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Nationalism and Research.

AMONG the many developments of recent disturbed conditions in China, there is one which has passed almost unnoticed, but nevertheless is of such moment to the world movement in science as to merit more than a cursory reference. This is the attitude which has been adopted by a section of educated Chinese towards the prosecution of certain branches of scientific research within the borders of China by non-Chinese workers. Objection has been taken to the exploitation, as it is regarded, of the relics of China's past by expeditions coming from Europe and America.

In the spring of this year an article was circulated to the Chinese press by Kuo Wen, in which a joint statement was made on behalf of several Chinese scientific organisations in Peking, announcing the formation of a United Association to fight the efforts of various scientific expeditions to search for the remains of ancient man and other evidence of a palæontological and archæological character in various parts of China. This manifesto had special reference to Dr. Sven Hedin's journey into the desert region of western China; but it was also undoubtedly aimed at the expedition of the American Museum of Natural History to Central Asia. It at any rate moved Mr. Roy Chapman Andrews, the leader of the American expedition, to a vigorous and lengthy reply in the *North China Daily News* in July last, in which he stressed the indebtedness of China itself as well as the world of science at large to this and similar expeditions for scientific research. Since then it has been decreed that no specimens of birds may be exported from China, and only three scientific specimens of any other species of animal or plant life. In view of the lack of museums or reference facilities in China, this decree will obviously greatly hamper identification and research. The later barring of Mongolia to the American expedition is ostensibly attributed to military and political reasons.

That the extent of China's indebtedness to western science is great is a matter which is beyond question. Nor would it be denied by many of the Chinese themselves. In the present instance the protest which is raised on an issue in relation to certain specific material, even though the motives underlying it are undoubtedly mixed, may be taken at its face value as representing a genuine opinion of a certain section, at least, of educated Chinese, and not solely as a reactionary reflex of a

conservatism which abhors all foreign intervention of any kind whatsoever. It is rather the manifestation of an exaggerated, and perhaps it might be thought perverted, nationalism. This attitude is by no means confined to China; it can be paralleled at the present day in other countries, and it has given rise to problems of considerable magnitude in the prosecution of scientific research in countries rich in remains of the past, in which a strong movement towards nationalism has led the more ardent spirits to desire the exclusion of foreigners from such studies, although the natives themselves are not always fully competent to undertake them. In Egypt this feeling was given emphatic expression at the time of the opening of the tomb of Tutankhamen, and it is the essence of the spirit in which concessions, much more strictly limited than in the past, are now granted to foreigners. In India the difference in conditions has for the moment obscured the result, though the problem affects a wider scientific field; but the substitution of Indians for Europeans in official posts of organisation and research cannot but affect such studies until parity of intellectual qualifications has been attained. In both cases a political theory is adversely affecting the vigorous and effective prosecution of research.

Granting for the moment that nationalism were a possible or even desirable ideal in the prosecution of research, it must be abundantly clear that in countries which are only just beginning to advance along western lines of development, undue restriction of exploration and excavation defeats the very object in view. It closes the best avenue to scientific training open to the native student.

In both Egypt and India, interest in historical and archæological matters is no recent growth; yet it is the application of methods of research developed in Europe by European scholars which has been so fruitful in results. China is an even more striking example of the advance in knowledge of the past which has been effected by foreigners. The interests of the Chinese themselves being turned in other directions, they had neither the inclination nor the technical training to look for and appreciate the importance of the evidence which lay under their feet until attention had been directed to it by the work of alien investigators.

Of purely geographical exploration it is scarcely necessary to speak in this connexion, while the borderland researches of A. von le Coq, of Dr. Sven Hedin in Tibet, of Sir Aurel Stein in Chinese Turkestan, and of Koslov in Mongolia, are too well known to need more than passing mention. All alike have played an important part in opening up China and the adjacent lands to the knowledge of the western world, have revealed their great stores of archæological riches, and have helped to attract the attention of scientific workers to Central and Eastern Asia as a fruitful and profitable field of research. Nor is it necessary to do more than refer to the recent work of Shirokogoroff on the physical anthropology and culture of China. But China has now assumed a position of significance in palæontological and anthropological studies in a broader sense; and granted the continuation of exploration, may contribute evidence of the greatest importance for the problem of the origin of man and the development and distribution of his early culture. The sensational discovery of the eggs of the dinosaur by the expedition of the American Museum of Natural History has overshadowed the less striking but perhaps no less valuable archæological data collected by that expedition which related to early man in the stone age and the early ages of metal in this area. Equally valuable and stimulating have been the researches of P. Licent and P. Teilhard du Chardin, whose investigations have brought to light stone implements of types analogous to those of the Palæolithic age in western Europe in conditions which apparently place it beyond question that the geological evidence assures their quaternary date.

The discovery of evidence for quaternary man in China is of first-rate importance, but its interest has since been greatly enhanced by the discovery of teeth, claimed to be human or sub-human, at Chou Kou Tien, and estimated to be contemporary with Piltdown man. This in turn would lend support to the human origin attributed to fossil teeth of primitive type bought in Peking some years ago. Coming to a later period, a discovery of the greatest interest arose from the excavation of sites of neolithic culture in Honan and Fengtien, on which there occurred painted pottery similar in technique and decoration to that which has been found in the early archæological strata of Western Asia, Mesopotamia, Anau, Susa, and other sites. Although the question of dating still remains open, this discovery links up with a series of sporadic finds stretching across Asia and appears to bring China into some sort of relationship, still to be defined, with the west at an early date.

These results have been achieved through the labours of non-Chinese men of science, and without the active co-operation of the Chinese themselves, although those who have been responsible for the results acknowledge that in most part they have

received full and courteous consideration at their hands. But many difficulties have been encountered. This must be taken neither as a criticism nor an attribution of blame. The difficulties were in part financial, in part due to a failure to appreciate the opportunities for research in this field, even when pointed out. That China now assumes a place of importance in the study of early prehistory is due almost entirely to Dr. J. C. Andersson, the Swedish investigator, who acts as mining adviser to the Chinese Government. By his own work, in directing and inspiring the work of others, and by raising funds for publication, he has made prehistoric China known to the world.

There is an interesting parallel in the occasion for the protests which have been raised both in Egypt and in China. In the former case the Egyptians viewed with apprehension the opening up by foreigners of the richest tomb ever found, of which part of the contents at least were to leave the country; the Chinese were aroused by the almost fabulous but entirely fortuitous monetary value attributed to the dinosaur's eggs. In these two instances the circumstances were exceptional, but there is a principle involved which is the crux of international participation in research in which the results are, to a very considerable degree, both material and limited in extent. No country which has become scientifically self-conscious can view with equanimity the danger that it may be despoiled of its scientific treasures by foreigners, and there is grave danger, unless some equitable arrangement is devised, that this may extend from the collection and exportation of specimens and objects of scientific interest to all prosecution of research in the field by others than natives. Something of this feeling is to be discerned in India and Egypt; it appears to be a danger in China. It may, perhaps in present conditions inevitably will, crop up in countries in which archæological research is now being conducted under the auspices of a protecting or mandatory power, such as in Mesopotamia and Palestine. That day may still be distant.

Even countries intellectually advanced are not entirely free from this spirit, and we have on more than one occasion raised a protest against the grant of exclusive concessions for archæological excavation to a single nationality, as for example in Albania and Afghanistan. Again, where the problem of international co-operation has in part been solved by the establishment of archæological schools as in Greece, the number of excavations which may be undertaken by any single school tends to become more strictly limited.

It is impossible not to sympathise with the attitude of those who feel that scientific material, and particularly the evidences of the past history of their country, should not be reft from them by outsiders, especially by mere collectors. A historical site when once turned over by the excavator can never be restored, be he competent or the reverse. Archæological material taken from the country will never be returned. It is to the interest of science itself that a government should claim the right of control through permits and concessions, if only as a safeguard against the incompetent investigator; but much more may be demanded, and it is difficult to see where to draw the line. Scientific research in these fields is world-wide in its bearing, and restriction in any one area hampers progress in the whole in the study of the broad problems of origin, development, and distribution. Investigation should therefore be undertaken by the best man available at the moment, irrespective of nationality. The results should be made accessible to all by the exhibition of series characteristic of the objects found in museums, readily accessible to the great intellectual centres of the world, and by early and detailed publication of the descriptive matter relating to the site or find. How best to reconcile the conflicting interests is a problem for which a solution will have to be found, possibly as a result of some international agreement through machinery such as the League of Nations may afford.

Science in the Public Services.

The Ministry of Agriculture and Fisheries. By Sir Francis L. C. Floud. (The Whitehall Series.) Pp. x+330. (London and New York: G. P. Putnam's Sons, 1927.) 7*s.* 6*d.* net.

THE Ministry of Agriculture and Fisheries is one of the newer departments of the State; though it only obtained its designation as a Ministry in 1919, it was founded in 1889 as the Board of Agriculture, and took over certain functions which had previously been administered by the Privy Council. Later Acts have extended its interests and powers, but it remains unique among departments of State in Great Britain in that it deals with a special section of the community rather than a particular function of government.

The Ministry is concerned with legal and land questions, with statistics, education, research, and labour, but only as they affect farmers and farming, and independently of other departments like the Board of Education which deal generally with one

of these matters. As the author of this book says at the outset, "Agriculture and Fisheries are the only industries which have a Cabinet Minister of their own to represent them in the Government." If on one hand this gives a singular unity of purpose to the department, on the other it is the source of constant trials, both to its ministers and officials. The industry of agriculture is not unnaturally disposed to regard the Ministry as its own special servant and the minister as its advocate. No other office is so permeated by a public seeking assistance or redress; no other minister is so subjected to advice and admonition. The Minister of Agriculture is indeed allowed but little respite from criticism, and he must not expect any compensation in the way of support from the farmers he represents. This may in part explain the fact that from 1914 onwards there have been eleven ministers of agriculture.

The book before us is the work of the recently translated Permanent Secretary of the Ministry, Sir Francis Floud, a man who writes with authority, not only because of his familiarity with every detail of its work but also because of the singular trust and affection that his administration has inspired. The book sets out lucidly and with precision the services rendered by each division of the Ministry, the powers with which it is endowed, and the regulations it is called upon to enforce.

These functions are many and various. On the legal side the Ministry used to determine the tithe rent charge, and is still responsible for redemptions; it is the guardian of common lands, their regulation and possible enclosure; and it is the custodian of the corporate estates of the universities and colleges of Oxford, Cambridge, and Durham, and of Winchester and Eton. It controls the acquisition of land for small-holdings and allotments; it has other controls to administer, such as those concerned with certain diseases of animals and plants, with rats and mice and weeds, and with the sale of seeds, fertilisers, and feeding-stuffs. The Ministry is further responsible for the expenditure on agricultural education and research in England and Wales. The Fisheries Division is a separate department *in petto* with its own local authorities to deal with—the fishery boards—its own functions of control over fishing and fishermen, its own research to foster and its own statistics to collect. Kew Gardens and the Ordnance Survey are other self-contained organisations for which the Ministry is ultimately responsible.

As regards many of these functions, however, and those the more important, the Ministry is less the actual executive than the administrative body which lays down conditions and defrays, wholly or in part, expenditure incurred by other authorities charged with the execution of the work. For example, the maintenance of educational agencies like the agricultural colleges and the farm institutes depends chiefly upon funds supplied by the Ministry, but the management of these institutions rests with the universities and kindred bodies, or the local authorities. Again, the research institutes, which are largely founded and supported by the Ministry, are under the control of a university or independent governing body, and their officers, even though their rates of pay are determined by the Ministry, are in no sense civil servants. In research, as regards fisheries alone is this principle of delegation departed from, for the Ministry's veterinary laboratory and its phyto-pathological laboratory are concerned only with such investigations as may affect the administration of the department.

It will be seen that the work of the Ministry is largely of a technical character, and, as Sir Francis Floud states, "the work of the Ministry could not be carried out without the employment of a large number of specialist officers, whose work, though different in character, is just as important as that of the administrative or clerical staff." Sir Francis admits the equal importance of the technical officer, and has always acted on that view, but none the less the system of the office permits of no scientific specialist rising to the rank or pay of an assistant secretary, except the chief veterinary officer. In his view the executive should—

"enlist men who have received a good general education in the schools and universities and give them a thorough training in the routine of a Government Department." "It is far better that the ordinary staff of the Department should make no pretensions to be experts. The important thing is that they should have open and adaptable minds, and the capacity to exercise a sound judgment on the advice or proposals, often divergent and contradictory, which come before them from the experts and the practical men of the industry. There is a distinct technique of administration which must be learnt, and it must be combined with a sense of proportion and a recognition of political, financial, and practical limitations with which the specialist is often impatient."

The case for the subordination of the scientific officer could not be better put, and it emphasises the fact that in the higher ranks, whether it be of a government office or a business, it is the administrative faculty that is the essential, besides which nothing else counts. But the advocates of

this traditionally English view have never explained why administrative ability is incompatible with technical knowledge. Men have to be judged as men, and if the irresponsible specialist is apt to be too absolute in his dicta, Government departments are not unfamiliar with the pseudo-administrator whose art is to put a smooth face on things and to anticipate the jumping of the cat.

Though the made 'expert' can rarely be brought in to take over the complex routine of governmental administration, it should be open to the young scientific officer who enters the service as a specialist to pass over to the executive and be placed later in the running for the higher offices, but only as he shows himself capable of that type of work. The ideal administrator will possess a critical background of technical knowledge. Its absence matters little while departments are mainly regulatory, but as they become increasingly constructive, and the Ministry of Agriculture has had to move in that direction, the need for combining both types of mind will become insistent. Yet the prospects of scientific men in government service are not improving. The Ministry of Agriculture has enjoyed since the War a scientific staff in which the industry has confidence, and a feature of Sir Francis Floud's administration was the sympathetic understanding with which he used it. But it may be doubted whether such a staff can be repeated, so limited are the opportunities likely to be under the alien Civil Service tradition and the pressure on promotion boards of Whitley Councils in which the clerical element dominates.

The Natural History of Ornithorhynchus.

The Platypus: its Discovery, Zoological Position, Form and Characteristics, Habits, Life History, etc. By Harry Burrell. Pp. ix + 227 + 35 plates. (Sydney, N.S.W.: Angus and Robertson, Ltd.; London: The Australian Book Co., 1927.) 25*s*.

AS its amplified title indicates, this work does not set out to be a systematic descriptive scientific treatise on *Ornithorhynchus anatinus*. It is true that it necessarily includes incidentally a good deal in the way of the morphology and physiology of the animal, but it is entirely in accord with the scheme of the author that detail appropriate to a more academic and systematic treatment of structure and function should be either omitted or subordinated to his main purpose. The book is pre-eminently the product of a genuine field naturalist—a type unfortunately less common than it used to be—an amateur, in the proper and literal sense of a devoted lover of the animals he knows so well.

His book, as Mr. Burrell informs us, "is the result of nearly twenty years' personal observation of the Platypus in its haunts while collecting specimens for the University of Sydney and the Commonwealth National Museum." Without any disparagement of earlier contributions to the natural history of the monotremes from the beginning of the nineteenth century onwards, and including those resulting from the special expeditions of Caldwell and Semon, it may safely be said that no such complete story of the life history, habits, and behaviour of Ornithorhynchus has ever been presented as that we have now before us in Mr. Burrell's admirably illustrated pages.

The author speaks regretfully of the hindrances to his work occasioned by administrative regulations. Surely some easy mean might be discovered between the former extreme of total neglect of the problem of protection of fauna of such singular interest and scientific importance, and the more recent extreme of a well-nigh indiscriminating prohibition of collecting even for disinterested scientific purposes. Is it too much to hope that the recently organised Commonwealth Bureau of Scientific and Industrial Research may be empowered to exercise a wisely advisory function in the regulation of local scientific activities of this nature, whether conducted by Australian or extra-Australian agencies?

Meanwhile, one can only admire the tenacity with which Mr. Burrell has pursued his task in spite of all obstacles, and gratefully welcome the very substantial contribution he has been able to make to the natural history of the archaic mammal the intimate life of which he has so successfully investigated. Only those, perhaps, who, like the present writer, have themselves essayed the pursuit of the same difficult quest, both personally and by proxy, can adequately realise what that tenacity and that success really mean.

The earlier chapters of the work before us, dealing with the discovery and early descriptions and with the former controversies on the zoological position and the oviparous character of the animal, are of slighter importance to the present-day zoologist. Yet they do, no doubt, provide a useful résumé for the non-scientific reader, especially in Australia, of the growth of knowledge concerning an animal the unique features of which have all along presented a problem of unusual interest.

Chapters v.-vii., on general characteristics, on

nervous organisation and sensory perceptions, and on the spur and crural gland, contain a good deal of useful information, much of which is from first-hand observation: the last of these sections, however, seems unnecessarily diffuse.

It is the latter half of the book, from Chap. viii. onwards, which will more especially engross the interest of the student of natural history. Chap. viii. treats at considerable length of the elaborate nesting burrow and its construction. On this subject the author can speak with the knowledge and authority derived from long, laborious, and fruitful investigation. The value of his account is also greatly enhanced by an admirable series of photographic illustrations.

Chapters ix. and x. are concerned with the general habits, food, and domestic economy of the animal. Chap. xi. will perhaps most of all attract the attention of the zoologist. In it are set forth Mr. Burrell's original observations on mating, egg-laying, hatching, and the growth of the young to adolescence. How well qualified the author is to contribute to our knowledge of these matters may be inferred from his record of personal observation of no fewer than seventy tenanted nests. Here again his statements are supported by a number of excellent photographic illustrations, amongst which those showing twin and triplet nestlings in their nests are specially noteworthy.

The final chapters deal with the subjects of 'preservation and economics,' and with that of the Platypus in captivity. It is no small achievement to have succeeded in keeping alive under observation and in good condition for months at a time, specimens of an animal so delicately adapted to its own natural conditions as Ornithorhynchus.

In the way of actual criticism, it may perhaps be said that when Mr. Burrell does descend to the discussion of morphological or physiological details, he is on less sure ground. Thus, for example, it cannot be admitted that (p. 67) the olfactory nerves are "relatively large" in a mammal that has by some authorities been classified (albeit with insufficient justification) as actually 'microsmatic.' In this connexion, too, one might have expected some reference to be made to that still enigmatical olfactory dependency, the vomero-nasal organ of Jacobson, which in Ornithorhynchus is of such imposing and well-nigh reptilian proportions and is almost, if not quite, the largest amongst mammals. To the nerves connected with this quasi-olfactory apparatus the apparent 'olfactory' nerve owes a fair share of its own quite modest proportions. It is scarcely too much to say that the discussion of the organs of sensory perception as a whole is weak and sketchy. The reference on p. 70 to the lateral line organs of fishes betrays a misconception of their real function. It is to be hoped that in any subsequent issue the reference, in Plate 3, to the openings of the naso-palatine canals as the 'nostrils' will be corrected, as well as the misleading legend 'jawbones' in Plate 4.

The bibliography at the end of the book is clearly in no sense a bibliography of Ornithorhynchus. Presumably it is meant to refer only to the topics dealt with in the book itself. But even in this sense it is far from complete. Although in Chap. vi. a slight attempt is made to deal with brain characters, no references are given even to the most important literature on this branch of the subject, including the work of Turner, Elliot Smith, and Ziehen. Again, whilst the characters of the snout or muzzle are correctly insisted on in the chapter on general characteristics, no reference is given to controversy on this subject in 1894 (cf. *Proc. Linn. Soc. N.S.W.*, vol. 9, Ser. 2, p. 688).

Any minor faults of omission and commission which the book may show are amply atoned for by its conspicuous merits in the direction of the author's authentic interest. Judged by its own proper criteria, Mr. Burrell's book must be pronounced to be a contribution of considerable value to the literature of the natural history of the Mammalia, a testimony to the industry and enthusiasm of its author, and a credit also to its enterprising Australian publishers. J. T. W.

A Persian Oil Field.

In a Persian Oil Field: a Study in Scientific and Industrial Development. By J. W. Williamson. Pp. 189+24 plates. (London: Ernest Benn, Ltd., 1927.) 7*s.* 6*d.* net.

THE Tigris and Euphrates join north-west of Basrah and thence flow to the Persian Gulf as the broad, silt-filled stream known as the Shatt-el-Arab. For some hundred miles the combined rivers wind their way between low banks of alluvium, on which, except for the small areas cultivated around the Arab villages, nothing of value grows save the date palm. The scene and the surrounding country have probably been much the same for the past two thousand years, although evidences of Roman irrigation works indicate that, at one time, vast areas of the country must have been under effective cultivation and have remained so until the system, lapsing into disrepair, enabled the highly charged waters of the two rivers again to impreg-

nate the soil with mineral salts so as to render it productive of little but the camel thorn.

If conditions are favourable, a traveller on the mail-boat from Bombay usually passes the bar at the mouth of the Shatt-el-Arab during the evening, and for the next few hours steams up the river between dark and inhospitable banks. Suddenly in the far distant sky a blaze of light is reflected and the ship passes a veritable township brilliantly illuminated and teeming with industrial life. Thereafter, until Basrah is reached, there is again nothing but the blackness of the uninhabited desert. The contrast is so great that the traveller finds it difficult to believe that twenty years ago this township was also part of the desert and that it was here that the first pioneers, many of whom are still active in the Company's service, started to build the piers and jetties from which at the present time a large proportion of the oil is transported to the home refineries at Llandarcy and Grangemouth. For it was here, at Abadan, that the Anglo-Persian Oil Company decided to build its refinery and loading station at the head of the pipe lines which carry the crude oil from the 'Fields' some 150 miles distant northward across the desert.

The book under review contains a description of the country developed by the Company, and is the outcome of a visit paid by the author during the cold weather of 1926. It is divided into two sections—Part I. "The Science," and Part II. "The Humanities"—and constitutes a striking record of British initiation and achievement which is good to read.

Although the author disclaims any intention of producing a technical book, yet it is evident that his wide knowledge of general science has enabled him to impart to Part I. of his book a breadth of view and of sympathetic treatment which throws the policy of the Company in regard to the development of the scientific side of its activities into strong relief. The scientific problems of the Persian oil field are unique, and can be solved only by systematic research in which the chemist and physicist must combine to help the geologist and engineer. Much has been achieved, but much remains still to be done. It is evident from the author's record that great and successful efforts are being made to meet the inherent difficulties of the situation.

For one who has had an opportunity of visiting the places he describes, it is of particular interest to note the able manner in which the author takes the reader by the hand and leads him through the various phases of oil production, beguiling him with pleasant but instructive conversation by the way, yet refraining from satiating him by the glib talk of millions; for statistics, however veracious, are apt to produce a state of repletion from which the ordinary reader usually emerges in a condition of static disbelief.

Part II., dealing with "The Humanities," records a system which any industrial organisation might follow with advantage to itself and its workers. It describes the means adopted by the Company to render the lot of its European staff pleasant and congenial. An account is also given of the housing and care of the native worker, and of the means taken to educate his children. Above all, attention should be directed to the description of the admirable medical service, which, under the care of the medical directorate, has reached a degree of efficiency probably without parallel.

The illustrations, of which there are a large number, are excellent and are very clearly reproduced. Without question, the author is to be congratulated on having produced a thoroughly readable volume which places on record, in a manner understandable by all, an epic of achievement of which all Britons must be proud.

JOCELYN THORPE.

Maxwell's Scientific Papers.

The Scientific Papers of James Clerk Maxwell. Edited by W. D. Niven. (Photographic Reprint by arrangement with the Cambridge University Press.) Vol. 1. Pp. xxxii + 607. Vol. 2. Pp. viii + 806. (Paris: J. Hermann, 1927.) 3 livres 6.

IT is not often that a reissue of the collected papers of an outstanding scientific man has been called for. Some of the papers cannot fail to have *historical* value because of the part which their original publication played in the development of science; but that value alone would not be sufficient to secure the demand. The work involved must be of present-day importance. Therefore its consequences must still be in process of development; and it follows that if, as in the present case, the republication follows the first publication after an interval of half a century, the main papers involved must have been of very epoch-making type. The condition of *present* value is a sufficient test; but the most essential condition is that of *permanent* value. Present value persisting after the lapse of fifty years suggests permanence, and at least points to some enduring quality—the direct impress of the distinctive personality of the man.

