NATURE

SATURDAY, FEBRUARY 16, 1929.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3094, Vol. 123]

Forests and the Royal Commission on Agriculture in India.

SEVERAL aspects of the Report of the Royal Commission on Agriculture in India have already been commented upon in NATURE (July 24, Aug. 4, and Nov. 17, 1928). The position of forestry in the different Provinces is dealt with in the appropriate sections, and the evidence before the Commission has recently been published. Perhaps the first point which strikes a forester after reading the chapter on forests in the Report of the Commission is the Commission's apparent acceptance of the definition of 'forest' as areas producing large timber. "Many of the forests of the plains," the Commissioners remark, "are forests only in name. Few timber trees are to be found in them, but they provide a certain amount of fuel and grazing." It is to be hoped that this definition will not come to be accepted for the forests of the British Empire.

In the most intensively managed forests in some European countries the definition of 'forests' includes both categories, and it has come to be recognised as the result of much bitter and costly experience that the management of the second category, the fuel and grazing grounds, is often the most difficult. It cannot be left to either the village community or to the civil officers. For the efficient management and improvement of such forest areas the highest professional talent, coupled with administrative experience and great tact, is required. It is for this reason that we find in some parts of Europe senior executive officers possessed of these attributes delegated to the charge of 'forest' areas, "forests only in name," as the Commissioners term them, of which the sole reason of maintenance is the provision of fuel and grazing for the agriculturist. In fact, such 'forest' areas, for they are unquestionably accepted as forests coming within the work of a Forest Department, are as necessary for the well-being of the agriculturist as the big timber forests, the produce of which is required for the industrial sections of the community.

In connexion with the timber forests, it is stated with truth that the bulk of the areas are inaccessible to the vast majority of cultivators. This is an obvious fact (not restricted to India alone), and the inevitable aftermath of ill-regulated expansion of agricultural lands in the past, with no due provision being made by the reservation of blocks of forest in suitable positions, even though situated on land adapted to agriculture. This has been the history of the past development of agricultural India. Between the sixties and eighties of last century,

forest officers often directed attention to the point, but their voices went unheard when balanced against the clamour for the land and the revenue to be obtained from it by the development of agriculture. It is, however, incorrect to state that the distances of the timber forests and the difficulties of transport "result in the great mass of the agricultural population deriving little or no direct benefit from the forests proper." In many countries, the main forests nowadays are situated in the hilly regions and serve to protect the sources and catchment areas of the chief rivers and their tributaries. The agriculturist in the plains is directly dependent upon the water from these areas, although, as often in India, he may be situated several hundred miles distant. The maintenance of an even flow in the rivers and in the spring level of the underground water which feeds innumerable tanks and wells used for watering the crops in India would certainly undergo a drastic change for the worse were the distant timber forests to disappear.

The observations, questions asked of witnesses, the deductions arrived at by the Commissioners, and their recommendations on the subject of the forests in their relation to agriculture, are of considerable importance, since the latter forms the basic industry of the country. Briefly, the chief subjects considered may be enumerated as grazing, fuel requirements and their nature, and the question of the formation of forest areas, the object of which should be the provision of grazing and fuel on a regulated basis of management. There is much else in the Report of interest to the forester, but here we confine ourselves to the three points mentioned.

The Commission devoted considerable attention to the forest grazing business and to the efforts which had been made by cutting and baling grass from the forest to induce the villagers to make use of the dry grass instead of taking the cattle out daily to the forest. So far, the villager has persistently refused to make use of baled grass or to alter his age-long customs. He accepts it as an inevitable ration in times of famine when distance precludes him from sending his cattle to the forests, which are thrown open to all the animals which can reach them. In many forests of the country, serious harm has resulted from the excess grazing of animals in the forest, under which all young growth is browsed and the soil becomes beaten down and hardened under the hoofs of successive generations of animals. "It is," say the Commissioners, "from the Forest Department more than any other that complaints are heard of overstocking of grass land with animals of no economic value, for this is a subject that is being constantly forced upon their notice in the extensive grazing areas under their control." The forest officer, perforce, sees most of this grazing business, since he has to provide for the animals. But it is surely an anomaly to fix the responsibility for the failure of the villager to make use of baled grass or to improve his herd of animals upon the forest officer; and yet successive famine and agricultural commissions, etc., have done so in this matter of cattle and grazing.

The forest officer is, however, not responsible for the village or villagers and their agricultural methods. The onus in this respect lies with the agricultural departments, and in earlier days rested entirely upon the civil district officer. The remarkable increase in the numbers of the cattle, sheep, and goats throughout the country, following upon the settled order introduced and maintained by the British, could not perhaps have been foreseen; but whenever the question has come up during the past half-century, those who should have been responsible for the development of agriculture in all its phases, including animal husbandry, simply followed the old methods of the natives, and the forest officer was ordered to make provision for grazing, which each decade became heavier, once the villager had entirely destroyed, by over utilisation, the grazing lands in his vicinity.

