illuminated the dark background of Hellenic life by a reference to the remains of the prehistoric age or interpreted the monuments of that still dumb epoch from the records of historic Greece.

Fresh evidence pointing in the same direction is presented in the monograph before us. Its first section describes thirteen gold seals allegedly found together in a Mycenæan tomb near Thisbe in Bœotia. Some of the seals are engraved with religious subjects and serve to extend the already large series of Minoan prototypes for classical rites and Minoan deities in the Greek pantheon. The scene of a goddess rising from the earth on Seal 6 comes startlingly close to later representations of the *anodos* of Kore. Yet there is really nothing surprising in this; Persephone (Phersephassa) has a "pre-Hellenic" name, her "mother" came from Crete, her cult-centre at Eleusis is the site of a Mycenæan village. Those commentators who see in Persephone a corn-maiden should observe that the goddess on the seal holds poppies in her hands, a feature paralleled later in the art of Magna Grecia. Another novel suggestion is that the two girl attendants of the Minoan goddess who figure on Seal 5, as on other Minoan gems, are in a sense forerunners of the Dioscuri. Sir Arthur Evans, however, unlike Dr. Farnell, admits that the Heavenly Twins were Aryan deities, blood-brothers of the Vedic *divo napātā*, and supposes that they had assimilated the pre-Hellenic figures, as happened in other cases.

It was, however, above all through the Homeric epics and heroic saga that the Mycenæan age lived on into the classical. The centres of the great cycles of heroic myth—Mycenæ, Thebes, Tiryns, Iolkos, Kalydon—are precisely the centres of Mycenæan culture, as Prof. Nillson has recently shown. The correspondence between the heroic and the Mycenæan geography of Greece is, indeed, so exact that a study of the legends enables us to locate in advance the prehistoric sites; it was thus that Dörpfeldt was led to the discovery of the rich tombs of Kakovatos, the half-forgotten site of Nestor's capital. Ever since Dr. Schliemann's first discoveries, the Mycenæan objects have been used with conspicuous success to illustrate Homeric descriptions of houses, works of art, weapons and methods of fighting, though other passages in the poems seem to reflect a different environment. Finally, names celebrated in Homer, Achæans and even Atreus himself (if Dr. Forrer's interpretation of a tablet from Boghaz Keui be correct), have been discovered in historical Hittite and Egyptian texts. Such discoveries have naturally invested the old "Homeric question" with a new significance and revolutionised our view of the Heroic Age; the towns and figures of saga are becoming historical, the splendours of the epic concrete realities. Three seals from Thisbe are now presented as marking a quite new and decisive step in linking up the Mycenæan age with the Heroic and so with the Classical; they seem to imply that some of the legends at least existed, in very much the form that has come down to us, so early as the fifteenth century B.C. Two intaglios represent concrete episodes from the Oedipus cycle—the hero's encounter with the Sphinx and the killing of Laïus in the Hollow Way. The third is interpreted as depicting the vengeance of Orestes on his guilty mother and her paramour, Aegisthos.

Hence some of the material used by the epic poets would have existed in saga form by the fifteenth century B.C., when the Thisbe seals are said to have been engraved. This evidence, if it be accepted, would have a decisive bearing on the whole Homeric controversy; it would afford brilliant confirmation for the theory of a "Minoan epos," already suggested by Sir Arthur Evans in 1912 to account for the Mycenæan traits in Homer; and this Minoan epos might easily be identified with the "Heroic Chronicle" inferred by T. W. Allen from the literary data as the source from which "Homer" drew much of his material.

Now if a body of saga really existed in a form from which later rhapsodes could borrow descriptions of actual works of art—our author cites Nestor's cup as an example—and embodied accounts of historical events, like the death of Aegisthos, which were "transferred" to a different context, the attractive theory of an "Achæan period" at the end of the Mycenæan becomes superfluous. Commentators have identified the epoch of Achæan domination described in the Iliad with the archæological period known as Late Mycenæan B, when, after 1250 B.C., "Homeric" innovations—cremation, iron, slashing swords and breast-plates—begin to appear within the framework of Mycenæan culture, just in order to reconcile the Mycenæan and un-Mycenæan aspects of Homeric life; the contem-

porary Hittite and Egyptian references to Achæans—in Asia Minor and Libya—are merely invoked incidentally as confirmatory evidence. The "nameless Mycenæans" would be the Achæans of Homer, the un-Mycenæan traits in the present poems anachronisms introduced by the later minstrels who used the older saga.

It is true that the Heroes would not then be Greeks. Sir Arthur Evans in this volume again insists that the Mycenæan civilisation was implanted in Greece by actual conquerors come from Crete, and even invokes the Keftian word *Akashau*, found in an Egyptian school-book, to prove that Aegisthos at least was a Minoan. At the same time their subjects may, he admits, have included Greeks. It would then be easy to comprehend how such civilising conquerors became Hellenised in the imaginations of their Greek subjects and were appropriated by later generations as national heroes. Such, we submit, is the only logical conclusion to be drawn from the theory of a Minoan epos, though its author does not go so far, but seems still to adhere to the theory of an "Achæan period," two or three centuries later than the Thisbe seals or the episodes they depict.

It is only fair to warn the reader, however, that the evidence of the seals cannot yet be accepted as conclusive; for their authenticity is still in dispute. Their owner can, indeed, add to his own authoritative opinion in their favour the judgment of two other experts. He further points out that two seals in the "same" group exhibit peculiarities in design, now paralleled on other indisputably genuine documents which could not have been known to a forger when the Thisbe treasure came to light. Finally, the existence of Mycenæan tombs near Thisbe is established. Nevertheless, the circumstances in which the jewels were discovered are shrouded in mystery. The treatment of the whole group as a unit rests on the subjective estimation of technical criteria; and it is precisely technical peculiarities in some of the seals, notably the three depicting heroic themes, that give rise to uneasiness. The unpleasant possibility must be borne in mind that a forger added these more striking specimens to a group of genuine but rather commonplace gems. That does not, of course, detract in the least from the enormous value of Sir Arthur's commentary on the scenes, the masterly account of the evolution of the chariot, for example.

Fortunately no such suspicions attach to the unique gold ring which gives its title to this monograph. It is undoubtedly a remnant of the regal wealth once buried in the great tombs of Kakovatos, which had been plundered long before the Germans excavated them scientifically. The elaborate scenes engraved on this unique signet are interpreted by its present owner with his usual penetrating insight and perfect mastery of comparative mythology. But the world of ideas thus revealed is quite un-Homeric. We see the World Tree and its canine guardian, prototype of Cerberus. From other details Sir Arthur is able to deduce that the Mycenæans conceived souls as butterflies and the chrysalis as a symbol of resurrection. With the aid of this idea, several curious objects from the shaft graves of Mycenæ can be explained, and the miniature balance comes to suggest the idea of a weighing of souls.

The author considers that the ring, like others from Minoan and Mycenæan funerary deposits, belongs to a special sepulchral type of signet, designed for suspension and not worn on the finger, the origin of which he finds in an ivory specimen from an Early Minoan tomb in Crete. It is true that the inner diameter of the hoop—14·5 mm.—seems too small for the finger of an adult. Nevertheless, the bosses adorning the hoop have been rubbed down a little, just as they would have been by actual wear on the finger, a point which is not noted in the publication.

V. GORDON CHILDE.

The Isle of Mull.

(1) *Memoirs of the Geological Survey, Scotland. Tertiary and Post-Tertiary Geology of Mull, Loch Aline, and Oban. (A Description of Parts of Sheets 43, 44, 51, and 52 of the Geological Map.)* By E. B. Bailey, Dr. C. T. Clough, W. B. Wright, J. E. Richey, and G. V. Wilson; with Contributions by E. M. Anderson, H. B. Maufe, Dr. G. W. Lee, B. Lightfoot, Dr. T. O. Bosworth, and G. A. Burnett; with Petrology by Dr. H. H. Thomas and E. B. Bailey; with Chemical Analyses by E. G. Radley and F. R. Ennos; and Palæobotany by Dr. A. C. Seward and R. E. Holttum. Pp. v+445+6 plates. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1924.) 15*s*. net.

(2) *Memoirs of the Geological Survey, Scotland. The Pre-Tertiary Geology of Mull, Loch Aline, and Oban. (Being a Description of Parts of Sheets 35, 43, 44, 45, and 52 of the One-inch Geological Map of Scotland.)* By Dr. G. W. Lee and E. B. Bailey; with Contributions by S. S. Buckman and Dr. H. H. Thomas. Pp. iv+140+2 plates. (Southampton: Ordnance Survey Office; London: Edward Stanford, Ltd., 1925.) 4*s*. 6*d*. net.

(1) THE larger of these two memoirs, that on the Tertiary geology of Mull, represents the results of work commenced by the Geological Survey in 1907. The title-page includes the names of five principal authors and of eleven other contributors. The task of the principal author and editor can have

been no easy one, and one is prepared for the complexities of the memoir by the opening words of the introduction: "It may safely be maintained that Mull includes the most complicated igneous centre as yet accorded detailed examination anywhere in the world." The reader should study the plan of the memoir in the opening chapter and refer to this again and again as he reads the successive chapters in which the intricate history of the island unfolds itself. The map which accompanies the memoir is a most complicated piece of detailed work, in which no less than 74 different symbols are employed. Its interpretation is greatly assisted by the provision of plates in the body of the memoir showing simplified maps, in black-and-white, of the various stages of the igneous cycle.

Those geologists who are fortunate enough to visit the island will welcome the "Itinerary" in Chap. i. and the wealth of detail in succeeding chapters which indicate where important sections can be seen. The second chapter, which gives a critical survey of geological research in Mull, will be read with great interest. There have been many controversies over the geology of the district, and the memoir brings new light to bear on them. Subjects of outstanding interest are: the type of volcanic activity prevailing in Mull, the causes of double-tier columnar jointing, and the distinctions between intrusive sills and lava-flows.

There are also many new conceptions, some of which cannot fail to find a place in the interpretation of other volcanic centres. The "propylite-area" of Judd is shown to be an area of pneumatolysis about a volcanic centre, within which the degree of freshness of the rocks and the type of weathering are profoundly affected. The "inclined-sheets" described by Dr. Harker in Skye are represented here by "cone-sheets," intrusive sheets, very numerous and of considerable thickness in the aggregate, which, viewed as a whole, "suggest the partial infilling of a number of cone-shaped fractures with inverted apices united underground." The intrusion of a series of cone-sheets characterises the second cycle of igneous activity in Mull following the formation of a Kilauean lava-dome with a central caldera some five miles in diameter.

Another mode of igneous intrusion which is wonderfully illustrated in the later stages of the volcanic history of the island is that of the ring-dikes. Few of these present complete ring-outcrops, but the Loch Bà felsite forms an almost complete ring, and follows a ring-fracture which outlines an area of subsidence similar to the first-formed caldera, but centred about a new focus which was the seat of the later phases of igneous action.

The various chapters on petrology contain contributions of the first importance. The sequence of igneous intrusions is explained on the assumption of at least two magmatic cycles, in both of which the magma-sequence is from basic to acid, followed by a third intrusion of the parental basic magma as a swarm of north-west to south-east dikes, which are the last evidences of igneous activity left by subsequent denudation. The authors' explanation of the magma-sequence is briefly outlined in the opening chapter. Important evidence of gravitational differentiation is obtained from the ring-dike of Glen More, which is exposed for a height of about 1500 feet and shows a gradual transition from basic quartz-gabbro at the bottom to acid granophyre at the top.

The results of the careful study of very interesting sapphire-bearing aluminous xenoliths in the Loch Scridain sills has been the subject of a paper elsewhere, but the summary of the results given here will be none the less welcome. Only one new rock name—Craignurite—is introduced, but there is fresh information on little-known rocks described by two of the contributors to the memoir, and some welcome definitions of other names which have been widely used in British Survey nomenclature.

The only sedimentary rocks of Tertiary age in Mull appear below the lavas or very low down in the volcanic sequence. Fossils from the well-known plant-beds of Ardtun are described by Prof. Seward and Mr. Holttum, who confirm Mr. J. S. Gardiner's conclusion of their Eocene age and show that they are related to the Lower Tertiary flora of Greenland and other Arctic regions.

The last five chapters deal with the post-igneous history of the island, pre-Glacial, Glacial, and post-Glacial, and with its economic geology, the last amounting to nothing more than adequate supplies of good road-metal inconveniently situated for shipping, and some seams of Tertiary lignite of rather poor quality.

(2) The smaller of the two memoirs describes the pre-Tertiary rocks of Mull and other areas on Sheet 44 and adjacent sheets which have escaped denudation or have not been buried by the volcanic accumulations. Several interesting points may be mentioned. In the account of the Ross of Mull granite, particular attention has been paid to its contact metamorphism, and something is added to Dr. T. O. Bosworth's earlier account of this. A small patch of Carboniferous rocks on the mainland near Inninmore is of especial interest, as only two other occurrences are known in the Western Highlands. Rhætic beds containing the *Pteria contorta* fauna are described from the Gribun district: they are not known *in situ* elsewhere in Scotland. The Inferior Oolite is much thinner than in Skye; it shows close resemblances to the succession of rocks of the same age in the classical districts of England.

The Cretaceous rocks include the only known occurrence *in situ* of Upper Cretaceous rocks in Scotland. In the White Sandstone, which lies below the Chalk, the "millet-seed" character of some of the sands is regarded as evidence of desert conditions on the shores of the Cretaceous sea.

The final chapter on the economic geology includes an account of the building stone quarried in the very decorative Ross of Mull granite, and a record of a good glass-sand at Loch Aline, on the mainland.

Chemical Problems of Soil Fertility.

Base Exchange in Soils: a General Discussion held by the Faraday Society, December 1924. Pp. 547-617. (London: The Faraday Society, 1925.) 5*s*. net.

ONE of the directions in which little real progress has been made in agricultural science, in spite of an immense amount of careful work, is in the exact specification of soil fertility by means of chemical analyses. Such analyses have, in general, only qualitative significance, and their main purpose is to serve as a check to the direct field observations. In recent years considerable progress has been made, however, especially by American workers, who have paid especial attention to the concentration of radicles in the so-called "soil-solution." Progress in such a complex problem as the fertility of a normal soil is most likely to be made if extreme cases are taken, such as alkali and acid soils, where certain factors are thrown into high relief. The work of Kelly and others in California, on alkali soils, and of Bradfield in Missouri on acid colloidal clay, are good illustrations of the method. More recently Dr. Hissink and his collaborators at Groningen, Holland, have effectively used the well-known electrical double layer hypothesis as the basis of a reasonably complete theory of base exchange that can be applied to a wide range of soil conditions: the exchangeable bases are held on the surface of the clay particles by chemical attraction between them and the clay and humus acids. In a suspension of soil in water, some of the surface molecules are ionised, and an electrical double layer is formed containing anions of soil acids inside, and outside the cations H′, Mg″, Ca″, K′, Na′. Students of soil science will recognise in this hypothesis a restatement in modern terminology of the essential features of Way's classic investigations of 1850.

Dr. Hissink, in his introductory paper, considers both the degree of saturation of the soil (which is the ratio of the quantity of adsorbed bases actually present, to the total amount the soil could hold) and the relative proportions of exchangeable bivalent and univalent bases. The relation of these factors to soil properties such as physical condition and *p*H value is discussed in detail, and with special reference to Dutch land-reclamation problems. Messrs. Page and Williams present some important studies of base exchange in the classical Broadbalk permanent wheat and Park grass plots at Rothamsted. The long-continued treatment of these plots with various artificial manures would be expected to accentuate many of the base exchange processes, and thus to provide yet another illustration of the incomparable value to agricultural science of long-time experiments. The results show that on the acid soil of the grass plots from which chalk is absent, the amount of exchangeable calcium is correlated with the *p*H of the soil. On Broadbalk, where considerable quantities of chalk still remain, the relative proportions of the different bases vary consistently with the manuring, and there is some evidence of a gradual conversion of exchangeable potash to a non-exchangeable form or vice versa depending on whether potash manures are used or not.

The value of the base exchange theory in suggesting not only new view-points of known facts, but also fresh lines of work, is well shown by the remaining papers. Prof. Comber reviews earlier work based on the physical adsorption hypothesis and has some cogent observations to make on the part played by electro-negative ions. Messrs. Robinson and Williams, of Bangor, in a study of some Welsh soils subject to high rainfall, show that their lack of response to liming, although they appear "acid" by lime requirement tests, is due to the presence of considerable proportions of exchangeable calcium as determined by Dr. Hissink's method. These soils are "acid" in the chemical sense but not "sour" in the agricultural sense. Mr. E. A. Fisher contributes two suggestive papers on the relation of base exchange to adsorption phenomena, and the swelling of soil colloids. Mr. Saint, working in Prof. Comber's laboratory, shows that there is no consistent relation between the *p*H value, the "lime-requirement" and the Comber thiocyanate test of acidity for soils of different types.

The verbatim report of the discussion is at least as interesting as the papers, and there is much healthy criticism of both methods and results. Attention should be directed to Dr. T. P. Hilditch's discussion of industrial developments of synthetic alumino-silicates for water-softening purposes and the close relation of this to base exchange in soils.

This is the third general discussion on agricultural problems that the Faraday Society has held since 1920. The value of these discussions and the demand for the reports is shown by the fact that the accounts of the first two meetings are now out of print. The high level of the present discussion and its modest price will certainly ensure an equally gratifying demand for copies.

B. A. KEEN.

Our Bookshelf.

The Flora of the Malay Peninsula. By Henry N. Ridley. (Published under the Authority of the Government of the Straits Settlements and Federated Malay States.) Vol. V. Monocotyledones (concluded), Gymnospermeæ, General Indices. Pp. v + 470. (London: L. Reeve and Co., Ltd., 1925.) 42*s.* net.

VOL. V. of this "Flora of the Malay Peninsula" deals with the remainder of the Monocotyledons, and with the Gnetaceæ, Coniferæ, and Cycadaceæ. Seven new species and specific names occur in the Palmaceæ, three in the Pandanaceæ, four in the Aroideæ, two in the Eriocaulaceæ, five in the Cyperaceæ, and thirty-nine in the Gramineæ. In this latter family many of the additions are from the manuscript of Dr. O. Stapf. In the Coniferæ the only new species is *Podocarpus deflexus* from high altitudes on Gunong Tahan.

Bound with this volume is a supplement in which is described material which has reached the author since the publication of the respective volumes dealing with the natural families to which the species belong. This occupies fifty-seven pages and includes several new species. The author also gives a brief discussion on the origin of Malay plant names. The remainder of the volume contains four general indices to the whole work; an index to English plant names, and what will be found particularly valuable, an index to Malay plant names; an index to the two hundred and twenty-eight illustrations, and an index to botanical names.

This "Flora," which is completed with the present volume, is one of the most outstanding accomplishments among floras of this magnitude. The author, after many years' residence in the tropics, during which he collected much of the material described, has not only worked over the whole of the specimens and written the manuscripts, but, unaided, has also supervised the entire publication. The general preparation of the work was well in hand before publication, and this has enabled the whole of the five volumes to be produced within a period of only four years, during a part of which the author was prevented from active work by illness. He has been fortunate in securing the services of Mr. J. Hutchinson for the illustrations, which are a distinctive feature of the work, and provide a welcome innovation in colonial floras. Mr. Ridley must be congratulated on having completed and produced during the first few years of his retirement a work of such first importance.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. 30: *Copper Ores of the Midlands, Wales, the Lake District and the Isle of Man.* By Henry Dewey and T. Eastwood; with Contributions by Dr. Bernard Smith and R. G. Carruthers. Pp. v+87+6 plates. (London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1925.) 2*s.* net.

THIS memoir deals with a large number of occurrences of copper ores outside Devon and Cornwall, which, although now of very limited economic importance, are nevertheless of considerable scientific interest because of the great variety of modes of occurrence which they present.

On this basis the ore-bodies are divided into (1) impregnations of the country rock, (2) lodes, and (3) pipes and other irregularly shaped bodies. The first type includes the ores forming a cement in certain Triassic rocks in Cheshire and elsewhere. The curious occurrence at the Turf Mine, Dolfrwynog, in Merionethshire, where wood, leaves, and hazel-nuts lying at the base of a peat-bog were either coated or impregnated with copper or its ores, appears also to afford an interesting case of impregnation which might throw some light on the formation of the Triassic ores. It is, however, somewhat illogically discussed under the third category. The Ecton Mine in Staffordshire, belonging to the latter type, contained an irregular pipe-like mass of ore which has been worked to a depth of 225 fathoms below the surface.