How much might be attainable in that way was made clear at the threshold of Maxwell's scientific life when it was said of him by his Cambridge tutor

that it seemed to be impossible for him to think wrongly on a physical subject. How much had been attained in its brief duration was perhaps most impressively made evident by the incident of the entry into a railway carriage at a Dumfriesshire station of a countryman who took his seat with the single remark, "Maxwell is dead."

It may be sufficient to refer, in illustration merely, to the three main lines of investigation which are dealt with in the papers. In the subject of colour vision, the work of the man who, simultaneously with and independently of Helmholtz, introduced for the first time methods of precision into a previously vague field of inquiry, is still of value to a multitude of workers; for he dealt with the best methods which could be used. In the subject of the electromagnetic field and its properties, the results of his epoch-making inclusion of optical phenomena are of fundamental importance in the now pressing investigation of the state of ionisation of the upper atmosphere. Experience has verified the soundness of his judgment regarding the form of the equations of the field; and new discovery regarding electrons has led to the natural extension of the equations, on his own lines, by the recognition of electric currents of convection. In the subject of molecular theory, his work has recently been finding its verification alike in the field of things smaller than atoms, whereof knowledge had not reached him, and in the field of a stellar universe wherein the atoms are suns. This is an interesting astronomical reversion if his molecular investigations arose in connexion with his work on the rings of Saturn.

The student who desires to follow Schrödinger in his endeavour continuously to bridge the gaps indicated by the modern atomic and quantum postulates and to restore to the physicist the Maxwellian ether, of which some relativists thought they had deprived him, could not do better than read as a preliminary the papers in which Maxwell applies the Hamiltonian characteristic function to the solution of some optical problems. In the perusal of any of the papers the student will learn something of the mode of working of the mind of one who was a master amongst masters. It is not possible for a student to make too much use, in that way, of the works of the great thinkers. Thereby he may at least train himself to heighten the value of whatever work he does.

To the Cambridge University Press and to the firm of J. Hermann are due the thanks of physicists for the completion of a greatly needed reissue. The quality of the photographic work, and of the general technique, is high. W. PEDDIE.

Our Bookshelf.

Bauxite: a Treatise discussing in Detail the Origin, Constitution, known Occurrences, and Commercial Uses of Bauxite: and including Particulars regarding the Present Condition of the Aluminium Industry and the Peculiar Importance of Cryolite in the Extraction of Aluminium from Bauxite. By Dr. Cyril S. Fox. Pp. x+312. (London: Crosby Lockwood and Son, 1927.) 30*s.* net.

WITH the increasing popularity of the metal aluminium, increasing interest is being taken in its principal ore, bauxite, and Dr. Fox has opportunely provided a trustworthy and comprehensive treatise on the occurrence and uses of this substance. He distinguishes two principal modes of origin, the terra rosa (*sic*) type representing the insoluble residue of great masses of soluble limestone or dolomite, and the lateritic type resulting from the decomposition *in situ* of original aluminous rock. The former occurs mainly in the Mediterranean region of Europe, and the latter in the tropical monsoon lands of Asia, Africa, and America.

The largest known reserves of ore are of the lateritic type, and the author's descriptions of typical occurrences are of great interest and value. There will be general agreement with his conclusion that lateritic bauxite and lateritic ironstone stand at opposite ends of a series of tropical decomposition products, of which true laterite with, theoretically, equal quantities of hydrated ferric oxide and trihydrate of alumina occupies the middle. Dr. Fox gives a useful summary of current opinion upon the nature of the process of lateritic weathering in the tropics, and suggests a number of conditions which seem to him necessary for the formation of laterite. The economic aspects of the bauxite and aluminium industries are discussed in considerable detail and supported by statistical information. The book is well printed and well illustrated, and the author is to be congratulated on producing a work which meets a pressing need of the day.

Modern Bee-Keeping. By Herbert Mace. Pp. 225+xix+16 plates. (Harlow, Essex: The Publisher, *Modern Bee-Keeping*, 1927.) 5*s.* net.

HAVING chosen such a title as that of "Modern Bee-Keeping," the author might be expected to show familiarity both with modern apicultural practice and also with the recently ascertained facts of science. He repeats, however, without comment, the old statement that *Braula cœca* is pupiparous, even though the egg and larva have been figured by several observers, and the damage done by the larval tunnels in the cappings of honey has actually been illustrated in an English-speaking bee journal.

Again, the old theory that the brood food is regurgitated chyle is given here as an undisputed fact, whereas the opposing view that it is a secretion of the lateral pharyngeal glands is the one more generally held at the present time. Referring to races, the author confounds the brown German bee of pre-Isle-of-Wight days (*Apis mellifica* L.) with

the black heath bee (*Apis mellifica* var. *Lehzeni*) of Holland and parts of France.

In the chapters on disease, much confusion of thought as to etiology and causative organisms is shown, both in referring to brood diseases and also diseases of the adult bee, which are all brought together under the term "Isle of Wight Disease." Remedial measures are given, sometimes without making it clear for which disease they are intended, and without insisting that a correct diagnosis is necessary before prescribing.

It would be easy to continue to criticise the scientific part of the book; and the same could be done with the part dealing with practical methods, but here we are dealing with matters of opinion. Suffice it to say that many of the operations should be condemned as being calculated to spread bee diseases rapidly through the apiary. D. M.

The General Theory of Thermodynamics: an Introduction to the Study of Thermodynamics. By Prof. J. E. Trevor. Pp. x+104. (Boston, New York, Chicago and London: Ginn and Co., Ltd., 1927.) 1.60 dollars.

THE object of Prof. Trevor's book is to "develop the general laws of Thermodynamics with logical consecutiveness and mathematical clarity" for students of physics, physical chemistry and engineering, for mathematicians and practising engineers. No applications of general principles are considered. The treatment departs considerably from traditional lines, as would be expected from the author's paper in the *Journal of Physical Chemistry*, 1908, and familiar words and phrases are used in new and disconcerting senses. Thus when a weight w is raised a small distance dh, "the inexact expression wdh denotes the work absorbed" (p. 12). The equation $dE = dW + dQ$ "asserts that the work and heat absorbed are integrals of exact differential expressions" (p. 13). In connexion with the pv diagram, "an irreversible path cannot be depicted by a curve in the plane" (p. 18). The law of dissipation runs, "when a thermally and dynamically isolated body undergoes a change of state that admits of a reversible path, the change of the entropy of the body is positive" (p. 85), which appears unduly restrictive. In later chapters, for example, that on the porous plug experiment, the treatment conforms more to tradition. It is not easy to understand how the book can serve as "an introduction to the study of thermodynamics."

Memoirs of the Geological Survey of England and Wales. Explanation of Sheet 232: The Geology of the South Wales Coalfield. Part 2: *Abergavenny.* By Aubrey Strahan and Walcot Gibson; with Notes by J. R. Dakyns and Prof. W. W. Watts. Second edition, by Dr. T. Robertson. Pp. xi+145+4 plates. (London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1927.) 3*s.* 6*d.* net.

THE first edition of this important memoir was published in 1900, and the need for a new edition has been made the occasion of certain additions and corrections, none of which can, however, be said to be of any serious importance. A good deal of palæontological work has been done, especially perhaps in the Millstone Grit. Naturally, the active development of the collieries during the last quarter of a century has thrown valuable light upon the structure of the coalfield. The Carboniferous Limestone has been exhaustively studied and the question of its dolomitisation has been examined in detail. The fact that a quarter of a century of active work has necessitated so little change in any of the fundamental portions of the memoir is evidence of the care and thoroughness with which the work was originally done.

Soil Conditions and Plant Growth. By Sir John Russell. (The Rothamsted Monographs on Agricultural Science.) Fifth edition. Pp. viii+516+6 plates. (London: Longmans, Green and Co., Ltd., 1927.) 18*s.* net.

THIS well-known text-book has now reached its fifth edition, a sufficient proof of its value and popularity. The last edition has been revised in the light of the author's recent travels abroad, during which he has had many opportunities of seeing the work of other stations. Nevertheless, the book retains its original character, and continues to give great (and no doubt well-merited) prominence to the work of Rothamsted. In recent years that has been largely concerned with soil biology in what may be loosely termed its purer aspects, but the agronomist feels that field results have followed slowly and is glad that soil tillage—which exercises a profound influence on the soil flora and fauna—is now engaging the serious attention of Rothamsted. We doubt also whether sufficient prominence has been given to the work of other soil laboratories, such as Bangor. The recent revolution in the methods of soil analysis, as referred to in App. I., for example, is due entirely to the original work carried out there.

Some Nigerian Fertility Cults. By P. Amaury Talbot. Pp. xi+140+16 plates. (London: Oxford University Press, 1927.) 12*s.* 6*d.* net.

MR. AMAURY TALBOT here describes the beliefs of the Ibo and Ijaro tribes of the Degamo division to which he was posted in 1914. For the most part they centre around the cult of Ale, the Mother-Earth goddess, and her consort, the Thunderer. Mr. Talbot describes at some length the M'bari houses or shrines and the ceremonies connected with them. He has brought considerable acumen to bear on the interpretation of these rites; but perhaps his most pregnant suggestion is made in connexion with the cult of the Great Drum. By an ingenious line of reasoning, he unravels the symbolism of the representation of the tortoise and identifies it with the female pudenda. Of the many ceremonies and beliefs connected with the promotion of the fertility of the crops which serve to illustrate the principles of the "Golden Bough," the most striking is that relating to the priest of the Elele Yam cult, whose office, like that of the priest of Nemi, reverted to the man who succeeded in slaying him.

Letters to the Editor.

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

The Diffraction of Cathode Rays by Thin Films of Platinum.

IN a letter to NATURE of June 18, Mr. Reid and I described the rings formed when a beam of cathode rays was sent at normal incidence through a thin film of celluloid and struck a photograph plate placed some distance behind the film. These were attributed to a diffraction of the cathode rays by the film, the cathode rays behaving as waves of wave-length h/mv according to de Broglie's theory of wave mechanics, and regularities in the structure of the film, or in the size of the molecules, making it behave as a kind of diffraction grating. In a paper now awaiting publication by the Royal Society, this work has been confirmed and extended to films of gold, aluminium, and of an unknown (probably organic) substance. In particular, the relation that the size of the rings is in all cases inversely as the momentum of the cathode rays is fully confirmed, and the number and size of the rings correspond remarkably with what is to be expected from the known crystalline structure of gold and aluminium, using de Broglie's expression for the wave-length of the cathode rays.

The present letter describes an extension of these results to the case of platinum. The difficulty was to get a film of platinum sufficiently thin to permit of the passage of the cathode rays without so much scattering as to mask the rings. One method was to obtain a thin film of platinum by cathodic spluttering on glass and removing the deposit by hydrochloric acid. This gives films thin enough to be transparent and several millimetres each way, but when they were mounted on frames, they always broke during the course of drying. To avoid this, I tried mounting them on the thin celluloid films used in the earlier experiments. This, of course, has the disadvantage that one would expect to get the rings due to both celluloid and platinum superposed. However, the most marked celluloid ring is about half the size to be expected for the smallest platinum ring, the other celluloid rings being very faint, under the conditions of experiment. It was found that when a photograph taken with platinum on celluloid was compared with one for celluloid alone, several new rings appeared. The photograph (Fig. 1) shows the innermost and strongest of these, the celluloid ring inside being visible only as a disc owing to over-exposure. In addition there were two new outer rings too faint to reproduce. Photographs were taken of these rings with various speeds of rays, and the size varied inversely as the momentum within the errors of experiment.

Since platinum is a face-centred cube of side $3{\cdot}91 \times 10^{-8}$, the distances d between successive crystal planes are given by $\dfrac{3{\cdot}91 \times 10^{-8}}{\sqrt{h^2+k^2+l^2}}$, where h, k, l are the indices of the plane, to be so chosen that they are all even or all odd. The smallest values of the denominator are $\sqrt{3}$, $\sqrt{4}$, $\sqrt{8}$, $\sqrt{11}$, $\sqrt{12}$. Each of these spacings gives a ring in the Debye-Scherrer method of X-ray analysis, and if the view that all particles behave like waves is correct, should do so with cathode rays also, assuming that small crystals orientated at all possible angles to the beam are present in the film. It is believed that the ring illustrated is a compound of the $\sqrt{3}$ and $\sqrt{4}$ ring unresolved (in the case of gold, which gives better films, the corresponding rings have actually been resolved), the two outer rings being $\sqrt{8}$ and an unresolved compound of $\sqrt{12}$ and $\sqrt{11}$. Taking the diameter of the inner ring as the mean of $\sqrt{3}$ and $\sqrt{4}$, the diameters of the outer rings are $\sqrt{8{\cdot}2}$ and $\sqrt{11{\cdot}1}$ as a mean from four plates. The absolute size of the rings is given by the Bragg law $n\lambda = 2d \sin\theta$. Taking the inner ring and using the above formula for λ, I find for the side of unit cube $3{\cdot}75 \times 10^{-8}$ (mean of 6 plates) against $3{\cdot}91 \times 10^{-8}$ as found by X-rays. This is 4 per cent. low, and would be about 6 per cent. low if the relativity correction were put in. The values found for gold and aluminium were also low by about the same amount. This may be due to a systematic experimental error, or may have a theoretical reason (for example, be analogous to the Compton effect).

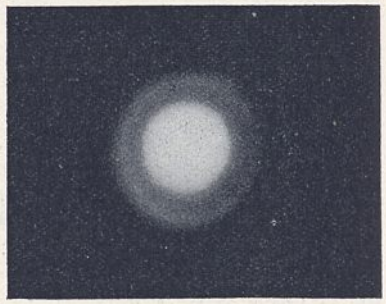

FIG. 1.

These results have been confirmed by some experiments with a thin piece of platinum further reduced in aqua regia. Though this was still too thick as a whole, it must have had thin patches, as photographs showed, besides spots due to holes and the direct beam, other 'diffracted' spots arranged in circles round the centre. These are explained by supposing that in this film, which had probably been originally made by rolling, the crystals were not situated in all possible directions, and so did not give complete Debye-Scherrer rings, but only spots on them, more like a Laue pattern. It was possible to distinguish between the spots corresponding to the two inner rings, and the ratios of their distances from the centre were $\sqrt{3} : \sqrt{4{\cdot}2}$ (mean of two plates).

The energy of the rays used in these experiments varied from 30,000 to 60,000 volts, and the distance from film to plate was 32·5 cm. G. P. THOMSON.

University of Aberdeen, Nov. 17.

Note added in proof.—Using a very thin piece of platinum leaf, I have now been able to obtain rings similar to those described above, without the use of celluloid backing. The inner ring is resolved into two as in the case of gold.

Method of Fossilisation of an Insect Wing.

IT has long been known that when the wing of an insect becomes fossilised the original chitin is either completely destroyed or else replaced by some other substance, such as carbon, silica, or oxide of iron. This, however, does not explain the extraordinary perfection with which some insect wings have been preserved, even in Palæozoic strata. A recent study of two thousand fossil insects from the Lower Permian of Kansas, approximately two hundred millions of years old, has brought to light many specimens in which the wings are as perfect as if they had just been dissected from the insect; yet it is evident that the original chitin is not present, neither is it replaced by any other substance. The explanation of this is to be found as follows:

The wing of an insect is really a bag the sides of which have been brought into contact and fused together

except along the vein-channels. Thus there is an *upper side* formed of one layer of chitin, and an *under side* formed of a second layer in contact with the first. The *chætotaxy*, or armature of hairs, is usually different on these two layers. Now, when a geologist finds a rock specimen containing an insect wing, he may, if he is lucky, succeed in splitting it with a blow of the hammer in such a way that he obtains *two* perfect impressions; these are called the *obverse*, in which convex veins appear convex in the impression, and concave veins concave, and the *reverse*, in which convex veins appear concave, and vice versa.

A little consideration will show that if we took impressions of the upper and under surfaces of the wing of a recently killed insect, in dental wax or plasticine, it would be the *upper* surface which would give the *reverse* impression and the *under* surface the *obverse* impression. Now, in the Kansas fossils there are many in which both impressions are preserved perfectly, with colour-pattern complete. This is particularly true of the fine species *Lemmatophora typica* Sell., already figured in NATURE (June 12, 1926, Fig. 2), and typical of the extinct order Protoperlaria, ancestral to our recent Perlaria or Stone-flies. The accompanying illustration (Fig. 1) shows a small portion of the reverse impression, greatly magnified, from the region of the cubital fork of the forewing. The chætotaxy consists of an immense number of minute hairs or microtrichia, resembling those of recent Perlaria, but somewhat stouter and shorter. This armature of fine hairs, then, must have been originally on the upper side of the wing in the living insect. If, however, we examine an obverse impression from the same species, we find much smaller and more slender microtrichia present, together with a row of strong spines along the costal margin (evidently of use in preventing the forewing from folding too far back over the hind in the position of rest).

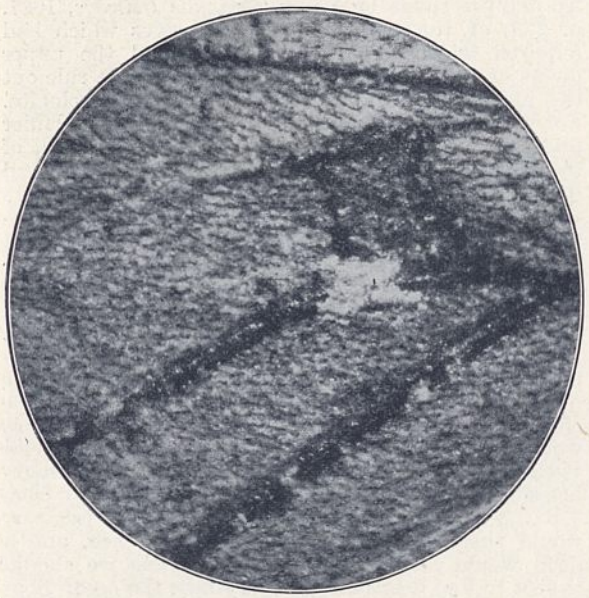

FIG. 1.—*Lemmatophora typica* Sellards, family Lemmatophoridæ, order Protoperlaria, Lower Permian of Kansas, U.S.A. Portion of reverse impression (upper surface) of forewing, showing the chætotaxy of numerous microtrichia. (Much enlarged.)
Photo by W. C. Davies, Curator, Cawthron Institute.

Thus we see definitely, for the first time, that the two impressions on the rock are actually the separate impressions of upper and under surfaces of the wing, and that they are separated by the exceedingly slight but measurable space represented by the thickness of the disintegrated chitin of the wing. The reason why the impressions are so perfect appears to be, not only that the grain of the rock is so fine that even the tiniest hair has left its impression, but also because the pigments of the wing, unlike the chitin, have proved indestructible, and are actually preserved on the rock, even in the case of the tiniest coloured hair! That this is so can be simply demonstrated by exposing one of the coloured fossils to bright sunlight, when it will be found to fade markedly after a few hours only, just as the pigment in the wings of butterflies fades in museum cases exposed to the light.

R. J. TILLYARD.
Cawthron Institute, Nelson, N.Z.,
Sept. 21.

Abel's Pituitary Tartrate.

IN 1919, Abel and Kubota isolated from the pituitary gland a 'single principle' which they identified as (*a*) histamine, (*b*) the 'plain muscle-stimulating and depressor constituent.' This conclusion, which they upheld in 1920 and withdrew in 1921, implied that the pressor constituent was not the plain muscle-stimulating (oxytocic) or the depressor substance. In 1923, Abel, Rouiller, and Geiling prepared a tartrate from pituitary extracts 1250 times as active on the uterus as histamine acid phosphate. This tartrate, they asserted, contains a 'single principle' responsible for the pressor, oxytocic, diuretic, and depressor activities. About the same time Hogben and Schlapp, studying the inversion effect, that is, the depression following a second injection of commercial extracts in the cat, found that with alcoholic extraction the depressor activity of their own preparations gave a diminishing depressor response, so that, with a powder made from glands put in ice-cold acetone immediately after killing, extraction for forty-eight hours resulted in a preparation which, with undiminished pressor activity, elicited no depressor action when administered in quantities equivalent to one hundred times the threshold for the pressor effect.

This was fully consonant with observations previously made by Schafer and Vincent, and with the properties of highly concentrated pressor fractions prepared by Dudley (1923), who in collaboration with Dale (1921) had advanced evidence indicative of the separate identity of the oxytocic and pressor substances. The work of the latter was confirmed independently first by Dreyer and Clark (1923) and later by Fenn (1924). Using a method of pressor assay designed by Hogben, Schlapp, and Macdonald to give an accuracy as great as that obtained with Dale's procedure for standardisation of the oxytocic principle, Schlapp (1925) conclusively proved the possibility of separating the two constituents by Dale and Dudley's method, that of Dreyer and Clark, and by a new procedure of his own. At the end of last year there appeared in *Physiological Reviews* a résumé of recent work on the pituitary gland from Abel's laboratory. In it Geiling maintained the validity of the claims of Abel and his co-workers to have concentrated a 'single principle' to which the manifold pharmacodynamic properties of pituitary extracts can be attributed. Beyond the bare statement that Abel and his colleagues were not able to subscribe to Dale and Dudley's contention, no attempt was made to explain why several groups of workers had been successful in concentrating the pressor and oxytocic activities in separate fractions. With reference to the inversion effect, however, Geiling made the following pronouncement:

"Unpublished experiments of the writer show clearly that even after a defatted pituitary powder has been extracted forty-eight hours in a Soxhlet with absolute

alcohol, as described by Hogben and Schlapp, it will still produce, when injected into etherised cats, either with intact or with cut vagi, and in the *same doses* as used by Hogben and Schlapp, a lessened response with the second injection, and later injections will effect the inversion. . . . Hogben and Schlapp are in error, when they assert that the fall in pressure is due only to the depressor substance and is not an intrinsic property of the infundibular extract." (Italics inserted.)

Owing to departure from the American continent, the present writer was prevented from replying at the time to this *ex parte* and undocumented statement in what one presumed to be an impartial survey of existing literature. Two subsequent publications, however, one by Vincent and Curtis (*Endocrin.*, **10**), and one by Draper (*Am. Jour. Physiol.*, **80**), together with the text of Geiling's experiments (Geiling and Campbell, *Jour. Pharm. Exper. Ther.*, **29**), now call for comment on the claims of Abel and his collaborators to have concentrated a 'single principle.'

As regards Geiling and Campbell's experiments, it is to be noted that they admit having used a commercial preparation, and frankly state that "the outstanding feature of their experiments was the variability in the development of a depressor response." Their tracings show no saline controls, and, where an undoubted depressor effect is indicated, the dosage was much greater (five times) than that used by Hogben and Schlapp: they made no quantitative comparison of depressor activity during the progress of extraction, an essential point in the thesis of Hogben and Schlapp; and, finally, they seem to have obtained their very transient depressor effects by rapid injection of cold extract. It now appears from Vincent and Curtis's paper, which upholds the view that the depressor action of pituitary extracts is due to a separate substance, that rapid injection of cold saline can of itself produce the type of depression which Campbell and Geiling obtained.