The period of mineralisation is not known with certainty, but is suggested to be the same as that of Devon and Cornwall, *i.e.* post-Carboniferous. This conclusion appears to ignore a number of arguments that have been advanced in favour of an earlier age for the mineralisation of Wales and the Lake District, namely, post-Silurian. In this connexion, there is a serious contradiction in regard to the lodes of Caldbeck Fell, Lake District; on one page they are said to be later than the Wolfram veins of Carrock Fell, but on another page they are stated to be cut and displaced by those veins. We scarcely expected to see in these days the Ffestiniog beds (Cambrian) referred to in a Geological Survey memoir as Lower Silurian. Traces of this antiquated nomenclature occur also on other pages.

Department of Scientific and Industrial Research: Fuel Research Board. Technical Paper No. 14: *The Enrichment of Coal Gas by the Injection of Oil into the Retorts during Carbonisation.* Pp. vi+61. (London: H.M. Stationery Office, 1925.) 1*s.* 9*d.* net.

THE volume of gas obtained from coal by carbonisation can be increased by gasifying a portion of the residual coke with the formation of water gas. The two processes can be either carried out in separate plants or combined as in the steaming of vertical retorts. Blue water gas has a low heating value which is, therefore, often increased by admixture of oil-gas as in a carburetted water-gas plant. This low calorific value of blue water gas also causes a reduction of the heating value of the mixed gas produced when "steaming" the charge in vertical retorts is practised. "Carburetting" the gas produced during this operation is a possible way of securing the gas-making advantages of "steaming" while maintaining adequate calorific value. Technical Paper 14 of the Fuel Research Board records tests made on the effect of injecting gas oil through a water-cooled tube into the charge of Glover-West Vertical Retorts while "steaming." It was found practicable to inject up to 10 gallons of oil per ton of coal carbonised, and by the combination of oil-injection with "steaming" to raise the thermal yield of gas by 14 per cent. per ton of coal. While the water cooling of the oil tube necessitated the expenditure of extra heat in the setting, in the cracking process itself this was inappreciable, and it seems possible that the water cooling can be dispensed with. The method gives promise of improving the gas-making efficiency of the continuous vertical retort and its adaptability to load-fluctuations. H. J. H.

Die Mumifizierung von Vögeln und kleinen Säugetieren ohne Abbalgen, bei Erhaltung des natürlichen Körpers. Von Ludwig Kirchroth. Pp. 74. (Klosterbeuburg bei Wien: Ludwig Kirchroth, 1923.) 2*s*. 6*d*.

THIS is the second edition of a pamphlet with a similar title published in 1906. It details the methods, worked out by the author, of preparing birds and small mammals as museum specimens, without skinning them in the manner usually adopted, and yet preserving the natural shape and form of the body. The method consists essentially in the injection of two media, one, a preserving fluid, and the other, a preparation of kaolin and fine siliceous marl, designed to prevent loss of shape due to shrinkage. The author gives full details of the instruments to be used, of the constitution of the media for injection, and of the preliminary preparations required before injection is done. Any wire supports which may be necessary for the subsequent mounting of the specimen can be inserted during the mummification process. The method is most applicable to specimens which are to be mounted for exhibition purposes. The author claims that it is easy to carry out, is cheap and speedy, and that it has stood the test of twenty years' experience. It certainly seems worthy of a trial and deserves to be more widely known. With this object in view, the author promises an English translation, at a cost of fifteen shillings, which may be obtained from him. Museum curators and taxidermists will find this pamphlet of great interest, and will be well advised to give the method a thorough and exhaustive test.

Pitman's Electrical Educator. Edited by Dr. J. A. Fleming. (Complete in 30 fortnightly Parts.) Part 1. Pp. 56. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 1*s*. 3*d*. net each part.

THE Preacher said that of writing books there is no end, and that much study is a weariness to the flesh. Judging by the contents of the first part of this popular educator, the second part of the above statement scarcely applies to this book. In the frontispiece it is stated that it is a highly valuable work for electricians, electrical engineers, contractors, apprentices and students. In addition, it is intended for those engaged on the commercial side of the electrical industry. Many eminent engineers and men of science are contributing to this volume. In the foreword, Dr. Fleming points out that electrical engineering has advanced so rapidly in recent years that it is quite impossible to deal with every part of the subject in a single volume. We are told that the student and the practical engineer desire to obtain a general acquaintance with the subject from a single book if possible, and that the articles will interest every engineer, whatever his status or knowledge. It will be seen that the programme is somewhat ambitious. We wish it success, but the first part does not enable us to judge of its practical value.

Woodcuts of British Birds. By E. Fitch Daglish. With Descriptions by the Artist. Pp. 165. (London: Ernest Benn, Ltd., 1925.) 25*s*. net.

MR. DAGLISH'S work may be commended not only to bird-lovers but also to art-lovers. He is a master of decorative style and of his craft of wood-cutting, and he knows his birds. Some of his portraits are triumphs —the red-backed shrike, for example, against bramble leaves; the reed bunting silhouetted upon a marvellous background of reed stems; the spotted flycatcher immobile on a laburnum perch; the long-eared owl among the most decorative of pine twigs; or the splendid blackcock busy with display. There is also the puffin, and the crested grebe, the pied wagtail and the wren (the wren in a tangle of every kind of spring flower), the jay and the jackdaw—each one a penetrating portrait and at the same time a real work of art. Not all are so successful—the bullfinch looks stuffed, the dipper and the heron rather scraggy, the stonechat is enlarged too much, and is in a false pose. But the best are as good as they can be, and all are interesting. The notes on the habits and appearance of the birds are, we take it, designed to obviate the necessity of going to the library and taking down heavy histories of birds, and they are more than ample for this purpose, and pleasantly written. Would that more artists were naturalists, more naturalists artists!

Fuel Economy and Smoke Prevention. By John B. C. Kershaw. Being the third completely revised and rewritten edition of "Smoke Prevention and Fuel Economy," by W. H. Booth and J. B. C. Kershaw. Pp. xiii+268. (London: Constable and Co., Ltd., 1925.) 16*s*. net.

IT is probable that the interchange of terms in the old and new editions of this work is due to the change in modern thought. Owing to the increase in the price of the raw material and the necessity for the working costs to be decreased as much as possible, it is natural that the emphasis should be placed on the fuel economy aspect of the problem rather than on the smoke abatement. The author has summarised much of the recent work on the constitution of coal, as well as some of the later work on the utilisation of low-grade fuels. The early chapters deal with the general preparation and treatment of coals, the remainder being devoted to the description and examination of the various processes for the combustion of fuels and the utilisation of waste products.

The Oxford Economic Atlas. By J. G. Bartholomew. Sixth edition, revised by John Bartholomew. Pp. xii+64. (London: Oxford University Press, 1925.) 6*s*. net.

THIS is the sixth edition of an atlas first published in 1910. The number of plates remains the same, namely sixty-four, but a few desirable changes have been made, and all the plates have been revised. Prof. Lyde's interesting and suggestive introduction has also been revised. There is little to criticise in this useful work; certainly the high standard of cartography should be noted. Only a few minor matters require comment. The maps of world isobars still show low pressure in high southern latitudes. In the map of ocean currents more detail might be added in Arctic regions. The Marion and Crozet Islands are French, not British possessions, and in the map of religions the Falkland Islanders need not be shown as having no religion at all. In the map of fisheries, which includes whaling, there is no record of the valuable whale fisheries in South Georgian and South Shetland waters.

Letters to the Editor.

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

Investigation of the Origin of Insular Races of Land Mollusca in the Scilly Isles.

THE study of insular species of animals has for a long time been regarded as an important adjunct to evolutionary research, and the rôle of insular segregation as a factor in specific divergence has been stressed by numerous workers. It has of later years been held that one of the best ways of studying the effects of such isolation is the intensive survey of small groups of islands of tolerably recent formation, in which the divergence can be seen at its earliest stages and perhaps correlated with any incipient ecological divergence that may be manifest in the islands in question. Surveys of this kind have been made from time to time, but the result of such work seems as yet unsatisfactory for several reasons (*e.g.* insufficiency of material, lack of information as to the forms found on the adjacent mainland, and deficiency in ecological data). As a consequence an attempt has been set on foot in the present year to tackle the problem afresh, more particularly by means of intensive collecting and ecological study and in particular by detailed comparison of insular and mainland forms obtained from similar habitats. It is not claimed that more positive results will be obtained at once by these means than by the distinguished researches of previous workers; but it is hoped that a better approach to the problem may be provided. Thanks to financial assistance from the Government Grant Committee of the Royal Society and the Godman Exploration Fund of the Natural History Museum, a short reconnaissance was made last July in the Scilly Islands and west Cornwall for the purpose of studying the land mollusca of these areas.

It is needless to say that the choice of islands suited for such a study was not easy. The Clare Island Survey and other data showed that, so far as the land mollusca are concerned, no differentiation occurs in the British Isles in islands situated only a few miles from the mainland. The scantiness of molluscan groups, otherwise suitable for such a study, in certain areas (acid rocks, pine and heather formations) had also to be considered; while questions of access and transport were also of weight. Certain of the Hebridean islands were considered suitable; but the paucity of information as to the mainland fauna of the west of Scotland induced those responsible for the survey to prefer the Scilly Isles. So far as is known at present, there are no species of British mollusca restricted to any outlying islands. A survey of this nature had, therefore, to concentrate on the search for any varietal or racial differences which might be found between the insular and mainland forms. To that end a very exhaustive knowledge of the variability of the adjacent mainland forms from which the insular types may be derived or to which they may be most closely related, was indispensable. Indeed, the significance of a varietal form which might occur, *e.g.* on Scilly, could only be assessed on the basis of a fairly exhaustive knowledge of the total variability of the relevant species in the west of England. For it is quite possible that a varietal form found on Scilly might be absent from west Cornwall, yet occur in east Cornwall or Devon. The necessity for a fairly exact knowledge of the related mainland fauna was a strong reason for choosing the Scilly Isles in preference to the Hebrides, as the mollusca of the west of England are far better known than those of the west of Scotland.

The Scillies are a group of some 140 rocks and islands situated about 30 miles from Land's End, being divided from the mainland by a channel about 40 fathoms in depth. They resemble the extremity of the adjacent Cornish mainland in being composed of a mass of granite with a certain amount of drift and recent deposits. The general physical conditions are largely the same in the two areas except that there is a heavier rainfall in west Cornwall, rather less sunshine, and a slightly lower temperature.

The work of this year's survey was confined to collection and observation on St. Mary (Scilly) and in the area west of a line drawn from Hayle on the north coast of Cornwall to Marazion on the south coast. It was thought that in the time available a better general indication of the amount of divergence would be obtained from this comparison than from a survey of a number of the Scilly Isles themselves.

A doubt was originally entertained that, owing to the horticultural business carried on in Scilly, there might not be a danger of contamination of the fauna of the latter through imported bulbs, etc. Further examination of this possibility showed, however, that it was not a factor to be considered seriously.

St. Mary may be regarded as ecologically similar to the Cornish area except in the following features. (*a*) It has a maximum height of only 160 feet as compared with the maximum of more than 800 feet found near St. Ives. (*b*) The atmosphere is probably damper at certain periods owing to the presence of sea-fogs. (*c*) There is no metamorphosed slate and greenstone, as is found round the granite nucleus of the Land's End *massif*. We have therefore for comparison an insular and a mainland area extremely similar in ecological conditions but differing in certain details. It is in conditions such as these that we would expect to find, if the conventional view as to the origin of insular forms is correct, the beginning of racial divergence.

It is undesirable to discuss at the present moment the evidence for the date at which the Scilly Isles were separated from the mainland, though this is obviously an important question.

The Conchological Society in its list (1921) of British land and freshwater Mollusca attributed some 25 species to the Scillies out of a total of 163, while west and east Cornwall are recorded as each having 74. This year's survey has enlarged the Scilly fauna by about ten more records. So far as we know at present, this group of islands seems to contain a rather impoverished sample of the mainland fauna.

The results of this survey are as yet uncertain, and some time must elapse before an opinion can be formed on the amount (if any) of divergence between the Cornish and Scilly land molluscs. It is likely that, after a preliminary survey of the material obtained, further collections of critical forms may have to be made. At present, however, it may be said that there seems at first sight to be very little difference between the two series. In one case which has been worked out in some detail—that of *Cochlicella barbara*—exactly the same varietal forms occur on St. Mary and in the Land's End area, and *in the same numerical frequency*. Actually there is more difference between colonies of *C. barbara* from Somerset and Marazion than between those of Marazion and St. Mary. It may be pointed out, however, that in the question of the origin of local or insular races negative evidence is just as important as proof of positive divergence; inasmuch as it enables us to form an idea as to the local rate of evolution.

It is hoped that, if suitable material is obtainable, it may be possible to conduct genetic research on the insular and mainland forms with the view of studying their physiological relationship.

It may be stated that of recent years the fauna of Scilly has attracted the attention of zoological specialists in various groups, *e.g.* insects, birds, and mammals. Mr. K. G. Blair has made considerable progress in the study of the insects, while the discovery of a species of Crocidura, a genus of white-toothed shrews hitherto not recorded from the British Isles, is due to the diligence of Mr. W. Blair.

Recognition of the assistance rendered by numerous specialists must be deferred until a final report is prepared; but an early acknowledgment is due to Profs. J. Stanley Gardiner and E. S. Goodrich, the Trustees of the British Museum, Messrs. C. Tate Regan and Oldfield Thomas, Major A. Dorrien-Smith of Tresco, and Mr. W. N. Blair for valuable assistance in promoting and assisting this survey.

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Some Relations between the Band Spectra of Zinc, Cadmium and Mercury and their Atomic Spectra.

DURING recent years much attention has been given to the band-spectra of zinc, cadmium and mercury, and we can sum up the results therefrom as follows:

(1) The wide spacing of the band-lines shows (E. Hulthèn, *Zeit. f. Phys.*, 11, 284, 1922) that the spectra cannot originate from the pure molecules (Me_2) of these elements, but from their compounds with a lighter element, forming small molecular moments of inertia (due to the relation of line-spacing $\Delta\nu = h/8\pi^2 I$)—probably from the hydrides MeH (A. Kratzer, *Ann. d. Phys.*, 71, 72, 1923). This assumption was strongly confirmed by the fact that any other atomic combination would be expected to show an isotopic effect on the band-lines, which would be easily detected by the high resolving power of the spectrographs used (R. Mulliken, NATURE, 113, 489, 1924). From their careful investigation on the exciting conditions of the mercury bands, Compton and Turner (*Phil. Mag.*, 48, 360, 1924) concluded that the excited mercury atom reacts with a hydrogen molecule forming a hydrogen atom and an excited molecule of mercury hydride. This excited molecule radiates the band-spectrum and then may dissociate into a normal atom and a hydrogen atom.

(2) It appeared further from the analysis of the mercury bands (E. Hulthèn, *Zeit. f. Phys.*, 32, 32, 1925), that they can be divided into two systems of bands, each one corresponding to the electron transition from two separate sets of vibrational states $\nu_1(n)$ and $\nu_2(n)$ into one final set $\nu(p)$. The band-spectra of zinc and cadmium show the same states of condition—as will be published later. In Table I. the electron frequences ν_1 and ν_2 of the systems are given:

TABLE I.

	ν_1.	ν_2.	$\nu_2-\nu_1$.
Zn	23263·6	23594·0	330·4
Cd	22278·0	23279·0	1001·0
Hg	24933·9	28617·1	3683·2

In all three spectra the vibrational as well as the rotational states indicate considerably more stable conditions of the excited than of the not-excited molecules. Thus in the mercury spectrum, $\nu_1(n_1) = 1940$, $\nu_2(n_1) = 1986$ and $\nu(p_1) = 1204$. Moderate nuclear vibrations (p~5), corresponding to the energy of 0·37 volt, are able to dissociate the not-excited molecule. These facts are all in excellent agreement with the conclusions of Compton and Turner.

We are now able to advance a step further in the discussion of the problems. Comparing the values of (1) with those of (2), giving the terms $1S$ and $2p_2 - 2p_1$ of the atomic spectra, we find an interesting parallel between the two classes of spectra.

TABLE II.

	$1S$.	$2p_2-2p_1$.
Zn	75766·8	388·9
Cd	72538·8	1001·0
Hg	84178·5	4630·3

Especially convincing is the agreement between the last columns of (1) and (2), indicating that the excited molecules must have some close conformities with the $2p_i$ states of the excited atoms. Compton and Turner also found that the mercury bands were emitted from the striated regions of high concentration of mercury atoms excited to the $2p_i$ states. From the intensity rule for triplets (5 : 3 : 1), a third band-system, corresponding to the excited $2p_3$ state of the atoms, must be expected to be very faint. The question of its occurrence must here be left unanswered, although the photographs show a confusion of faint lines where the bands are expected to be situated.

From the present facts one may conclude that the Me-atoms remain in their metastable $2p_i$ states during the molisation-act with the hydrogen atom—the other hydrogen atom carrying away the energy not to be quantitiesed by the molecule. The electron transition is located in the Me-atom, the hydrogen atom being optically inactive. Returning to their normal states the Me-atoms soon lose touch with the hydrogen atom and so the molecule dissociates. The values of (1) are throughout smaller than those of (2). This can be ascribed to the hydrogen nucleus acting with a strong electric field (~10^7 volt/cm.) on the electron system of the Me-atoms.

E. HULTHÈN.

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September 28.

A Compound Thermostat for Students' Use.

IN view of the expense involved in equipping laboratories with more accurate apparatus, the following device suggested to me by Prof. Lancelot Hogben may prove serviceable for class work in experimental biology, where thermostats are often required for various purposes such as the temperature curve of an enzyme reaction. By using the gradient between two fixed temperatures (that of boiling water and of the main water supply) sufficient constancy can be obtained for students' work.

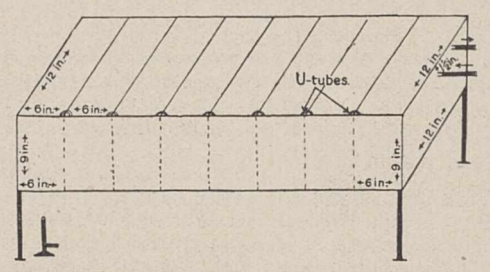

FIG. 1.

The construction is as follows: A box of galvanised

iron is made 48 in. in length, 9 in. in depth, and 12 in. broad. It is divided by partitions 6 in. apart into 8 compartments. To the first is soldered near the top two brass tubes, one connected with the tap, the other with sink to act as an overflow. All the compartments are filled with water to the same level. The box is placed on iron legs and the water in the compartment farthest from the overflow is kept boiling with a bunsen flame. To prevent the water boiling away, U-tubes are inverted over each partition so that each siphons from its neighbour. In the compartment at one extreme, the temperature is kept about at room temperature by the circulation of the tap water: at the other, it remains at about 100° C. The temperatures of the intermediate compartments and the constancy obtainable when the apparatus is running may be judged from the following figures:

	Compartments.							
	1.	2.	3.	4.	5.	6.	7.	8.
Saturday, 12.50 P.M.	22·5	25	28·5	33·5	41·5	50·5	67·5	99
Monday, 9.30 A.M.	21·75	24·5	28·0	32·5	39·0	47·5	62·0	98

The only requirements are: a sheet of galvanised iron (or copper), solder, two short pieces of metal tubing, and a bunsen. The entire cost of the apparatus is well within ten shillings. By boring holes in strips of metal or wood to place across the compartments, each of the latter may be made to hold thirty or even more test-tubes. If compressed air is laid on, the water in each compartment may be kept in motion by bubbling a jet of air through it.

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The Cause of Surface Tension.

THE reply by Mr. N. K. Adam, in NATURE of September 26, p. 464, to my note on the cause of surface tension, contains a very great deal with which I heartily agree. His method of calculating the shape and size of the drop from the surface energy is, of course, perfectly valid; as so often happens in mechanics, there are different ways of resolving the forces, each way bringing out features that the other ways do not. I can even agree with him that thinking in terms of the tension has not been found to be a good "means of gaining insight into the molecular structure of surfaces," and should not urge the actual use of this conception upon any one who prefers not to use it. Where I cannot quite follow him is in concluding that, because the tension has proved to be conceptual dynamite in practice, therefore the tension itself has no physical existence.

Perhaps a few words of further explanation might be added to my discussion of the statics of the drop. Just because the motion of the particles is so rapid, one can reason in terms of averages and proceed as in the kinetic theory of gases. Downward momentum is carried into the drop by molecules diffusing into it across the plane P which forms its upper boundary, and upward momentum is carried out by those that leave; the algebraic result is a steady average onflow of downward momentum into the space below P, equivalent to a positive downward pressure often called the "kinetic" or "thermal" pressure. In addition, there are forces acting across the boundary due to repulsion and attraction between molecules. The net result over the central part of the drop is an average flow downward of downward momentum, equivalent to a pressure which is the ordinary "hydrostatic pressure"; its direction must be downward in the interior, because the reaction or converse aspect of the same process is an upward force or flow of upward momentum which supports the weight of the superincumbent water.

Of course, the identity of the molecules within the drop is continually changing, but that is immaterial for our present purpose. It is clear that downward momentum is, on the average, steadily flowing into the space below P, both for the reason just stated and through the action of gravity, and this momentum must obviously be escaping somewhere. The effect of cohesion has already been taken account of in arriving at the hydrostatic pressure. (Or, again, if cohesion holds the drop, then the drop is pulling downward on the water above instead of pressing upward upon it, and what in turn holds this water up?) The only possibility is that downward momentum is, on the whole, escaping upward through the surface skin; which is another way of saying that there is a genuine tension in the skin similar to that in a stretched sheet of rubber.

The very interesting question as to the *structure* of this surface skin is an entirely different matter. The particular line of attack to which I wished to direct attention merely reveals to us one of its *activities*.

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The Isotopic Composition and the Atomic Weight of Chlorine in Meteorites.

HARKINS and Stone, in a letter under the above title in NATURE of September 19, state that they have found the atomic weight of meteoritic chlorine identical with that of chlorine as found on earth, within the limits of their experimental error. The question of the constancy of isotopic composition of chlorine has already proved of interest to several investigators, and one may recall the work of Curie in 1921 and of Gleditsch and others in 1922 and 1923, on the chlorine from certain ancient minerals. Their results are now confirmed by Harkins and Stone.

In the case of meteoritic chlorine, the matter is somewhat complicated by the question as to whether the rather small proportion of chlorine present is primary or secondary, that is, whether or not it is genuinely extra-terrestrial in origin. It may be recalled that the freshly cut iron surface of many chlorine-containing meteorites exhibits, in a humid atmosphere, a characteristic "sweating" that has been attributed to the presence of lawrencite or deliquescent ferrous chloride. Such meteorites rust rather rapidly, even on museum shelves. The late Prof. Mallet, a very keen observer and an analyst of a type now unfortunately very rare, became convinced, after work with meteorites of this kind, that the chlorine was secondary. He writes: "The exudation of watery drops containing metallic chlorides is observable only at points on the outside and on cut surfaces along the lines of fissures communicating with the outside."

Undeterred by knowledge of this uncertainty, in the autumn of 1921 the present writer determined the atomic weight of chlorine from the "shale balls" associated with the Canyon Diablo, Arizona, meteorite. Material for this investigation became available through the courtesy of a colleague, Mr. W. F. Magie. Sulphur was completely absent, a fact which weighs against the probability of contamination of the meteoritic matter by terrestrial

liquors. In the analytical work, silver chloride was reduced to silver in a current of hydrogen, and the atomic weight of "ordinary" chlorine compared with that from the meteorite. Had the result shown a difference in atomic weight, then one could have been confident that the chlorine was not of terrestrial origin. But the results were identical within 1 part in 2000, which was not outside the estimated experimental error. They were never published, because of the uncertainty as to the true source of this "meteoritic" chlorine.

It will be of interest to learn how Drs. Harkins and Stone have reassured themselves as to the extra-terrestrial origin of the meteoritic chlorine studied in their careful investigation.

ALAN W. C. MENZIES.

Princeton University,
October 10.

The Spectrum of Si^+ (Once Ionised Silicon).

PROF. A. FOWLER has recently shown that the spectrum of Si^+ is similar in constitution to that of Al, that is, consists of doublets having $2p_2$, $2p_1$, as the highest terms. A number of lines, ascribed by Fowler to Si^+, remain, however, well outside his scheme of classification, and some of these can be arranged in a group of quartets.

MULTIPLET 1.

j	1	2	3
	(0)	(1)	
1	17154·38 . . 116·0 . .	17038·38	
	62·19	62·25	
	(2)	(0)	(1)
2	17216·57 . . 115·94 . .	17100·63 . . 199·89 . .	16900·74
		134·56	134·96
		(1)	(3)
3		17235·19 . . 199·49 . .	17035·70

Interval ratio . . $116{\cdot}00 : 199{\cdot}89 = \frac{2{\cdot}9 : 5}{3 : 5}$ observed / calculated (Landé)

$62{\cdot}20 : 134{\cdot}76 = \frac{2{\cdot}3 : 5}{3 : 5}$ observed / calculated (Landé)

This is a pp'-combination.

The intensity rule is only roughly obeyed.

MULTIPLET 2.

j	1	2	3
	(1)	(0)	
1	18382·63 . . 116·48 . .	18266·15	
	339·49	339·11	
	(0)	(1)	(2)
2	18043·14 . . 116·10 . .	17927·04 . . 199·86 . .	17727·18

This seems to be an intercombination between doublet P and quartet p-terms. But none of the known doublet P's has 339 as frequency difference.

The differences occurring in these multiplets occur in other pairs which have not yet been classified, *e.g.*

$$\begin{matrix}(0) & (0)\\ 18402{\cdot}19 & -18286{\cdot}73 = 115{\cdot}46\end{matrix}$$

$$\begin{matrix}(0) & (2)\\ 18415{\cdot}41 & -18280{\cdot}08 = 135{\cdot}33\end{matrix}$$

$$\begin{matrix}(1) & (1n)\\ 20573{\cdot}45 & -20373{\cdot}87 = 199{\cdot}58\end{matrix}$$

The group having the successive differences 199 and 116 correspond to p-terms of a quartet series. Evidently a quartet series is possible for Si^+, but it is only feebly developed under the usual methods of excitation. Without more data on the spectrum of Si^+, it is not possible to find out more information on the point.

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A Slow Process Method of Cyanide Fumigation for the Control of White-Fly in Tomato Houses.

EXPERIMENTS have shown that it is possible to generate hydrocyanic acid gas from a mixture consisting of 3 parts by weight of powdered sodium bicarbonate and 1 part by weight of high grade sodium cyanide (98 per cent. purity) for the purpose of fumigating tomato houses in the control of white-fly (*Trialeurodes vaporariorum*, Westw.).

The mixture is scattered on the dry paths of the houses at the rate of one ounce to every 1000 cubic feet space. The results show that mortality for adult fly is as great as that obtained where the gas is generated quickly from sodium cyanide and sulphuric acid in jars, but the percentage mortality for the scale stages is slightly higher in the latter method.

Economically the slow generation obtains practically as good a control as the quick method, and has great advantages in the saving of labour, and in minimising risk of scorching to plants which are grown soft. Whereas one man is required to each house in jar cyaniding, a large block of houses can be fumigated by one man when using the mixture described. The same precautions are necessary for the plants as in the case of jar cyaniding, but there is greater safety in fumigating by the slow process on windy nights. It is not advisable, however, to fumigate during heavy rain in leaky houses.

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Cheshunt, Herts.

Retrograde Metamorphosis.

UNDER this denomination is understood the step-back from the normal state of an animal to that of a more primitive one. I was undergoing the strong sun-cure in Grado, an island in the Adriatic Sea, where the full sun shines for weeks together, with only slight interruptions, exposing to it the naked skin from morning until evening during the whole day. Belonging to the fair type, my body was only in some parts covered with spare hair. After some time perfectly new, very fine hair was formed on all parts of the body, and after the lapse of five weeks there was a remarkably thick cover of fine, very light hair even on those parts of the body where there was not a trace before, to prevent the body, which became dark red-brown, from being burnt. This observation has been made by me repeatedly for fifteen years, but it is not easy for others to repeat it.

BOHUSLAV BRAUNER.

Charles' (Bohemian) University,
Prague, October 7.

Prof. Andrew Gray.

DR. ALEXANDER RUSSELL'S memoir of Prof. Andrew Gray, which appeared in NATURE of October 24, will be read with sympathetic interest by Prof. Gray's many friends. I must be one of the oldest of them surviving, for I was Gray's fellow-student in my uncle's natural philosophy class in Glasgow in the session 1874–75, in which he carried off the second prize and I the fifth. From my knowledge of him at that time and since, I am able to appreciate the accuracy of Dr. Russell's notice, with the exception of one small error of date. Prof. Gray succeeded my uncle (Lord Kelvin) on his resignation of the natural philosophy chair in 1899, not after his death in 1907.

JAMES THOMSON.

22 Wentworth Place,
Newcastle-upon-Tyne,
October 25.

The Transformations of the Plant World in Geological Time.[1]

By Dr. D. H. SCOTT, F.R.S.

THE record of plant life in geological time is especially interesting from the fact that it shows a definite succession of phases of vegetation, each with a distinctive character of its own. So distinct are these successive floras that a high authority has even doubted whether the evolution of land plants was necessarily continuous. While the theory of descent remains undisputed among biologists, it has been suggested that there may have been, at certain periods, recurrent invasions of the land from the sea, thus giving the terrestrial flora a fresh start. Whatever we may think of this bold hypothesis, it at least serves to show that the diversity of the successive phases of plant life is more marked than their continuity. At present, however, we are concerned with the story, rather than the theory, of the succession of floras through the ages.

The word "transformation" is used for the change from one type of flora to the next. Four such great transformations are known.

1. From marine to land flora. The time of this profound change is unknown: it may have occurred about the Upper Silurian period, but some botanists would put it much earlier.

2. From the early land flora to the typical Palæozoic vegetation. Time, about the Middle Devonian.

3. From the Palæozoic to the Mesozoic type of flora. Time, Permian to Trias. This was the transformation which suggested to Prof. Seward his idea of discontinuity, referred to above.

4. From the typical Mesozoic to the modern type of flora. Time, Cretaceous. This transformation was the most important from our own point of view, as it ushered in the reign of the true flowering plants.

All these transformations, as we observe them, are apparent, not real; they mark the obvious changes in the flora, when the new groups became dominant. The actual origin of the new types must always have lain much further back than the date of the conspicuous transformation.

Of the hypothetical "Plankton" stage, when the ocean swarmed with unicellular creatures, as yet neither plants nor animals, we can have no geological evidence. The succeeding "Benthic" phase (to use Dr. Church's term), the age of the rooted Algæ, is well represented from the Cambrian onwards. Calcareous seaweeds naturally lend themselves best to preservation. Highly organised seaweeds, allied to our living Corallines, are present in the Cambrian. Calcareous Algæ of another class (Siphoneæ) are found at least so far back as the Ordovician. The history of their evolution, all through the succession of strata, has been traced by Dr. Julius von Pia of Vienna, while the importance of calcareous seaweeds as rock-building organisms has been demonstrated by Prof. Garwood. A huge Alga (non-calcareous) known as Nematophycus, goes back to the Silurian. In the Lower Devonian of Canada, specimens three feet thick were described by Sir William Dawson. There is reason to believe that Nematophycus could live on land, but its structure is that of a complex Alga. The Cambrian and Ordovician records are sufficient to show that in the ages previous to the first transformation (the invasion of the land) plant life in the sea had already attained a high grade of development.

THE FIRST TRANSFORMATION.—We have no satisfactory evidence of a land flora before the Upper Silurian,[2] and even then the records are scanty and scarcely free from doubt. Psilophyton, characterised by its leafless, spinous, forked stems and long, terminal spore-sacs, has been doubtfully recorded from the Wenlock beds of the Silurian, and is well known from the Lower Devonian. Among other Lower Devonian plants we have Arthrostigma (like a magnified Psilophyton), the moss-like capsule called Sporogonites, and naked forked stems or fronds (Hostimella). All are very simple, practically leafless plants, but there is little to show how the transition from marine life was effected.

Our best knowledge of the early land flora is derived from the Middle Devonian, but we must be on our guard here, for recent work in Germany has shown that vegetation was already far advanced at that period. In fact the Middle Devonian flora presents a mixture of apparently primitive forms and quite complex types of plants. Among the famous plants of Rhynie, Rhynia and Hornea are no more elaborate in external form than quite ordinary seaweeds, though fully equipped with a vascular system and stomata for life on land. Kidston and Lang's new genus, Hicklingia, may perhaps be somewhat nearer the Algæ than Rhynia. The more advanced Asteroxylon, with a leafy stem, is of the same age. Dr. Kräusel finds that, in a German species, no less than three form-genera, Hostimella, Psilophyton, and Thursophyton, occur as parts of the Asteroxylon plant. This quite agrees with the conclusions of Kidston and Lang.

Asteroxylon has some primitive features, and is, of course, to be reckoned as a member of the Early Devonian flora. It is the more remarkable, that on the same slab with Asteroxylon Dr. Kräusel found a specimen of Cladoxylon, a plant of singularly complex structure, hitherto only known from the Lower Carboniferous or possibly the highest beds of the Upper Devonian. Other highly organised plants were obtained from the Middle Devonian, and it is evident that in this formation earlier and later floras overlapped.

One of Kräusel and Weyland's Middle Devonian plants, Aneurophyton, resembles the contemporary American plant Eospermatopteris, the chief constituent of the fossil forest of Gilboa in the State of New York. Both appear to have had the stature and habit of Tree-ferns, but Eospermatopteris is described as bearing seeds, and is thus regarded as the earliest of the "Seed-ferns," which played so important a part in the Carboniferous flora.

In anatomical structure Aneurophyton recalls the famous "cone-bearing tree" of Hugh Miller, described by him some eighty years ago, from the Middle Old

[1] Substance of a lecture delivered before Section K (Botany) of the British Association at the Southampton meeting, 1925.

[2] I leave out of account the problematic *Archæoxylon Krasseri*, said to be a vascular plant from the pre-Cambrian of Bohemia. In spite of Dr. Kräusel's careful investigation, there is room for much scepticism as to this sensational record.

Red Sandstone of Cromarty. In this case only the wood is known, but Miller's fossil afforded the first evidence of highly organised plants in the Middle Devonian.

THE SECOND TRANSFORMATION.—It has become a little difficult to know where to place this. We have been accustomed to draw a sharp distinction between Early (Lower *plus* Middle) and Late (Upper) Devonian floras. Now we know that some very high types had appeared before the Middle Devonian period was over. The general *facies*, however, of the Upper Devonian vegetation was so distinctive that we may still regard it as marking the first appearance of a typical Palæozoic flora.

Here we meet with many plants with the habit of ferns, as, for example, the noble *Archæopteris hibernica* of Kiltorkan. Among such fern-like specimens there is little doubt that both true ferns and the so-called "Seed-ferns" were represented. Great club-mosses, comparable to those of the succeeding Carboniferous period, were already well developed. Plants with whorled leaves, of families more or less akin to the later calamites and horse-tails, were present. Stems, as highly organised anatomically as those of any modern conifer, indicate that gymnosperms were already flourishing. Leaves recalling those of the maidenhair tree may have belonged to some unknown type of seed-bearing plant.

Then we come, without any marked break, to the rich vegetation of Carboniferous times. The Lower Carboniferous shows the Palæozoic flora in its purest form. Seed-ferns were abundant and varied. Higher gymnosperms were finely represented by the great Pitys trees with leaves something like stout pine-needles. True ferns, usually of types strange to us, were common everywhere. Club-mosses attained a gigantic stature, and some of them had developed a kind of seed, an organ not known in this group after Carboniferous times. The calamite trees appeared, and in a distantly related family the cone of Cheirostrobus was the most elaborate cryptogamic fructification known, either fossil or recent.

The still richer Upper Carboniferous vegetation is so well known as to need little description. New groups, both of true ferns and of the seed-ferns, appeared. The investigation of the vast Chinese flora of the period by Dr. Halle is now yielding fresh examples of the latter class.

The Pitys trees were replaced by the well-known Cordaitean family, of lofty stature, with long leaves like a dragon-tree, and little catkins, complex in structure. The club-mosses, calamites, and sphenophylls (a group remotely allied to the horse-tail stock) reached their zenith.

All this rich and varied flora lasted on with little change into the Permian period and then came to an end. This, at least, was the case with the northern flora. Towards the close of the Palæozoic age, botanical districts became differentiated; the vegetation of India and the southern hemisphere was then different from that which prevailed in the north. The southern type (which made some local incursions into more northern areas) is known as the Glossopteris flora, from its most characteristic genus. Glossopteris and Gangamopteris, plants with simple, fern-like fronds, were probably seed-ferns. The gigantic club-mosses were absent from the southern flora and the calamites were of different kinds. The general *facies* of the vegetation was distinct from that of the north. The age of the Glossopteris flora is now determined as Permo-Carboniferous, but some of the genera still survived in early Mesozoic times. Hence the transition appears to have been less abrupt in the south than in the north.

THE THIRD TRANSFORMATION.—So far as the northern flora is concerned, the change was complete. From the Trias onwards we find no certain examples either of seed-ferns or cordaitean trees. So far as we know, the two great Palæozoic races of seed-plants had disappeared, though perhaps a few relics may have survived. The club-mosses of the Mesozoic are few and modest. The horse-tails begin to approach those of our own day; the ferns are exceedingly numerous and varied, and belong to more or less modern families, for the most part quite distinct from those of Palæozoic age.

The seed-ferns were replaced by a vast array of so-called cycads. These plants were no doubt allied to the recent family, but the great majority of the Mesozoic forms were far more highly organised in their reproductive apparatus. In like manner the cordaiteans were succeeded by the conifers, of families not unlike those still living, and by the maidenhair trees, an important race in Mesozoic times. Further, the vegetation of the world again became, in a broad sense, uniform; the botanical districts of the late Palæozoic were obliterated.

Now all this was a vast change, for which we are as yet unable to account. Yet there are some indications that the transformation was initiated at an earlier period. Foliage of a quite cycadean character is known from Permian and even Carboniferous rocks, though the evidence from fructifications is doubtful. Among conifers we have Walchia, a well-known genus with probable Araucarian affinities, in the Upper Carboniferous and Permian. Leaves like those of the maidenhair trees also occur in Palæozoic rocks, though they are not entirely convincing by themselves. On the whole it seems fairly clear that some of the most characteristic Mesozoic groups had already begun to appear in Palæozoic times.

The desert conditions which were prevalent in the Triassic period may, as has been suggested, help to explain the rapid change in the character of the vegetation. It is also possible that the source of many of the Mesozoic races is to be sought in the Glossopteris flora of the south, where, as already mentioned, the transition seems to have been less sudden. We are not really driven to any such violent assumption as a new invasion from the sea.

THE FOURTH TRANSFORMATION.—This great change, which became manifest during the Cretaceous period (late Mesozoic), introduced the modern type of vegetation. It has been well said that "we are still living in the Cretaceous epoch." For us, the great point of interest is the sudden advent of the true flowering plants, the angiosperms.

It is evident that the transformation was already far advanced in Lower Cretaceous times, for Dr. Marie Stopes has found a number of dicotyledonous stems of that age, with a structure as varied and as complex as that of present-day trees. There is nothing primitive about these early dicotyledons.

The Lower Cretaceous flowering plants were contemporary and associated with members of the old Mesozoic flora, cycads, and so on, which were still predominant. In the Gault and Upper Cretaceous the angiosperms have gained the upper hand, and the vegetation assumes quite a modern character. Both monocotyledons and dicotyledons are present, in about the same proportions as in the living flora. Among the former, palms, reeds, and lilies, among the latter, willows, walnuts, beeches, oaks, planes, maples, breadfruits (found in Greenland), laurels, gum trees, ebonies, and dogbanes indicate some of the families represented. In fact the evidence shows that, from about the middle of the Cretaceous epoch, flowering plants were flourishing very much as they are now, so far, at least, as families or even genera are concerned.

We still have no clue to what Darwin called the "abominable mystery" of the sudden appearance of the higher plants. We have seen that they already existed, fully developed, in Lower Cretaceous times. It is interesting to inquire whether we have any earlier records. They are very scanty. Prof. Seward has described, from the Stonesfield Slate of Middle Jurassic age, simple, ovate leaves, like those of a dicotyledon. We cannot be certain; for there are ferns such as Drymoglossum with fronds somewhat similar, but dicotyledonous affinities are strongly suggested.