Whatever be the truth with regard to this issue, there is now little room for doubt about the separate identity of the oxytocic and pressor substances. Draper (1927) has repeated Schlapp's work, using the improved method of pressor assay, and a method of diuretic standardisation devised by himself for the purpose. His observations, like Schlapp's, Fenn's, and those of Dreyer and Clark, confirm the view of Dale and Dudley. In addition, Draper directs attention to a point which, in view of the aggressive tone of Geiling's review, is worthy of quotation:

"A study of these data [*i.e.* those of Abel, Rouiller, and Geiling] reveals the fact that the three activities were not preserved in their original proportions. On the contrary a great loss of the pressor and diuretic activities seems to have taken place. . . . 0·2 mg. of a tartrate having an oxytocic titer of 500 times histamine acid phosphate is shown to cause a slight rise of blood pressure in an anæsthetised cat, and 0·05 mg. is shown to produce a submaximal diuretic effect in an anæsthetised rabbit. These doses had the oxytocic activity of 100 mg. and 25 mg. of histamine acid phosphate respectively, and were the oxytocic equivalent of 100 c.c. and 25 c.c. of the liquor hypophysis U.S.P. ix. Since one tenth to one hundredth of a c.c. of liquor hypophysis is sufficient to raise the blood pressure of a cat and to promote diuresis in a rabbit, it is evident that these activities had been almost completely destroyed or eliminated in the process of purification."

In short, if Abel and his associates have evidence, as yet unpublished, to support Geiling's statement that "all the physiological properties of our active substance increase in intensity and in the same ratio *pari passu*," it is unfortunate that such data have been withheld from other groups of workers. The data they have placed at the disposal of other investigators prove the very opposite. If, on the other hand, no such data are available, one may hope that Abel will relinquish his claims to have concentrated a 'single principle' with the same candour as he displayed in withdrawing his previous view that the oxytocic and depressor substances were different from the pressor and identical with histamine.

LANCELOT HOGBEN.

University of Cape Town, Sept. 1.

Oceanic Deeps and the Thickness of the Continents.

IN a recent paper dealing in part with the structure of the lithosphere (*Geological Magazine*, June 1927) I assumed the substratum of the floor of the Pacific to be mainly eclogite, and I hinted at the possibility that the great bordering deeps of that ocean might mark the sites of great intrusions of peridotite. This speculation, however, fails to accord with the requirements of isostasy and is therefore unsatisfactory. An analysis made by Hiller (*Gerlands Beiträge*, 1927, p. 279) of the velocities of long waves which had followed widely different paths around the upper layers of the lithosphere seems, moreover, to rule out the identification of the Pacific sima with eclogite. For waves having a period of 18 to 20 seconds, Hiller finds velocities of 3·7 km. per sec. in the material of the Pacific floor, and 2·9 in that of Europe, Asia, and America. He adds that these are the respective velocities to be expected in sima and sial. Comparison of the ratio of these velocities (1·27) with that of the corresponding P- or S-wave velocities in gabbro and granite (1·23), indicates that the floor of the Pacific down to a depth of the same order as that of the sial of the continents behaves as gabbro would do.

If this identification be adopted, a reasonable explanation can be offered to account for some of the more puzzling features of the oceanic deeps. The effect of intense compression on a thick floor of gabbro would be, not to produce mountains or submarine swells, but to transform the gabbro into its high-pressure facies, eclogite. The change of density from 3 to 3·3–3·5, and the simultaneous action of isostasy, would therefore lead to marked subsidence, and a deep would result. On this hypothesis we should expect to find deeps along belts where the ocean floor borders the compressed mountainous edges of the sial; precisely, in fact, where they do occur. Deeps, moreover, should not occur everywhere around such borders, for in many places a thin covering of sial over the original gabbro would effectively prevent their development.

Thus, the two kinds of material, sial and sima, adopted by Wegener to explain the two dominant levels of the earth's solid surface, continental and oceanic respectively, serve equally well to explain the upward and downward departures from those levels. Compression and over-thrusting of the sial increase its thickness without seriously altering its density, and so lead to the uplift of plateaux and mountain ranges. Compression of the sima along adjacent belts (if the sima be normally of gabbroid composition and free from even a thin covering of sial) results in a marked increase of density, and so leads to the formation of the greatest tracts of subsidence—the oceanic deeps.

If now we assume the following approximate data:

Sial: mean density, 2·7 (ranging downwards in composition from granite to diorite, apart from its superficial veneer of sediments);

Sima: mean density, 3·0, where composed of gabbroid material, and 3·4 where this is in the eclogite facies, or where the sima is composed of peridotite;

we can balance a sial column through, say, Tibet, with an average altitude of 5 km., against an eclogite column through an oceanic deep covered with, say, 8 km. of sea water. If x be the depth of the level of equal pressure below sea-level, then approximately

$$2{\cdot}7(x+5) = 8 + 3{\cdot}4(x-8)\,; \text{ giving } x = 46{\cdot}7 \text{ km.}$$

Applying this method to the average floor of the Pacific, we easily deduce a thickness of 25 km. of gabbro underlain by 3·4 material (eclogite or peridotite); and finally, for the sial thickness corresponding to continental regions of average elevation we arrive at about 31 km., also underlain by 3·4 material. In support of this figure the latest estimate made by Dr. Jeffreys may be cited. His investigations of the records of the Jersey and Hereford earthquakes of 1926 indicated in each case a granite layer of about 10 km., underlain by an intermediate layer approximately twice as thick (*M.N.R.A.S., Geophys. Suppl.*, I., 1927, p. 483). If I am right in interpreting the composition of the intermediate layer as quartz-diorite to diorite, then the sial of the neighbourhood of Great Britain, the North Sea, the English Channel, and the adjoining parts of Europe—a nearly average region, though slightly low—should be about 30 km. thick.

Dr. Lawson and I have previously shown that radioactivity appeared to set a limit of 15 or 20 km. to the average thickness of the sial (*Phil. Mag.*, Dec. 1926, p. 1218). If, then, this thickness be really 30 km., it becomes certain that the radioactivity of the sial must fall off very rapidly in depth. Probably the most remarkable evidence supporting this hitherto little explored possibility is to be found in the atomic weight and isotopic constitution of common lead. These show quite conclusively that no appreciable part of the latter has been derived from the disintegration of uranium and thorium during known terrestrial history. Otherwise the atomic weight of ordinary lead would range between 206·9 or less, and 207·2 or more. That there is a real distinction between ordinary lead and radioactively generated lead has now been finally demonstrated by Dr. Aston's recent success in obtaining the mass spectrum of lead (NATURE, Aug. 13, 1927). It follows from these results that, until the time of its dispersal through and concentration from magmas, the lead of common ores must have lain in an environment where it was not appreciably affected by admixture with generated lead. In other words, I suggest that the dioritic base of the sial through which ordinary lead may originally have been dispersed, is extremely poor in the radioactive elements uranium and thorium, relative both to the higher levels of the sial and to the underlying levels of the sima.

Thus we see that an estimate of 30 km. (or a little over) for the mean thickness of the sial is in accordance with such widely different phenomena as the great depths of the oceanic deeps and the practical invariability of the atomic weight of ordinary ore-lead. Smaller estimates of thickness appear to leave both quite unexplained. ARTHUR HOLMES.

The University,
Durham, Oct. 28.

The Golgi Apparatus in Higher Fungi.

THE Golgi material in plant tissues is only now being worked out. Guilliermond of Paris in 1922 obtained Golgi apparatus in barley roots by the silver impregnation method; and in March 1926 he published a paper in *C. R. Acad. Sci.*, Paris, on the relation between the plant vacuolar system and the Golgi apparatus. He treated the epidermal cells of very young leaves of *Iris germanica* and meristematic tissues of young shoots of *Elodea canadensis*, some Chlarophyceæ, Cyanophyceæ, bacteria, and some fungi (Levure and *Oidium lactis*), with the silver impregnation methods of Cajal and da Fano as well as with vital staining with neutral red. In the majority of cases he could obtain the precipitates of vacuoles (metachromatic corpuscles) stained in the form of the network of canals constituting the Golgi apparatus.

Botanists generally are of opinion that the plant vacuolar system and the Golgi canals of animal cells are morphologically and physiologically equivalent. This is further supported by the recent remarkable researches of Parat, who has shown that the Golgi apparatus in animal cells also consists of a number of vacuoles. By the silver nitrate method of Golgi I have obtained clear blackened networks in close association with the nuclei in cells of the root-tips of Allium, Lilium, and Canna.

It seems that the presence of Golgi bodies in higher fungi (especially Basidiomycetes) has not been reported as yet. For the last eight months I have worked on a number of our common Agarics and Polypores, collected fresh and living, namely, *Lentinus subnudus*, *Lepiota mastoideus*, *Flammula dilepis*, *Entoloma microcarpum*, *Psathyra lucipeta*, *Panaeolus cyanascens*,

FIG. 1.—Golgi apparatus in *Lentinus subnudus*; after fixing for 10 days in potassium bichromate and osmic acid. Camera lucida drawing, under immersion lens, Zeiss apochromat, 2 mm., N. A. 1·4. ×1100.

Schizophyllum commune, *Polyporus zonalis*, *Ganoderma lucidum*, *Lenzites repanda*, etc. The basidia of all of them were studied, and for the sake of close parallel comparison each specimen was simultaneously treated in four different ways, namely, (1) by fixing in Fleming's strong fluid mixed with an equal quantity of water, and finally staining the microtome sections (5-6 μ thick) with Heidenhain's iron-hæmatoxylin; (2) by fixing in Bensley's fluid to study the form and the location of the vacuoles; (3) by fixing in Golgi's bichromate and silver nitrate method (rapid process); and (4) by vital staining with a very weak solution of neutral red.

By the silver impregnation method I could get within the basidia of the majority of specimens a clear network of blackened coil, usually corresponding with the position of the vacuoles. In some the black coil was found close to the top of the basidia, in some the coiled threads were at the bottom, and in others they were on the sides almost at the central part of the basidia. In Bensley's fluid the vacuolar system came out prominently as a unit. In Fleming's fluid the details of the nuclei were distinctly seen. Staining with neutral red, the metachromatic bodies within the vacuoles took a deep red stain in the form of droplets; big round drops taking a diffused stain showed in their interior a number of bodies deeply stained; these vacuoles were found in varying positions within the basidia. By successive trials it has been found that the specimens usually fixed in potassium bichromate and osmic acid from six to ten days showed good formation of the Golgi apparatus.

Some of the specimens showed the deposit of the fragments of black threads not yet united into a coil; these are what are known as 'Golgi bodies' as distinct from the 'Golgi apparatus.' Fig. 1 shows the Golgi apparatus in basidia of *Lentinus subnudus*.

I have camera-lucida drawings of a number of basidia from most of the specimens showing the presence of the Golgi apparatus. I hope to publish the details of each specimen in a later paper with the necessary illustrations.

S. R. BOSE.

Botanical Laboratory,
Carmichael Medical College,
Calcutta, Sept. 28.

Sound Absorption Coefficients measured by Reverberation and Stationary-wave Methods.

THERE are two methods of measuring the amounts of sound absorbed by various materials. One is the reverberation method of W. C. Sabine, in which a specimen of the material to be tested is mounted on the walls of a reverberation chamber and the coefficient of absorption is deduced from the effect which the presence of the specimen has on the rate of decay of sound in the chamber. The other consists in placing the specimen at the end of a pipe down which sound-waves are made to pass. The reflected and incident waves interfere, and the coefficient of absorption is calculated from observations made on the interference pattern within the pipe.

The advantage of the second method is that only small specimens are needed for a test. Generally a specimen with an area of not more than 1 square foot is sufficient, whereas for a reverberation test an area of about 100 square feet is needed. It is obvious, however, that the coefficients measured by the two methods will not necessarily have the same value. In the pipe (or 'stationary-wave') method it is the coefficient of absorption at normal incidence which is measured, whereas in a reverberation test (according to current theory) sound impinges on the specimen at all angles of incidence from 0° to 90°.

In a recent paper (*Proc. Roy. Soc.*, A, vol. 115, pp. 407-419, 1927) I have shown how the coefficient of absorption of an 'acoustic plaster' can be calculated for any angle of incidence from the 'acoustical admittance', a quantity which can readily be determined from observations made with stationary-wave apparatus. If $\Omega_1 + i\Omega_2$ is the acoustical admittance per unit area of the absorbing material, and a is the velocity of sound in air, it is shown that the coefficient of absorption for sound incident at angle θ is given by

$$\alpha_\theta = 1 - \frac{(\cos\theta - a\Omega_1)^2 + (a\Omega_2)^2}{(\cos\theta + a\Omega_1)^2 + (a\Omega_2)^2}.$$

This expression can be introduced into the theory of reverberation as usually developed (for example by E. Buckingham, Sci. Papers of the Bureau of Standards, No. 506, p. 201), and the 'reverberation' coefficient of absorption, say α, can then be found in terms of acoustical admittance. In this way I find that the reverberation coefficient is given by

$$\alpha = 8a\Omega_1\left[1 - a\Omega_1 \log_e \frac{a^2(\Omega_1^2+\Omega_2^2) + 2a\Omega_1 + 1}{a^2(\Omega_1^2+\Omega_2^2)} + \frac{a^2(\Omega_1^2+\Omega_2^2)}{a\Omega_1}\left\{\tan^{-1}\left(\frac{1+a\Omega_1}{a\Omega_2}\right) - \tan^{-1}\left(\frac{a\Omega_1}{a\Omega_2}\right)\right\}\right].$$

This somewhat formidable expression can be used to calculate the reverberation coefficient when the acoustical admittance per unit area is known. For example, for a certain acoustic plaster (made in the Building Research Board's laboratory to a modified Sabine formula), $a\Omega_1 = 0{\cdot}0813$ and $a\Omega_2 = -0{\cdot}0100$ at 512 vibrations per second (see *Proc. Roy. Soc.*, A, vol. 115, pp. 417-418, 1927). From this we find that the coefficient at normal incidence is $\alpha_0 = 0{\cdot}28$. This is the coefficient as usually measured by the stationary wave method. From the expression just given it is found that the reverberation coefficient is $\alpha = 0{\cdot}45$. Hence the reverberation coefficient of the acoustic plaster is much greater than the coefficient at normal incidence. Some support is given to this result by the values of the coefficients for the acoustic tile known as 'Akoustolith.' Stationary-wave measurements at 512 vibrations per second give 0·26 for the absorption at normal incidence (*Proc. Phys. Soc.*, vol. 39, p. 281, 1927), while the reverberation absorption coefficient is reputed to be between 0·36 and 0·38. F. R. Watson ("Acoustics of Buildings," p. 25) quotes 0·36. The difference is not so marked as that calculated for the modified Sabine plaster, but it is in the same sense.

The practical importance of establishing a relation between absorption coefficients by the reverberation method and those found with stationary-wave or similar small-scale testing apparatus is obvious, although it appears to have been sometimes overlooked or ignored in the past.

E. T. PARIS.

Air Defence Experimental Establishment,
Biggin Hill, Kent,
Oct. 25.

Flame and Combustion.

If I know not the meaning of the voice, I shall be unto him that speaketh a barbarian and he that speaketh a barbarian unto me.

IN my early days, I happened to be present in Vice-Chancellor Bacon's court when a ward in Chancery came up to be spoken with. After a long whispered conversation with her the Vice-Chancellor said to her counsel: "Mr. ——, the lady does not know her mind; when she knows her mind, let her again come here and speak with me." The young lady protested indignantly 'that she did know her mind'—but to no purpose. After a few more words with her, the judge repeated what he had said. Counsel took the hint and bore the fair protesting one away. Messrs. Bone, Townend and Co. (NATURE, Nov. 12, p. 694) are like that lady: they have burst violently into flame without having mastered the very tangled story of the great drama of chemical interchange which 'flame' connotes. Like the modern school-boy and college-student, they want teacher to learn them their lessons. I have always been against spoon feeding. Moreover, Prof. Bone is the last person to learn through others. When the firm has full grip of the case, if here, I shall be pleased to speak with them. Thus far but no further does my imagination go at present. It is not for me even to help on a decision whether it be safe to accept its guidance at any time.

Prof. Finch seems to have made interesting experiments. He always does and I have the very highest regard for his work. To dissect out the meaning of his observations will not be easy and is not even to be attempted upon such premature partial publication. Still, I may say, that I fail to understand how even that marvellous material 'water' can play an electrical and not a chemical part. I must confess that I am old-fashioned enough—if not medieval—to retain my faith in one Faraday and that I regard the two 'parts' as inseparable and interdependent, perhaps also because I learnt physics and chemistry as one subject in my blameful youth. Here again it is necessary to think down to the intimate process of interchange. This no one will do.

Mr. Egerton, too, appears to have made valuable

observations but he also uses language so ambiguous that it is scarcely possible to guess what he means. Thus, he concludes that the process of combustion is "autocatalytic." This sounds very learned. The statement must carry profound conviction and endless joy to the 'anti-knock' soul. Yet, what does it mean, how will it help us to make the internal combustion engine efficient? 'Catalytic' is one of those blessed words which carry no particular meaning—the shibboleth of the day, lisped in every scientific nursery. At least three special perambulators have been chartered to carry the infant catalysis 'hopping' in chemists' gardens: yet neither the Cambridge nor the Princeton nor the Johns Hopkins nurse can tell us what mission the baby is bawling. I see the note dates from Oxford. Looking this up in my Gazetteer, I find: A place where grass grows and dictionaries are made, but the meanings of words are not calculated in use. Then, in the new volume of the "Dictionary of National Biography," I find the statement made of the late Lord Rayleigh: "There still lingers in Cambridge a tradition as to the lucidity and literary finish of his answers in this examination [the Mathematical Tripos]. Every paper he wrote, even on the most abstruse subject, is a model of clearness and simplicity of diction." When we can say this of the papers we write on combustion, perhaps we shall begin at least to know where we are not.

HENRY E. ARMSTRONG.

Movements of the Lower Jaw of Cattle during Mastication.

AMONG the biological phenomena exhibiting a definite sense of rotation, as, for example, the growth of certain creepers and of the shells of snails, one that does not seem to have been studied and to which we wish to direct attention here, is the masticating motion of cattle. Close investigation shows that the lower jaw of the animal is displaced with respect to the upper jaw, not in a purely horizontal or a purely vertical direction, but simultaneously in both directions with such a phase difference that a clearly evident rotation results. Theoretically this can, of course, take place in two senses, and observation teaches that both possibilities are realised in Nature. Taking the direction of the food as positive, we shall denote as right- and left-circular cows those of which the chewing motion, viewed from the front, turns clockwise and counterclockwise respectively.

This nomenclature is based on the tacit assumption that one and the same cow always maintains its sense of rotation. We could confirm this by a limited number of observations but are aware that more complete data, extending over longer periods of time, are necessary definitely to settle this point. Statistical investigations on cows distributed over the northern part of Sjælland, Denmark, led to the result that about fifty-five per cent. were right-circular, the rest left-circular animals. As one sees, the ratio of the two kinds is approximately unity. The number of observations was, however, scarcely sufficient to make sure if the deviation from unity is real. Naturally these determinations allow no generalisation with regard to cows of different nationality.

The fact that both senses of rotation are realised raises the question if simple laws govern the hereditary transmission of the property referred to. Concerning the snails mentioned above, one knows that Mendel's laws in their simplest form apply, while in most other cases the actual occurrence of only one sense of rotation makes such investigations impossible. Particularly it would be interesting to ascertain which of the two modifications is the dominating one. We are, unfortunately, not in a position to bring evidence on this important point, but believe that those having a more intimate acquaintance with cattle will find it easy to give an answer.

P. JORDAN.
R. DE L. KRONIG.

University Institute for Theoretical Physics, Copenhagen.

Polarisation Effects in Measuring Electrostatic Fields.

IN listening to a lecture by Dr. Aston, in which the mass spectrograph was described, the writer was interested to hear that a polarisation of the plates of the condenser determining the electrostatic deflexion of the positive rays affected the field to such an extent to be one of the causes which made it necessary to recur to relative measurements in interpreting the results. Dr. Aston mentioned that the effect could be reduced by gilding the plates.

A few years ago attention had been centred on these polarisation or double layer effects in connexion with X-rays, in discussing the question how far such a layer formed under the influence of the electronic bombardment of the anticathode might affect the velocity of the electrons reaching the target. It is remarkable that they are so prominent in positive ray experiments, where the cathodic bombardment cannot be intense.

In Dr. Aston's determinations the polarisation was a disturbance, which he was able to trace in his results and to eliminate entirely.

Few physicists are in this fortunate position and to the writer it seems of interest to direct attention to the fact that, so long as no greater knowledge as to the conditions determining the magnitude of these polarisation effects is obtained, they constitute a particular source of error, which is but too easily overlooked in a number of cases where the production of stray rays cannot be eliminated, for example, in the determination of e/m for the electron according to some classical methods.

J. BRENTANO.

The University, Manchester, Nov. 12.

Biology and Birth-Control.

IT would interest me, and possibly some of your readers, if the writer of the review of my "Right of the Unborn Child" in NATURE of Nov. 5 would cite the sentences in which, according to him, I make "contemptuous remarks about God."

KARL PEARSON.

University College, London, W.C.1.

THE answer to Prof. Pearson's question is that he quoted with approval, as expressive of his meaning, J. C. Squire's lines, including "'Good God!' said God, 'I've got my task cut out.'" This seems to me contemptuous, and even blasphemous.

E. W. MACBRIDE.

The 'Green Flash.'

REFERRING to page 728 of NATURE of Nov. 19, greenish appearances at sunset and sunrise may be due to various causes; but I am personally convinced that the sudden green flash, seen by some people when the last rim of the sun disappears behind a sharp horizon, is mainly physiological; for I see (if it can be called seeing) a momentary greenness when I switch off a bright lamp, with metallic filament, suspended above my bed.

OLIVER LODGE.

Normanton House, Lake, Salisbury.

Alloys and their Importance in Engineering.

IN an interesting and suggestive presidential address delivered to the Institution of Mechanical Engineers on Oct. 21, Sir Henry Fowler paid a tribute to the help that mechanical engineering has received, in the solution of many of its most difficult problems, from the work of the man of science. Particularly he attributed the remarkable changes that have taken place since Stephenson built the *Rocket* to new materials and the physical states in which they can be supplied; and in large measure these have been the outcome of scientific research. The whole profession of mechanical engineering is to-day dependent on metals. "Although many ingenious contrivances have been made from wood and stone, mechanical engineering only commenced when metals became available for use."

In the middle of the nineteenth century, railways were developing very rapidly and the makers of iron rails could not cope with the demand, but the truly scientific work of Bessemer and his production of steel relieved the situation. Between 1850 and 1926 the world's production of cast iron grew from 4½ million tons to 77 million tons. In 1870 the total steel produced was less than ½ million tons; in 1927 more than 90 million tons were made. Only three metals were used for the manufacture of the *Rocket*; to-day, on the L.M.S. railway, fifty-five specifications for metals are used, and the British Engineering Standards Association has prepared standard specifications for more than 100 varieties of steel. Sir Henry Fowler pointed out that the work of Bessemer and of Siemens and Martin insured for many years a sufficient quantity of steel, but the work of two other men of science, Thomas and Gilchrist, who in 1876 discovered that phosphorus could be very appreciably diminished by using a basic lining in the melting furnace, increased enormously the possible supplies.

The improvement and control of the quality of steels by improved methods of manufacture and the development of new alloy steels for tools and other purposes have revolutionised not only the methods of the machine and fitting shops, but also the designs of all types of machines and structures. The development of photomicrography and the pyrometer have contributed in no small measure to the success that has been achieved. Michael Faraday a century ago in England, and Berthier in France, experimented on alloys of nickel and chromium, but it was not until 1857 that Mushet alloyed tungsten with iron and made self-hardening steel; the remarkable developments in cutting speeds and in automatic machinery, consequent upon the new alloy tool steels, has almost entirely taken place, however, during the last twenty-five years. In 1882, Hadfield produced the manganese steel, so largely used to-day, because of its hardness, for points and crossings and dredger buckets, and later produced the silicon steel which has had very remarkable effects upon the construction of transformers and other magnetic and electrical apparatus.

During the twentieth century the nickel and nickel-chromium steels and the so-called molybdenum and vanadium steels made by the addition of small quantities of these metals to the nickel-chromium steels have not only played a considerable part in the development of the automobile and the aeroplane, but steels have also been produced having remarkable magnetic, or non-magnetic, properties and others which resist both corrosion and high stresses at normal and high temperatures in a remarkable manner. Some of these alloys resist the action of the strongest acids and are proving of the greatest service in the chemical industry. Others are not only valuable for case-hardening boxes and heating pots but also give promise of helping in the solution of difficulties in superheater elements, in the development of high temperature - high pressure vessels for distillation and synthetic processes and the gas turbine.