Much more important are Mr. Hamshaw Thomas's discoveries in the Lower Oolite of Yorkshire, a little older than the Stonesfield Slate. He has found fruits, ranged in two rows on a stalk, each fruit enclosing a number of seeds. Thus the structure was undoubtedly angiospermous in the literal sense, for the fruit was closed. Associated with these organs Mr. Thomas finds branched stamens, with four-lobed anthers like those of an angiosperm, and also compound palmate leaves. He gives good reasons for thinking that all these remains belonged together. It is evident that Mr. Thomas's fossils throw a new light on the early history of the angiosperms, though their relation to the main line of descent is still an open question.

The series of transformations we have briefly sketched is sufficiently striking. What has been called the succession of dynasties is, no doubt, the great feature in the past history of the kingdom of plants. We have, as yet, little to show by what means one dynasty succeeded another, or how the successive dominant races were related. That each new type arose much earlier than its full manifestation is obvious, and, as we have seen, there is often direct evidence of precursors in an age previous to the transformation of the flora. To unravel the course of descent in the transition, apparently so abrupt, from each flora to the next in succession, is at present a task beyond our powers; we have attempted nothing more than to state the problem.

Photochemical Problems.

THE subject of photochemistry is one to which increasing attention is being given at the present time, as is exemplified by the large attendance and spirited controversies in the meeting, very international in character, held by the Faraday Society at Oxford on October 1 and 2. Whilst as a specialised field for the study of the action of light on chemical substances it is not without interest, in a broader sense it is the most important of all the sciences, for not only does it provide a common meeting-place for physicists, astronomers, and chemists, but, as the botanists have long observed and the medical profession is now realising, life is in great measure dependent on photochemical action.

In all photochemical reactions it is necessary to distinguish between what are termed primary and secondary processes. The first action of the light in producing chemical change is to undergo absorption by a molecule, thus converting it into an "activated" or "excited" molecule. According to the quantum theory all molecules excited or activated in this way become a distinct species characterised by a definite energy constant, which, in certain cases, is directly related to the frequency of the radiation absorbed by the relationship due to Stark and Einstein, $E = h\nu$.

It is these activated molecules which are the reacting species in photochemical processes and, according to some investigators, notably Perrin, in thermochemical change also. If all reactions were simple, it is clear that for every quantum of light absorbed one molecule should enter into chemical reaction and we should obtain a very simple relationship between the amount of chemical action obtained and the number of light quanta absorbed. Closer consideration, however, indicates that this simple law may be but rarely fulfilled, for such an excited molecule may perform one of three possible operations. It may fluoresce and thus lose its newly acquired energy by the emission of radiation. Again, it may collide with another molecule, when one of two possibilities are open to it: on collision the internal energy may be liberated in the kinetic form, resulting in what is termed a supra elastic collision, or the internal energy may be handed on to the molecule it comes in contact with, this molecule then departing as an active molecule, a process termed photosensitisation. Finally, the possibility of chemical reaction on collision is presented. It is little wonder that in many reactions the photochemical efficiency is low.

In addition to such reactions there exists an ever-increasing group in which the photochemical yield is much greater than is to be anticipated from consideration of the amount of light absorbed, or, one quantum apparently can cause several, in some cases tens of thousands of molecules to undergo reaction. Such reactions are now designated as "chain" reactions, and the various hypotheses as to their mode of action are at present a matter of heated controversy. One of the simplest explanations is that of the "atom" chain, which may be represented in operation in its simplest form by the following sequence of operations:

$$(1)\ Cl_2 + h\nu \longrightarrow Cl'_2$$
$$(2)\ Cl'_2 + H_2 \longrightarrow HCl + H + Cl$$
$$(3)\ H + Cl_2 \longrightarrow HCl + Cl$$
$$(4)\ Cl + H_2 \longrightarrow HCl + H.$$

in which the primary photochemical process of activation (1) is followed by a series of steps 2, 3, 4. It is clear that 3, 4 represent two links in a chain which can only terminate when an atom is arrested in some manner.

The great ingenuity required in devising probable chain mechanism for reactions, such as the photochemical decomposition of hydrogen peroxide or the chlorination of hydrocarbons of the aromatic series, has caused many to reject this conception, originally due to Nernst, and to substitute in its place one of the following hypotheses. According to the "hot molecule" theory of Christiansen and Kramers, the products of a reaction such as

$$Cl'_2 + H_2 = 2\,HCl$$

must contain not only the original energy of activation but also the energy liberated by the chemical reaction; they are thus more "active" than their neighbours. It is imagined that a "hot" molecule formed in this way may excite another reactant molecule on collision. Again, it may be imagined that this energy, instead of being contained in the products, may be liberated as radiation which is absorbed by the surrounding reactants activating them in turn; this conception has in fact been made even more concrete by the definite conception of a "quantum" chain.

More recently, due to the investigations of Frank and Cario, the scope of the methods of photosensitisation in which an excited molecule can, on collision with a reactant, hand on its energy of activation to it, thus causing subsequent chemical reaction, has been greatly extended by the employment of mercury vapour as sensitising agent. By such means the amount of energy capable of being conveyed in this manner is far greater than with the sensitising agents usually employed, such as molecules of the halogens or the dyes employed in the photographic plate. It is possible that the active nitrogen of Lord Rayleigh ($V = 9{\cdot}5$ volt) may prove an even more powerful conveyer of energy than mercury atoms excited with the line $\lambda 2537$. The ready production of atomic hydrogen in this manner has opened up a path by which the properties of the organic radicals, such as ethyl, formed by the reaction

$$C_2H_4 + H \longrightarrow C_2H_5$$

may be investigated.

Whilst these natural processes may be considered at the present time to be capable both of reasonably precise experimental investigation and their real existence capable of being demonstrated, the situation is quite otherwise in certain other phenomena, an adequate explanation for which is as yet not forthcoming.

It is found that in certain reactions hitherto considered as extremely simple in character, such as the decomposition of ozone, the photochemical efficiency may remain unchanged even for low pressures of the reactant and sensitising agent, chlorine, whilst the presence of indifferent gases exerts a marked influence on the reactant velocity. According to the experiments of Wien, the life of an excited molecule is of the order of 10^{-7} seconds and metastable forms of active molecules are as yet unknown. Whatever the active species may be in this particular reaction, it is clear that it must have a relatively long life; furthermore, it can suffer a number of collisions with indifferent gas molecules without losing its energy, this number varying with the nature of the gas. Various explanations, such as the existence of intermediate compounds, the restriction of the reaction to the walls of the vessel and replacing the concept of an excited molecule by an excited atom, have all been advanced on very slender foundation.

Finally, it would appear from consideration of the decomposition of nitrogen pentoxide at very low pressures, that the process of distribution of internal energy amongst these molecules can proceed at a rate much faster than is to be anticipated from the Maxwellian period of molecular relaxation. If, indeed, this process occurs through the agency of radiation, nitrogen pentoxide must be singularly opaque to its own self-generated radiation.

It may be anticipated that increased attention will be given to the subject of photochemistry, for it is clear that it opens a door to some of the most interesting and important fields in the region of atom dynamics, a subject on which, in the words of Goethe, we are anxious to have "more light." ERIC K. RIDEAL.

French Contributions to Metallurgy.

THE well-known attention which has been devoted to the history of metallurgy by Sir Robert Hadfield receives an interesting supplement in a paper recently read (Oct. 5) in Paris at a congress of industrial chemistry organised by the French Society of Chemical Industry. The main theme of the address is the interrelation of British and French research in metallurgy, but the aspect, which to most readers will be found of the greatest interest, is the excellent résumé given of the debt which this subject owes to French men of science. As an example, the author pays generous tribute to the importance, in connexion with his own discovery of manganese steel, of the investigations carried out by the Terre Noire Cie. on the commercial production of ferrous alloys very high in manganese.

The paper, which is characterised by the pleasing discursiveness associated with similar lectures which Sir Robert Hadfield has already delivered on metallurgical history, contains, however, nothing more interesting than the photo-micrograph, now published for the first time, of the structure of the iron of the famous Delhi pillar, to which the author has devoted considerable attention. To metallographers interested in the remarkable resistance of this pillar to corrosion this structure shown in Fig. 1 will be of more than passing interest. The almost complete freedom from slag throws more than a little doubt on the view that a large part in the resistance of wrought iron to corrosion, a fact still awaiting an adequate explanation, is played by inclusions of slag.

The account given of French contributions to metallurgy since the time of Réaumur (1722) is of considerable interest. In the 150 years which followed, there appeared a number of important metallurgical books in France, of which the titles of 27 are recorded. A brief account is given of the more important contributions to metallurgical knowledge during this period. Among the older names one meets those of Réaumur himself, Berthollet, Vauquelin, the discoverer of chromium, the metal which rendered the production of a rustless steel a possibility, of Berthier

and Le Play. In more recent years the tradition has been carried on by Le Châtelier, Moissan, Pourcel, Osmond, Dumas, and Guillaume, whose work on the special alloys of iron resulted in the discovery of "Invar," an iron-nickel alloy the coefficient of expansion of which at ordinary temperatures is negligible. Such a list shows how keen has been the interest taken by French scientific workers in metallurgical problems. The debt due to them is not readily appreciated, that due to Le Châtelier being even greater than Sir Robert acknowledges, since, in addition to the credit already given, there must be added that due for his researches on the transformations of silica at elevated temperatures, which in no inconsiderable manner paved the way for the recent advances in our knowledge of the refractory materials in general.

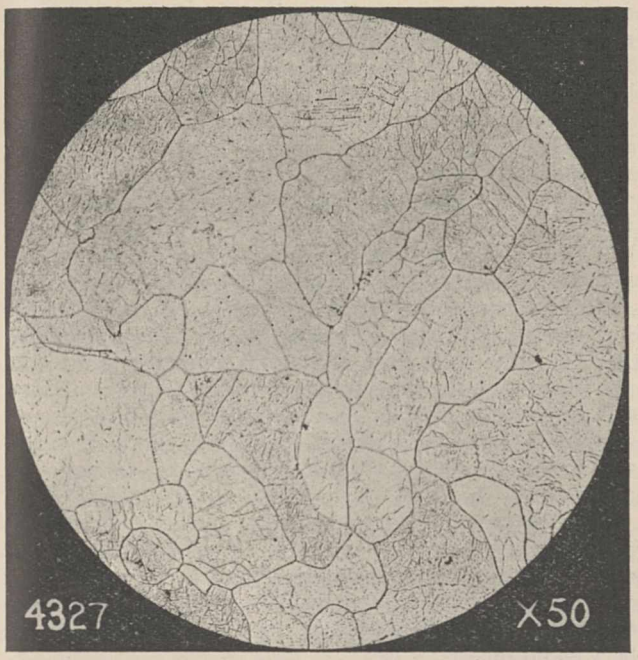

FIG. 1.—Photomicrograph of a specimen from the Delhi iron pillar.

Sir Robert's concluding remarks are of wide interest and may well be quoted in full:

"In offering my contribution to this distinguished gathering of prominent scientists, who have come from so many countries to attend this Congress, I venture to point out that this very gathering itself affords an obvious testimony to the truth of the saying that 'Science knows no boundaries.'

We are met, here in Paris, the renowned capital of France, and, it may with truth be said, the city wherein, perhaps more than in any other throughout the whole world, science receives most help and most encouragement.

In a memoir which I communicated to the University of Oxford, towards the beginning of this year, I showed an engraving in which was represented one of the greatest scientists of medieval England, Roger Bacon, in the act of presenting a book, the record of his work, to the University of Paris, about the year 1250. During the fourteenth and fifteenth centuries Paris was, indeed, the centre of science.

The University of your city was, even then, exercising considerable influence on the universities at that time established in England. I might cite, as an example, Jean Buriden, Rector of the University of Paris, who was one of the founders of modern dynamical science. M. Picard, chief secretary of the Academy of Sciences, has already written, on this subject, a memoir most carefully and interestingly drawn up, with reference to the facts I have mentioned.

That which was true of the past centuries is still true of the present day. Paris has not lost her ancient renown in the sciences; she still preserves it, and it may very frequently be observed that the great ideas which spread through the world of science are ideas the origin of which may often be traced to distinguished Frenchmen.

I venture to believe that in uttering these sentiments I am expressing, not my own views alone, but those of my colleagues here present, and those, indeed, of the whole world. I trust that France will maintain, in the future, the position which the wisdom of her great men has won for her in the past."

One cannot but be impressed throughout the address by the intimate connexion of the work of French men of science with industrial problems, a liaison which has proved of the greatest importance. A quotation by Percy, in the preface to his classical work on the "Metallurgy of Iron and Steel," from Réaumur, remains as true to-day as it was two hundred years ago: ". . . L'utile bien considéré a toujours de curieux, et il est rare que le curieux bien suivi ne mène pas à l'utile. . . ." F. C. T.

The Cierva Auto-Gyro.

By Prof. L. BAIRSTOW, F.R.S.

A NEW flying machine, quite unlike the normal aeroplane and bearing a strong resemblance to a helicopter, has flown very successfully and excited general interest. It is yet too early to see the full consequences of this notable achievement, but perhaps not too soon to attempt a preliminary statement of what appears to be its general principles, in order to prevent undue expectations.

The auto-gyro has the normal parts of an aeroplane except its wings; the latter are replaced by a screw rotating freely about an axis which is nearly vertical in flight. Except when starting, this screw or auto-gyro, is not mechanically driven, but is maintained in rapid rotation by the play of aerodynamic reactions. The forward motion of the craft is produced by the normal airscrew and engine of an Avro biplane, the body, controls, and under-carriage of which are retained, except that a very large movement is given to the elevators. Ailerons have been fitted to the craft, but are said to be unnecessary.

In flight the body of the auto-gyro appears to be supported by a flat shuttlecock, and when flying slowly its performance is astonishing. The inventor claims the possibility of flight at ten miles an hour, and exhibition flights at Farnborough in the last fortnight have shown that, when flying in a light wind, the device can hover over the ground. Furthermore, after shutting off the engine, safe descent can be accomplished at an angle of 60° to the horizontal, the craft coming to rest with a forward run of a few yards only. As at present arranged, starting from the ground is primitive; a rope is passed round projections on the auto-gyro screw and rotation up to about 60 rev. per min. produced by hauling on this rope. Taxi-ing over the ground in the normal way then brings the speed to 120-150 rev. per min., when the machine may safely leave the ground. The run is rather long.

From remarks made by the inventor, it appears that the use of the engine for starting the screw has been contemplated, so as to make it possible to rise from a confined space. The auto-gyro screw as it exists at present is unsuited for driving whilst in the air, and it is not clear that such driving would be advantageous.

From some approximate data given publicly by the inventor, it appears that the complete craft weighs about 2400 lb. and has a highest speed of flight of 68 miles per hour. The Avro biplane with the same engine weighs 1800 lb. and flies at about 90 miles per hour near the ground. So far as I know, the height to which the new machine can climb has yet to be determined.

The auto-gyro screw has four blades, the total area of which is about half that of the wings of the standard Avro aeroplane, and this makes the average loading some 30 lb. per sq. ft. as against the 6 lb. per sq. ft. of the aeroplane. In flight the device seems to be very stable and easy to control, and in this respect the invention gives a solution of one of the very difficult problems connected with the production of a successful helicopter.

The stresses due to rapid rotation are dealt with by ingenious but not novel means, and one can only marvel that in reducing the stresses the inventor has also got a stable aerodynamic system with other good qualities. The auto-gyro screw is mounted on a fixed shaft almost in the plane of symmetry of the fuselage and some 6 or 8 feet above its centre line. The four wings of the screw are hinged to a sleeve which rotates freely on ball bearings on this fixed shaft. The axes of the hinges are close to the shaft and nearly normal to it.

On the ground the weight of the blades is taken by rubber springs and guy wires, but these cease to operate in flight. The lift of the blades produces a moment tending to fold the blades upwards, and this is balanced by a moment due to centrifugal forces. By suitably curving the blades, bending stresses are almost eliminated, and as the centrifugal forces are large, a balance of moments is obtained with an upward tilt of less than 10 degrees. The same agency—centrifugal force—is left to deal with stability, gyroscopic couples, and gusts.

Due to the hinging and the varying lift on the separate blades in the course of a revolution, a certain amount of flapping occurs. It is claimed—without great emphasis—that the flapping is beneficial to the operation of the screw, although other experiments by the inventor have shown that rotation may be maintained with a fixed screw. It is remarkable to find that forces inclined ahead of the axis of rotation exist over a wide range of speed of flight. Even when the forward speed is only 20 miles per hour, these forces urge the advancing blades to speeds upwards of 150 miles per hour at the tips. As yet there is little knowledge of the effect of forward speed on the rotational speed of the auto-gyro, possibly because the pilot has so manœuvred his craft as to maintain a specified minimum. One of the suspicions voiced is that rotation would tend to stop at high speeds. Further, it is possible that vertical descent would be too rapid for safety; descent at an angle of 60° appears to cover most requirements when landing, and vertical descent may not be required in any case of importance.

The existence of tip speeds of 150 miles per hour readily accounts for the high average loading of the blades, since, other things being unchanged, the force per square foot of wing varies as the square of the speed. An element of wing moving at 150 miles per hour has then more than fifty times the pressure of the same wing at 20 miles per hour. There is, in fact, no need to look for new types of air flow to account for the phenomena observed. No difficulties are anticipated in analysing the performance of the auto-gyro by existing methods of calculation and knowledge of aerodynamics. From the details which this analysis will give, new developments may perhaps follow, but one general conclusion may already be drawn with some confidence. It may be expected that the auto-gyro will be a less efficient organ of transport than the aeroplane.

The arguments for such conclusion have already appeared in NATURE in a discussion of the possibilities of the helicopter (August 18, 1923, vol. 112, p. 229). So long as wings are used in producing lift, there will be a consequential resistance which cannot fall below a certain minimum proportion of the lift. The least amount of work expended in producing a given lift and moving a wing through a prescribed distance is then determined by conditions of airflow beyond the control of a designer. Obviously the path taken by the wings of an aeroplane between two points is the shortest possible, and the longer coiled path of the wings of a screw requires a larger expenditure of work.

This summary leads to conclusions typical of most engineering problems, no single solution containing in itself the whole of the desired qualities at their maxima. Combination of aeroplane and auto-gyro is not yet suggested, and much research lies ahead before the benefits of the new invention can be translated into terms applicable to commercial aircraft. Should uses be found for a new type of craft in which high speed and high efficiency are not essential, the new invention gives valuable help at once. No combination remotely approaching the performance of the auto-gyro at low speeds has yet appeared in the history of heavier-than-air craft.

Obituary.

PROF. H. MAXWELL-LEFROY.

IT must be with feelings of very genuine regret that entomologists, and especially those occupied with economic work, both at home and throughout the Colonies and abroad, will have learnt of the tragic death of Prof. Lefroy, which occurred on October 14, as the result of an accident. Four days previously he had been found unconscious in his laboratory at the Imperial College of Science and Technology, South Kensington, and although removed immediately to St. George's Hospital, he succumbed without having once regained consciousness. At the subsequent inquest, death was attributed to the effects of a gas with which he had been experimenting as an insecticide, whilst already suffering from toxæmia due to exposure during previous work of a similar nature extending over a period of years. The funeral took place at Kensal Green Cemetery on October 17.

Harold Maxwell-Lefroy was born in 1877 at Itchel Manor, Crondall, Hants. From Marlborough College he went up to King's College, Cambridge, graduating with first-class honours in the Natural Sciences Tripos in 1898. At Cambridge he had specialised in his old hobby, entomology, and, after a brief interlude of teaching, in 1899 was appointed entomologist to the Department of Agriculture of the West Indies. His stay at Barbadoes was not long, but it served as a very excellent introduction to the study of the entomology of the tropics, and it was no doubt largely as a result of his work there that at the end of three years he was appointed Imperial Entomologist to the Government of India. At Pusa in Bengal he found unlimited scope for the exercise of his organising abilities, and soon succeeded in placing his Department on a sound footing, and bringing it up to a level of efficiency that has been well maintained ever since. The problems which confronted him were many and varied; they seem only to have acted as an incentive to greater energy, and India owes him no small debt for the work he put in during his eight years of office there.

Chief amongst Lefroy's publications during this period were "Indian Insect Pests" (1906) and "Indian Insect Life" (1909), both of which are of standard value, whilst the latter is still the only comprehensive work on Indian insects available. Lefroy was a great believer in good illustrations, and both works are profusely illustrated. The Entomological Series of the Memoirs of the Department of Agriculture of India from the time of their commencement by him in 1906, until his retirement in 1912, likewise bear eloquent testimony to his insistence on illustration and to the range of his activities. The first memoir, on the Bombay locust, was followed by a list of the more important insects injurious to agriculture in India. This list, the first of its kind, enumerated some 150 species, the majority of which were figured, and included in the case of each a brief account of what was known of its development and bionomics, much of this information naturally being quite new. There followed a series of memoirs dealing more fully with a number of particular pests, a valuable survey of the Eri silk question, an elaborate paper on the food of birds (in collaboration with C. W. Mason), others on biting flies, etc., the final publications dealing with insecticides, an aspect of his subject which, curiously, seemed to attract him throughout the remainder of his career more strongly than any other.

Towards the end of 1910 Lefroy returned to England and commenced work at the Imperial College of Science, where later he was appointed professor of entomology. Here he showed ability and energy as great in the creation of a school for the training of entomologists as formerly he had shown in the tackling of the economic problems of the tropics, whilst his knowledge and experience, his remarkable capacity for dealing practically with the administrative and lay aspects of insect problems, and above all his never-failing enthusiasm, personal friendliness, sympathy and generosity, have been and will remain a source of strength and inspiration to numbers of his former pupils, now widely scattered throughout the Empire.

With the outbreak of the War, as was characteristic of the man, one of his first actions was to attempt to join the colours. He was turned down. Nevertheless he succeeded in serving in various capacities quite unconnected with his scientific qualifications. As an economic entomologist he primarily devoted the greater part of his time to the house-fly problem, and also made use of his great powers as a convincing lecturer in teaching sanitary officials, doctors, and Army officers. Later he was attached, as temporary Lieutenant-Colonel, to the Mesopotamian Field Force for the specific purpose of coping with fly pests, and afterwards he was called in to deal with the wheat trouble in Australia, where he successfully applied the methods already in use in America. On his return to South Kensington he again settled down to his work of teaching, and to investigations in various directions, and was so engaged at the time of his death.

One who had the pleasure of working with him during his earliest days at South Kensington will never forget the cheerful optimism with which he undertook the most herculean labours, the extraordinary speed at which he worked, the zest with which he attacked and demolished every new obstacle, and the unexpectedness of many of his actions. The writer well remembers how, in order not to waste the day, he would start it by rising at 4 or 5 o'clock in the morning, and then cycle some twenty or thirty miles into the country to spray several acres of some friend's crops, before getting a belated but always very excellent breakfast. He was always impatient to get on. It has been said of him that much of his work was wasted; it is probably equally true to say that he himself was always the first to recognise his mistakes, as he certainly was the first to forget them in his enthusiasm for the next line of investigation. Quite unable to disguise his disgust at carping, obstructive criticism, he had little use either for ineffective discussion. To use his own words, "the training [of the economic entomologist] will have to be that of the practical field entomologist . . . and the last thing it wants to be is the academic zoological training of the average English university." It was the practical side of his work, with its innumerable opportunities for the exercise of inventive ingenuity, that always appealed to him most; the systematic

arrangement of collections, and kindred subjects, he admitted were necessities, but, as he never failed to remind his students, "systematics are no part of an economic entomologist's work, and should be left strictly to those whose concern they are."

In recent years Lefroy published little of a scientific nature, confining himself in the main to devising methods and apparatus for applying the results of his investigations, and this with no little success. Apart from this, there can be no doubt that since the War, and even during it, he rendered great service to entomology in Great Britain by his continued efforts to force the general public to a realisation of the interest and importance of the subject to which he was devoted. If in the process he employed such varied and unconventional means as newspapers and popular magazines, broadcasting, and even the kinematograph, it is none the less true that a measure of success attended his efforts which would have been absent had less spectacular methods been employed. His death at the early age of forty-eight leaves entomology the poorer by the loss of a very remarkable man.

DR. BRAYTON H. RANSOM.

DR. B. H. RANSOM, Chief of the Zoological Division of the United States Bureau of Animal Industry, died, after a brief illness, in Washington on September 17, in his forty-seventh year.

In Dr. Ransom, America has lost one of its most brilliant parasitologists. The Division of the Bureau of Animal Industry which he had administered since 1906 has played a very prominent part in the solution of many urgent problems in economic parasitology and has contributed many invaluable discoveries to science —not the least important of which was the recent introduction of carbon tetrachloride in the control and treatment of hookworm disease in man. Dr. Ransom's personal contributions to this work are so numerous that it is impossible to do more than mention a few of the more outstanding. He demonstrated the transmission of the stomach worms of horses by flies; and developed many practical control measures for stomach worms of ruminants. He did much research on the life-history of the pig ascarid and was able to devise a practical means of eradication for this important swine pest. His work on the parasites of human importance in meat products—especially in connexion with the Trichina worm and "Measles" of mutton and pork—was of fundamental importance. He published monographs which have even now become standard works of reference on the cestodes of North American birds, on the intestinal nematodes of ruminants, on the Heterophyid trematodes of man and other animals, and on other subjects; and many other papers of a very high scientific standard on morphology, life-history, biology and classification of the parasitic helminths have appeared from his pen.

Dr. Ransom had many friends—some of whom he had never seen—and few enemies. No man was more ready to lend a helping hand to the beginner, and many a young parasitologist owes much to his friendly assistance. In his premature death the world has lost a valuable and conscientious worker, and parasitologists a considerate and helpful friend.

Current Topics and Events.

PROF. H. A. LORENTZ took his doctor's degree at the University of Leyden on December 11, 1875: his friends wish to take the opportunity afforded by the fiftieth anniversary of that event to offer to him some token of their esteem and affection. For this purpose, a general committee including physicists from all countries, and an executive committee consisting of Prof. Kamerlingh Onnes, Prof. Zeeman and Dr. Fokker, has been formed. It is proposed to raise a fund, to be called the Lorentz Fund, to be devoted to the advancement of theoretical physics. It is intended that the fund should provide for the continuance of the lectures on problems of modern physics which Prof. Lorentz has given at the University of Leyden since his retirement from his professorship under the age limit. Other objects of the fund are to assist Prof. Lorentz's own researches, to aid the publication of treatises and scientific papers, to provide research and travelling fellowships, and generally to assist whatever may be useful for the advancement of theoretical physics. The fund will have an international character, being available for foreign physicists for work in the Netherlands and for Dutch physicists for work at centres of physical research abroad. It will be administered by the Leyden University Council. Sir J. J. Thomson, Trinity Lodge, Cambridge, will be glad to receive subscriptions for the fund.

CONSIDERABLE interest has been aroused by the discovery of part of a human cranium during excavations on the site of Lloyds' new buildings in Leadenhall Street, in the City of London. It was found by a workman at a depth of 42 ft. below the level of the street. The deposit at this point is the blue clay below the Pleistocene gravel, and it is the same stratum as that in which a skeleton of a woolly rhinoceros has been discovered. The newly discovered fragment of a human skull, which is the posterior two-thirds of the brain case, was exhibited and described at a meeting of the Zoological Society on October 20 by Prof. G. Elliot Smith and Mr. Warren Dawson, to whom it had been sent for examination. The bone is definitely mineralised, and there would appear to be no reason to doubt that it is contemporary with the stratum in which it is found, and not an intrusion of a later date. The fossilisation of the bone at the line of fracture indicates that the skull was broken in ancient times and not recently. As regards the cranial fragment itself, certain features suggest that the muscles of the neck were not of the massive character that might perhaps be expected in an early type of man, and point to the skull being that of a female, while the condition of the sutures indicates an age of about forty-five years. The endocranial cast was very much flattened and showed resemblances to the Neanderthal type. Prof. Elliot

Smith, however, is definitely of the opinion that the skull belongs, not to Neanderthal man, but to *Homo sapiens*.

AN announcement in the *Times* of October 20, that Dr. Grimme, professor of Semitic philology at the University of Munich, had discovered a record of the rescue of Moses from the Nile by "Hatshepsut, daughter of Pharaoh," has aroused considerable interest in the newspaper world. According to a despatch from the Berlin correspondent of the *Times*, the discovery was made known at a private meeting of the Society of German Citizens of the Jewish Faith; but, as a matter of fact, Dr. Grimme's suggested decipherment of the inscription in question, which was found by Sir Flinders Petrie in Sinai in 1904, was published in book form in 1923, and is reviewed by Mr. T. G. Pinches in *Ancient Egypt* for September, where there also appears an illustration of the signs which have been identified as signifying "Hatshepsut" as they appeared on the original inscription; they appear with additions made out from a photograph, and as set out by Dr. Grimme. It is, of course, uncertain that the language is Semitic, but Dr. Grimme, working on a comparison of old Phœnician and Egyptian characters, concluded that the inscription is characteristically Old Hebrew. The identification of Hatshepsut (Hyatsepsu) and Yoseph suggests that some of the characters *may* be correctly interpreted. The reviewer, while acknowledging that "there seem to be good comparisons on the Egyptian side," is of the opinion that there are grave doubts as to the justification of the comparisons on the Old Hebrew or Phœnician side.

IN *Scribner's Magazine* for October, Prof. E. James Swift discusses quackery and its psychology. His purpose is to reveal the weak spots of the human mind which make it an easy prey for the infection of humbuggery. He gives examples from ancient and present times, from various countries, of beliefs firmly held for which, however, there was no objective proof. He places the onus of self-deception on the imagination, the lure of the mysterious, and the subtle influence of obscure explanations. He compares the activities of professed conjurors and spiritists, the former consciously setting out to play on the credulity of the audience, and the others less consciously using the same devices. Every scientific observer knows the importance of the negative instance and its elusiveness unless one is prepared. When, however, we have arraigned imagination as the culprit in self-deception, we have not answered the problem of why man lends himself to deception, why a scientific training in one direction is no guarantee of accurate observation in another. Is it that the attitude of credulity is the more natural as being that of the child, which we only give up after long and laborious training, and so, the scientific attitude being late in development both in the race and in the individual, is therefore much less stable?

AN account of the twentieth Norwegian expedition to Svalbard (Spitsbergen) is contributed by Dr. Hoel to *Aftenposten* (Oslo) of September 17. The chief object of the expedition was to complete the survey of the eastern half of the coal-field between Van Mijen Bay and Is Fjord, a somewhat difficult task owing to the thickness of the superficial deposits. In the course of mapping, a saurian skeleton about two metres long was found in Jurassic shale, west of Store Fjord, but its excavation had to be left for another year. Large portions of fossil trees of Tertiary age were found on the hills at Van Mijen Bay. On Bear Island a seam of pure galena, 30 cm. to 40 cm. thick, with other seams of mixed barytes and galena, hold out a promise of profitable working. The inner part of Is Fjord was sounded, and the chart of the waters between South Cape and Cross Bay, on a scale of 1 : 100,000, was completed for publication. Oceanographic observations detected a considerable increase of temperature (so much as 2° to 3° C.) at nearly all depths. The atmospheric temperature was also relatively high, and a rapid decrease of the glaciers was perceived. Dr. Hoel also remarks on the considerable diminution of the reindeer stocks, and suggests the need of preservation by law.

THE September issue of the Journal of the Franklin Institute is of exceptional interest, as it contains the report of the presentation of Franklin medals to Prof. P. Zeeman and Dr. Elihu Thomson, the former being honoured for his discoveries in magneto-optics, and the latter for his pioneer work and inventions in electricity and electrical engineering. The addresses of the recipients are printed in the same issue. Prof. Zeeman's suggestive address on "Magnetisation of Spectrum Lines: Reminiscences and Prospects" contains a reference to the very powerful magnetic fields which the research worker can now command: the strongest statical field so far obtained is 63,700 gauss (Deslandres), and the strongest field of short duration (0·01 sec.) is 500,000 gauss (Kapitza). Dr. Elihu Thomson's constructive address reviewed the mechanical, thermal, and optical properties of fused silica, and adumbrated the use of both fused sand and fused quartz on a greatly extended scale. Large quantities of the opaque material, made from sand, will probably be used for making insulators for high-tension transmission lines, singly capable of withstanding voltages so high as 200,000. Fused silica, owing to its highly elastic nature, is well adapted for making tuning forks of standard pitch. Fused quartz is suitable for making astronomical mirrors, condensing lenses for kinematography, the temperature-compensation mechanisms of clocks and watches, standards of length, and also for optical prisms and lenses, as it is now quite easy to remove internal striæ by fusing the quartz in a good vacuum, and then subjecting it to high pressure. Fused quartz will be used in increasing quantities for the application of ultra-violet radiation in therapeutics, and possibly also in the preparation of food.

CAPT. R. B. SEYMOUR SEWELL, I.M.S., has been appointed Director of the Zoological Survey of India. Dr. Sewell was educated at Christ's College, Cambridge, and is well known for his zoological writings in connexion with Indian zoology.

THE secretary of the Moscow Society of Naturalists informs us that, on November 7, M. A. Menzbier, president and honorary member of the Society, and professor emeritus of the First Moscow University, will attain his seventieth year. As no public celebration of this anniversary is to be held, letters and congratulations should be addressed to the secretariat of the Moscow Society of Naturalists, First Moscow University, Mokhowaya, N.11.

THAT the value of the work carried out at the Imperial College of Tropical Agriculture in Trinidad is appreciated throughout the Empire is shown by the steadily increasing list of donors to the special appeal, now being conducted by the Duke of Atholl during Lord Burnham's absence abroad. Recent donations and promises include 500*l.* from Platt Bros. and Co., Ltd., and 100*l.* each from the Sun Life Assurance Co. of Canada and the United Alkali Co., Ltd. Contributions may be sent to Mr. Algernon Aspinall, Secretary, 14 Trinity Square, London, E.C.3, or to the bankers of the fund, Barclays Bank (Dominion, Colonial and Overseas), 30 Gracechurch Street, E.C.3.

THE menace of foot-and-mouth disease is again threatening Great Britain, several outbreaks having been reported in districts widely separated from one another, the origin of which is quite unknown. In consequence the Ministry of Agriculture and Fisheries has issued a circular letter directing attention to the outbreak and advising stock-owners to obtain a copy of the leaflet issued by the Ministry on the subject. This deals with the chief symptoms of the disease, and gives directions for the precautions to be taken to avoid infection and what should be done if infection is suspected. The leaflet (Form No. A 129/T.A.) may be obtained free of charge on application to the Secretary of the Ministry, Whitehall Place, S.W.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, October 26, the following officers were elected:—*President*: Sir Alfred Ewing; *Vice-Presidents*: Prof. J. H. Ashworth, Prof. T. H. Beare, Dr. W. B. Blaikie, Sir Robert Blyth Greig, Prof. T. H. Bryce, and Prof. E. T. Whittaker; *General Secretary*: Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*: Dr. A. Lauder, Prof. W. Wright Smith; *Treasurer*: Dr. J. Currie; *Curator of Library and Museum*: Dr. A. Crichton Mitchell.

FROM a recent number of *Sperryscope*, the organ of the Sperry Gyroscope Co., we learn that Mr. Elmer A. Sperry has just been elected a member of the National Academy of Sciences, Washington, and has also received the honorary degree of D.Sc. from the North-western University, Evanston, Ill. In being presented for the degree, Mr. Sperry was described as "An electrical engineer and a physicist who has shown remarkable skill in applying scientific methods and knowledge to the solution of practical problems; inventor of the Sperry Gyro-compass; of many valuable aeronautic instruments; of the highest power searchlight; of fire control for the United States Navy; a pioneer electrical manufacturer in America; and a founder member of the Society of the American Institute of Electrical Engineers."

THE current session of the Royal Society of Arts will be opened on Wednesday, November 4, at 8.30 P.M., when the inaugural address will be delivered by Sir Thomas H. Holland, chairman of the council, the subject being "The Organisation of Scientific Research throughout the Empire." Other meetings before Christmas include "Colour Printing," by Mr. David Greenhill; "Recent Progress in Indian Forestry," by Prof. E. P. Stebbing, and "The Imperial College of Tropical Agriculture," by Dr. H. Martin Leake, Mr. L. S. Amery, M.P., presiding. A course of three lectures under the Cantor Trust will be delivered by Dr. R. Lessing on "Coal Ash and Clean Coal." At meetings after Christmas the following papers will be read: "Investigations in Agricultural Science at Rothamsted," by Sir John Russell; "Religions and Races in the Punjab," by Sir Michael O'Dwyer (Sir George Birdwood Memorial Lecture); "The Work of the Imperial Institute," by Sir Richard Redmayne; "Women and Children in Indian Industries," by Lady Chatterjee; "Some General Problems of Fruit Preservation," by Prof. J. McLean Thompson; "The Propagation of Electric Waves," by Mr. J. E. Taylor; "Problems in Paint and Varnish Technology," by Dr. H. Houlston Morgan; "Domestic Heating," by Dr. Mary Fishenden; "Modern Views of Vitamins," by Prof. J. C. Drummond; "Horse Traction and Motor Traction," by Mr. James Paterson; and "Indian Maps and Surveys," by Colonel W. M. Coldstream. Courses of lectures will also be delivered by Dr. G. W. C. Kaye, on "The Production and Measurement of High Vacua"; by Mr. W. F. Higgins, on "Thermometry"; and by Mr. C. R. Peers, Director of the Society of Antiquaries, on "Ornament in Britain."

IN the annual report of the Otago University Museum for 1924, Prof. Benham gives the chief place to a valuable gift of ethnographic objects by Mr. Willi Fels. This consists of three main sections. First, 200 oriental fire-arms and other weapons. Secondly, a fine series of Maori objects, including a tiki with head erect as in the Marquesan ornaments of the same name. Thirdly, material from Pacific groups other than New Zealand, among which an extensive collection of lime knives from the Massim area, which is claimed to be one of the finest in existence. These large additions accentuate the need for more exhibition space, more work-rooms, and an increased staff. Another New Zealand museum, that of Auckland, also records the acquisition of a great collection illustrating Pacific ethnology. This is the Edge-Partington collection, purchased and presented by Mrs. Selwyn Upton and Mr. W. Cecil Leys as a memorial to their father, the late Dr. T. W. Leys, long a member of the council of the Auckland Institute. The report for 1924–25 announces the commencement of the War Memorial Museum, and the hope is expressed that its opening may be made the occasion for the holding of the Pan-Pacific

Science Congress in Auckland in 1928 or 1929. The curator of this Museum is now Mr. Gilbert E. Archey, and the assistant-curator is Mr. L. T. Griffin.

WE have received a copy of Catalogue No. 13, 1925, of second-hand books offered for sale by W. H. Robinson, 4 Nelson Street, Newcastle-upon-Tyne. The list is of a miscellaneous character, but includes sections devoted to voyages and travels (including Americana), folklore and archæology, and old scientific books. The prices asked appear to be reasonable.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An assistant pathologist at Westminster Hospital—Secretary, Westminster Hospital, S.W.1 (November 6). An assistant lecturer in the department of pharmacy of the Brighton Municipal Technical College—F. H. Toyne, 54 Old Steine, Brighton (November 7). A lecturer in agricultural chemistry at University College of Wales, Aberystwyth—Secretary (November 14). An agricultural chemist, with experience in biochemical investigation, a mycologist, an entomologist, and a botanist, principally for physiological investigations, for the Tea Research Institute about to be established in Ceylon—T. Petch, the Tea Research Institute, c/o the Ceylon Association in London, 6 Laurence Pountney Hill, E.C.4 (November 30). An editor for a Journal of Abstracts and Reviews to be established by the British Empire Cancer Campaign—Secretary, British Empire Cancer Campaign, 19 Berkeley Street, W.1 (November 30). A junior scientific assistant in connexion with Admiralty Research—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A senior water works engineer in the public works department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/13,684). A civil engineer in the public works department of the Government of Nyasaland—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/14,046). A lecturer in hygiene and public health at Charing Cross Hospital Medical School—The Secretary, Chandos Street, W.C.2. A chemical engineer and an organic chemist for the Research Station, Canadian Pulp and Paper Association—The Association, 701 Drummond Building, Montreal, Canada. A clinical pathologist at the Crichton Royal Mental Hospital, Dumfries—The Physician-Superintendent. An assistant mining lecturer under the Warwickshire Education Committee—Bolton King, County Education Office, Warwick. A lecturer in physics at the Royal Technical College, Salford—Secretary for Education, Education Offices, Salford.

Our Astronomical Column.