Turning from steels to the non-ferrous metals, the developments in the copper alloys, bronzes and brasses, and in the aluminium alloys, have been equally remarkable. Muntz metal was the first of the alloys of copper that could be forged and extruded, but it was not until mass production became important that full advantage of this alloy was taken. To-day the British Engineering Standards Association specifications demand for high tensile brass a breaking strength of 45 tons per sq. inch, and for brass bars 28 tons per sq. inch, and an elongation per cent. of 25 per cent. on a gauge length of not less than four diameters.

Alloys of copper—brasses and bronzes—of greater strength than these are possible. In these developments the work of contributors to the reports of Alloys Committee of the Institution of Mechanical Engineers has played an important part.

Aluminium in the commercial form has only been known for thirty-five years. In 1913 the world's production of aluminium was 64,000 tons, but in 1926 this had risen to 235,000 tons. In the pure state it is of comparatively little use to the engineer, but when alloyed with zinc and copper, with copper, manganese, and magnesium (4 per cent. Cu, ½ per cent. Mn, ½ per cent. Mg as duralumin), with copper, nickel, and magnesium (4 per cent. Cu, 2 per cent. Ni, 1½ per cent. Mg as Y alloy), with copper and silicon (a 4 per cent. Cu, 4 per cent. silicon is a good casting alloy for sund or die), and with other metals, a remarkable series of light alloys having specific gravities from 2·8 to 3·1 have been produced. Duralumin can be forged, extruded, and cold drawn, and by suitable heat treatment can be made to give a breaking stress of 32 tons per sq. inch with from 6 to 10 per cent. elongation. The Y alloy can be hot rolled and heat treated to give 24 tons per sq. inch and 23 per cent. elongation; all the other alloys can be cast into intricate shapes, and some of them make admirable die castings. For many parts of aeroplanes, aeroplane engines,

and automobiles these alloys have proved invaluable. In the United States of America railway carriage frames are being constructed of duralumin, thus diminishing the dead weight, as compared with the net weight carried, very considerably. Die castings of intricate shapes, such as gear wheels, are now being made, to a remarkable degree of accuracy, of aluminium bronzes—alloys of copper and aluminium, containing more than 80 per cent. of copper.

The rapidity with which these alloys have been developed and have won the confidence of engineers is a tribute to the careful scientific work that has been done in connexion with their constitution and physical properties. The success achieved by the aluminium alloys has encouraged a number of workers to investigate the possibilities of alloying magnesium, which has only a specific gravity of 1·7 as compared with 2·67 for aluminium, with other metals, and already some success has been achieved in the application of magnesium alloys, containing more than 90 per cent. of magnesium, to the manufacture of high-speed pistons for internal combustion engines and other purposes.

Sir Henry Fowler paid a tribute to the important research work done in the great works, at the National Physical Laboratory, and also at the universities, but he emphasised the necessity for researches conducted jointly by men of science and engineers. Unfortunately, he did not suggest any method whereby the ability at present in the universities, which owing to pressure of teaching and other routine duties is not able, except at the cost of health, to apply itself to the solution of many problems with which industry is faced, can be given the necessary time and means to carry out research. The only hope seems a more generous provision of funds for the direct assistance of research in the engineering and metallurgical departments of the universities, in order that the condition of the apt quotation with which the address concluded may be fulfilled: "The wisdom of the scribe cometh by the opportunity of leisure; and he that hath little business shall become wise."

Scientific Aspects of Intense Magnetic Fields and High Voltages.[1]

By Sir ERNEST RUTHERFORD, O.M., Pres.R.S.

IN the past our laboratories have had to be content with the comparatively weak magnetic fields provided by the ordinary electro-magnets and the voltages supplied by simple electrostatic machines and induction coils. In order to push further our investigations in many directions, much stronger magnetic fields and higher voltages are required in the laboratory. Scientific men thus naturally follow with great interest advances in these directions, whether undertaken for purely scientific or for technical uses.

By means of modern electrostatic machines it is not difficult to produce weak direct currents at potentials from 200,000 to 300,000 volts, while a large well-insulated induction coil can give momentary voltages of a similar magnitude. The wide use of X-rays for diagnostic and therapeutic purposes has led to a marked improvement in apparatus for exciting intense X-rays. The requirement of very penetrating X-rays for deep therapy in our hospitals has led to the construction of comparatively light transformers, which will supply the requisite small currents at voltages between 300,000 and 500,000.

One of the simplest ways of producing very high voltages is by the Tesla transformer, in which the oscillatory discharge of a Leyden jar is passed through the primary of an air transformer. In this way it is not difficult to produce voltages in the secondary of the order of a million volts, and I understand as much as five million volts have been obtained in the Carnegie Institution of Washington. The striking effects produced by these rapidly oscillating discharges from a Tesla coil, and the immunity with which long sparks may be taken through the body, are well known to all. The rapid frequency of the oscillations and the comparatively small energy given to the secondary of a Tesla coil has, however, restricted its use for general technical purposes as a source of high voltages, although it is now finding an application for the testing of insulating materials.

In order to transmit electrical power economically over long distances, there is a continuous tendency to raise the voltage in the transmission lines. This increase of the operating voltage has led to the need of very high voltages to test the insulating properties of these lines and their transformers and the effect of electric surges in them. In the course of the last few years a number of high-voltage plants have been installed for testing purposes in various countries, which give from one to two million volts. These voltages may be obtained either by a very large well-insulated power transformer or more generally by a cascade method employing several transformers in which the secondary current of one transformer passes through the primary of a second, and so on, the cores of the successive transformers being mounted on insulating pedestals. This cascade method is very advantageous for the purpose, since it allows a great reduction in weight and dimensions of the transformers. Such a high-tension plant in full operation is a striking sight, giving a torrent of sparks several yards in length and resembling a rapid succession of lightning flashes on a small scale. Actually the highest voltage so far obtained by these methods is very small compared with the voltage in a normal lightning flash from a cloud to the earth, where the difference of potential may be as high as a thousand million volts.

There appears to be no obvious limit to the voltages obtainable by the cascade arrangement of transformers, except that of expense and the size of the building required to install them. I am informed that the General Electric Company of

[1] From the presidential address delivered at the anniversary meeting of the Royal Society on Nov. 30.

Schenectady has a working plant giving 2,800,000 volts (max.), and hopes soon to have ready a plant to give 6 million volts.

While no doubt the development of such high voltages serves a useful technical purpose, from the purely scientific point of view interest is mainly centred on the application of these high potentials to vacuum tubes in order to obtain a copious supply of high-speed electrons and high-speed atoms. So far, we have not yet succeeded in approaching, much less surpassing, the success of the radioactive elements, in providing us with high-speed α-particles and swift electrons. The α-particle from radium *C* is liberated with an energy of 7·6 million electron volts, that is, it has the energy acquired by an electron in a vacuum which has fallen through this difference of potential. The swiftest β-rays from radium have an energy of about 3 million electron volts, while a voltage of more than 2 million would be required to produce X-rays of the penetrating power of the γ-rays.

The application of high voltages to vacuum tubes presents serious technical problems, but a vigorous attack on this side of the question has been recently undertaken by Dr. Coolidge. In 1894, Lenard made the discovery that high-speed cathode rays generated in a discharge tube could be transmitted into the open air through a very thin window, and made very important observations on the laws of absorption of these swift particles. The voltage used to accelerate the electrons in these experiments seldom exceeded 80,000 volts and the rays were stopped in passing through a few inches of air. Taking advantage of the great improvements in vacuum technique and the ease of supply of electrons from a glowing filament, Dr. Coolidge has constructed an electron tube which will stand 300,000 volts, the rays passing into the air through a thin plate of chrome-nickel-iron alloy about 0·0005 inch thick.

It has not so far been found practicable to apply much more than 300,000 volts to a single tube, on account of the danger of a flash over, due possibly to the pulling-out of electrons from the cathode by the intense electric field. For the application of still higher voltages, a number of tubes are arranged in series and communicating with one another, the fall of potential in each being about 300,000 volts. In these preliminary experiments, a large induction coil has been used to generate the voltage. So far, experiments have been made with three tubes in series and 900,000 volts, giving a supply of electrons corresponding to one or two milliamperes through the thin window in the last tube. This gives an intense beam of high-velocity electrons, which spreads out into a hemisphere, due to the scattering of the electrons in passing through the metal window and the surrounding air, extending to a distance of about two metres from the window. Marked luminous effects are produced in the air itself and in phosphorescent bodies placed in the path of the rays. I am informed by Dr. Coolidge that further experiments are in progress, and it is hoped to extend the system for still higher voltages.

While the energy acquired by the individual electrons in falling through 900,000 volts is smaller than that possessed by the swifter β-particles expelled from radium, the number emitted from the electron tube is very much greater; for example, the number of electrons per second corresponding to a current of 2 milliamperes is equivalent to the number of β-rays emitted per second from about 150,000 gm. of radium in equilibrium.

While important progress has been made in artificially producing streams of swift electrons, there is still much work to be done before we can hope to produce streams of atoms and electrons of a much higher individual energy than the α- or β-particle spontaneously liberated from radioactive bodies. As we have seen, the α-particle from radium *C* is initially expelled with an energy of about 8 million electron volts. So far, the α-particle has the greatest individual energy of any particle known to science, and for this reason it has been invaluable in exploring the inner structure of the atom and giving us important data on the magnitude of the deflecting field in the neighbourhood of atomic nuclei and of the dimensions of the nuclei. In case of some of the lighter atoms, the α-particle has sufficient energy to penetrate deeply into the nucleus and to cause its disintegration, manifested by the liberation of swift protons.

It would be of great scientific interest if it were possible in laboratory experiments to have a supply of electrons and atoms of matter in general, of which the individual energy of motion is greater even than that of the α-particle. This would open up an extraordinarily interesting field of investigation which could not fail to give us information of great value, not only on the constitution and stability of atomic nuclei but also in many other directions.

It has long been my ambition to have available for study a copious supply of atoms and electrons which have an individual energy far transcending that of the α- and β-particles from radioactive bodies. I am hopeful that I may yet have my wish fulfilled, but it is obvious that many experimental difficulties will have to be surmounted before this can be realised, even on a laboratory scale.

We shall now consider briefly the present situation with regard to the production of intense magnetic fields. Electro-magnets are ordinarily employed for this purpose, and the magnetic fields obtainable are in the main limited by the magnetic saturation of the iron. By the use of large electro-magnets and conical pole pieces, the magnetic induction can be concentrated to some extent. For example, in the large Weiss electro-magnet, a field of 80,000 gauss can be obtained over a volume corresponding to about a pin's head, and a field of about 50,000 gauss through a volume of about 20 cubic mm. In general, however, most experiments have been restricted to fields less than 35,000 gauss.

In order to push this method of obtaining

magnetic fields to the practical limit, Prof. Cotton, of Paris, has designed and has under construction a very large electro-magnet. The cross-section of the iron will be of the order of one square metre, and about 500 kilowatts will be required to excite it. Such a large electro-magnet will not give a much stronger maximum field than existing ones, but will produce a field of given intensity through a larger volume. No doubt this electro-magnet will prove very useful in experiments where steady fields of high intensity are required through a reasonable volume.

In order to provide magnetic fields of the order of half a million gauss, the use of the electro-magnet must be abandoned. Some years ago, Dr. Kapitza suggested that intense momentary magnetic fields could be obtained by sending a very strong current through a coil for such a short interval that the heating effect in the coil is restricted to a permissible value. It is well known that momentary currents of great intensity can be produced by the discharge of a large high-voltage condenser through a coil. Experiments of this kind have been made by Dr. Wall, in which the duration of the discharge was of the order of one-thousandth of a second. It is estimated that in this way a field of about 200,000 gauss may be reached.

In his experiments to obtain intense magnetic fields, Dr. Kapitza at first employed a special form of accumulator to send a very strong current through a coil for about one-hundredth of a second, the current if necessary being sharply broken after this interval. In this way it was shown to be practicable to carry out experiments on the Zeeman effect, and in bending α-particles in magnetic fields considerably stronger than those obtainable with ordinary methods. In subsequent experiments, a generator of special design was installed, which gives a very large current, of the order of 70,000 amp., at 2000 volts when short-circuited. A heavy current from the generator is passed for about one-hundredth of a second through a coil and then sharply broken by means of a specially designed automatic break. By this means very strong momentary currents can be produced.

The main difficulty in these experiments has been to construct a coil strong enough to withstand the enormous disrupting forces which arise when a large current is passed through the coil. By special attention to the design, a coil has been made which gives a field of 320,000 gauss over a volume of about 3 c.c. without any signs of fracture. Measurements have been regularly carried out in fields of this magnitude. It is anticipated that the present design of coil will give about 500,000 gauss before bursting, and that still higher fields can be obtained in coils specially constructed for the purpose.

As the current only lasts about one-hundredth of a second, oscillograph methods have to be employed to determine the strength of the current and magnetic field. There seems to be no inherent difficulty in conducting magnetic experiments in these momentary fields, for the shortness of the time available is in many cases compensated for by the magnitude of the effects which arise in such intense fields. The investigations, which have been carried out in the Cavendish Laboratory, have been made possible by the generous support of the Department of Scientific and Industrial Research, which has defrayed the cost of the apparatus and experiments.

The application of these new methods of producing intense fields opens up a wide region of research, where all magnetic properties can be examined in fields ten to twenty times stronger than those hitherto available. Such researches cannot fail to yield results of great interest and importance and to advance our knowledge of magnetic phenomena.

While the application of external magnetic fields of the order of one-million gauss will no doubt markedly perturb the orbits of electrons in the outer structure of the atom, it is not to be anticipated that they will seriously affect the stability of atomic nuclei. General evidence indicates that the magnetic fields within the nucleus are much too great for such a relatively weak external field to cause a disruption of the nucleus. In this direction, the bombardment by high-speed particles is likely to be far more effective than the strongest magnetic field we can hope to generate.

This advance of science depends to a large extent on the development of new technical methods and their application to scientific problems. The recent work to which I have referred, on the development of methods of producing high voltages and intense magnetic fields, is not only of great interest to scientific men in itself but also promises to provide us with more powerful methods of attack on a number of fundamental problems.

News and Views.

IN February 1925 the residuary trust funds of the estate of the late Dr. Conway Evans, medical officer for the Strand district, who died in 1892, were transferred to the president of the Royal Society and the president of the Royal College of Physicians of London, and their successors in office, that in accordance with the terms of his bequest they "shall apply the same in giving rewards to such person or persons who, in the opinion of the Presidents, have rendered, or shall from time to time render, some valuable contribution or addition to science as it exists at the time of my death, either by invention, discovery, or otherwise." In accordance with this trust, the president of the Royal Society and the president of the Royal College of Physicians of London have made the first award of the Conway Evans Prize, amounting to 500 guineas, to Sir Charles Sherrington, on the ground that his work on the physiology of the nervous system, and chiefly on the physiology of the brain and spinal cord of the higher animals, has brought many complex nervous functions for the first time within the range of investigation and analysis. His discoveries have had a profound influence throughout the world on the experimental sciences of physiology and

psychology and have thrown a flood of new light on many of the symptoms of nervous disease. In making this first award for some valuable contribution to science as it existed at the time of the death of the testator, the presidents of the Royal Society and of the Royal College of Physicians state that they have had no hesitation in selecting as conspicuously worthy of such recognition the work of Sir Charles Sherrington, which they believe to be of outstanding value for science and for humanity.

THE twenty-fifth annual report of the Imperial Cancer Research Fund gives an account of another year of steady progress without any sensational discoveries. The interesting facts about multiple tumours receive special attention. Two independent cancers in the same person are very uncommon, and it has been found impossible to produce tar-cancer in mice after removal of a spontaneous mammary cancer or of an experimental cancer. One malignant tumour evidently causes the body to do something which to some extent protects it against another tumour. The nature of this mechanism is under investigation: it might well be the explanation of some of the vagaries of the occurrence of cancer in man. As in most cancer research institutes, the hypothesis of Gye and Barnard is under intensive examination: confirmatory results have been obtained, but there is as yet no unanimity about the facts or their interpretation. The financial position of the Fund is fairly satisfactory, but an uncomfortably large proportion of the income comes from temporary and casual sources.

WE learn from the Annual Report of the British Photographic Research Association that the Department of Scientific and Industrial Research has offered to the Association a block grant for the five years ending May 31, 1932, that will make up the income of the Association from other sources (its members' subscriptions) to £5000 per annum. There are certain conditions, and the one that is essentially new requires the appointment of a "Research Committee of technical and scientific persons in whom shall be vested the supervision of the scientific investigations of the Association." It is very satisfactory to know that, although the income of the Association will probably be rather less than it has been, the useful work that it has been carrying on for the last ten years will be continued. The Report gives the details of the last year's work, and states that investigations into the fundamental properties of the silver halides are being continued in order to ascertain whether the mechanism of the latent image formation can be connected directly with some purely physical property which can be studied in the absence of such complicating factors as gelatin.

THE kinematograph film is being increasingly used for educational purposes, and we note with interest that two films dealing with disease-carrying insects have recently been produced by the National Department of Health of Argentina, one on the house-fly and its relation to disease, and the other on mosquitoes and malaria. Both films were prepared at Buenos Aires under the direction of Dr. Barbará, of the Bacteriological Institute, but though primarily intended for propaganda purposes in Latin America, they could readily be adapted for instructional courses in medical entomology elsewhere; we believe copies can be obtained on loan. The house-fly film is particularly good, and includes photographic records from Nature of the complete life-history of the fly; habits of adults, oviposition (the actual deposition of an egg is shown), egg-hatching, larval growth and movements, pupation and hatching of adults. The characteristics of various Muscidæ are shown, and there are some remarkable photographs of the development of bacteria and the life-history of trypanosomes. The mosquito film is not quite so full, and the producers have made greater use of drawings and diagrams, but the life-history of culicine mosquitoes is well shown, also various control methods, and the development of malarial parasites, besides symptoms and treatment of the disease.

THE following appointments have been made by the principal trustees of the British Museum: Mr. R. A. Smith, to be Keeper of British and Medieval Antiquities, in succession to Mr. O. M. Dalton, who retires in December; Mr. E. J. Forsdyke, to be a Deputy Keeper in the Departments of Antiquities, in succession to Mr. R. A. Smith; Mr. H. I. Bell, to be a Deputy Keeper in the Department of Manuscripts, in succession to Mr. J. A. Herbert, who has just retired. The principal trustees have also made the following appointments in the Natural History Museum: Dr. L. J. Spencer, to be Keeper of Mineralogy, in succession to Dr. G. T. Prior, who retires on Dec. 16; Dr. W. D. Lang, to be Keeper of Geology, in succession to Dr. F. A. Bather, who retires next February. Mr. J. Ramsbottom, to be a Deputy Keeper in the Department of Botany, on the promotion of Dr. Spencer; Mr. M. A. C. Hinton, to be a Deputy Keeper in the Department of Zoology, on the promotion of Dr. Lang.

IN February next, after forty years' service in the British Museum (Natural History), Dr. F. A. Bather retires from the post of Keeper of the Department of Geology. His vigorous and cheery personality will be missed by geologists visiting the Museum no less than by his colleagues. Educated at Winchester and Oxford, he joined the staff of the British Museum in 1887 as assistant in the Department of Geology, and was placed in charge of the Echinoderma. After becoming assistant keeper, and later deputy keeper, he succeeded Sir Arthur Smith Woodward as Keeper of the Department in 1924. Dr. Bather was elected F.R.S. in 1909; was awarded the Lyell Medal by the Geological Society in 1911; has been president of Section C of the British Association, and of the Museums Association; he is now president of the Geological Society. Dr. Bather's original work on the palæontology of the echinoderms has gained him a world-wide reputation, and amongst the distinguished palæontologists of to-day he stands in the front rank. His memoirs and papers are too well known to need mention here; not only are they models of scientific method, but also they possess a literary charm seldom found in the writings of scientific authors.

IN his presidential addresses to Section C of the British Association at Cardiff (1920), and to the Geological Society last February, Dr. Bather dealt in a masterly manner with the principles of palæontology, and his listeners felt that those addresses were worthy of Huxley. Dr. Bather does more than look on fossils from the point of view of a morphologist and evolutionist; as is so well shown in his "Caradocian Cystidea of Girvan," he regards them as animals which once lived, and endeavours to correlate form with function, morphology with physiology. For several years Dr. Bather contributed the section on Echinoderma to the *Zoological Record*; although these are masterpieces of bibliography and analysis, one cannot avoid a feeling of regret that so much of his time was taken away from original research. In another direction, by the active interest which he has taken in the work of the Museums Association, Dr. Bather has rendered good service to his country; he has contributed many papers to the Association's journal dealing with the preparation and exhibition of specimens and other matters of importance to the curators of provincial museums. After his release from the cares and responsibilities of office, all who know Dr. Bather, whether personally or only from his writings, will fervently hope that leisure and health will enable him to continue for many years his splendid work in palæontology.

DR. W. D. LANG, who has been appointed Keeper of the Department of Geology in the British Museum in succession to Dr. F. A. Bather, was educated at Harrow and at Pembroke College, Cambridge. He graduated in 1901, and obtained the degree of Sc.D. in 1919. Dr. Lang became an assistant in the Department of Geology in 1902, and was placed in charge of the lower groups of invertebrates; he became assistant-keeper in 1924, and afterwards deputy-keeper in the Department. His palæontological work deals mainly with corals and Polyzoa, treated from an evolutionary viewpoint—his conclusions concerning genetic relationship being based on ontogeny and zonal succession as well as on morphological characters. Of his numerous memoirs on these groups of fossils, we can only mention "Growth-stages in Parasmilia" (1909), "The Pelmatoporinæ, an essay in the evolution of a group of Cretaceous Polyzoa" (1919), and "Catalogue of the Fossil Bryozoa (Polyzoa) in the British Museum: Cretaceous" (1921, 1922). In a series of papers in the *Proceedings of the Geologists' Association*, Dr. Lang has done yeoman service for students by his lucid exposition of some of the general principles of palæontology; of these papers we may name "Old Age and Extinction in Fossils," "Homœomorphy in Fossil Corals," "Trends in Carboniferous Corals." Dr. Lang has not confined himself to work in the Museum, but for many years has devoted his vacations to the investigation of the faunal succession of the Lias of the Dorset coast; the last of his numerous papers on this subject was read before the Geological Society on Nov. 16. We feel confident that Dr. Lang will worthily maintain the high standard set by his two predecessors in the Department of Geology.

DR. GEORGE THURLAND PRIOR, Keeper of Minerals in the British Museum (Natural History), who retires on Dec. 16 at the age of sixty-five years, entered the museum in 1887 to fill the vacancy caused by the death of Walter Flight, who had done the greater part of the chemical work of the department. Dr. Prior was well qualified for this work. He had obtained a demyship in natural science at Magdalen College, Oxford, in 1881, and gained a first class in the honours schools of natural science in both chemistry (1885) and physics (1886), and had also studied for a short time in Germany. His papers on chemical mineralogy dealt with many minerals presenting interesting problems for the analyst, such as the niobates and tantalates of the rare earths, the cerargyrite group, and some of the sulpharsenites and sulphantimonites of copper and silver. About 1893 he undertook the care of the rock collections in the department in addition to his chemical work, since when he has published many petrographical papers of which the most important are his account of the volcanic rocks of British East Africa and the report on the rock specimens collected by Scott's (*Discovery*) Antarctic Expedition of 1901–4. On the appointment of Sir Lazarus Fletcher as Director of the Natural History Museum in 1909, Dr. Prior was made Keeper of Minerals. He then turned his attention to the meteorite collection, and here he found ample scope for careful critical chemical investigation, which led to the publication of numerous descriptions of meteorites and two papers of particular interest giving his views on their genetic relationships and classification. In addition he has written a "Catalogue of Meteorites," giving a full account of the falls represented in the museum collection. He was elected a fellow of the Royal Society in 1912, and was awarded the Murchison Medal of the Geological Society in 1927. He is now president of the Mineralogical Society, of which he had been the secretary since 1909.