RETURN OF FAYE'S COMET (1925 *h*).—It is welcome news that this comet, after long search, has been photographed by Dr. Baade with the 1-metre reflector at Bergedorf. It was discovered in 1843, and has been observed regularly every 7½ years, except for the returns of 1903 and 1918. One reason for its non-detection in 1918 was the fact that Fontana's search ephemeris was based on M. Fayet's period, published in 1910, which is now known to have been two months too short. It is inadvisable to publish periods of periodic comets deduced from short arcs, as they are subject to great uncertainty.

Before the present return, Mr. Cripps computed the perturbations and published the following elements in the Journal of the British Astronomical Association, Vol. 35, No. 6.

T	1925 Aug. 6·66 U.T.	
ω	199° 43′ 15″	1925·0.
Ω	206 13 46	
i	10 36 31	
ϕ	34 51 29	
n	485·42″	

It now appears that T is actually Aug. 7·56, and Mr. G. Merton gives 484·87″ as the corrected value of n. The other elements are not much in error.

Dr. Baade's observation is as follows:

	R.A. (1925·0).	N. Decl.
Oct. 20d 2h 36m 5s	8h 5m 18·39s	9° 33′ 2·0″

The magnitude of the comet was 13. A small tail was shown on the photograph.

Once the exact place was known, Dr. Stobbe re-examined earlier Bergedorf plates, and has found images of the comet on those taken on Aug. 20 and Sept. 15. These are sufficiently distinct for measurement, and will be useful for improving the elements.

It is interesting to note that five of the six periodic comets due in 1925 have now been detected. The only failure has been Schorr's comet, which was very unfavourably placed. There are already nine recorded perihelion passages of comets in 1925, a number that has only once been exceeded; in 1898 there were ten. It was equalled in 1886 only. This shows a reawakening of interest in the search for comets, which had somewhat fallen off.

The following ephemeris of Faye's Comet for 0h is from the corrected elements.

	R.A.	N. Decl.	log r.	log Δ.
Nov. 1	8h 22m 36s	7° 12′	0·2620	0·1774
9.	8 31 52	5 42	0·2709	0·1659
17.	8 39 6	4 16	0·2799	0·1539
25.	8 44 14	2 59	0·2892	0·1425

THE CAPE OBSERVATORY.—The annual report of the Cape Observatory for the year 1924 deals with a very large amount of work. Investigations of special interest described in it are the parallax of Mars observed both visually and photographically at the near approach in August 1924, and the determination of the moon's semidiameter (15′ 32·70″±0·04″) and parallactic inequality from a long series of occultations going back to 1880. Both these investigations gave a value close to 8·805″ for the solar parallax, and the Mars investigation was the means of elucidating many points about atmospheric dispersion, etc., which will be useful at the opposition of Eros in 1931. The discussion of the motion of the moon's perigee and node agreed in giving 1/294·8 for the earth's compression.

The plates of the Cape Astrographic Catalogue are now being retaken through the glass, which will facilitate the determination of proper motions by placing them, film to film, against the earlier plates. Meridian observations of stars and heliometer observations of planets are also being carried on as usual. The working list for the former includes all stars brighter than 7·5 magnitude south of Decl. 30° south.

Research Items.

ANTIQUITIES FROM THE RUSSIAN ALTAI.—Dr. Alexis Zakharow, of the Russian Historical Museum, Moscow, describes in the Journal of the Royal Anthropological Institute, vol. 55, pt. i., some of the antiquities from two cemeteries on the Katanda Steppe, which were discovered by W. Radloff so long ago as 1865. These antiquities, however, have never been described. The first cemetery contained 30 to 40 tombs covered with mounds of round pebbles, and a row of flat barrows, which, however, Radloff considered to be places of sacrifice. In this cemetery were found skeletons of horses with bits of iron, human remains, male and female, knives of iron, and arrowheads of iron and bone. Spearheads with tubular sockets, and fragments of a bow, were among the objects found with male burials; copper ear-rings of spiral form were with the female skeleton. In the eighth and last kurgan excavated were fragments of garments. In the second cemetery, the most interesting objects came from a large kurgan more than seven feet high and 100 feet in diameter. The skeletons of at least six horses were found in this mound. There were also a number of garments and nine figures of horses carved in wood, of which five are in full profile, two with heads turned full face, and two lying down. Figures of other animals, such as a stag, a bear, and a dragon, were also found. Small kurgans in this second cemetery produced textile material of which the decorative pattern has been reconstructed. From this it is conjectured that it is Chinese in origin and belongs to the seventh or eighth century A.D.

THE NEOLITHIC AGE IN THE NORTHERN FAYUM, EGYPT.—A preliminary report by Miss Caton-Thompson on important finds made by her in the Fayum last season on behalf of the British School in Egypt appears in *Man* for October. They consisted of bone implements and pottery of Neolithic age from sites along the northern shore of the Qarun Lake. The investigations were undertaken to inquire into problems relating to the flint industry of the Fayum, and one of the results was the first discovery of pottery and bone implements to be associated with that culture. Though prehistoric sherds abound on the sites, few pots were found in sound condition. Many were practically powder only held together by salt. These had to be measured and drawn *in situ* without attempt at removal. The forms found were: globular with flattened base, globular with restricted top, rectangular dishes, cups, saucers. Some showed traces of a slip. All were badly fired. In the rectangular dish were found five lumps of hæmatite, two quartz pebbles, parts of a flint nodule, and twelve freshwater bivalve shells of *Spatha cailliardi* Martens. The bone implements, which were surface finds from lacustrine clays, consisted of harpoons, with barbs of a less acute angle than the Magdalenian specimens, and bone points, bevelled and showing striations for attachment. A unique specimen has a butt end which is squared off and a grooved spiral on the stem.

UTILISATION OF PEAT.—At the recent British Association meeting at Southampton, Dr. F. Mollwo Perkin gave an account of recent progress in the peat problem. The various types of peat were described, and emphasis placed on the central difficulty of reducing the water content of freshly dug peat (90 per cent. in round figures) sufficiently to permit any form of manufacture to be economically attempted. Maceration, heating and compression, electro-osmosis, chemical treatment, and combinations of several of these have been tried, mostly without success. It is believed that a combination of maceration, heating in an autoclave followed by sudden release of pressure, and briquetting will prove a solution. The briquettes are stated to prove well suited for use in domestic heating appliances, and are of course smokeless. A plea is made for the development of such a process for utilisation of peat to produce domestic and manufacturing fuel and useful by-products.

THE PLANT AS A MEASURE OF THE HABITAT.—Frederic E. Clements and Glenn W. Goldsmith publish many data in the Carnegie Institution Publication, No. 356, "The Phytometer Method in Ecology," on the growth and upon the performance of measurable functions, such as transpiration, by plants or small plant communities, which they consider form the most trustworthy index to the habitat. They consider that the increasing standardisation of such "phytometer" methods will cause them to replace the less satisfactory of the instruments designed to measure individual factors of the environment, such as the atmometer, etc. This may be so, but the individual plant is such a complex recording instrument that the interpretation of its record of the habitat, even as a guide to the behaviour of other reasonably similar plants, is often a very difficult problem, and probably it will be long before the student of plant habitat ventures to plumb the possibilities of the environment without the aid of a battery of physical instruments, each designed to record the fluctuation in one separate physical factor, as rainfall, humidity, temperature, etc.

TRANSPLANTING CROP PLANTS.—In the United States, the annual value of crops which are usually transplanted amounts to nearly 200,000,000 dollars, grown on an area of 1,289,000 acres, representing 57 per cent. of the acreage and 63 per cent. of the value of all vegetables other than potatoes. This renders the work by Loomis (Memoir 87, Cornell Experiment Station) on the value or otherwise of transplanting, of great commercial value. Transplanting is becoming recognised as an economic expedient not directly promoting the development of the plant. Experiments indicated that in the early seedling stages all vegetables could be transplanted with little or no injury, but with advancing maturity the injury increased in all cases, but more in some crops than others. The roots of transplanted plants were more branched than those not moved, but the general effect of the process was to retard development, the degree of retardation depending upon the plant, its age and the conditions of transplanting; to some extent, also, the total yield was reduced. All crops seemed to be equally resistant to rapid wilting at the time of transplanting, but they varied in their ability to withstand unfavourable conditions afterwards, presumably due to differences in the rate of re-establishment of their roots. The effects of hardening off seedlings were investigated by transpiration studies before and after transplanting, which showed a more rapid recovery of the normal rate in plants previously hardened, this recovery being apparently associated with quicker root development. A clear correlation has been established between ease of transplanting and rate of new root formation, plants seriously injured by transplanting showing normally rapid top growth and slow root replacement. Root replacement seems to be the largest single factor concerned in transplanting, though the age at which suberisation of the older roots occurs may also have some bearing upon the matter in its relation to their

power of absorbing water immediately after the root tips have been broken off when the plants are disturbed.

SOUTH AFRICAN WEEDS.—One of the heritages left to South Africa by the Boer War appears to be a number of troublesome weeds, and as "Weed No. 1" in the reprints issued by the Union Dept. of Agriculture appears such an introduction, the spear thistle, *Cnicus lanceolatus*. It is curious also to read in this series of the jointed cactus, *Opuntia aurantiaca*. Introduced in the Cape Province as a garden plant in 1878 the plant is now proclaimed as a most dangerous weed, which has rendered many farms quite valueless and will cost many thousands of pounds to eradicate. Thus its habit of growing from any small fragment, which pleases its cultivator under glass in Britain, is evidently very differently regarded now in South Africa. These reprints contain excellent illustrations in colour by K. A. Lansdell, the Botanical Assistant, Division of Botany, Pretoria. Whilst South Africa thus discovers invaders to the flora flourishing far too readily, it appears to be in danger of losing many valued native plants owing to the commercial traffic in these wild flowers. The Journal of the Botanical Society of South Africa (Part 11, 1925) therefore welcomes a new ordinance passed by the Cape Provincial Council which enables the police to seize protected flowers exposed for sale and the magistrate to inflict severer penalties. At the same time the list of protected flowers has been pruned so that the law is not unnecessarily invoked, and the hope is expressed that the law will now be generally respected and its provisions enforced. Apparently the trade in protected flowers has been so profitable that fines have been comfortably paid and the law has been dead letter in practice, so that during 1924–25 the Journal estimates that the native flora disappeared from this cause more quickly than ever before.

GLACIERS OF MOUNT EVEREST.—In an article in the *Geographical Journal* for October on the rocks and glaciers of Mount Everest, Mr. N. E. Odell describes a remarkable feature of the East Rongbuk glacier which takes the form of a corridor 50 feet deep and 100 feet wide, lying longitudinally in the glacier for about three miles between the altitudes of about 18,700 and 20,000 feet. The steep sides of this trough are buttressed or pillared with fretted ice. The trough lies about 400 yards from the left side of the glacier and seems to be coincident with a medial moraine, since moraine matter was found on many parts of the floor. At the upper end of the trough, when the winter snow had gone, Mr. Odell found clear evidence of severe stress in the form of "ribbon structure" in the ice, not to be confused with the bedded structure of glacier ice due to entirely different causes. From the evidence of foliation and faulting it would appear that the trough is due to actual fusion of the ice by heat engendered in the compression, accompanied by evaporation of the fused ice. The topography of the district and the course and gradient of the glacier flows show that this explanation is feasible. Mr. Odell believes the trough to be a permanent feature of the East Rongbuk glacier. In a later part of the article evidence is given for a former great extension of the glaciers of the Mount Everest region. A geological map accompanies the article.

THE CLIMATE OF ALEXANDRIA.—A discussion on the above, compiled by Mahmoud Hamed, has been issued by the Ministry of Public Works, Egypt, as Physical Department Paper No. 19 (Government Publications Office, Cairo, price P.T. 5). Meteorological observations were first made at Alexandria in 1869. From 1875, observations were made daily at 9 h. and 21 h., and from 1888 until 1900, observations were taken eight times daily. Afterwards, observations were under the control of the Survey Department and were made three times daily at 8 h., 14 h., and 20 h. In the spring, depressions from the Sahara sometimes pass over Alexandria and these "Khamsin" depressions usually bring hot south winds. During the summer the pressure system over Egypt remains almost undisturbed, and settled weather with cool northerly winds, and rather high humidity at Alexandria, prevails. The maximum atmospheric pressure occurs normally in January, but sometimes so early as November, or so late as February; the minimum pressure occurs in July. The coldest month is January with a mean temperature of 14° C., and the warmest is August with the mean 26°·2 C. The highest temperature ever recorded, since 1888, is 43°·7 C. on June 16, 1915, during the passage of a shallow depression over the Delta. The highest black bulb thermometer in vacuo reading at 14 h. is 64°·0 C. in May and June 1915. During the summer the sun is obscured by clouds only for about an hour and a half a day, while in the winter time it is obscured on the average for about four hours. On an average there are about five gales in the year, the majority occurring in December, January, and February. Tables and diagrams are given showing the average *meteorological* results. The whole work is well carried out and is of considerable interest.

PETROLEUM IN THE NETHERLANDS.—During the period 1903 to 1923 a systematic investigation into the mineral resources of the Netherlands was carried out on behalf of the Dutch Government, chiefly with the object of locating concealed coal deposits. The undertaking involved the sinking of fifty borings from 500 to 1400 metres in depth, one hundred borings varying from 25 to 200 metres, and a large number of shallow test-holes for geological examination of the superficial rocks. Operations were carried out mainly in three districts, South Limburg, North Limburg and North Brabant, and parts of East Guelderland and East Overijsel. In the last-mentioned district an interesting discovery was made of petroleum associated with Permian salt deposits overlying coal beds. A boring at Corle (1921 to 1923) had yielded gas- and oil-impregnated cores of salt, and when Government operations ceased in 1923 it was resolved to examine this well more closely for oil. Since the boring had been made primarily for salt recovery, the casing had been constantly filled with water, under high pressure, and whatever oil indications there might have been, had thus been obscured. Accordingly the water was pumped from the boring and in February 1924, and for some time afterwards, a quantity of mineral oil accumulated, of which some 250 litres were collected and submitted to laboratory testing. Dr. P. Tesch, director of the Dutch Government Geological Service, gives some account of these results in Economic Intelligence, published at the Hague on August 1, and states that the oil was thin, had a specific gravity of 0·84, and yielded on distillation 10 per cent. of benzine, 30 per cent. of kerosene, 55 per cent. of fuel oil, and 3 per cent. asphalt, no lubricating fractions being found. Dr. Tesch concludes that the oil originated in the Permian salt beds, and having regard to the position of the particular locality on the border zone of the Munster basin, and probably to the fact that petroleum has often been found in association with the German salt deposits, he is of the opinion that prospects are not unfavourable but, in fact, justify a continuance of exploratory operations.

These have now been taken in hand by private enterprise, but whether commercial success will ensue is a moot point.

THE THEORY OF FERROMAGNETISM.—A new theory of ferromagnetism is put forward by Mr. L. W. McKeehan in the August number of the *Physical Review*. It is assumed that magnetisation is due to intra-atomic changes, involving changes in the orientation of electronic orbits which are governed by quantum dynamics, and to inter-atomic changes (stresses and strains between the atoms). Magnetostriction, the change in dimensions which takes place in the material, originates in the changes of electronic arrangement in the atoms producing atomic magnetostriction; this sets up the inter-atomic stresses and strains. Hysteresis loss and magnetic hardness are due to the energy required to produce the local deformations which take place when successive atoms or small groups of atoms are magnetised. The very low hysteresis loss and the very high initial permeability observed in permalloy by Messrs. O. E. Buckley and L. W. McKeehan, and described by them in the same issue of the *Physical Review*, result from the fact that magnetostriction has opposite signs for the two constituents iron and nickel of this alloy, and that in small groups of atoms the atomic magnetostrictions compensate. The differences between the magnetic properties of iron, nickel, and cobalt are regarded as due to the differences between their atomic magnetostrictions. The theory gives a satisfactory explanation of the form of the B, H magnetisation curve, and is not inconsistent with the observations of Buckley and McKeehan, which show that with about 81 per cent. of nickel the magnetisation curve of permalloy is practically independent of the mechanical tension.

SOLID PHASES OF THE ALUMINIUM-ZINC SYSTEM.—The equilibrium diagram of the aluminium-zinc system has been studied by many investigators, notably Heycock and Neville, Shepherd, Rosenhain and Archbutt, Hanson and Tanabe. In all these diagrams the liquidus consists of three branches, in which, in the majority of cases, the results agree with each other. The solidus and solubility lines in the solid phases show, however, a great divergence from each other. Hitherto the majority of changes in the solid phases have been investigated by the quenching method. A recent investigation by T. Isihara, published in the 97th Report of the Research Institute for Iron, Steel, and other Metals in Japan, was undertaken in order to find a correct equilibrium of the solid phases by determining the electrical resistance and volume changes of the various phases, and also by using X-ray analysis as a supplementary aid. As a result of this work a number of alterations are suggested for the diagram. The maximum solubility of aluminium in the α constituent is found to be 0·3 per cent. at room temperatures. The author regards the β constituent as a solid solution containing an unknown concealed compound. The range of the eutectoid transformation extends from 0·3 to 65 per cent. of aluminium. The actual eutectoid composition has been found to be 21 per cent. of aluminium. The solidus of the β phase varies from 380° to 440° C., according to the concentration of aluminium. The solubility of zinc in γ varies considerably with rise of temperature. Its maximum at room temperature is 23 per cent.

THERMAL DECOMPOSITION OF OZONE.—Some experiments are described by Griffith and McKeown in the Journal of the Chemical Society of September 1925 which help to eliminate the discrepancies existing between the results of measurements of the thermal decomposition of ozone. The decomposition is carried out with ozonised oxygen under varying pressures, alone, and in the presence of argon, nitrogen, carbon dioxide, and helium. These gases exert a positive "catalytic" effect, but oxygen acts as a negative "catalyst." The explanation of these results is based on the idea that complexes are formed and these are decomposed by collision, the complex yielding ozone in the presence of oxygen, and oxygen in the presence of the inert gases.

INFLUENCE OF ULTRA-VIOLET LIGHT ON CHEMICAL REACTIONS.—The results of experiments on the effect of ultra-violet light on dried hydrogen and oxygen have been published by H. B. Baker and M. Carlton in the Journal of the Chemical Society for September 1925. The gases, prepared from baryta solution by electrolysis, were collected over mercury in pairs of carefully cleaned quartz tubes; one dried with a plug of phosphorus pentoxide, the other left undried. The tubes were exposed to the light from the lamp after periods of two to eight, and in one case twelve weeks. In all the experiments the reaction was greater in the tubes containing the undried gases. The water formed in the earlier stages assisted the reaction if the gases were exposed to the light again before the drying agent could remove it.

AN ALTERNATIVE VIEW OF THE STRUCTURE OF PROTEIN.—Prof. Keita Shibata has a very interesting preliminary note on new views and experiments upon protein structure in the Japanese journal *Acta Phytochimica*, vol. 2, No. 2, April 1925. Whilst the twenty or so amino-acids which form on the usual view the "bausteine" of the proteins have now been known for some time, there are still singularly few observations which throw any light upon the way in which they are linked in the natural proteins, and Fischer's classic suggestion, of chains of polypeptide character, is based mainly upon the synthesis of relatively simple and diffusible polypeptides by methods which are probably inapplicable in a living system. Of recent years the long peptide chain has come under criticism again, and the suggestion of anhydrides, a type of "peptin ring," been made. Prof. Shibata has been thinking of possible analogies with the complex carbohydrates, upon the structure of which so much light has been thrown of recent years, and thus has been led to the attempt to "depolymerise" proteins by analogous methods, such as heating in anhydrous glycerine. The method has met with considerable success, many proteins passing completely into solution, and the substances thus obtained are never free amino-acids and peptides, but considerable yields of crystalline bodies are obtained, which may be recognised as anhydrides of the type of diketopiperazin derivatives. Naturally amino-acids or peptides may be attached as short side chains to these bodies; Shibata thinks that the ammonia given off during the depolymerisation arises from the free acid amide groups of those anhydrides which contain asparagin or glutamin as components. During the progress of the depolymerisation the biuret reaction is lost, and it is known that anhydrides such as asparaginimid give the violet reaction with alkali and copper salts. Furthermore, by heating anhydrides of amino-acids in glycerine in the presence of small crystals of barium hydroxide, Shibata has obtained, on subsequent precipitation with alcohol, substances which enter into colloidal solution in water, do not readily dialyse, and give many of the reactions of proteins. Further details of this important work will be awaited with interest.

The Wheatstone Memorial at Gloucester.

AS was mentioned briefly last week, p. 623, on October 19 Sir Charles Sherrington, president of the Royal Society, unveiled at Gloucester a bronze memorial tablet to Sir Charles Wheatstone, who was born at Barnwood, Gloucester, on February 6, 1802, and died in Paris, October 19, 1875. The memorial tablet is placed on the outer wall of St. Michael's Church, and on it is reproduced in low relief the portrait of Sir Charles Wheatstone, by Samuel Laurence, in the National Portrait Gallery. The lettering beneath the portrait is as follows :

SIR CHARLES WHEATSTONE
D.C.L., LL.D., F.R.S.

BORN AT THE MANOR HOUSE, BARNWOOD, GLOUCESTER, 6 FEBRUARY, 1802.

Pioneer of the Electric Telegraph and the first, with (Sir) Wm. F. Cooke, to render it available for the public transmission of messages, 1837. Inventor of the Stereoscope, 1838. Conducted the first experiments in submarine telegraphy, 1844. Contributed to our knowledge of Acoustics and of Spectrum Analysis. Invented the Rheostat, the Polar Clock, the Automatic Transmitter and Receiver and the Rotating Mirror for determining the speed of Electricity. Applied and improved the Resistance Balance of Christie, known as the "Wheatstone Bridge." Invented the self-exciting shunt-wound Dynamo, 1867. Knighted, 1868.

DIED IN PARIS, 19 OCT., 1875.
BURIED AT KENSAL GREEN CEMETERY, LONDON.

To commemorate his Services to Science this Tablet is placed here on the 50th anniversary of his death.

Previous to the unveiling, a meeting was held in the Gloucester Guildhall, at which the Mayor (Mr. F. W. Duart-Smith) presided. At this meeting Sir Charles Sherrington, representing the Royal Society, Mr. R. A. Chattock (president of the Institution of Electrical Engineers), Col. H. G. Lyons (director of the Science Museum), Mr. F. E. Smith (president of the Physical Society), and Mr. J. C. W. Reith (British Broadcasting Co.) paid tribute to the many achievements of Wheatstone, and particularly to his genius of application ; he was one of the great experimenters of last century, and his discoveries led to marked progress in many branches of physics. The early advances made in telegraphic communication were in no small measure due to him, and his discovery of the self-exciting property of the shunt-wound dynamo was of tremendous importance. Mr. William Bellows, of Gloucester, spoke of the home life of Wheatstone ; he was a man of extreme modesty and failed as a lecturer : on the other hand, he possessed a personality that inspired confidence, and his genial manner to those helping in his experiments endeared him to all in his laboratory.

Sir Charles Sherrington, in the course of his address, said that as the years go by, the recollection of what Wheatstone did, not only for Great Britain but also for the whole civilised world, becomes more and more significant and an inspiration to all who contemplate it. Last century brought to light an increased knowledge of the processes of Nature and a more complete understanding of the laws which govern them, thus putting into men's hands new means of harnessing Nature's powers for the service of man and of civilisation. Amongst those to whom that advance is due was Charles Wheatstone, who will for ever be regarded as one of the most outstanding men of his time. That was apparent and recognised during his lifetime and he received many honours, yet the far-reaching character of his achievements could not have been so evident as they are now, viewed along the perspective of the years. The flight of time has brought still further an unexampled fruition to the scientific ideas and their practical application which his genius fostered and cultivated.

If the lessening of the great spaces and distances which sunder human communities one from another on the surface of the earth, and if the enabling of them to communicate and converse as though they were near neighbours, is to help human kind and to support and advance civilisation, then the telegraph is one of the most noteworthy of human triumphs, and Charles Wheatstone was one of the benefactors of the human race.

Wheatstone always strove to enhance the practical application of science to the needs of man, but he also strove unceasingly to penetrate philosophically the secrets of Nature for the sake of truth itself. The method of electrical measurement which goes by his name is a model of elegance and accuracy. His genius had that trait of creative imagination which enabled him to foresee whither the new facts he observed might lead the spirit of man in its analysis of material Nature. Thus in an early and fundamental contribution which he made ninety years ago to what has since become a special branch of physical science, spectrum analysis, he wrote a prophetic announcement, and it is not too much to say in fulfilment of those observations that the opinion of Wheatstone stands as precursor of some of the most far-reaching investigations that we possess to-day into the physical and chemical structure of the universe.

Gifted with musical tastes, Wheatstone was in early life a maker of musical instruments. He soon contributed a number of experiments of much beauty towards the analysis of musical sounds. Akin to those may be regarded his observations on vision, his invention of the stereoscope, and his discovery that the mind can, from two flat but slightly dissimilar pictures simultaneously presented to the eyes, obtain in full perspective and with startling distinctness the third dimension of sensual space. It is interesting that to Wheatstone, the physicist, should thus be due a fundamental observation in modern psychology bearing on the synthetic powers of the mind. This formed the subject of his Bakerian lecture to the Royal Society in 1852.

Wheatstone's connexion with the Royal Society was long and intimate. He was elected when quite young, and remained a fellow of the Society until his death—a period only a few months short of forty years. He had the unusual honour of receiving two Royal medals, and twice he delivered the Bakerian lecture to the Society. Finally he received the "blue riband" of the Society, the Copley Medal, which is awarded without distinction of country for research work.

Wheatstone was indeed a man of many gifts and activities. Perhaps the time is approaching when the advance of science will depend more and more on collective investigation—when individual share towards the achievement of great results will loom less large by reason of the completer organisation of the investigations, so that the grand total will come to be attained by the participation of many investigators. But in all such achievements there will be leaders. Such was Charles Wheatstone, and such is his memory to-day. He was a leader in the making of the intellectual edifice of his time.

The University of Leeds Appeal.

THE appeal of the University of Leeds for 500,000*l.* was launched on Friday, October 23, under excellent auspices. As patron of the appeal, the Duke of York was able to announce in the Majestic Theatre, at a large and representative gathering drawn from all parts of Yorkshire, that the campaign was opened with a total sum, in hand or promised, of 157,039*l.* Considering the depressed industrial conditions at the present time, this can very reasonably be taken as an excellent beginning. The comprehensive nature of the subscription list indicates the widespread interest that has been aroused by the case put forward by the University authorities.

The rapid growth of the University since the War has produced a situation in which it is almost impossible to carry on the work efficiently unless the accommodation is extended. The present number of students is more than twice as large as before the War; the staff has been doubled; but the buildings, save for some temporary erections, remain the same. The work is handicapped by overcrowding and by the use of unsatisfactory temporary sheds and converted dwelling-houses. Departments are split up into several parts separated from one another. The proper co-ordination of the work becomes extremely difficult, if not impossible. In particular, the library, so essential to university work, is in respect of housing most defective of all. With so strong a case to put before the public, it is not surprising that widespread interest has been aroused.

Founded as the Yorkshire College of Science in 1875, and granted a Royal Charter in 1904, the University of Leeds has grown with astonishing rapidity. At the coming of age celebrations last year, delegates from all parts of the British Empire showed their appreciation of the position which it holds at present in university life. The success which has attended it during the last twenty-one years is a measure of its embarrassments at present; and it is to get rid of these embarrassments that the appeal has been put forth. It is intended to substitute for the chaotic collection of private houses and temporary hutments, which at present supplement the premises of the University, a range of buildings suitable for university work, and, at the same time, worthy of the dignity of a university.

The meeting in the Majestic Theatre was a memorable one. The Vice-Chancellor (Dr. J. B. Baillie), who, in the enforced absence of the Chancellor, the Duke of Devonshire, presided over the great gathering, opened with an eloquent and felicitous speech, and the high note then struck was maintained throughout. He was followed by the Duke of York, who, in the course of an inspiring appeal, said: "You, as Yorkshiremen, will do well to consider how valuable an asset to your county and your commerce, your industries, and your population, is the University of Leeds. The teaching and research work undertaken in all its forty departments contribute directly and indirectly to the services of the community."

The Speaker of the House of Commons, Mr. J. H. Whitley, M.P., in a message of encouragement and hope, incidentally referred to the fact that he was once a teacher himself, and that in his connexion with education in the West Riding he felt there was "an inexhaustible amount of both talent and character in the humbler homes of our people." The influence of impressive buildings was touched upon in characteristic fashion by the Dean of York (Dr. Foxley Norris), now Dean-elect of Westminster. While not quite convinced that the University of the North ought not to have been at York, he was sent to say that York would do its best to help the scheme for Leeds. Mr. Philip Snowden, M.P., who is a native of the West Riding, in a closely reasoned speech, said much to the point upon the functions of a university. He would like to see our universities even more democratic than they are. Without being misunderstood, he would rather see the desired half-million raised by the pound contributions of 500,000 comparatively poor people than by the large and generous gifts of a few wealthy people. He hoped that trade unions, co-operative societies, and other working-class organisations in the West Riding would take up the matter of the appeal and thus show their desire for the extension of democratic education. The Marquis of Hartington, M.P., brought a message of hope and encouragement from his father, the Chancellor of the University. A memorable meeting ended on a note of confidence and optimism, but with the words of the Vice-Chancellor in mind: the first hundred thousand ensures against failure; the last hundred thousand ensures success.

Inheritance and Insanity.

THIS year's Harveian Oration before the Royal College of Physicians of London was delivered by Sir Frederick Mott on heredity in relation to mental disease. A subject of more pressing urgency and general public interest could scarcely have been chosen. The gravest problems of individual ethics and State medicine depend entirely for their solution on the state of our knowledge concerning it; yet precise knowledge is fragmentary and may be misleading.

Sir Frederick Mott cited the inquiries of Miss Agnes Kelley a little more than ten years ago into the pedigrees of three groups of persons: adult patients in the London County asylums, high grade mental defectives, and normal children from the elementary schools of Bethnal Green, London. Insanity was very much more prevalent in the pedigrees of insane persons than in those of mental defectives, being in the proportions of 50 per cent. and 25 per cent. Conversely, mental deficiency was more apparent than insanity in the family histories of the defective children; while the charts of the normal school showed insanity and mental deficiency only in a very small percentage of cases. Further, Sir Frederick and his co-workers collected information, extending in many instances to four and five generations, concerning 4000 individuals at one time or another in London County asylums, and came to the conclusion that there was a signal tendency to antedating in respect of dementia præcox, manic-depressive insanity and involutional melancholia: that is to say, if a parent suffered from manic-depressive insanity, or a parent or grandparent suffered from involutional melancholia or senile dementia, one or more of the descendants might suffer from dementia præcox during adolescence.

Sir Frederick, however, gave no indication of the effect on these conclusions of the present tendency to broaden the clinical conception of stereotyped, adolescent, dementia præcox which fits so neatly into board of control schedules and asylum administration. A parallel criticism occurs in consideration of his views on the genetic origin of this disease set forth in considerable detail in the course of the oration. He

outlines a correspondence between the activity of the interstitial cells of Leydig in the testis and the inception of the great sexual occurrences in ontogeny, the determination of sex and the acquirement of functional activity. Yet he says that *at birth* there was "plenty of evidence of nuclear mitosis, and I came to the conclusion that numbers of the cells had attained maturity and were on the way to a regressive atrophy." At puberty the cells of Leydig reappear, after "commencing manifestations of nuclear activity and karyokinetic figures" at eleven years. What ontogenic event coincides, then, with the "maturity" of these cells at birth?

It is evident that we know far too little of the histological appearances of the endocrine glands at successive ages in the normal animal, and of their influence upon the body functions at different periods or at any period of life. But Sir Frederick Mott is to be congratulated upon a continuity of effort in the elucidation of a baffling problem. It is to be hoped that his great labours, no less than the eminence of his advocacy, will encourage a more concerted attack upon the manifold problems of mental fitness.

The French Congress of Industrial Chemistry.

THE fifth French Congress of Industrial Chemistry was opened at Paris on October 4, under the auspices of the Société de Chimie Industrielle, and was organised in conjunction with the Exposition Internationale des Arts Décoratifs at the Grand Palais and with the centenary of Chevreul's discoveries of the nature of fats and his manufacture of the stearine candle. The Congress was preceded by a series of non-technical addresses on the applications of chemistry to a number of industries, and by a reception at the Grand Palais. The formal opening of the Congress on October 5 was presided over by Monsieur de Monzie, the Minister of Public Instruction; it included an address by Sir Robert Hadfield on his own recollections of metallurgy in France. The Congress then resolved itself into sixteen sections, in each of which important papers on many branches of chemical industry were read and discussed. The official banquet was held at the Palais d'Orsay, the chair being taken by Monsieur E. Borel, Minister for the Marine, and the formal adjournment of the Congress took place on October 8 under the presidency of Monsieur C. Chaumet, Minister of Commerce. The following two days were spent in visits to works, one group of those present inspecting factories in the neighbourhood of Paris and a second travelling to Grenoble to visit the international exhibition of water-power and works in the vicinity.

The celebration of the discoveries of Chevreul on fats and oils was held at the National Museum of Natural History, in which Chevreul did his work, on Sunday, October 11. The place of honour was taken by the President of the French Republic, Monsieur Doumergue, and, after a number of short speeches, Prof. Henry E. Armstrong delivered an appreciation of the work of Chevreul and its consequences; the silver gilt medal of the Société de Chimie Industrielle was presented to Prof. Le Chatelier and to Prof. Armstrong. The proceedings terminated in a banquet at the Club, which was during the War the Cercle Interallié and is now La Bienvenue Française. The British delegates to the Congress included Prof. Armstrong, Mr. E. C. Evans, Prof. C. S. Gibson, Mr. A. J. Greenaway, Sir Robert Hadfield, Mr. E. A. Hailwood, Sir Frederick Nathan, Sir W. J. Pope, Dr. S. Miall, Mr. A. R. Smith and Mr. E. A. Umney.

One of the most striking features of this very successful Congress, in addition to the admirable manner in which it was organised and fitted in with the exhibition and the Chevreul centenary, was the fact that quite a number of Cabinet ministers took an active and even an enthusiastic part in the proceedings. Each of these gentlemen, when he spoke, showed a clear appreciation of the importance of pure science and of its applications to industry; it is an unfortunate fact that we cannot imagine a number of Cabinet ministers taking an active and appreciative part in a congress of applied chemistry in Great Britain.

W. J. P.

University and Educational Intelligence.

CAMBRIDGE.—Lists of candidates who have passed the recent First and Second Examinations for Medical and Surgical Degrees have appeared. In the First Examination lists the number of those who satisfied the examiners before matriculating—which in most cases means that they received the necessary instruction at school—is large; the percentages of non-matriculated candidates on the several pass lists being: Pt. 1 (Chemistry), 60 per cent.; Pt. 2 (Mechanics), 80 per cent.; Pt. 3 (Physics), 67 per cent.; Pt. 4 (Biology), 40 per cent. More of these candidates take the examinations in October than at any other season of the year, but the figures quoted emphasise the fact that, while most of the public schools make it their business to prepare boys for the chemistry and physics, not a few are now also able to do so in biology.

Authorisation has been granted for the following reappointments: Dr. Duckworth (reader in human anatomy); Prof. W. E. Dixon (reader in pharmacology); Mr. S. W. Cole (lecturer in medical chemistry); Dr. T. S. Hele and Dr. F. J. W. Roughton (lecturers in biochemistry); Dr. Shillington Scales (lecturer in medical radiology and electrology).

The following have been elected to fellowships at Trinity College: Prof. G. E. Moore, Mr. A. S. F. Gow, Mr. R. V. Southwell, Mr. P. W. Duff, Dr. J. A. Chadwick, Mr. H. O. Evennett, Dr. P. Kapitza.

At Corpus Christi College Mr. T. R. B. Sanders has been appointed lecturer in engineering, while Mr. C. H. E. Smyth and Mr. R. A. Butler have been elected fellows.

At Emmanuel College the following have been awarded Research Studentships: Mr. E. G. Lewis (External), Mr. G. E. Hutchinson (Honorary), and Mr. C. Rimington, whilst grants for research have been made to Mr. A. Sopwith, Mr. W. L. Cuttle, and Mr. R. A. R. Hartridge.

The following reappointments have been made: Mr. J. T. Saunders, fellow and tutor of Christ's College, to be demonstrator of animal morphology; Mr. H. H. Brindley to be demonstrator of biology to medical students.

The Lees Knowles Lectures on military science are to be given by Maj.-Gen. Sir Frederick Maurice, K.C.M.G., whose subject will be "Statesmen and Soldiers in the American Civil War."

The degree of Doctor of Science *honoris causa* is to be conferred on Sir Edgeworth David, professor of geology at the University of Sydney. There is a pleasant rumour abroad to the effect that Sir David intends to spend some weeks in Cambridge in the near future.

EDINBURGH.—The following changes in the staff have recently taken place: Prof. J. Shield Nicholson has resigned the chair of political economy, which he has held for forty-five years; Prof. Godfrey H. Thomson has taken up duty as professor of education in succession to the late Prof. A. Darroch; Mr. A. D.

Hobson has been appointed lecturer in experimental zoology, and Mr. S. W. P. Steen and Dr. A. C. Aitken lecturers in mathematics.

LEEDS.—At a meeting on October 21 the Council expressed its thanks for the contribution promised by the Worshipful Company of Clothworkers towards the further development, equipment, and maintenance of the Textile Industries and Dyeing Departments of the University. This increased financial assistance provides for a capital grant of 18,300*l.* on buildings and permanent equipment, and for an additional annual grant of 3000*l.* during the next seven years to ensure the more efficient maintenance of these Departments. The grants made for capital endowment (buildings and equipment) since the institution of the Yorkshire College of Science now amount to 98,488*l.*; the annual grants made from 1874 to the present year amount in the aggregate to 144,804*l.*

An offer by Col. Stephenson Clark, Past-Master of the Clothworkers' Company, of a fund of 1000*l.* for the establishment of a scholarship tenable in the Clothworkers' Departments, was accepted with most grateful appreciation. A fund amounting to 2079*l.* was handed over to the Council for the establishment of a scholarship to be known as the "Arthur Smithells Scholarship." The Exchequer Grant allocated to the University by the University Grants Committee has been increased by 14,000*l.* a year.

On the grounds of intellectual distinction and of long and meritorious service to the University the title of emeritus professor was conferred upon Dr. T. Wardrop Griffith, who recently retired from the chair of medicine.

APPLICATIONS are invited by Guy's Hospital Medical School for the Beaney scholarship in materia medica. The scholarship, which is of the annual value of 50*l.* and tenable for three years, is open to candidates who have received part, at least, of their medical education at Guy's Hospital. The latest date for the receipt of applications, which should be sent to the Dean, is December 19.

A COURSE of four "Armourers and Brasiers' Company" lectures on "Metal Crystals," appealing to those engaged in metallurgy, engineering, and allied industries, and to students of chemistry and physics, is to be delivered at the Chelsea Polytechnic, Manresa Road, S.W.3, by Prof. H. C. H. Carpenter, on November 5, 12, 19, and 26. The lecture hour will be 8 o'clock and admission will be free without ticket.

THE new engineering laboratories of the University College of Swansea were to be opened on October 30 by Lord Eustace Percy, president of the Board of Education. The buildings provide a floor area of 16,000 sq. ft., and this development has been made possible by the generosity of local engineering firms and collieries. The nucleus of the fund of 50,000*l.*, which is the sum required for the whole building scheme, was provided by the Welsh Engineers and Founders' Association and some donations from anthracite colliery owners led by Mr. C. F. Cleeves. The value of the plant which has been presented to the Department of Engineering now amounts to 10,000*l.*, and includes an experimental boiler plant obtained by the generosity and exertions of Sir James Kemnal. With the aid of this plant and backed by the local coal and oil industries, it is intended to make combustion engineering a prominent feature in the work of the Department. Organised visits to works are contemplated, while a course in the theory of accounts and works costing is being given voluntarily by Mr. R. A. Wetherall, Borough treasurer to the Corporation of Swansea.

Early Science at Oxford.

November 2, 1683. It was ordered, that a Loadstone should be cut *secundum Axem*, and then one half of it *secundum Æquatorem*; and triall be made, whether ye parts will retain ye same poles, which ye whole had. Mr. Piggot proposed an experiment viz: that ye needle of a compass will change its place at ye approach of ye *centre* of gravity of a bar of Iron, drawn up perpendicularly, from ye earth, by it. He was desired to try this experiment, before ye company ye week following. Dr. Wallis was then pleased, to shew us a draught of a chimney-peice, in ye Rectory House at Helmsdon, in Northamptonshire, which has ye date of ye Lord 1133 on it, in numeral figures; from whence it seems to appear, that numeral figures were in use amongst us, about 120 years sooner, than is generally supposed.