DR. LEONARD JAMES SPENCER, who succeeds Dr. G. T. Prior, entered the Department of Minerals in 1894. He was then twenty-four years of age, and had studied at Bradford Technical College, at the Royal College of Science in Dublin, and at Cambridge, where he was a scholar of Sidney Sussex College. He gained a first class in Part 2 of the Natural Sciences Tripos in 1893, taking geology, for which he was awarded the Harkness Scholarship. Before taking up his duties at the museum he studied for a short time under Prof. Groth in Munich. He has published a great number of papers on descriptive mineralogy, including accounts of the new minerals miersite, parahopeite, tarbuttite, chloroxiphite, and diaboleite. He translated Max Bauer's "Precious Stones" in 1904 and R. Braun's "Mineral Kingdom" in 1908–12, wrote "The World's Minerals" in 1911, and has contributed numerous articles on crystallography and mineralogy to Thorpes' "Dictionary of Applied Chemistry," and to the "Encyclopædia Britannica." But it is as an abstractor, editor, and indexer of mineralogical papers that Dr. Spencer has rendered especially useful service to the science. Since 1895 he has written abstracts for the Chemical Society. From 1900 until 1914 he was

referee for the mineralogy volumes of the "Catalogue of Scientific Literature." He undertook the editing of the *Mineralogical Magazine* in 1901, became collaborator for mineralogy and crystallography in the International "Tables annuelles de constantes et données numériques" in 1912, and commenced the publication of *Mineralogical Abstracts* in 1920, the majority of the abstracts for which have been written by himself. For his earlier work he was awarded the Wollaston Fund of the Geological Society in 1902. He was elected a fellow of the Royal Society in 1925.

PROF. W. A. BONE, lecturing before the Chemical Society on Nov. 24, took as his subject "Gaseous Combustion at High Pressures." Since 1920, Prof. Bone and his junior colleagues at the Imperial College of Science and Technology have been engaged in the study of the combustion of mixtures of hydrogen, carbon monoxide, or methane with oxygen and diluent gases under considerable initial pressures; as was recently announced in NATURE, this work is shortly to be extended and amplified. Prof. Bone commenced his discourse by emphasising the actual abnormality of the conditions which man is in the habit of regarding as normal, and quoted Prof. Eddington's statement that, apart from the interstellar cloud which is at the moderate temperature of 15,000°, probably nine-tenths of the matter of the universe is above 1,000,000°. "We must," he said, "keep our minds open to the reception of knowledge accruing from a study of gaseous interactions under what until recently would have been considered abnormal conditions of density and pressure." Had the pressure of our atmosphere been several hundred times what it actually is, the story of chemistry would have been rather different. The value of high pressure work lies in the fact that it accentuates the operation of influences which are either masked or overlooked at the ordinary pressure. There is a great increase in the rate of chemical change, and a proportionate decrease in cooling and dissociation effects; moreover, the increase in density of the medium may affect both the emission and the absorption of radiation during the explosion.

BOMBS and other apparatus now in use at the Imperial College were described and illustrated by Prof. Bone in his lecture referred to above; the spherical bombs are capable of withstanding explosion pressures up to 2000 atm., and a cylindrical one withstands explosion pressures of 1200 atm. The latter can be fitted with quartz windows for spectrographic work, and may then be used up to 500 atm. The behaviour of theoretical hydrogen—air and carbon monoxide—air mixtures is in striking contrast; the pressure in the former rises in about 0·005 sec. to 400 atm. (max.), then immediately beginning to fall, whereas in the latter the pressure takes 0·18 sec. to reach 410 atm. (max.), and begins to fall only after a considerable interval. The replacement by hydrogen of a very small proportion of the carbon monoxide enormously accelerates the pressure rise in explosions in gases initially at 50 atm. Prof. Bone also described experiments leading to the recognition of the phenomenon of nitrogen 'activation,' and dealt with the consequent secondary production of nitric oxide in the presence of excess oxygen. The spectrographic evidence shows that steam does not function chemically, but that carbon monoxide reacts directly with oxygen in carbon monoxide-air explosions, that the radiation emitted in such direct interactions is strongly absorbed by either carbon monoxide or nitrogen, and that in a carbon monoxide-air (excess) explosion at 25 atm. initial pressure, no nitric oxide is formed during the actual explosion period, although more than 2·5 per cent. of nitrogen dioxide may be found in the cooled final explosion products. Prof. Bone paid tribute to the devotion and skill of his junior colleagues, the late Mr. W. A. Haward, and Drs. D. M. Newitt and D. T. A. Townend.

AT the water engineers' congress on Nov. 17, in connexion with the Public Works, Roads and Transport Exhibition at the Royal Agricultural Hall, Islington, Prof. J. W. Gregory gave a lecture upon water divining. He defined the geological problem as being why a method once used in the search for so many objects is now practically restricted to that for water, for which it is perhaps now more used than at any previous time. He explained this as due to shallow water being so widely distributed that the diviner is bound to have a large percentage of successes, while the failures are forgotten. In many cases there is no clue to such water, and the search for it must be often 'wild-catting'; men expert in the search for such water may be often particularly successful. There are three rival explanations—that the rod moves in response to a physical force, to clairvoyance, or to muscular response to the recognition, often perhaps unconsciously, by the diviner of faint clues to water. Prof. Gregory considers that the decision between these views must depend upon the evidence. He discussed the chief British evidence and claimed that all the controlled experiments are against the divining rod. He referred especially to those organised by the *Sanitary Record and Municipal Engineering* at Guildford in 1913, to the tests by Prof. Wertheimer and Prof. Sollas, and to that for oil divining under the supervision of Sir John Cadman at the Anglo-Persian Company's experimental station. Four cases put forward as most convincing evidence for the divining rod by Barrett and Besterman were also discussed, but Prof. Gregory claims that they give no support to either the physical or clairvoyant explanation of the divining rod.

"THE Nile and the Use of its Waters" was the subject taken by Sir Murdoch Macdonald for his recent presidential address to the Junior Institution of Engineers. Sir Murdoch described the possibilities of land reclamation and irrigation improvements which still exist in Egypt, and explained the constructional works at present under consideration. One proposal, he said, is to heighten the Aswan dam by seven metres, and, so far as stability is concerned, it would be perfectly safe. The Gebel Aulia site for a new dam and reservoir in the White Nile just beyond Khartum is an excellent position, and a relatively low dam built on the sandstone formation would be capable of keeping in a large volume of water. Other suggested

sites for dams are at Lake Tsana and Lake Albert. To meet all the demands of Upper and Lower Egypt for reclamation and irrigation, the summer supply of the river must be increased to about 1500 tons per second, with correspondingly greater volumes during the other periods of the year. Account must also be taken of developments in the Sudan, but the Sudan area is too restricted to take such a quantity of water from the Blue Nile as would harm Egypt. Sir Murdoch said that there is conjoined with all these works, and others which may yet be suggested, a political aspect, but if the builders of all or any of them do not forget the rule that the right of first user to water can not be taken away, that it is a right which can not be separated from the property to which it applies, then justice would be done in the distribution of water to all the inhabitants of the Nile Valley, and the immemorial position in this respect of Egypt in the lower part of that valley would be fully conserved.

SIR J. C. W. REITH writes an interesting article on the connexion between the State, the people, and broadcasting, in the *Nineteenth Century* for November. He points out that we are accustomed to associate controversy with heated crowds, exaggeration, misrepresentation, and general unreasonableness. We think of broadcast politics as differing only in degree and not in kind from platform politics. This, however, is not the case. From the programme department's point of view, politics of the platform type would be quite unsuitable. Statesmen will find it necessary to develop a new technique of political argument. This technique will develop as the years go by, but it may be said in advance that it will derive little from classical or even from parliamentary oratory, and nothing at all from the pulpit or the soap-box. We cannot say how far it will dare to go into a detailed exposition of facts and figures. It is idle to speculate, for the capacity of broadcasting audiences is always developing, and the type of matter acclaimed yesterday is barely conceivable to-day. The possibility of harm can only be prevented by securing a high and conscientious type of man or woman for the profession; one independent alike of the frown of the threatening tyrant and the ardour of the citizens bidding evil. The essential qualification is implicit in the conception of service. The word 'fairness,' with all its unspoken connotations, may be taken as representing it in this particular sphere of action.

THE publication last week of Sir Baldwin Spencer's work on the Arunta coincided, appropriately enough, with the announcement that he had been awarded the Rivers' Memorial Medal for 1927 by the Council of the Royal Anthropological Institute. This medal, which was founded in memory of the distinguished president of the Institute whose death took place while he was still in office, is awarded for work of pre-eminent merit in the field; in the case of Sir Baldwin Spencer, for the epoch-making work which he carried out in collaboration with the late Mr. F. J. Gillen among the native tribes of Central and Northern Australia.

THE Hopkins Prize of the Cambridge Philosophical Society has been awarded as follows: For the period 1912–15, to Prof. R. A. Sampson, Astronomer Royal for Scotland, for his researches on the internal constitution of the sun, on optical systems, on Jupiter's satellites, and on practical chronometry; for the period 1915–18, to Sir Frank Dyson, Astronomer Royal, for his contributions to the general progress of astronomy, and to the spectroscopy of the solar atmosphere; for the period 1918–21, to Prof. A. S. Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, for his work on the classification of the motions of the stars, and on their structure, and on the influence of gravitation on rays of light; for the period 1921–24, to Dr. J. H. Jeans, secretary of the Royal Society, for his work on the theory of gases, and on radiation, and on the evolution of stellar systems.

ON Dec. 7, Prof. Louis Dollo, Honorary Conservator at the Royal Museum of Natural History at Brussels, will attain the age of seventy years. On that day there will be presented to him a commemorative volume containing articles by fifty-five biologists, as an appreciation of his work in extending to fossils the laws that govern all forms of life. The British contributors to the book are the late William Bateson, F. A. Bather, W. T. Calman, C. Forster Cooper, H. Gadow, E. S. Goodrich, J. P. Hill, J. E. Marr, W. D. Matthew, G. E. Pilgrim, C. T. Regan, A. C. Seward, W. J. Sollas, J. Stanley Gardiner, and A. Smith Woodward. The volume will be the first of a new serial, *Palæobiologica*, edited by Prof. O. Abel and published by E. Haim in Vienna.

THE annual general meeting of the Decimal Association will be held at the Institution of Electrical Engineers on Tuesday next, Dec. 6, at 5 P.M., and will be open to anyone interested in promoting the adoption of the metric system of weights and measures—the international language of quantity—and decimal coinage into Great Britain. Addresses will be given by Sir Richard Gregory, the retiring president, and by Sir Hugo Hirst, who is succeeding him in that office.

REFERRING to the paragraph in NATURE of Nov. 19, p. 740, on the proposed Institute of Indexing, we are asked to state that the primary object of Mr. W. R. Douglas Shaw's proposal to establish such an Institute is to improve the standard of book indexes. The proposal provides for the compilation of indexes by the Institute which, however, would neither be conducted for profit nor as a trade union, but as an international fellowship of those interested in the use or production of books and indexing facilities.

IN our issue of Nov. 5, p. 648, we published a review of Vol. 1 of Dr. George Sarton's "Introduction to the History of Science," at the head of which appeared the names of the American publishers. We are now informed that Messrs. Ballière, Tindall, and Cox, 8 Henrietta Street, London, W.C.2, are publishing this work in the British Empire at 45*s*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant on the scientific staff of the *Discovery* Expedition to undertake the preliminary sorting of the zoological collections—The Secretary, *Discovery* Committee, Colonial Office, Whitehall, S.W.1 (Dec. 9).

A lecturer in physics in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Dec. 9). An assistant in the botany department of the West of Scotland Agricultural College—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (Dec. 12). A controller of technical education under the Egyptian Ministry of Education—The Director, Egyptian Educational Office, 39 Victoria Street, S.W.1 (Dec. 14). A Government analyst and bacteriologist, Cyprus—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 15). A professor of economics (including economic history and statistics) in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Dec. 31). Eight appointments to the Forest Service of Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (April 7). Two first-class honours graduates for research in optics and allied studies, and in vacuum physics, in the Research Laboratories of the General Electric Co., Ltd.—The Director, Research Laboratories, General Electric Co., Ltd., Wembley. A full-time teacher of rubber technology at the Northern Polytechnic, Holloway—The Clerk, Northern Polytechnic, Holloway, N.7. A full-time teacher of engineering subjects and metal work at the Doncaster Technical College—The Principal, Technical College, Doncaster. A lecturer in tropical sanitation and hygiene at the Liverpool School of Tropical Medicine—The Hon. Dean, School of Tropical Medicine, Pembroke Place, Liverpool. A young graduate with good general chemical and physical knowledge, preferably with some experience of the technique of colour and colour lake manufacture—The Director, Research Association of British Paint, Colour, and Varnish Manufacturers, Waldegrave Road, Teddington.

ERRATUM.—In NATURE of Nov. 26, p. 770, col. 2, line 9, for "$0{\cdot}137d^2$" read "$0{\cdot}137d^3$." The equation should thus read: $\theta = \sqrt{6(d + 0{\cdot}3d^2 + 0{\cdot}137d^3 + \ldots)}$.

Our Astronomical Column.

THE TOTAL LUNAR ECLIPSE OF DEC. 8.—No total lunar eclipse at a sufficient altitude for refined work is visible in England between the years 1920 and 1938. We therefore have to make the most of those that are somewhat unfavourable. The first contact of the moon with the umbra on Dec. 8 occurs at 3.52 P.M., with the moon on the horizon; totality begins at 4.54 and ends at 6.15, the moon's altitudes, as seen from London, being 9° and 21° respectively; the last contact with umbra is at 7.18; penumbral eclipse continues for another hour, but for the latter portion of it the dimming of the moon's light is too slight to be discernible.

There are two classes of observations that can be usefully made during total lunar eclipses. The first is examination of the amount of light on the eclipsed disc, and its variation in different regions. It is only the lower regions of the earth's atmosphere that have sufficient refractive power to bend the sunlight into the inner part of the shadow; these regions are liable to have their transparency affected by cloud, so that observation of the eclipsed moon gives an integrated measure of the clearness of the earth's atmosphere round the great circle that has the moon in the horizon at the time of observation. Some have tried to establish a correlation between the illumination of the eclipsed moon and the sunspot cycle, and there are advantages in considering an integrated atmospheric effect of this kind rather than the records of isolated stations.

The other useful observations to make during lunar eclipses are occultations of faint stars; the best values of the moon's semidiameter were derived from such observations. During the coming eclipse, ι Tauri, mag. 4·7, will disappear at 4.30 P.M., P.A. 84°, and reappear at 5.19, P.A. 245°; B.D. 21° 754, mag. 8·2, will disappear at 4.57, P.A. 90°, and reappear at 5.46, P.A. 238°. The latter is taken from the *B.A.A. Handbook*. The times are for London. The darkness of totality can also be utilised for observing comets, which are usually lost for several days about full moon.

COMETS.—The comet Schwassmann-Wachmann has now been photographed on three days at Bergedorf, the following positions having been telegraphed from the I.A.U. Bureau, Copenhagen:

			R.A. 1927·0.	Decl. 1927·0.
Nov.	15d	21h 33·6m U.T.	1h 32m 14·2s	+20° 54′ 42″
	18	20 24·8	1 31 10·7	+20 46 47
	22	18 27·8	1 29 53·5	+20 36 25

From these, Mr. J. Möller, of Copenhagen Observatory, has computed the following parabolic orbit:

T	1926 May 3·368 U.T.
ω	328° 23′
Ω	331 38
i	10 5
log q	0·44793

This orbit implies that the comet passed perihelion 18 months before discovery, and is now outside the orbit of Jupiter. It would have been near opposition at the time of perihelion, and very much brighter than it is now.

It must be borne in mind that the preliminary orbit of such a distant comet is subject to considerable uncertainty. Thus, in the case of comet Shajn-Comas Sola in 1925, the early elements differed much from the final ones. The following ephemeris, calculated from the above elements, is not likely to be much in error:

0h.	R.A.	N. Decl.	log Δ.
Nov. 30	1h 27m 54s	20° 18′	0·7211
Dec. 8	1 26 22	20 0	0·7331
16	1 25 32	19 46	0·7457
24	1 25 25	19 34	0·7587

The *Bulletin of Tokyo Observatory* gives the following orbit of an object discovered there last January (designated Tokyo 1) which seems from its movement to be a comet, though its aspect was planetary.

T	1927 April 9·4662 U.T.	
Ω	343° 5′ 10″	1927·0
ω	199 10 4	
i	5 59 59	
ϕ	62 27 25	
n	101·933″	
log a	1·027796	
Period	34·809 years	

The perihelion distance is 1·20 units, the aphelion is near the orbit of Uranus. From the moderate inclination, the object would be liable to make close approaches to Jupiter.

Research Items.

POLYNESIAN RELIGION.—In *Bulletin* 34 of the Bernice P. Bishop Museum of Honolulu, Mr. E. S. Craighill Handy has published an extensive study of the essential elements of the belief and practice characteristic of the ancient worship of Polynesian peoples, the result partly of three years' literary research, partly of five years' personal investigation in the different island groups of Polynesia. On analysis it appears that the religions of the various island groups at the time of their discovery were of a composite nature. An ancient foundational system is fundamentally related to the culture as a whole, and is most pronounced in the large island groups on the periphery, Hawaii, the Marquesas, and New Zealand. It is termed Indo-Polynesian because the sources are to be found in regions long dominated by Indian religious influence. Second in importance is the region in which Tangaloa was regarded as supreme being, a region nearer the centre of recent cultural evolution, namely, Samoa, Tonga, and the Society Islands. Later intrusions or borrowings come from Melanesia and America, the Melanesian coming by way of Fiji and Tonga, or by borrowings of Polynesian voyagers, the American by the borrowing of Polynesian adventurers who found their way to Mexico and Peru. The Indo-Polynesian religions show traces of ancient Indic, south-east Asiatic, historic Hindu, and Chinese influences. It may be that the fusion of the first three may have taken place in south-east Asia or Indonesia before they were carried to Polynesia, while the Chinese influences may have been brought in by stray Chinese Tan-kah-lo—seafarers of the river population.

'ELEPHANT HEADS' IN MAYA SCULPTURES.—Mr. J. Eric Thompson, Field Director of the British Museum Expedition in British Honduras, in an article in the *Scientific Monthly* for November, revives the question of the significance of the 'elephant heads' in the drawings of Maya sculptures at Palenque made by Waldeck at the beginning of the last century. While Waldeck unquestionably intended to portray elephants' heads and his treatment of the tapir is distinctive, Mr. Thompson points out that not only is Waldeck's accuracy in other matters not above question, as is shown by reference to Maudslay's work, but also he was strongly influenced by a belief in the Asiatic origin of American culture and that this might have influenced his interpretation of an indistinct original. As the originals have since perished, the question is beyond solution one way or the other by direct evidence. Mr. Thompson summarises the arguments for and against judicially, but holds that even if the case for the elephant were proved, it would not support the diffusionists, though the attitude that America was never affected to any appreciable extent by Asiatic culture would have to be abandoned. Recent archæological research has shown that of the essential elements in the culture for which 'diffusion' is claimed, agriculture and pottery-making antedate the elephants by at least a thouasnd years.

FUNCTION OF THE EPIGLOTTIS.—The epiglottis is a tongue-shaped cartilaginous flap situated at the anterior border of the larynx. It used to be thought that this structure acted as a 'lid' to the larynx, falling back over the laryngeal aperture in order to prevent ingress of food or liquid during swallowing. This view was shown to be erroneous by Stuart, who proved that during swallowing the epiglottis actually moves forward and does not fall back. Moreover, when the epiglottis in man is destroyed by disease, swallowing remains unaffected, and many animals do not possess it yet swallow perfectly. Mr. V. E. Negus (*Jour. of Anatomy*, vol. 62, Pt. 1, 1927, p. 1) now suggests that the principal function of the epiglottis is to preserve the integrity of the olfactory sense (smell) when the mouth is open; it prevents entrance of air by the mouth by apposition to a long soft palate, thus compelling the inspired air to pass through the nose. The epiglottis is best developed in deer and antelopes, animals which largely rely on powers of scent for their actual existence, and in carnivores such as the wolf and lion, which are, therefore, able to open the mouth widely and yet to preserve undiminished the integrity of their powers of scent. In some instances the epiglottis may subserve a subsidiary function in respiration and in deglutition, but not in phonation, and song birds do not possess it.

COCCIDIOSIS IN CATS AND DOGS.—Justin M. Andrews (*Amer. Jour. Hygiene*, vol. 6, pp. 784-798, Nov. 1926) has studied the course of infection with *Isospora felis* and *rivolta* in cats. The incubation period is two to four days, and the duration of symptoms does not usually exceed a week. The prepatent period (from the administration of the oocysts to the appearance of the parasites in the fæces) is usually five or six days, and the patent period averaged about thirty days. There was some indication that the severity of the infection varied directly with the number of oocysts originally administered. One attack of coccidiosis seems to render cats and dogs non-susceptible to subsequent infection by the same organism. This immunity lasts for seven months, and probably for life. The author considers that *Isospora hominis* is peculiar to man, and that it occurs more frequently than has been reported.

THE LUMINOUS ORGANS OF WATASENIA.—G. Shima (*Proc. Imp. Acad. Tokyo*, July 1927) in a note on the nature of the luminous bodies of *Watasenia scintillans*, refers to the three classes of luminous organs present in this squid. In one of these, innumerable rod-shaped bacteria occur in the luminous cells, and in the other two classes of organs similar bacteria occur, though in fewer numbers. A pure culture—a colony—of the bacteria of the first organ when placed in a dark chamber was found to emit light of the same nature as that produced by the luminous organs of the live squid. The part of the luminous organ in which the bacteria occur gives a lipoid reaction. The author points out that luminous bacteria have been recorded hitherto in the Myopsida, but now they are shown to be present in Watasenia, which belongs to the Œgopsida. In another œgopsid, *Enoploteuthis chunii*, the author has found similar bacteria in the luminous organs, which correspond to the second and third classes of organs in Watasenia.

THE NUCLEUS OF AMŒBA.—Monica Taylor, S.N.D., states (*Quart. Jour. Micr. Sci.*, vol. 71, Pt. 2; 1927) that long and careful examination of cultures has failed to reveal any trace of syngamy in the life-history of *Amœba proteus*. Metcalf stated that the life cycle of this species may require a year for its completion, and this is substantiated by the present author. The development period during which the culture contains no adults or very few is followed by one during which the adults increase rapidly in numbers because of fission. The latter period may be prolonged almost indefinitely by sub-culturing, but without such interference it lasts almost six months. The nucleus of the young amœba is disc-shaped, and consists of a karyosome more or less centrally placed

in a reticulum of nucleoplasm. Chromatin in varying amounts is present in this reticulum. The karyosome is a much more conspicuous object in the developmental stages than in the adult, possibly because in the latter the chromatin blocks under the nuclear membrane arrest attention. The deeply staining portions of the karyosome in both young and old amœbæ contain chromatin and the latter passes out at intervals to the nucleo-reticulum, gradually making its way to the periphery as the nucleus grows in size, so that in adults ready to form encysted young the karyosome appears to consist of a vacuolated reticulum of nucleoplasm. When the nucleus is fully adult the chromatin of the periphery becomes subdivided into patches, large and not regular to begin with, but later forming 'blocks.' These blocks are therefore bits of the karyosome which in turn give rise to the chromatin blocks that escape into the cytoplasm of the agamont and form the karyosomes of the agametes. The author concludes that the rudiment of the nucleus in a developing *A. proteus* is wholly karyosomic and remains so throughout the encysted condition.

THE THEORY OF SAND DUNES.—A new development in the theory of sand dunes is made by Dr. Vaughan Cornish in a recent paper on "Waves in granular material formed and propelled by winds and currents" (*Geophysical Supplement, Monthly Notices, R.A.S.*, July 1927, pp. 447-467). It refers to waves in ridges, the crests of which are not level but undulating, with alternate peaks and saddles. Since the formation of these has been observed during a period of constant wind, the phenomenon cannot be regarded merely as a complication due to veering winds; it is a definite dynamical feature of the final stage of dune development in an unconsolidated material. It is natural to expect that collapse will occur, in a series of steep sand-waves transverse to the wind, if the current increases too quickly, and also that breakdown will take place first at special points, determined by accident; what requires explanation is the persistence of the peaks which remain after such breakdowns. Dr. Cornish finds evidence, from the form and size of the small ripples on the windward slopes of the ridges, indicating that over the windward face of the peaks there is a confluence of the winds towards the saddles, and that the convergence results in a spinning movement that increases the scouring action in front of the saddles. On the lee side of the ridge, the finer particles carried in the vortex may be deposited behind the peaks, though in some cases it was found that deposition occurred behind the saddles, the ground immediately behind the peaks being at a lower level.

CONTINUOUS X-RAY SPECTRA.—One of the outstanding problems in connexion with the production of X-rays, that of the origin of the continuous spectrum, has been studied by W. Duane in an investigation described in the September number of the *Proceedings of the National Academy of Sciences*. A modified Coolidge bulb was built in which the effective target was a small volume of mercury vapour at low pressure. This was excited by a homogeneous beam of electrons the energy of which was just insufficient to remove the *L* electrons, whilst the softer *M* rays produced were unable to pass through the mica observation window of the tube. The feeble intensity of the resulting pencil precluded the use of a spectrometer, and its average wave-length had therefore to be found by measurement of the absorption coefficient in aluminium. Quoting from one set of results, the average wave-length was 1·10 A., whilst that corresponding to the applied potential was 1·04 A., a difference of only 6 per cent. The conclusion drawn from these and similar data is that in at least a large number of impacts the electron transfers the greater part, if not all, of its kinetic energy into radiation, and that the latter is nearly, if not exactly, monochromatic.

ELECTRIFICATION BY FRICTION.—In a communication to NATURE, Mr. W. A. Macky, of University College, Auckland, gives a preliminary account of his experiments on the effect of the pressure of the surrounding gas on the electric charge produced by rubbing together a metal disc 2 cm. in diameter and an insulating disc 3 cm. in diameter. The metal disc, of aluminium or steel, was connected to an electroscope with a condenser in parallel and the readings of the instrument were taken on separating the discs after their flat surfaces had been rubbed together by rotating the disc of insulator. As the pressure of the gas was reduced, the readings of the electroscope fell for discs of glass, sulphur, and ebonite, from 100 volts at atmospheric pressure to 2 or 10 volts at less than a centimetre of mercury, while for discs of silk or chamois, the fall was only to about 75 volts. Similar affects were found in air, oxygen, hydrogen, and other gases. (The author appears not to be aware of the work of McClelland and Power, or of the theory of Riecke.) When the insulator disc was of glass, any faulty insulation caused the reading of the electroscope to increase to amounts of the order of 850 volts when the rubbings were repeated without the discs being discharged. This effect the author ascribes to the charge on the insulator disc leaking to the back surface and therefore not taking part in the withdrawal of the charge from electroscope and condenser when the two discs are brought together. The electroscope in consequence shows a residual charge, to which rubbing adds the normal charge, and as a result the total is increased.

SUPERCONDUCTIVITY.—Superconductivity was the name given by Onnes to the peculiar type of electrical conduction which is exhibited by certain metals at the extremely low temperatures obtainable by the use of liquid helium. He found that the electrical resistivity of certain metals as, for example, mercury, tin, and lead, decreases at first uniformly as the temperature is lowered. The resistivity then decreases less rapidly until the critical temperature is reached, when it suddenly drops to less than 10^{-12} times its value at 0° Kelvin. It was also found that if the specimen at a temperature less than the critical temperature was placed in a magnetic field and the field was gradually increased, the resistance became normal at a certain critical value of the magnetic field. It was further found that if the specimen were immersed in a bath the temperature of which was maintained at a value somewhat less than the critical temperature, then when the current in the specimen was gradually increased, the resistance of the specimen suddenly became normal for a certain value of the current. In 1917, Silsbee made the suggestion that this critical current and the critical magnetic field were not independent phenomena. It is highly probable that the threshold current is that which produces a field equal to the critical magnetic field. Onnes and his associates did a large amount of experimental work the results of which support this hypothesis. In Scientific Paper No. 556 of the Bureau of Standards, Silsbee makes a detailed analysis of the experimental results got at Leyden. His results support the assumptions on which his theoretical work is based.

RADIO DIRECTION-FINDING.—The Department of Scientific and Industrial Research has issued a special report (No. 5) on radio direction-finding by Dr. R. L. Smith-Rose (London: H.M. Stationery Office; 1*s.* 9*d.*). It summarises the progress that has been made in this

direction during the last five years. A comprehensive survey of the subject is given and the results obtained during the last two years are included. A theoretical discussion on broad lines is also given. This proves the notable contribution which the study of direction-finding has made to the solution of the important problem of the propagation of radio waves round the earth. The explanation of the propagation of radio waves round the earth as merely a phenomenon of diffraction presents many difficulties. A partial explanation can be made by making the hypothesis of a conducting layer in the atmosphere. Eckersley showed that while the transmission of vertically polarised waves by the conducting layer was sufficient to explain the measured values of radio signal strength, it was necessary to assume that the down-coming waves at the receiving end contained a horizontally polarised component in order to explain the variations in the apparent bearings observed on direction-finders. Experiments strongly confirm this theory. As the result of the intensive research being carried out in various parts of the world on the propagation of radio waves, the mechanism of the actual deflexion from the ionised layer is rapidly being placed on a satisfactory quantitative basis. The author concludes that the appreciable errors which occur when using the direction-finder at night are caused by the down-coming waves polarised with the electric force horizontal. As a direct result of the theoretical analysis, a system of direction-finding has been developed in which the night errors to which all closed coil systems are apparently liable have been reduced to a negligible amount.[5]

A NEW CATHETOMETER.—The cathetometer is a laboratory adjunct of which the cost is usually much more impressive than the range of accomplishments. A pattern recently produced by Messrs. Casella, of 49/50 Parliament Street, Westminster, therefore disturbs a tradition. This instrument is not only strikingly versatile, but also, strangely enough, is being put on the market at a much lower figure (£26) than its more simple predecessor. The central vertical column, supported by a heavy flat tripod with adjustable feet, is present as in the earlier type, but the telescope carriage, instead of travelling thereon, rides upon two of the three vertical brass rods which form a sort of cage rotating about the central column. One of these rods is engraved with a scale of 1 metre divided into millimetres and readable by vernier to 0·05 mm. The carriage can slide freely or may be rigidly clamped at any height on the scale; it can also be adjusted by fine motion screws for height and level. Similarly, the cage can rotate freely, may be rigidly clamped to the central shaft, or may have its motion finely controlled. The central column has a head and levelling screw, so that the whole apparatus may be laid horizontally. In this position the apparatus will serve as a reading telescope for use with a balance or galvanometer, or it may be used as a comparator of length, either by means of its accessory mountings, for end gauges, or, by changing the object glass, for measures of length.

THE SURFACE TENSION OF MOLTEN METALS AND ALLOYS.—The surface tensions of molten tin, bismuth, cadmium, lead, zinc, and antimony have been redetermined by Yosiharu Matuyama by a dropping method (*Science Reports*, Tohoku Imperial University, vol. 16, No. 5, June 1927, p. 555). At the melting points the values in vacuum for the six metals are: 59·1, 40·1, 67·9, 47·9, 80·0, and 37·5. The surface tension falls linearly as the temperature is raised, the values at 600° C. being for the first five about 51·6, 35·0, 60·2, 43·2, and 75·5. The constant in Eötvös equation connecting the surface tension with temperature is found to vary from 0·9 to 1·2 for tin, bismuth, lead, and zinc. The method has been applied to the three alloy systems, cadmium-antimony, zinc-antimony, and lead-antimony. In each case the tension falls from that of the metal with the higher value to that with the lower on a fairly gentle curve, rapidly at first and later more slowly. In the two former systems, however, there are small breaks at compositions corresponding with the compounds CdSb and Zn_3Sb_2. The conclusion drawn is that these compounds do not dissociate completely on fusion.

THE CRYSTAL STRUCTURES OF AMMONIUM, POTASSIUM, AND RUBIDIUM CUPRIC CHLORIDE DIHYDRATES.—In the September issue of the *Journal of the American Chemical Society*, S. B. Hendricks and R. G. Dickinson describe the results of an investigation of the crystal structures of the compounds $R_2CuCl_4.2H_2O$, where R represents ammonium, potassium, or rubidium. The study of salt hydrates and ammoniates by the methods of X-ray analysis is, in general, rendered difficult by their low crystallographic symmetry, and this case was no exception. Laue and spectral photographs were used, and their interpretation necessitated a very careful examination of reflection intensities. For each of the salts, the structural unit contains two $R_2CuCl_4.2H_2O$ and is based on a simple tetragonal lattice. Each copper atom is immediately surrounded by two oxygen and four chlorine atoms, two of the latter being at a distance from the copper 0·75 A. greater than the distance of the other two. Each alkali atom is surrounded by four oxygen atoms, four copper atoms and eight chlorine atoms. The inequality of the two copper to chlorine distances is naturally assumed to indicate that the copper exerts different forces on the two pairs of chlorine atoms, and this fact, together with the behaviour of these compounds in solution, seems to show that they are of the double salt rather than the complex salt type. In the case of $K_2CuCl_4.2H_2O$ the dimensions of the structural unit were found to be $d_{100}=d_{010}=7{\cdot}45$ A. and $d_{001}=7{\cdot}8$ A.

A STUDY OF THE STRUCTURE OF THE SURFACE OF ORDINARY SOLUTIONS.—A long contribution on this subject describing work carried out by J. W. McBain and G. P. Davies has just appeared in the September issue of the *Journal of the American Chemical Society*. As compared with the large amount of data for films of insoluble materials resting on the surface of a solvent such as water, very little is known about the structure of the surfaces of solutions. The determinations of Donnan and Barker of the absolute adsorption of a substance from true solution at the air interface, using nonylic acid solution, are thought to be inaccurate, and an improved method is described. The adsorptions per square centimetre of surface of aqueous solutions of *p*-toluidine, camphor, and amyl alcohol are given, and these amounts are considerably in excess of those required for a monomolecular surface film. It is suggested that, in addition to a monomolecular film, there is an excess concentration in the immediate neighbourhood of the surface and chains of oriented molecules extend inwards into the solution. The authors point out that this conception affords an explanation of some other results. The numerical results obtained are in disagreement with Gibbs's formula, and the authors use the strict thermodynamic formula of Gibbs, taking into account all the components present, even the gas in contact with the surface. It is also considered essential to include terms not in the Gibbs equation in order to allow for the electrical effects which occur at all surfaces.

Synthetic Formaldehyde.

FORMALDEHYDE, which is greatly in demand for disinfection and for the manufacture of artificial resins and synthetic dyes and drugs, was at one time chiefly imported into Great Britain as a 40 per cent. aqueous solution (formalin) at a price which stimulated investigations into the possibility of its synthetic production. Since it is made by the catalytic dehydrogenation of methyl alcohol, usually over a copper contact mass, its price will naturally be dependent on that of wood spirit, and hence on the demand for wood charcoal, unless alternative supplies of the alcohol become available, as is now in fact the case. The falling exports of wood distillation products from the United States of America, and the large natural sources of gaseous hydrocarbons within the Empire, are facts which indicated clearly enough the direction in which research should be undertaken. The Chemistry Research Board of the Department of Scientific and Industrial Research consequently decided to explore the possibility of the economical production of formaldehyde by the oxidation of hydrocarbons.

The work was carried out at the Royal Naval Cordite Factory, Holton Heath, Dorset, and is the subject of a report entitled "The Production of Formaldehyde by Oxidation of Hydrocarbons" (Chemistry Research, Special Report No. 1) by Messrs. W. Ledbury and E. W. Blair, which has just been published by H.M. Stationery Office (2*s*. net). This report deals both with the production of the formaldehyde and with its recovery from aqueous solutions. Although the account of the investigations shows that the formaldehyde can be manufactured according to the proposed process in the form of a dilute solution, it is pointed out that the commercial success of the method has been forestalled by a greater success: that of the manufacture of methyl alcohol ('methanol') from mixtures of carbon monoxide and hydrogen. By this means the price of formaldehyde has been reduced from £130 to £40 per ton, and even the United States of America is importing from Germany supplies of this commodity.

Valuable information, however, has been gained in connexion with the concentration of dilute formaldehyde solutions, and the Board has wisely decided to place on record the whole of the data. The Report first describes the production of formaldehyde by the controlled oxidation of ethylene, methane, etc.; much of the work has already been published in detail, and is therefore familiar to those interested in the subject. The Report covers the transition of the laboratory experiments to semi-technical processes; the use of coal gas has also been examined, but the cost was found to be prohibitive except during emergency periods. A semi-technical investigation of the absorption by water of dilute formaldehyde vapours is next described, and reference is made to the bisulphite and ammonia compounds of formaldehyde.

The section on the recovery of formaldehyde from aqueous solutions commences with a description of a laboratory investigation of the distillation of formaldehyde solutions at atmospheric pressure, followed by the results of large-scale tests, and experiments on distillation under pressure and continuous distillation. Incidentally, it was found that iron, even in the form of an alloy containing only 9 per cent. of that metal, is unsuitable for use in the construction of stills for formaldehyde solutions on account of its activity in causing decomposition of that compound, whilst nickel, aluminium, and copper are non-reactive. The cost of concentration appears to be such that it is uneconomical to concentrate by distillation a solution appreciably weaker than 1·5 per cent.

History of the Desert Flora of the Old World.

DETAILED analysis of the systematics and distribution of various typical desert plants of central Asia has led the Russian botanist, M. G. Popov, to some very interesting general considerations on the origin and history of the desert flora of the Old World (*Bull. Univ. Asie Centrale*, Tashkent, livr. 15, 1927, pp. 239-292).

According to Popov's views, the primitive desert flora developed so early as in the Cretaceous, or even the Jurassic period. To this time must belong such forms as Welwitchia, Ephedra, etc., and the centre of origin must have been in the central parts of the Gondwana continent. Destruction of the latter resulted in the shifting of the main desert area into the southern hemisphere, where a continuous landmass existed during the Cretaceous period and a free exchange of desert forms between South Africa, South America, and Australia could take place. During this period such great groups of desert plants were developed as Zygophyllaceæ, Geraniaceæ, Rutaceæ, Capparidaceæ, etc., and for this complex of forms the author proposes the name of the Welwitchia flora.

At the same period the African continent was connected by the Lemurian with India, and over this bridge desert forms from South Africa migrated through the Deccan into central Asia, while northward migration of the desert flora on the African continent itself went so far north as the southern shores of the sea of Thetis, which occupied the place of the Sahara. Thetis separated the region of the Welwitchia flora from more northern parts of the Arctogæa, where a very different mesophilous flora, which originated on the Angara continent, developed.

Parallel with the migration of purely desert elements from South Africa northwards, there was an interchange of less xerophilous plants between western Asia and South Africa, by way of East African table-lands; in this way Erica, for example, migrated from south to the north, and Dianthus in the opposite direction. The disappearance of the Lemurian bridge separated the South African desert region from Asia, while the lowering of the East African mountains resulted in its separation from the Mediterranean deserts.

A further stage of the development was due to the disappearance of the Thetis sea, in place of which the vast desert belt stretching from Sahara to Mongolia developed. These deserts were invaded by the Welwitchia flora which already flourished on the southern shores of the Thetis. In this way the very uniform ancient Mediterranean flora was formed, and its further evolution consisted in extensive interchange of forms with America, by way of the Northern Atlantic. This, together with the dying-out of many ancient elements of the Welwitchia flora in the Palæarctic deserts, owing to changes of edaphic conditions, led to further changes in the flora of the latter now entirely separated from the South African desert region. As a result, a special desert flora was evolved, which may be called ancient Mediterranean, or Iranian, but its history is to be discussed in a later paper by the same author.

Anniversary Meeting of the Royal Society.

SIR ERNEST RUTHERFORD, in his presidential address at the anniversary meeting of the Royal Society on Nov. 30, referred to the scientific careers and work of the twelve fellows and three foreign members who died during the year. Among other subjects surveyed in the address are the publications of the Society and the attendance at the ordinary meetings. Sir Alfred Mond, on behalf of Imperial Chemical Industries, Ltd., has offered a subscription of £1000 a year until further notice to help to meet the deficit on the publication account, in substitution of that of £500 a year for three years made by Messrs. Brunner, Mond and Co. in 1925; and the Council has gratefully accepted the gift. Since the War "there has been a notable increase in the number of papers published by the Society. This is specially marked in the 'A' *Proceedings*, where, in place of one volume a year before the War three or four volumes now appear, the separate numbers being issued with promptness and regularity."

As one means of increasing the interest, and therefore the attendance, of fellows at the meetings of the Society, facilities have been provided for the display of experiments or demonstrations in the tea-room before and after the reading of papers.

We print elsewhere in this issue Sir Ernest Rutherford's remarks upon the results of investigations carried out in recent years to produce intense magnetic fields and high voltages for general scientific purposes; and we subjoin extracts from descriptions of the work of this year's medallists.

Presentation of Medals.

THE COPLEY MEDAL, AWARDED TO SIR CHARLES SCOTT SHERRINGTON.

Sherrington early chose as the special field of his investigations the physiology of the central nervous system. To this, during some thirty years, he has steadily devoted his great skill in experiment, bringing the immense complexities of its function within the range of objective analysis, and revealing fundamental plan and orderly sequence in the reflex actions by which it controls the activities of the body, and continuously adjusts them to the environment. The results of this work have been embodied in a series of some two hundred original memoirs, presenting a continuous record of progressive investigation. The earlier stages have been brought under review and treated synthetically by Sherrington in his now famous Silliman Lectures on "The Integrative Action of the Nervous System." In these he deals with the occurrence and significance of the muscular rigidity which appears when the higher brain is removed, with the co-ordination of muscular movements by reciprocal excitation and inhibition of antagonistic muscles, with the rhythmical, phasic activity which the conflict produces in the centres concerned with certain movements, and with the appearance of a purposeful character which the integrating action impresses on many forms of reflex response. The influence of Sherrington's investigations has spread far beyond the limits of his own laboratory and has inaugurated a new era in neurological investigation throughout the world.

A ROYAL MEDAL, AWARDED TO PROF. JOHN CUNNINGHAM MCLENNAN.

For more than thirty years Dr. J. C. McLennan has been an industrious and enthusiastic experimenter, his papers being mainly concerned with radioactivity, gaseous conduction of electricity, the spectra of the elements, and the liquefaction of gases. Among his works of outstanding merit may be mentioned the measurements he has made with his pupils on the fine structure of spectral lines, which are of much importance to modern theories of the mechanism of the atom. Recently he has had quite sensational success in tracing to its source the elusive auroral line λ5577, an extremely difficult task which had baffled the skill of many previous investigators. This is important not only in itself but also on account of the information it yields as to the structure of the upper atmosphere. Apart from his own private researches he has built up a most efficient school of physics in Toronto, and is largely responsible for the present strong position of physical science in Canada. He has devoted much energy to the establishment of a cryogenic laboratory in Toronto, a heavy task which he has carried out with much success.

A ROYAL MEDAL, AWARDED TO SIR THOMAS LEWIS.

From 1911 onwards to the present day, Sir Thomas Lewis has taken a leading part in the remarkable growth of our knowledge of the mammalian heart-beat, which has been one of the conspicuous scientific achievements of the period in question. Lewis's researches enabled him to locate the point of origin of the beat, and to plot out the course of the wave of excitation over the ventricles and auricles of mammals. By extending these observations to the hearts of representative vertebrates, he was able to compare the modes of spread of the wave with the special forms of the electrocardiagram, and thus to appreciate clearly the meanings of the several deflexions. Further extension to diseased hearts led to the interpretation of the abnormalities of the electrocardiagraphic record.

In 1911 Lewis was able to show that, as Cushny had previously suggested, certain cardiac irregularities are due to fibrillation of the auricles; and his later clinical and experimental work on auricular fibrillation and flutter suggest that the irregularities are due to the formation of an endless circulating wave of contraction in the auricles. Quite recently he has published the results of investigations of the peripheral circulation, upon which he has been engaged during the past twelve years.

THE DAVY MEDAL, AWARDED TO PROF. ARTHUR AMOS NOYES.

Prof. Noyes's researches have been chiefly concerned with the properties of solutions, in particular of electrolytic solutions. Soon after the inception of the electrolytic dissociation theory of Arrhenius, it was recognised that all was not well with the strong electrolytes. Whilst qualitatively their properties were accounted for by the theory, there yet existed marked quantitative discrepancies. Accurate measurement of the properties of such solutions was the first requisite for the attack of the problem, and to this task Noyes applied himself. His investigation of the conductance of aqueous solutions up to temperatures as high as 300° forms a classical example of exact physico-chemical measurement executed under conditions of great experimental difficulty.

His work on the influence exerted by one salt on the solubility of another, on transport numbers and the mobilities of the ions, on the ionisation of pure water at different temperatures, is all directed to the same end. Noyes showed the importance of the classification of the strong electrolytes according to their valency type and, more than twenty years ago, attempted to take into account the electrostatic forces between the ions. He thus foreshadowed the modern

theory now so widely developed by Noyes himself amongst other workers.

THE BUCHANAN MEDAL, AWARDED TO DR. MAJOR GREENWOOD.

Dr. Greenwood is specially distinguished for the statistical study of medical subjects, having applied the statistical method to the elucidation of many problems of physiology, pathology, hygiene and epidemiology. He has been pre-eminent in encouraging and developing the use of modern statistical methods by medical laboratory investigators and in securing the adequate planning and execution of field investigations. He is almost unique in the possession of both the medical knowledge and mathematical ability which are essential in these researches.

THE HUGHES MEDAL, AWARDED TO DR. WILLIAM DAVID COOLIDGE.

Science is under a great debt to Dr. Coolidge for the invention and production of a new type of X-ray tube, called by his name, of great flexibility and power, which has proved of great service not only to medical radiology but also in numerous scientific researches. In the last few years he has applied his unrivalled technical knowledge to the generation of high-velocity cathode rays, which can be passed into the air through a thin window as in Lenard's pioneer experiments thirty years ago. Such researches are of great importance to science, as they promise to provide us with new methods of obtaining a copious supply of swift electrons and high-speed atoms of matter for experimental investigations.

University and Educational Intelligence.

CAMBRIDGE.—Mr. G. E. Wherry has been elected to an honorary fellowship at Downing College. Mr. H. A. Roberts, Secretary of the Appointments Board, has been elected to a fellowship at Gonville and Caius College. Mr. F. C. Phillips has been elected to a fellowship at Corpus Christi College.

Prof. Nuttall, Magdalene College, has been re-elected Quick professor of biology. Mr. F. C. Bartlett, St. John's College, has been reappointed reader in experimental psychology. Miss M. S. Willis, Girton College, has been appointed demonstrator in geography.

It is proposed to add the Astronomer Royal, the Hydrographer of the Navy, the Director-General of the Ordnance Survey, and the Chief of the Geographical Section of the General Staff at the War Office to the committee for geodesy and geodynamics.