Dr. Aldrich discoursed of ye necessity of (at least) two drums in ye ear, otherwise in probability, he said, fourths would be agreeable notes. The anatomists are desired, to make use of what opportunity they shall have, for a farther enquiry into this matter.

1686. The Society having adjourned during ye long vacation, this day met again, and design constantly to continue their meeting.

An account was received from Dr. Wallis of a child which had on each hand 6 *fingers*, and on each foot six toes.

A Specimen from Dr. Lane of a strange *earth* which has a strong scent like Oyl of Turpentine, and upon distillation yeilds a good quantity of Chymical Oyl.

November 3, 1685. A letter was read from Mr. Ash concerning a girl in Dublin, who has several horns growing out of her skin.

Dr. Garden of Aberdeen communicated more of his observations concerning weather.

November 4, 1684. Mr. Musgrave communicated an account of a large preternatural Glandulose substance growing between the pericardium and ye heart of an Ox. The weight of ye whole substance, cleared from ye little fat &c: adjoyning to it, amounted to 19¾ lb. As to its figure it so far resembled a heart, that it was a long time taken for nothing else; but it was something flatter than a heart is naturally, each of ye flat sides makeing an equilateral triangle. In ye lungs were severall Cystides containing matter more or less fluid: one very large Cystis held some ounces of a matter not unlike that of a Steatoma.

The butcher who killed this Ox, says ye lungs grew fast to ye Pleura on both sides, which he affirms not to have happened once in 40 times in ye Cattle killed by him. He says also that this Ox though not overburdened with fat, complained much in travailing, which is easy to account for, there being not room for ye heart to be distended, as it ought, in its diastole.

Then Dr. Plot shewed some Saffron, which grew in Hereford-shire; its taste was tart enough, and it seemed little unlike our best saffron, wanting only its bright or yellow-red colour, and being of a much browner and darker hue, which also by some was supposed chiefly owing to its being very dry.

He shewed us likewise an *Ovum Centeninum*, which was given him that week for ye supposed Cocks-egg. It was somewhat bigger than a Pigeon's egg, of a pale box-colour, but opening it we found it nothing nigh full, otherwise not differing from an ordinary egg. So that we suppos'd it might be ye first egg of some young Pullett, one of the Society affirming, that he knew, some years since, a chick, which, wanting a day, or two of three months old, began to lay, and the eggs for some weeks were scarce bigger than this.

Societies and Academies.

LONDON.

Optical Society, October 15.—C. V. **Raman** and Sushil Krishna **Datta**: On Brewster's bands. The paper considers the explanation of Brewster's bands and other allied phenomena from the viewpoint proposed by Schuster (*Phil. Mag.*, Oct. 1924). When monochromatic light is reflected by or transmitted through two parallel plates in succession, a superposition of the Haidinger ring-systems due to the two plates is obtained. When non-homogeneous light is used, the Haidinger rings disappear and also the superposition pattern, except in the special case of the differential system of the first order for two plates of equal thickness. A simple geometrical explanation is thus forthcoming why Brewster's bands can be observed even in non-homogeneous light with thick plates in this case.—T. **Smith**: Lagrange's theorem and stationary functions. Lagrange's theorem for several variables is expressed in a concise notation and used to evaluate a function which is stationary for small changes in each of its variables.—W. G. **Collins**: Some new instruments for recording rapidly varying phenomena. In these instruments a fine stylus terminating in a highly polished spherical surface of small radius rests on a travelling strip of transparent celluloid. A record of the movement of the part of the instrument to which the stylus is fixed is obtained by the permanent deformation of the surface of the celluloid by the stylus. As this deformation is produced by very slight pressure and no material is removed from the celluloid, the energy required to produce the record is very small. Only a comparatively small amount of celluloid film is required, and the record is immediately available for examination by optical methods.

ROME.

Royal Academy of the Lincei: Communications received during the vacation.—U. **Cisotti**: Properties of functions of complex variables on any surface.—Leonida **Tonelli**: Convergency of Fourier's series.—Mineo **Chini**: Determination of the geodetics of certain surfaces.—Luigi **Fantappiè**: Resolution of a class of integral equations of the first species with constant limits.—Orazio **Lazzarino**: Conditions of existence of Volterra's reciprocity theorem.—Stefan **Mazurkiewicz**: Functions satisfying a generalised Lipschitz condition.—Alfredo **Sabbatini**: Integral quadratic equations with variable limits.—E. **Fermi** and F. **Rasetti**: Effect of an alternating magnetic field on the polarisation of resonance light.—Felice **Garelli**: Contribution to the cryoscopy of solutions of gases in various solvents.—Antonio **Pieroni**: Certain derivatives of pyridine.—Luigi **Rolla** and Giorgio **Piccardi**: Chemical statics of electronic phenomena. The qualitative and quantitative application to ionisation phenomena of the law of mass action and of laws derived therefrom is demonstrated, and a method is developed for the calculation of the potential of ionisation.—Maria **De-Angelis**: New observations on dachiardite. The results of crystallographic measurements of well-formed crystals are given.—C. **Jucci**: The third generation of crosses between silkworms of three or of four mutations. Is the "mutation number" a unitary Mendelian character?—G. **Bergami**: Influence of the embryonal trephones on the cicatrisation of wounds.—Vincenzo **Rivera**: Cure of certain vegetable tumours by means of X-rays. Cultures of *Bacterium tumefaciens* on peptone-agar are not affected by exposure to X-rays, whereas the tumours produced by this organism on *Ricinus communis* or *Pelargonium zonale* are arrested and destroyed by the rays, the plants afterwards exhibiting normal development.

Official Publications Received.

Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1924–25. (Cmd. 2491.) Pp. iv+155. (London: H.M. Stationery Office.) 3s. net.

The East London College (University of London). Calendar, Session 1925–1926. Pp. 180. (London: Mile End Road, E.1.)

Charles' University of Prague (Founded 1348): Faculty of Science. Prospectus for Foreign Students, Session 1925–26. Pp. 16. (Prague.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1924. By William Henry Fox. Pp. 68+3 plates. (Brooklyn, N.Y.)

Studies on the Variation, Distribution and Evolution of the Genus Partula: the Species of the Mariana Islands, Guam and Saipan. By Prof. Henry Edward Crampton. (Publication No. 228a.) Pp. vii+116+14 plates. (Washington: Carnegie Institution). 3.75 dollars.

Interferometer Experiments in Acoustics and Gravitation. By Prof. Carl Barus. Part 3. (Publication No. 310, Part 3.) Pp. ix+165. (Washington: Carnegie Institution.)

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 22: Some Corals from American Samoa and the Fiji Islands. By Prof. J. Edward Hoffmeister. (Publication No. 343.) Pp. v+90+24 plates. (Washington: Carnegie Institution.)

Proceedings of the United States National Museum. Vol. 66, Art. 17: Illustrations of Unfigured Types of Shells in the Collection of the United States National Museum. By William Healey Dall. Pp. 41+36 plates. Vol. 66, Art. 22: Miocene Gastropods and Scaphopods from Trinidad, British West Indies. By Wendell C. Mansfield. Vol. 67, Art. 19: The Adaptive Modifications and the Taxonomic Value of the Tongue in Birds. By Leon L. Gardner. Pp. 49+16 plates. Vol. 67, Art. 20: A Revision of the Insects of the Aphid Genus Amphorophora. By Preston W. Mason. Pp. 92+18 plates. (Washington: Government Printing Office.)

Ceylon Journal of Science. Section A: Botany. Annals of the Royal Botanic Gardens, Peradeniya. Edited by T. Petch. Vol. 9, Part 3, August 14th. Pp. 243-350. (Peradeniya: Director of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

Report on the Administration of the Meteorological Department of the Government of India in 1924–25, and a General Survey of Half a Century's Work since the Establishment of the Department. Pp. 34. (Simla: Government of India Press.)

Journal of the Photomicrographic Society. Vol. 13, 1924. Pp. 57+4 plates. (London: 4 Fetter Lane, E.C.4.) 7s. 6d.

London School of Hygiene and Tropical Medicine. First Annual Report to the Court of Governors, 1924–25. Pp. 10. (London.)

London School of Hygiene and Tropical Medicine. Report on the Work of the Tropical Division for the Year ended July 31st, 1925. Pp. 16. (London.)

Journal de la Société des Américanistes de Paris (reconnue d'utilité publique). Nouvelle Série, tome 17. Pp. xxi+509. (Paris: 61 rue de Buffon.) 40 francs.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 283: Astronomic Determinations by United States Coast and Geodetic Survey and other Organizations. By Sarah Beall. (Special Publication No. 110.) Pp. v+337+13 plates. (Washington: Government Printing Office.) 80 cents.

Diary of Societies.

SATURDAY, OCTOBER 31.

BRITISH ASSOCIATION OF CHEMISTS (Annual General Meeting) (at Midland Hotel, Manchester), at 3.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (Annual General Meeting) (at Newcastle-upon-Tyne), at 3.—H. P. Mould: Modernisation of Old Collieries.

MONDAY, NOVEMBER 2.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Mr. Shattock: Demonstration of Specimens in the Museum of some Bone Tumours.

ROYAL INSTITUTION, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—G. O. Case: The Influence of Aggregates on the Strength and Properties of Concrete.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol), at 6.—J. W. Beauchamp: Domestic Electrification (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—A. E. Malpas: Chairman's Address.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—C. S. Garland: Taking Stock.

TUESDAY, NOVEMBER 3.

LEEDS PHILOSOPHICAL AND LITERARY SOCIETY (in Philosophical Hall, Leeds), at 5.—Sectional Scientific Meeting.

MINERALOGICAL SOCIETY (Anniversary Meeting) (at Geological Society), at 5.30.—C. S. Garnett: The Dissociation of Dolomite.—B. J. Tully: A New Refractometer.—G. T. Prior: (*a*) The Meteoric Iron of Vaalbult Farm, Prieska Division, Cape Province; (*b*) Meteoric Stone of Witklip, Carolina District, Transvaal.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. H. Scott: Some Congenital Malformations of the Kidney in Reptiles, Birds, and Mammals.—Dr. F. P. Stowell: Physical and Chemical Conditions in the Sea Water of the Zoological Society's Aquarium—a Comparison

with the Water of the Open Sea.—A. Loveridge: A Mite Pocket in the Gecko *Gymnodactylus lawderanus* Stolickza.—H. C. Abraham: A Marine Spider of the Family Attidæ.—Major S. S. Flower: Contributions to our Knowledge of the Duration of Life in Vertebrate Animals. IV. Birds.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir William Henry Ellis: Address and presentation of Medals.

ROYAL AERONAUTICAL SOCIETY (jointly with the Institution of Automobile Engineers) (at Royal Society of Arts), at 7.—Wing Commdr. T. R. Cave-Browne-Cave: The Evaporative Cooling of Aero Engines and Condensation of their Exhaust Gas.

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—W. C. Gray and R. E. Ansell: Some Notes on the Properties of Nickel-Silver.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (in Birmingham University), at 7.15.—The Behaviour of Sulphur Dioxide in Acid Solutions:—Dr. W. Wardlaw: The Oxidising and Reducing Action of Sulphur Dioxide on Solutions of Metallic Salts.—S. R. Carter: Some Physico-chemical and Electro-chemical Aspects of Sulphur Dioxide as an Oxidising Agent.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—F. J. Dyer: Vitamins.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (Annual General Meeting) (at North British Station Hotel, Edinburgh), at 7.30.—At 8 (jointly with Society of Chemical Industry, Edinburgh and East of Scotland Section).—Dr. J. F. Tocher: Inaugural Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.30.—A. G. Ellis: Chairman's Address.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. J. A. Smythe: Methods and Uses of Metallography.

RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—Dr. F. W. Aston: Atoms and X-rays (Presidential Address).

WEDNESDAY, NOVEMBER 4.

INSTITUTION OF MINING ENGINEERS (Annual General Meeting) (at Institution of Mechanical Engineers), at 11 A.M.—H. E. Mitton: Sinking of a Colliery in the East Nottinghamshire Coalfield.—Prof. H. Louis: A Novel Point in Mineral Valuation.—A. E. Mavrogordato: Miners' Phthisis, Past and Present, on the Witwatersrand, and Methods of Dust Control.—Dr H. S. Hele-Shaw and T. E. Beacham: A New Form of Air-Compressor.—Dr. J. S. Haldane: Thermal Efficiency and Effectiveness of Heat-Engines.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—N. E. Odell: Preliminary Notes on the Geology of the Eastern Parts of Central Spitsbergen, with special reference to the Problem of the Hecla Hook Formation.—Dr. K. S. Sandford: The Geology of North-East Land (Spitsbergen).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Major B. Binyon: Chairman's Inaugural Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Newcastle-upon-Tyne), at 7.—H. E. Skinner: The Design of Cable Ships.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall, Westminster), at 7.—J. J. Lassen: The Modern Development of Combustion Recording.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.15.—S. R. Trotman, Dr. E. R. Trotman, and R. W. Sutton: An Investigation of the Nature of Wool Protein.—S. R. Trotman and H. S. Bell: The Sulphur Content of Wool.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Derby Graduates Section) (at Cavendish Café, Derby), at 7.30.—W. B. Flint: The Motor Omnibus as a Means of Transport.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—G. D. Elsdon and P. Smith: The Determination of Palm Kernel Oil and Butter in Margarine.—Dr. C. Newcomb: The Determination of Alcohol and Ethyl Chloride in Chloroform.—H. Atkinson: The Volumetric Determination of Soluble Sulphates by means of Barium Chloride and Potassium Stearate.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF ARTS, at 8.30.—Sir Thomas H. Holland: The Organisation of Scientific Research throughout the Empire (Inaugural Address).

THURSDAY, NOVEMBER 5.

ROYAL SOCIETY, at 4.30.—L. Ballif, J. F. Fulton, and E. G. T. Liddell: Observations on Spinal and Decerebrate Knee-Jerks with special reference to their Inhibition by Single Break-Shocks.—K. Furusawa: (*a*) Muscular Exercise, Lactic Acid, and the Supply and Utilisation of Oxygen. Part XIII. The Gaseous Exchanges of Restricted Muscular Exercise in Man; (*b*) A Spirometer Method of studying continuously the Gaseous Metabolism of Man during and after Exercise.—D. T. Harris: The Effect of Light on the Circulation.—*To be read in title only*:—Prof. A. V. Hill: The Surface Tension Theory of Muscular Contraction.—J. F. Fulton and E. G. T. Liddell: Electrical Responses of Extensor Muscles during Postural (Myotatic) Contraction.—L. N. Katz: On the supposed Pluri-segmental Innervation of Muscle Fibres.—L. N. Katz and C. N. H. Long: Lactic Acid in Mammalian Cardiac Muscle. Part I. The Stimulation Maximum.—H. J. G. Hines, L. N. Katz, and C. N. H. Long: Lactic Acid in Mammalian Cardiac Muscle. Part II. The Rigor Mortis Maximum and the Normal Glycogen Content.—Phyllis Kerridge, L. N. Katz, and C. N. H. Long: Lactic Acid in Mammalian Cardiac Muscle. Part III. Changes in Hydrogen Ion Concentration.—W. E. Garner: The Mechanism of Muscular Contraction.—R. W. Riding and Prof. E. C. C. Baly: The Occurrence of Helium and Neon in Vacuum Tubes.—Prof. O. W. Richardson: Structure in the Secondary Hydrogen Spectrum. III.—Prof. T. R. Merton and J. G. Pilley: On the Excitation of the Band Spectrum of Helium.—H. Hartley and J. E. Frazer: The Conductivity of Univalent Salts in Methyl Alcohol at 25° C.—C. S. Beals: The Arc Spectrum of Palladium. Its Zeeman Effect and Spectral Type.—N. Ahmad: Further Experiments on the Absorption and Scattering of γ-Rays.—R. A. R. Tricker: A Determination of the Variation of the Mass of the Electron with Velocity, using Homogeneous β-Rays. Preliminary Results.—E. H. Boomer: Experiments on the Chemical Activity of Helium.—R. M. Wilmotte: On the Construction of a Standard High Frequency Inductive Resistance and its Measurement by a Thermal Method.—R. B. Brode: The Absorption Coefficient for Slow Electrons in the Vapours of Mercury, Cadmium, and Zinc.—P. Kapitza and H. W. B. Skinner: The Zeeman Effect in Strong Magnetic Fields.—F. R. Weston: The Flame Spectra of Carbon Monoxide and Water Gas. Part II.—H. S. Hirst and Dr. E. K. Rideal: The Thermal Decomposition of Nitrogen Pentoxide at Low Pressures.—R. W. Gurney: The Number of Particles in the Beta-Ray Spectra of Radium B and Radium C.

LINNEAN SOCIETY OF LONDON, at 5.—M. Maxwell: The Home of the Eastern Gorilla.—Miss E. Bolton: Validity of Certain Species in Neuropteris Brongn.—Dr. H. S. Holden and S. H. Clarke: On the Seedling Structure of *Tilia europæa* L.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. P. Watson-Williams: The Toll of Chronic Nasal Focal Sepsis on Body and Mind (Semon Lecture).

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. Bramwell: The Myopathies (Bradshaw Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.—P. Dunsheath: Dielectric Problems in High-Voltage Cables.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir John A. F. Aspinall: Some Railway Notes Old and New (Thomas Hawksley Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Joint Meeting of Birmingham and Coventry Graduates) (at Broadgate Café, Coventry), at 7.15.

CHEMICAL SOCIETY, at 8.—O. Silberrad: Further Studies on a New Chlorinating Agent Preparation of Polychlor Derivatives of Toluene.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Section).—A. B. Smith: Some Problems on the Application of Lubricating Oils to Machinery.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Section).—H. N. Gresley: The Three-Cylinder High-Pressure Locomotive.

FRIDAY, NOVEMBER 6.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.), at 4.45.—Dr. A. I. Simey: The Prophylaxis of Common Colds.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Prof. J. Proudman, J. H. Powell, and others: Tides in Narrow Seas. Chairman, Dr. H. Lamb.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Exhibition of Microscopical Preparations made from Recent Cases of Intestinal Stasis.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with the Manchester Sections of the Institute of Chemistry and the Society of Dyers and Colourists, also the Manchester Literary and Philosophical Society) (at 16 St. Mary's Parsonage, Manchester), at 7.—Sir William H. Bragg: Long Chain Molecules.

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—Demonstration of the Agfa Colour Plate.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. H. Simmons: Flow Meters.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 7.30.—F. D. Verrill: Shipyard Pneumatic Plant and Pneumatic Riveting.

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

PHILOLOGICAL SOCIETY (at University College).

SATURDAY, NOVEMBER 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.), at 3.—G. W. Young: The Yellowstone Park, U.S.A. (Lecture).

PUBLIC LECTURES.

SATURDAY, OCTOBER 31.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. D. Forde: Stone-Age Man in Brittany.

MONDAY, NOVEMBER 2.

KING'S COLLEGE, at 5.30.—C. J. Gadd: The Science of Divination.—R. J. Bartlett: Psychology and Advertising.

TUESDAY, NOVEMBER 3.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Philosophy of Aristotle. (Succeeding Lectures on November 10, 17, 24, and December 1.)

UNIVERSITY COLLEGE, at 5.30.—P. Flemming: Bloomsbury and the Bedford Estate: a Study in Street Names.

WEDNESDAY, NOVEMBER 4.

UNIVERSITY COLLEGE, at 5.30.—Prof. W. M. Calder: The Early Christian Inscriptions of Asia Minor. (Succeeding Lectures on November 5 and 6.)

THURSDAY, NOVEMBER 5.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—W. G. Constable: English Medieval Painting.

KING'S COLLEGE, at 5.30.—Prof. Winifred Cullis: The Influence of the Home in Social Hygiene.

CHELSEA POLYTECHNIC, at 8.—Prof. H. C. H. Carpenter: Metal Crystals ("Armourers and Brasiers' Company" Lectures). (Succeeding Lectures on November 12, 19, and 26.)

FRIDAY, NOVEMBER 6.

KING'S COLLEGE, at 5.30.—Prof. J. S. Huxley: Science and Culture.

UNIVERSITY COLLEGE, at 8.—Prof. G. Dawes Hicks: Contemporary English Philosophy. (Succeeding Lectures on November 13, 20, 27, December 4 and 11.)

SATURDAY, NOVEMBER 7.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. A. Smith: Aspects of Roman London. I.