LONDON.—Prof. E. C. Williams, who has held the Ramsay Memorial chair of Chemical Engineering at University College since 1923, has resigned in order to occupy an important post in the Shell Oil group. His business will be the active development of the group's research organisation in California. Prof. Williams, who was a distinguished graduate and scholar of the University of Manchester, was employed for five years by the British Dyestuffs Corporation, and for one year as research chemist to the Joint Committee of the University of Leeds and the National Benzole Association. At University College, in temporary buildings, he has conducted courses of instruction on lines which he described in an inaugural address at the College in 1924. His work has been remarkably successful, and abundant evidence is forthcoming of the advantages gained by students who have added to their ordinary university curriculum in chemical science a period of study in the Ramsay Department of Chemical Engineering. The measure of success achieved has encouraged the College to an immediate and considerable development of the Department. A very strong and influential committee has been formed for the purpose of collecting a building and endowment fund, with Sir Alfred Mond as chairman, Sir R. Waley Cohen as vice-chairman, Sir David Milne Watson as honorary treasurer, and Sir Frank Heath as honorary secretary.

The title of professor of chemistry in the University has been conferred on Dr. J. F. Spencer, in respect of the post he holds at Bedford College. Prof. Spencer studied at University College, Liverpool, and at the University of Breslau. Since 1905 he has worked in the Department of Chemistry at Bedford College; in 1915 the title of reader in physical chemistry was conferred on him, and since 1919 he has been head of the department. His published work includes "The Metals of the Rare Earths" (1919), "An Experimental Course of Physical Chemistry," "The Magnetic Susceptibility of some Binary Alloys (with M. E. John, *Proc. Roy. Soc.*, A, 1927), and numerous papers in chemical journals.

A course of five free public lectures on "The Technique of Bacteriological Research" will be given by Mr. F. W. Twort, at the Royal College of Surgeons of England, on Dec. 5, 7, 9, 12, and 14, at 4 o'clock.

OXFORD.—Sir Edward Farquhar Buzzard, of St. Thomas's Hospital, Physician Extraordinary to the King, the newly appointed Regius professor of medicine, is well known as the author of numerous treatises upon diseases of the nervous system. He was one of the first of a highly talented succession of medical men at Magdalen College, including Drs. Jex-Blake and Golla of St. George's, Dr. Hurst of Guy's, Dr. Singer and Sir Bernard Spilsbury. He has also filled the office of secretary of the Royal Society of Medicine.

The wing of the Engineering Laboratory, recently completed, was open to the inspection of a large party of guests invited by the Vice-Chancellor and Prof. Jenkin on Nov. 24. By this addition, much-needed space will be found for the electrical equipment of the laboratory. Demonstrations were given of the methods of using the various testing machines.

An examination for the Radcliffe Travelling Fellowship, for which women are now also eligible, will commence on Feb. 14, and candidates are requested to send in their names to the Regius professor of medicine on or before Feb. 1, 1928.

THE King has consented to open the new buildings of University College, Nottingham, which have been given by Sir Jesse Boot, probably some time in July next.

SIR JAMES CURRIE, formerly Principal of the Gordon College at Khartum and Director of Education in the Sudan, has been appointed chairman of the governing body of Imperial College of Tropical Agriculture, in succession to Sir Arthur Shipley, who died on Sept. 22 last.

THE Committee of Award of the Commonwealth Fund Fellowships announces that it is now prepared to receive applications for the fellowships to be awarded in 1928. Last year there were 115 candidates, and 22 appointments were made. The fellowships are normally tenable at an approved American university for two years, and are open to persons of British birth domiciled in England, Scotland, Wales, and Ireland, who are graduates of recognised universities and are unmarried, and not more than thirty years of age. Women as well as men may apply. Provision amount-

ing approximately to £600 per annum will be made for the total expenditure involved during the tenure of a fellowship. Applications must be forwarded through the authorities of the university or college of which the candidate is, or was, a member. The form of application can be obtained from the Secretary to the Committee, Mr. R. H. Simpson, 50 Russell Square, London, W.C.1. Applications must reach the Secretary by Feb. 18 next.

COURSES in anthropology of the University of Paris for the coming session announced to open in December or early in January offer the usual wide field to the student. At the Institut d'Ethnologie, among the lecturers in courses for the diploma and certificate are M. Mauss (ethnology), M. Rivet (anthropology), and the Abbé Breuil (*archéologie exotique*). There are also courses of instruction in linguistics, biological and zoological anthropology, quaternary geology and palæontology and the physiology of man and the anthropoids. Under the Faculty of Higher Education a great variety of subjects is offered in preparation for the examination of the Institut d'Ethnologie, the lectures being distributed among various of the constituent institutions of the University. They cover ethnology, archæology, sociology, human geography, linguistics and phonetics, physical anthropology, and human palæontology and geology. As usual, special attention is given to the culture and languages of the natives of the French possessions both in Africa and the Farther East.

AN address on "The Royal Society of Arts: its Services to Trade and Training" was delivered on Nov. 2 by Sir Philip Magnus, who has succeeded Sir Thomas Holland as chairman of the Society's council. The address has just been published in the Society's journal. Sir Philip shows clearly that the "Society for the Encouragement of Arts, Manufactures, and Commerce," as it was called when it was founded in 1754, has kept its original purpose steadily in view. Until the middle of the nineteenth century the method chiefly used was the award of prizes of money and medals for discoveries and inventions. Whilst encouraging applications of science to commerce, it strove to discourage commercialism among men of science, restricting the grant of its prizes to those who published their discoveries for the public good. This ban on patented inventions was withdrawn in 1844. About this time the Society, impressed by the value of the evening technical classes provided by the Mechanics Institutions, took a leading part in the formation of a union of these bodies, and in this connexion initiated exhibitions of educational appliances. It was as an adjunct to these activities that the Society's examinations, now an important factor in the organisation of commercial education in Great Britain, were started in 1854. Originally designed on a comprehensive plan, including many non-technical subjects, the scheme was remodelled in 1876 so as to exclude all except subjects closely connected with trades and crafts, and was further restricted in 1879 to commercial subjects. To-day, with candidates numbering between sixty and seventy thousand, its examination system is the biggest in the world. Its value as an educational factor is now to be investigated by a departmental committee appointed by the Board of Education to inquire as to it and other systems of examination of part-time students "with particular reference to the place and value of examinations as an element in training for industrial, commercial, and professional activity."

Calendar of Discovery and Invention.

December 4, 1827.—Though the Admiralty had possessed steamboats from 1822, the first commissions for the command of steam vessels ever granted to naval officers were those signed by the Duke of Clarence, then Lord High Admiral, on Dec. 4, 1827, when H.M.S.S. *Lightning*, *Meteor*, and *Echo* were commissioned by Lieuts. Evans, Bullock, and Hay, respectively. This official recognition of steam vessels as auxiliary warships may be said to mark the birth of the steam Navy of Great Britain.

December 5, 1879.—Among those who extended the use of the camera in astronomy was Sir William Abney. Beginning his experiments on the chemical action of red and infra-red rays in 1874, he obtained a substance sensitive to these rays and with it explored a vast unknown and ever-invisible region of the solar spectrum, his map of which was presented to the Royal Society on Dec. 5, 1879.

December 7, 1820.—Davy was first elected president of the Royal Society in 1820, and his presidential address was read on Dec. 7. His address was entitled "Discourse on the Present State of the Royal Society and on the Progress and Prospects of Science," and it contained much respecting Davy's own views on science.

December 8, 1610.—One of the earliest users of the telescope was the English algebraist, Thomas Harriot, who in 1609 made sketches of the moon and later observed the newly found satellites of Jupiter. Harriot is also remembered for his observations of sunspots, which began on Dec. 8, 1610; from them he determined the sun's axial rotation.

December 8, 1864.—Maxwell, after taking his degree in 1854, read through Faraday's "Experimental Researches," and from that time adopted Faraday's conception of a medium as a guide throughout his electrical investigations. One of his earliest papers was "On Faraday's Lines of Force," read in 1855, but his great paper, "On a Dynamical Theory of the Electromagnetic Field," was read to the Royal Society on Dec. 8, 1864. In this, electromagnetic action was shown to travel through space at a definite rate in waves, and these waves to consist of disturbances which are transverse to the direction in which the waves were propagated. Nine years later, Maxwell expanded his work into his well-known "Treatise on Electricity and Magnetism."

December 8, 1874.—Few astronomical phenomena have been looked for so eagerly or prepared for so assiduously as the transit of Venus of Dec. 8, 1874. Many methods for its examination were studied, some four score posts of observation were provided, and the expeditions cost nearly a quarter of a million sterling. The chief aim of the astronomers was to improve the determination of the sun's distance, but it was afterwards said, "As regards the end for which it had been undertaken, the grand campaign had come to nothing."

December 9, 1813.—The honour of making the manufacture and sale of gas a commercial success belongs to Samuel Clegg, the first chief engineer of the London and Westminster Chartered Gas Light and Coke Company. On Dec. 9, 1813, he took out a patent for a gas meter, and he also made the first large gasometer and invented the first pressure regulating device.

December 10, 1845.—The original inventor of the pneumatic tyre was the Scotch engineer, Robert William Thomson, who on Dec. 10, 1845, patented a leather tyre with an internal rubber tube filled with air. He afterwards fitted such tyres on road carriages.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, Nov. 17.—**T. Graham Brown**: Absence of a linear relationship between graded simple reflex flexions and the relations thereof evoked by a constant extension producing stimulus. In decerebrate cats, graded flexion magnitudes of simple flexor shortening are obtained in response to flexion-producing stimuli of different intensities. Each of these simple shortenings is then subjected to the 'inhibitory' effect of a constant extension-producing stimulus—thus giving compound flexor shortening. Comparison of the magnitudes of simple flexor shortening and of compound flexor shortening fails to establish a linear relationship between the two.

T. Graham Brown: Absence of a linear relationship between the reflex flexor shortenings evoked by a graded series of flexion-producing stimuli and the 'inhibitory' lengthenings of a constant extension reflex evoked by the same stimuli. In decerebrate cats, graded reflex magnitudes of simple flexor shortenings are obtained in response to flexion-producing stimuli of different intensities. Each of these stimuli is then compounded with a constant extension-producing stimulus, and the resultant lengthening (relaxation) of the extensor muscle is measured. Comparison of the magnitude of simple flexor shortening and of compound extensor lengthening fails to establish a general linear relationship between the two.

T. Graham Brown: The relation of the magnitudes of remaining reflex shortening in two antagonistic muscles during compound stimulation. Where two antagonistic reflex stimuli are applied concurrently, the remaining shortenings of two antagonistic muscles during compound stimulation are related to each other. This relation is such that in many cases where one or both of the reflex stimuli are varied in intensity, the sum of the remaining shortenings in the two antagonistic muscles (each measured as a ratio to maximal reflex shortening) is constant. In other instances this constancy fails, but a series of sums bears an approximate relationship of linearity to the magnitudes of the simple reflex shortenings evoked by the series of graded reflex stimuli which are used in the experiment. The most general statement of this relationship is as follows: The sum of the proportional remaining shortenings in two antagonistic muscles, Y, is linearly related to the simple reflex shortening, X, evoked at each intensity of the series of graded reflex stimuli used in a series of compound reflexes, *i.e.* $Y = AX + B$.

Sybil Cooper and **D. Denny-Brown**: Responses to stimulation of the motor area of the cerebral cortex. The spinal discharge evoked by cortical stimulation can follow the rate of repetition of break shocks in that stimulus up to about 180 a second, indicating a very simple synaptic relation between the pyramidal tract and the anterior horn cell. Rates of stimulus above and below that rate usually cause a total electro-myographic rhythm of 160 to 180 a second. Varying types of grouping of the spinal discharge occur, among them being that of a 'dominant' rhythm of 35 to 50 a second, with no relationship to the rate of stimulus. The typical motor response to stimulation of the motor area shows signs of concurrent inhibition. Clonic after-discharge, 'epilepsy,' and the form of the motor response are the result of a conflict between inhibition and excitation.

J. Lorrain Smith and **T. Rettie**: The distribution of lymphatics defined by autolysis of their contents. Autolysis *post mortem* of the liquid contained in the lymph forms doubly refractile globules of 'soap,' often in such quantity that the lumen of the channel is filled continuously. Lymphatics of the liver are defined because in them the globules form abundantly and at a stage when, as yet, no sign of them is to be found in any other site.

Geological Society, Nov. 2.—**J. A. Douglas** and **W. J. Arkell**: The stratigraphical distribution of the Cornbrash: I. The south-western area. The stratigraphical distribution of the Cornbrash in south-western England, from Oxford to the south coast near Weymouth, is described, and the eleven brachiopod zones proposed by Mr. S. S. Buckman are discussed. The new records are added to Mr. Buckman's faunal range-diagram, and in this way it is shown that many of his conclusions regarding penecontemporaneous erosion and non-sequences in the Cornbrash, as expressed in his clinal diagram, have been based on insufficient data. A twofold rather than a threefold subdivision of the Cornbrash is advocated.

Linnean Society, Nov. 3.—**R. W. T. Gunther**: Exhibition of rotographs of some unpublished letters of John Ray. The letters were written by Ray to the antiquary, John Aubrey, and to the Keeper of the Ashmolean Museum, Edvard Lhwyd, between 1676 and 1703. It is proposed to print them *in extenso* as an extra volume in the Ray Society's series, together with Ray's letters to the secretaries of the Royal Society.—**T. A. Sprague**: The botany of Brunfels. Brunfels' interest in plants seems to have been chiefly confined to their medicinal properties, on which his classification was largely based, with the result that some of his 'genera' were highly artificial; 'Scrophularia,' for example, included *Scrophularia nodosa*, *Sedum Telephium* and *Ranunculus Ficaria*. His use of the terms 'male' and 'female' sometimes indicated differences in flower-colour between two plants which were otherwise more or less similar, the deeper colour in the following order—red, blue, yellow, white—being 'male,' and the paler colour 'female.' The term 'female' in other cases indicated a spurious kind or an abnormality. His herbal contains the first recognisable illustrations of many of the Linnean species, of which indeed they may often be regarded as the historic types.—**S. K. Mukerji**: The biological relations of *Mercurialis perennis* L. The known range of *M. perennis* has been considerably extended, and the discontinuity in distribution of the genus is more apparent than real. Seed output is low compared with many other woodland species, and only about 10 per cent. of the seeds formed in England are germinable. The root-system shows branched and unbranched roots, both infected with fungi, particularly the former. Shallow rooting is associated with very high water content of soil, and the lower the acidity the deeper the penetration. Great variation in leaf form and size occurs. The leaf margin bears hydathodes secreting an acid liquid containing potassium chloride and calcium carbonate. An intergradation of sex has been observed. Pollination is partly entomophilous but mainly anemophilous. The fruit explosively ejects the seeds to a distance of about 4 metres. *M. perennis* shows no correlation between dry weight and the total carbonate content of the soil, and it is apparently not a true calcicole but an oxyphobe. It shows decided preference for soils with a high organic content. Light intensity distinctly affects the distribution and growth of individuals of the different sexes separately, and light intensity may determine the sex of a plant under certain conditions.

Optical Society, Nov. 10.—**J. R. Hamblin** and **T. H. Winser**: On the resolution of gratings by the astigmatic eye. An investigation of the resolution of gratings by the human eye, commenced by H. H. Emsley in 1925, is continued. The irregular curves

representing variation of grating acuity from meridian to meridian is of the same general form in all astigmatic eyes. Experiments show that the images of gratings placed in various directions, which are produced by an ordinary astigmatic system, show irregularities of the same form due to the overlapping of the blurred images of the separate lines of the gratings. Thus an eye with regular astigmatism will exhibit irregularities in resolving gratings at various inclinations, and charts consisting of fine parallel lines are not trustworthy for testing ocular astigmatism.

Physical Society, Nov. 11.—G. W. **Sutton**: The power-factor and capacity of the electrodes and base of triode valves, with special reference to their use in thermionic voltmeters. A discussion of the conditions under which a three-electrode valve-voltmeter should be operated to ensure a minimum power consumption, and at the same time to give indications closely proportional to the square of the input voltage; and a simple method of adjusting the operating voltages to fulfil the necessary conditions.—H. **Lowery**: (1) The refraction and dispersion of (1) air, (2) oxgyen, (3) gaseous chloroform; (2) New determinations of the gaseous refractivities of (1) acetone, (2) methyl ether, (3) ethyl ether. The refractivities of air, oxygen and gaseous chloroform have been found for the green mercury line (λ5461), and the dispersion studied over the range λ4800 to λ6700. The gaseous refractivities of acetone, methyl ether and ethyl ether for λ5461 have also been measured.—Panchanon **Das**: The theory of the elastic pianoforte hammer. By making various approximations, formulæ are obtained from which it is possible to deduce the practical effect of the elasticity and velocity of the hammer, and of the position of its point of impact on the string.

EDINBURGH.

Royal Society, Nov. 7.—A. W. C. **Menzies** and P. R. C. **Macfarlane**: Some further notes on the salmon of the River Moisie, Eastern Canada. The Moisie catch is chiefly composed of salmon which have spent either 2 + or 3 winters in the sea, and one of the main features of interest is the high proportion of 'spring' fish which arrive in June and July—83 per cent. in 1923 and 41 per cent. in 1924. Grilse apparently are almost entirely absent from the Gulf of St. Lawrence rivers (only one was found in this Moisie collection), although they are present in large numbers in Newfoundland, and, apart from the two age groups already mentioned, the catch is composed almost entirely of fish on their second or third return to the river: 13 per cent. in 1923, and no less than 29 per cent. in 1924 belong to this last class of fish, which consequently form a proportion far beyond that usually found in European rivers. The average weight of the Moisie large spring fish, 20·5 lb., is much the same as that of similar fish on the eastern side of the Atlantic, but the weight of the 2 + winters group, 10·5 lb., is only comparable with that of the earlier of the migrants of the same history in Great Britain. Recovery after spawning is evidently rapid and growth is good. Only one-third of the smolts were two years old at migration, and the remainder were either three or four years of age.—L. H. **Easson** and R. W. **Armour**: Action of 'active' nitrogen on iodine. Experiments on the rate of the reaction between active nitrogen and iodine vapour and on the intensity of the light emitted for different pressures of iodine. The emission of the line 185 $\mu\mu$ was observed and the evidence for the energy content of active nitrogen discussed.—J. W. **Gregor**: The pollination of *Lolium perenne* and *L. italicum*. The prevalence of self-sterility in the agricultural grasses has indicated methods of breeding, and an investigation of this problem was necessary preparatory to the study of the survival of growth forms within wild populations. It has not been possible, so far, to increase the self-fertility of *L. perenne* and *L. italicum* by changing the environmental conditions, or by artificial methods of pollination. The results obtained from plants under strictly controlled conditions have been confirmed by growing these plants in the field isolated from other plants of the same species.—Dorothy J. **Jackson**: Wing dimorphism in the genus Sitona and its inheritance in *Sitona hispidula* F. (Coleoptera, fam. Curculionidæ). Wing dimorphism is common in the genus Sitona and has been specially studied in *S. hispidula*. In the macropterous form of this species the wings are fully developed. In the brachypterous form the wings are small and truncated, and the metathorax is modified in structure. The dimorphism is well-marked in the pupal stage. Some of the macropterous insects are capable of flight, others have the wing muscles greatly reduced and histologically abnormal. The macropterous and brachypterous forms are widely distributed in Europe and occur frequently in the same locality. Breeding experiments conducted to determine the genetical relationship of the two forms indicate that the brachypterous condition is inherited as a simple Mendelian dominant.—B. **Kaczkowski**: Contribution to the studies of the origin of European sheep. Craniological investigations on the sheep having been found unsatisfatory, the method of serological isoagglutination was applied in an attempt to discover the ancestral types involved in the development of modern European sheep. Two main blood groups are present in sheep; one (*A*), as found in *O. musimon* and in Polish local sheep, being dominant to the other (*O*), as found in the Southdown. The latter group may be divided into two sub-groups, one with, the other without, anti-*A*. It would appear probable that differences in origin exist between the English Southdown and the Polish local sheep.—E. T. **Copson**: On Fourier constants. By the use of a theorem recently proved by Titchmarsh, certain convergence properties of series of Fourier constants are obtained. The results are connected with the generalised Riesz-Fischer and Parseval theorems, but cannot be obtained by the use of these.

MANCHESTER.

Literary and Philosophical Society, Nov. 1.—J. N. **Langdon** and Edna M. **Yates**: Transfer of training in manual dexterity. The doctrine of transfer of training states that training in any specific form of mental activity is capable of having its effects transferred to any other activity of the same form although dealing with different material. A group of 32 subjects was trained intensively for a fortnight, in a laboratory adaptation of a process employed in driving-chain manufacture. Tests of manual dexterity and muscular ability were given before training was commenced and at the ends of the first and second weeks respectively. The same tests were given to a group of 28 subjects who received no training. All the subjects were of roughly the same age and type, and in each case the subject's payment was calculated upon actual performance, hence the predominant incentive to satisfactory performance was a financial one and may be assumed to be constant. Statistical analysis of the results reveals that there is no significant difference between improvement in the test performances of the trained and control groups respectively. In fact, the brief practice afforded by the first giving of the test is more effective than the prolonged intensive training on a similar, but not identical, performance. There is evidence, then, that training in manual dexterity is specific and not general.

SHEFFIELD.

Society of Glass Technology, Oct. 19.—J. F. **Hyslop**: Crystal growth and impact brittleness. The chief cause of brittleness in opal glass is the tendency of the glass to produce sharp angular crystals, and these may be formed by: (*a*) the tendency of the matrix to precipitate silica. If the opal is susceptible to this secondary devitrification, a careful choice of working temperature is necessary to avoid brittleness; (*b*) the tendency of the glass to grow angular instead of globular fluoride particles. This happens in a glass of low viscosity, and such a glass is brittle at low and high working temperatures.—E. J. C. **Bowmaker** and J. D. **Cauwood**: The detection of selenium in decolorised bottle glass. The glass is treated with hydrofluoric acid, a little strong nitric acid, and evaporated to dryness at about 90° C. Strong nitric acid is added to the residue, again evaporating to dryness. The residue is then dissolved with 1 : 1 nitric acid and a little water added. Strong sulphuric acid is added and the whole evaporated until fuming. After cooling, a piece of codeine sulphate is added with stirring, and the solution heated to fuming. A green coloration denotes the presence of selenium. Manganese and copper must be absent.

PARIS.

Academy of Sciences, Oct. 31.—Ch. **Depéret**: New observations on the neolithic deposits of Glozel (Allier). The authenticity of the deposits described by the author last year has been disputed. New excavations were made last July, in company with MM. Arcelin and Bjorn, of the Oslo Museum, under conditions which would render impossible the fraudulent introduction of objects. The author concludes that the date of the Glozel deposits dates from very early Neolithic and maintains the authenticity of the discoveries.—A. **Lévèque**: The theoretical solution of the problem of the exchange of heat by circulation of a non-viscous fluid in quiet movement, with velocity potential, inside a tube.—A. **Schidlof**: The interpretation of the masses of the electron and proton in a universe of five dimensions.—**Boutaric** and Mlle. G. **Perreau**: Refractometric measurements on colloidal solutions. Results of the application of the interference refractometer to colloidal solutions, especially the phenomena accompanying flocculation.—A. **Travers**: The ionic equilibrium $Al(OH)_3 + 6F \rightleftharpoons AlF_6 + 3OH$. Cryolite is stable over a wide range of *p*H.—Joseph **Péneau**: The age of the iron minerals attributed to the Gothlandian in the synclinal of Saint-Julien-de-Vouvantes.—Maurice **Piettre**: Remarks on agglutinating immunosera: localisation of the agglutinines.—Henri Jean **Frossard**: The treatment of deafness by the Laënnec method.—A. **Leulier**, P. **Sedallian**, and J. **Gaumond**: Diphteric toxin, nucleoproteids, and dialysis.

ROME.

Royal Academy of the Lincei, June 19.—L. **Palazzo**: Results of a magnetic exploration in the Giuba and Uebi Scebeli (Southern Somaliland).—P. **Vinassa**: The 'electronic number' and constituents of the globe. The electronic number, indicating the number of peripheral electrons which can be found in the various elements taking part in terrestrial combinations, seems to be not merely of geochemical interest, as it serves as the basis of a new classification of the elements.—C. **Foà**: The neurochemical mechanism of vagal inhibition in the heart of mammifers. The results of experiments on frogs indicate that stimulation of the cardiac vagus does not determine distance phenomena, and that the presence in the blood of a substance with vagal action may be assumed.—L. A. **Herrera**: Plasmogeny. Imitation of amœbæ by means of resin soap.—S. **Minetti**: The Taylorian development $\Sigma a_n z^n$, where $a_n = g(n)$ with $g(n)$ wholly transcendental.—L. **Laboccetta**: Equations of geometrical figures comprising a parameter with variation of which the line or surface represented passes continuously from the polygonal or polyhedral form to the circular or spherical form.—P. **Nalli** and G. **Andreoli**: The area of a surface, Stieltjes' multiple integrals, and multiple integrals of functions of several complex variables.—G. **Krall**: Green's functions relating to pluri-connected fields.—F. **Robles**: Rayleigh's theorems of small oscillations.—G. **Thomsen**: Dynamics of rigid bodies in general relativity.—A. **Masotti**: Motions of a perfect liquid by plane strata.—A. **Carrelli**: The hydrodynamic interpretation of the quantum theory.—G. R. **Levi** and C. **Fontana**: Gold purple. The supposedly cubical granules of gold in purple of Cassius have a side with the mean value 36 A. Addition of stannic acid has no influence on the degree of subdivision of the gold.—G. **Malquori**: The system, $Fe(NO_3)_3 - KNO_3 - H_2O$ at 25°. Nonohydrated ferric nitrate and potassium nitrate form neither additive compounds nor mixed crystals at 25°. The solubility curves of the two salts project beyond the point of intersection, a metastable region being thus exhibited.—G. **Natta**: Crystalline structure of cæsium trichloromercurate. This compound, $CsHgCl_3$, obtained by crystallisation of the solution containing excess of cæsium chloride, crystallises in the monometric system. The elementary cell is cubic, the side being 5·44 A. The positions of the ions in the cell are defined by the following co-ordinates: Hg $(\frac{1}{2}\ \frac{1}{2}\ \frac{1}{2})$; Cs (0 0 0); Cl $(\frac{1}{2}\ \frac{1}{2}\ 0)$, $(0\ \frac{1}{2}\ \frac{1}{2})$, $(\frac{1}{2}\ 0\ \frac{1}{2})$. The calculated density is 4·53.—A. **Rejna**: Crystalline structure of calcium hydroxide. For this compound the values given by Levi, namely, $a = 3{\cdot}52$, $c = 4{\cdot}93$, $c : a = 1{\cdot}40$, are confirmed, the value $u \sim \frac{1}{4}$ being assumed and the co-ordinates for Ca and O being Ca (0 0 0); O $(\frac{1}{3}\ \frac{2}{3}\ u)$: $(\frac{2}{3}\ \frac{1}{3}\ u)$.—L. **Scremin**: Variations in the ionic equilibrium as factors of pharmacological action. (i) Potassium and convulsant drugs. When the equilibrium $\frac{Na^+K^+}{Ca^{++}Mg^{++}}$ is modified in the sense of an increase in K^+, the cells of the posterior cornu react far more readily towards drugs which have the specific effect of increasing the reflex excitability. The cause of this action of the potassium ion is not known, but it may be due to the fact, observed by various investigators, that this ion renders the cell-walls more permeable and thus facilitates the entry of the drug.—P. **Aloisi**: Study of the manganiferous pyroxenes. Examination of two samples of Italian rhodonite reveals a variation in the sign of the double refraction with change of the relation between the manganese oxide and the oxides of other bivalent metals. This variation in sign appears to be accompanied by profound modifications in the whole orientation of the indicatrix.—A. **Desio**: Miocene echinoderms of Porto Bardia and of the oasis of Giarabub.—B. **de Finetti**: Conservation and diffusion of Mendelian characters. (ii) General case.—E. **Benedetti**: Modifications in the course of alcoholic fermentation arising from the effect of the oscillating electromagnetic field on the yeast. When either 5 per cent. glucose solution or beer wort containing yeast is subjected to the action of an oscillating electromagnetic field for a short time, the velocity of the subsequent fermentation is diminished. As the action of the field is prolonged more and more, this effect increases to a maximum and afterwards changes to an acceleration of the fermentation, this again changing to a retardation for still longer exposures to the field.

Official Publications Received.

BRITISH.

The New Zealand Astronomical Society (Incorporated). Bulletin No. 3: i: Do we Live in a Spiral Nebula? by P. O'Dea; ii: Is the Universe in a State of Cosmic Equilibrium? by F. Gawith. Pp. 19. Bulletin No. 4: The Interior of the Earth and its relation to the Surface Features. By P. O'Dea. Pp. 18. (Wellington, N.Z.)

Proceedings of the Royal Society of Edinburgh, Session 1926-1927. Vol. 47, Part 3, No. 20: The Theory of Orthogonants and Latent Roots from 1881 to 1918. By Sir Thomas Muir. Pp. 252-282. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2s. 6d.

Seventh Annual Report of the Scientific and Industrial Research Council of Alberta, 1926. (Report No. 20.) Pp. 53. (Edmonton, Alba.: W. D. MacLean.)

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-first Session, adopted at the Annual Meeting of Governors held on the 18th October 1927. Pp. 74. (Glasgow.)

International Commission on Illumination. Brief Report of the Bellagio Meeting, 31 August—3 September 1927. Pp. 23+2 plates. (Teddington: National Physical Laboratory.) 2s.; 50 cents.

FOREIGN.

Scientific Papers of the Institute of Physical and Chemical Research. No. 85: Reversed Spectra of Metals produced by Explosion under Increased Pressure. By Mitsuharu Fukuda. Pp. 47+4 plates. 80 sen. No. 86: Über die Bestandteile des Laganum (Echinoidea), I. Von Munio Kotake. Pp. 49-51. 20 sen. No. 87: Synthesis of the Homologue of Urushiol, II. By Sin-iti Kawai. Pp. 53-60. 20 sen. No. 88: Über die Kondensationsprodukte des Isatins. Von Munio Kotake. 1: Synthese der 2,3-Dioxy-3,4-dihydro-chinolin-4-carbonsäure. Pp. 61-65. 20 sen. No. 89: "P.C.R." Piston Ring and the Packing Ring Tester. By Masatosi Ôkôchi and Keikichi Ebihara. Pp. 67-80+plates 5-7. 30 sen. No. 90: Experimental Study on the Combustion of Mixtures of Hydrogen with Air or Oxygen in Eudiometer. By Torahiko Terada, Kiyohiko Yumoto and Ukitirô Nakaya. Pp. 81-128+2 plates. 50 sen. No. 91: A Theory of the Specific Heat, the Latent Heat of Fusion and Vaporization being taken into Consideration. By Uzumi Doi. Pp. 129-147. 30 sen. Nos. 95-96: Untersuchungen über die Celluloseester, von Ichiro Sakurada und Tadashi Nakashima; Über die Celluloseester der aromatischen Sulfosäuren, von Ichiro Sakurada und Tadashi Nakashima. Pp. 197-225. 25 sen. No. 97: Analysis of the Niobium and Tungsten Groups. By Isaburo Wada and Sechi Kato. Pp. 227-263. 35 sen. No. 98: Some Remarks on the Colloid Theory of Cements. By Tutomu Maeda. Pp. 265-269. 20 sen. No. 99: Effect of Grain Boundary upon the Hardness of Aluminium. By Keiji Yamaguchi. Pp. 271-300+1 plate. 35 sen. Nos. 100-101: The Formation of Oxy-derivatives of Diphenylene Oxide from Resorcin, by Yojiro Tsuzuki; A Method of determining Molecular Weights of Organic Substances in small Quantities by means of Freezing Point Depression, by Bennosuke Kubota and Takeo Yamane. Pp. 301-309. 20 sen. Nos. 102-104: On the Catalytic Action of Reduced Copper on Isoborneol, by Tetsusaku Ikeda; A new Process for the Synthesis of Camphor, by Tetsusaku Ikeda; On the Oxidation of Isobornyl Acetate with Ozone, by Tetsusaku Ikeda and Yasuji Fujita. Pp. 20. 30 sen. (Tokyo: Iwanami Shoten.)

CATALOGUES.

The Wild-Barfield Electric Kiln. Pp. 4. (London: Automatic and Electric Furnaces, Ltd.)

A Complete Catalogue of Constable Books. Part 1: General Literature; Part 2: Technical, Scientific, Educational and Medical. (Revised to October 31, 1927.) Pp. vii+184. (London: Constable and Co., Ltd.)

Clearance Catalogue of Miscellaneous Books. (No. 503.) Pp. 42. (London: Francis Edwards, Ltd.)

Books Beautiful. Pp. 32. (London: George G. Harrap and Co., Ltd.)

X-Ray News and Clinical Photography. No. 3, October. Pp. 25-40. (London: Kodak, Ltd.)

The Cambridge Bulletin. No. 58, November. Pp. 30+4 plates. (Cambridge: At the University Press.)

Diary of Societies.

SATURDAY, DECEMBER 3.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 A.M.—S. Hastings and G. R. Scarff: Some Notes on Paracusis Willisii from the Ferens Institute of Otolaryngology.—Dr. D. McKenzie: Posterior (Mastoid) Drainage in Acute Suppuration of the Middle Ear.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—G. Holst: Samuel Wesley and Robert Pearsall (III.).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—E. Longden: Foundry Practice in the United States of America.

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—Address by Chairman.

MONDAY, DECEMBER 5.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in University Chemical Laboratory), at 4.30.—Dr. E. K. Rideal: The Electron Work Function and Surface Action.—W. H. Mills and K. A. C. Elliott: Molecular Dissymmetry Dependent on Restricted Rotation about a Single Linking. The Optically Active Forms of Benzenesulphonyl-8-nitro-1-naphthylglycine.—*To be communicated by title only*:—Dr. F. G. Mann: Note on the Configuration of the Tetrammino-platinous Complex.—Prof. E. T. Whittaker: Note on the Law that Light-rays are the Null Geodesics of a Gravitational Field.—Miss M. D. Kennedy: Two Sets of Conditions for Expansion in a Laurent's Series.—S. Pollard: A Condition for Inverting the Order of Integration in a Repeated Integral.—Dr. F. Bath: On the Quintic Surface in Space of Five Dimensions.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. E. T. Whittaker: The Influence of Gravitation upon Electric Phenomena.—Prof. C. G. Darwin: The New Outlook on the Mechanics of the Atom.—*To be read by title only*:—Miss Nellie B. Eales: The Anatomy of a Fœtal African Elephant, *Elephas africanus* (*Loxodonta africana*). Part 2. The Body Muscles.—Prof. H. W. Turnbull: The Invariant Theory of the Quaternary Quadratic Complex. 1. The Reduced System.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Dr. J. A. Fleming: Number in Nature and in the Biblical Literature indicating a Common Origin in a Supreme Intelligence.

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

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (Annual General Meeting) (at London Day Training College), at 5.30.—At 6.15.—D. W. Oates: An Experimental Study of Temperament.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—Dr. W. Rushton: The Preservation of the Purity of River Water with Regard to Pisciculture.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—Prof. Browning: Pinking and Dopes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—N. E. Jackson and others: Discussion on Air Heating and Conditioning.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. C. H. Carpenter: Alloy Steels, their Manufacture, Properties, and Uses (Cantor Lectures) (IV.).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. H. S. Hatfield: Automatic Analysis of Liquids and its Application to Control of Water Softening Plants.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Major J. C. Cooper Clark and G. Laws: Lubaantun.

UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY (Birmingham University).—Prof. T. M. Lowry: Recent Advances in Stereochemistry.

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street, W.).—W. W. Hamill: Efficiency Methods in the Rubber Industry.

TUESDAY, DECEMBER 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William H. Bragg: A Year's Work in X-Ray-Crystal Analysis (III.).

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Sir Westcott S. Abell: The Story of the Ship.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at University College, Nottingham), at 6.45.—D. S. Munro: Modern Electrical Wiring as applied to Small Houses.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—A. C. Banfield: Some Odds and Ends from the New World.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—Sir James Walker: Electro-synthesis.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—J. E. Newson: Hot Extrusion Process.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Dr. H. M. Leake: Some Aspects of the Plant in Relation to Disease.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—W. A. Whatmough: Control in Carburation.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. A. C. Haddon: Notes on the late R. B. Deacon's Investigations in Malekula, New Hebrides.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—G. Jefferson, Dr. G. Riddoch, Dr. B. Shires, G. Stebbing, and St. J. D. Buxton: Discussion on Fractures of the Spine.

WEDNESDAY, DECEMBER 7.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (in Glasgow University), at 3.30.—Debate.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. L. R. Lempriere: The Health of the Public School Boy.

ROYAL SOCIETY OF MEDICINE (Surgery Section) (at St. Thomas's Hospital), at 4.—Demonstrations.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Institution of Mechanical Engineers), at 5.30.—J. W. Hall: Making and Rolling Iron (Presidential Address).

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—Dr. H. Lapworth: The Effect of Pumping Operations on Underground Waters.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—R. H. Barfield: The Attenuation of Wireless Waves over Land.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bradford Branch) (at Belle Vue Hotel, Bradford), at 7.—F. H. Paul: Design and its Effect on Maintenance Charges.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Edinburgh Section, Institution of the Rubber Industry, and the Institute of Chemistry) (at Ca d' Oro Restaurant, Glasgow), at 7.—Dr. D. F. Twiss: Sulphur in Rubber Manufacture.—C. Chapman: Naphthas and their Uses.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—H. Paterson: Chairman's Address.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—E. A. Alliott: Institution Laundries.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—R. Genders: Extrusion.

INSTITUTION OF SANITARY ENGINEERS (at Caxton Hall, Westminster), at 7.—G. T. Cotterell: The Use of Reinforced Concrete in Waterworks and Sewage.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—H. Toms: Oil Bromide Films and their Use in Determining the Halogen Absorption of Oils.—G. Middleton

and F. C. Hymans: Tests for Impurities in Ether.—Dr. H. J. Stern: Arsenic in Coated Papers and Boards.—Demonstrations:—Apparatus for Determining Benzoic Acid in Foods, by Dr. G. W. Monier-Williams; Sodium Flame for Polarimetric Work, by T. McLachlan and A. W. Middleton.

ROYAL SOCIETY OF ARTS, at 8.—S. J. Duly: The Damage to Cargo due to 'Ship's Sweat.'

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

EUGENICS SOCIETY (at Linnean Society), at 8.—Prebendary Gough, G. G. Coulton, and others: Disastrous Philanthropy.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section).—Prof. R. Robinson: The Indole Group of the Alkaloids.

INSTITUTION OF MECHANICAL ENGINEERS (Liverpool Branch) (jointly with Liverpool Engineering Society).—H. Gutteridge: Modern Portland Cement Plant.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—R. W. James and E. M. Firth: An X-ray Study of the Heat Motions of the Atoms in a Rocksalt Crystal.—I. Waller and R. W. James: On the Temperature Factors of X-ray Reflection for Sodium and Chlorine in the Rocksalt Crystal.—*To be read in title only*:—G. Nonhebel, J. Colvin, H. S. Patterson, and Dr. R. Whytlaw-Gray: The Coagulation of Smokes and the Theory of Smoluchowski.—P. I. Dee: The Mobility of the Actinium A Recoil Atom measured by the Cloud Method.—A. C. Menzies: Shifts and Reversals in Fuse-Spectra.—Prof. C. G. Darwin: The Electron as a Vector Wave.—W. Sucksmith, H. H. Potter, and L. Broadway: The Magnetic Properties of Single Crystals of Nickel.—Prof. L. N. G. Filon: On the Second Approximation to the 'Oseen' Solution for the Motion of a Viscous Fluid.—Prof. C. V. Raman and K. S. Krishnan: A Theory of the Optical and Electrical Properties of Liquids.—E. W. R. Steacie and F. N. G. Johnson: The Solubility of Hydrogen in Silver.—Dr. R. L. Smith-Rose and R. H. Barfield: Further Measurements on Wireless Waves received from the Upper Atmosphere.—Dr. F. H. Constable: Spectrophotometric Observations on the Growth of Oxide Films on Iron, Nickel, and Copper.—J. W. Lewis: An Experimental Study of the Motion of a Viscous Liquid contained between two Coaxial Cylinders.—C. E. Inglis: Oscillations of a Bridge caused by the Passage of a Locomotive.—G. R. Goldsbrough: Tides in Oceans on a Rotating Globe.—W. F. Sheppard: The Fit of a Formula for Discrepant Observations.—J. Taylor: On a Photoelectric Theory of Sparking Potentials.—Prof. C. G. Darwin: Free Motion in the Wave Mechanics.—Prof. A. Fowler: The Spectrum of Doubly Ionised Oxygen (O III).—Prof. H. Dingle: The Spectrum of Fluorine (F I).—Lord Rayleigh: (*a*) Series of Emission and Absorption Bands in the Mercury Spectrum; (*b*) The Line Spectrum of Mercury. Occurrence of the Forbidden Line λ2270.—W. H. Taylor and J. West: The Crystal Structure of the Chondrodite Series.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. Kewley: Petroleum Natural Gases and their Derivatives (I.).

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.30.—Dr. W. Davies: Samuel Hyde Memorial Lecture.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—F. J. Tritton: Demonstration of Three-colour Carbro.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—R. J. Lawson: A Description of Modern Telegraphs.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Instructor Capt. T. Y. Baker: The Design of Reflecting Prisms.

INSTITUTE OF METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7.30.—W. A. C. Newman: Strip Casting.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. W. Fletcher: Recent Work on Some Malayan Fevers.

INSTITUTION OF MECHANICAL ENGINEERS (Yorkshire Branch) (at Leeds).—J. H. Barker: Chairman's Address.

INSTITUTION OF MECHANICAL ENGINEERS (Western Branch) (at Bristol).—W. A. Stainer: Chairman's Address.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, DECEMBER 9.

INSTITUTION OF WATER ENGINEERS (at Geological Society), at 10.30 A.M.—Capt. W. N. McClean: Rainfall and Flow-off, River Garry, Inverness-shire.—S. R. Raffety: Underground Water Supplies, and the Need for Investigation of the Sources thereof.—J. W. Madeley: Failure of Slow Sand Filtration in Madras City.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Sir David T. Chadwick: The Indian Tariff Board: Discriminating Protection in Practice.

BIOCHEMICAL SOCIETY (in Imperial College of Science, Metallurgy Theatre, Royal School of Mines, South Kensington), at 4.45.—H. Henderson Smith, M. Hume, and I. S. MacLean: On the Presence of Vitamin A and Provitamin D in Yeast Fat.—W. T. J. Morgan and R. Robison: Dephosphorylated Methylhexosides derived from Hexose-diphosphoric Acid.—J. Pryde and E. T. Waters: Organic Phosphates from Rabbit's Muscle.—H. R. Hewer, H. Jairam, and S. B. Schryver: The Chemical Changes Taking Place in the Proteins of Muscular Tissue when Passing into Rigor.—H. J. Holman and S. B. Schryver: The Basic Hydrolysis Products of Certain Plant Proteins, and the Method of Separation.—E. J. Candlin and S. B. Schryver: The Relationship of Pectin to Hemicellulose.—E. C. Grey: Studies on the Nutrition of Pigeons.—R. K. Christy and W. Robson: Estimation of Chlorides in Biological Fluids.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. J. Evershed: The Solar Rotation and the Einstein Displacement derived from Measures of the H and K Lines.—W. M. Smart: The Constants of the Star-streams from the Groningen Proper Motions.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—H. P. Walmsley: The Scattering of Light by Individual Particles in Smokes.—J. J. Manley: On the Construction and Standardisation of an Interferometer Pressure Gauge.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Major S. J. Thompson: Economics in Engineering.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—C. W. Cairns and others: The Relation between the Drawing Office and the Shipyard and Engine Works.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. G. Rose: Management Graphics.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. C. H. Desch: Stresses in Non-Ferrous Castings.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Prof. A. G. Green: The Application of Methods of Dyestuff Analysis in the Examination of Pigments and Lakes.

UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY (Birmingham University).—Sir John Russell: Chemistry in Relation to Agriculture.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (jointly with Institution of the Rubber Industry—Manchester Section) (at Manchester).—W. E. Sanderson: The Colouring of Cold Cured Rubber.

SATURDAY, DECEMBER 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. J. M. Stratton: Recent Developments in Astrophysics (I.).

PHYSIOLOGICAL SOCIETY (at Bedford College for Women).

PUBLIC LECTURES.

SATURDAY, DECEMBER 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. Daryll Forde: Natural Man.

MONDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE (Barnes Hall), at 5.15.—Col. P. S. Lelean: The Mind and Health (Chadwick Lecture).

ROYAL SCHOOL OF MINES (Imperial College of Science), at 5.30.—Prof. H. Briggs: The Ventilation of Mines from the Engineering Standpoint. (Succeeding Lectures on Dec. 7 and 8.)

TUESDAY, DECEMBER 6.

UNIVERSITY COLLEGE, at 5.15.—H. Clifford Smith: The Equipment of a Mediæval House.

WEDNESDAY, DECEMBER 7.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. Mary W. Calkins: Conceptions of Meaning and of Value. (Succeeding Lecture on Dec. 9.)

KING'S COLLEGE, at 5.30.—Dr. E. Barker: The University and the University College.

LONDON SCHOOL OF ECONOMICS, at 6.—R. Sloley: Office Machinery: Demonstration of the Telegraphone.

FRIDAY, DECEMBER 9.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—W. G. Hatton: The Growing of Black Currants.

SATURDAY, DECEMBER 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Legacy of Egypt.

CONFERENCE.

DECEMBER 7, 8, 9.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).

Wednesday, December 7, at 5.—N. Swindin: Submerged Flame Combustion.

Thursday, December 8, at 5.—G. W. Daniels: The Design of Refrigerating Plants.—L. Chew: The Practical Aspect of Refrigeration as applied to the Chemical Industry.—R. J. Mitchell: Electrical Automatic Refrigerators for Domestic Use.

Friday, December 9, at 5.—W. J. Jones: The Problem of Industrial Lighting, with some reference to the Chemical Industry.—At 8.—R. G. Parker, D. N. Jackman, and J. N. Vowler: Continuous Weighing of the Contents of Vessels: The Weighmeter.—A. T. Green: The Properties of Silica and Fireclay Refractories in relation to their Industrial Usage.

CONGRESSES.

DECEMBER 7 AND SUCCEEDING DATES.

FIFTH PAN-AMERICAN CHILD CONGRESS (at Havana, Cuba).

DECEMBER 13 TO 16.

INTERNATIONAL CONFERENCE ON LIGHT AND HEAT IN MEDICINE AND SURGERY (at Central Hall, Westminster).

Dec. 13 *and* 14 (Section 1).—Light and Heat in Medicine and Surgery:—Dr. F. Nagelschmidt: Ultra-violet and Bioluminescence.—Dr. L. G. Dufestel: Contra-indications for Ultra-violet Therapy.—Dr. F. Hernaman-Johnson: Conjoint Ultra-violet Radiotherapy and Internal Medicine.—Dr. J. Saidman: The Therapeutic Uses of Infra-red Rays.—Dr. E. P. Cumberbatch: Recent Advances in Diathermy Treatment.—Dr. H. S. Banks: The Place of Actinotherapy in Public Health Work.

Dec. 15 (Section 2).—Scientific Research in Relation to the Practice of Actinotherapy:—Prof. Leonard Hill: The Ultra-violet in Sunlight and Artificial Sources.—Prof. I. M. Heilbron: Vitamin D and its Relation to the Irradiation of Foodstuffs.—Dr. F. H. Humphris: Can the Chemist and Physicist be of Use in Actinotherapy?—(Section 3).—Recent Advances in Optics:—S. G. Tibbles: Light and Vision.—I. Spiro: The Treatment of Certain Common Eye Diseases in the Young by General U-V Irradiation.—Dr. K. R. Smith: Eye Muscle Training.—Dr. F. W. Edridge-Green: Colour Vision.