The Commissioners accept, however, the continuance of forest grazing. "Since," they write, "it cannot be doubted that grazing in forests will, for a very long time to come, be an important feature of forest economy, we consider it essential that the intensity of grazing, consistent both with the proper development of the forest and the preservation of desirable grasses, should be determined as soon as possible. The Chief Conservator of Forests in the United Provinces informed us that knowledge in both these respects is at present defective." Yet, it may be pointed out, the answer was supplied (paragraph 183) by the Chief Conservator of Forests of Bengal, who, in referring to the deterioration of forests through excessive grazing, observed: "What appears to be light grazing in terms of head of cattle per acre is, in practice, concentrated near the village, in stream beds and grassy blocks; the last two being just where it does most harm." How could it be otherwise? The cattle leave the village in charge of an urchin or two soon after sunrise and return in the red evening light as the sun is dropping on to the horizon. Two to four miles from the village is the utmost reached.

The fuel or firewood (for it is chiefly the latter)

question is to some small degree analogous to that of the fodder one. One factor governs both, so far as the agriculturists dwelling away from forest areas are concerned, and this is the cost of carriage of the materials. Suggestions are made to the railway management upon this head. As is well known, over large tracts of India the only fuel used is cowdung. In the past the forest officer has often received ignorant censure for his inability to help to change this state of affairs whereby the manure of the fields is used to cook the food of the agriculturist. Of course, the problem is one for the Agricultural Department and its experts to deal with; but the Commissioners, although recommending methods of dealing with the provision of grazing and fuel lands, frankly show up the true position when they write (in connexion with the Central Provinces): "A scheme to place at the disposal of the people cheap firewood from fuel depots at convenient centres in order to remove the need for burning cowdung has not met with encouraging results. The continuance of this immemorial custom with firewood stacked almost at their door suggests that it is not lack of firewood which robs the soil of valuable manure"!

The Commissioners refer to the deplorable results of shifting cultivation (a matter which has already been treated upon elsewhere in NATURE), and they deal at some length with suggestions for improving the supply of fuel and grazing for villages when it is deficient throughout the country. Their recommendations, put briefly, are that areas should be earmarked and maintained for this sole purpose. They realise that their suggestion is not a new one; that in Bombay this method was already under trial, the areas so maintained being termed 'Minor Forests'; whilst in Madras the so-called poor scrub forests and grazing lands were being placed under 'panchayet' (that is, village) management.

The Commissioners express no opinion as to the better form of management, that is, whether this type of forest area should remain under the Forest or Civil Department, but they advocate a study of the subject of establishing this type of 'minor forest' in order that each village will enjoy easy grazing and cheap fuel. In these recommendations they will certainly have the hearty sympathy and the cordial support of the Forest Department. But, in conclusion, the warning note with which this article commenced may be sounded once again. Grazing and fuel areas, the primary object of which is to supply the requirements of a collection of individuals forming a village community who regard the area as their own property, require the most careful expert supervision and management if they are to continue to fulfil the objects of management. Once relax the supervision and each individual will exert himself to get his share. The Commissioners in dealing with Bengal appear to realise this. They write: "But it is not easy to convince the villager who needs fuel and the proprietor who needs cash, that temporary self-denial will be more than repaid later on"!

The Theory of Atoms.

The Greek Atomists and Epicurus: a Study. By Cyril Bailey. Pp. ix + 619. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 24*s*. net.

THE brilliant achievements of Hellenic genius in literature, art, politics, philosophy and mathematics have cast a reflected glory upon those Greek theories which may be considered as lying within the province of natural science. This refulgence is apt to tire our mental retina, and we are perhaps too prone to assume an inherent luminosity where, in point of fact, none exists. There is a tendency easily comprehensible but nevertheless entirely illogical to imagine that, since the Greeks excelled in philosophy, a similar excellence is to be found in their scientific attitude and theories. It was, however, long ago pointed out by Whewell that "as soon as they had introduced into their philosophy any abstract and general conceptions, they proceeded to scrutinise these by the internal light of the mind alone, without any longer looking abroad into the world of sense. They ought to have reformed and fixed their usual conceptions by observation; they only analysed and expanded them by reflection." Without going so far as to agree with his conclusion that "the whole mass of Greek philosophy therefore shrinks into an almost imperceptible compass when viewed with reference to the progress of physical knowledge," we may yet admit the general truth of his criticism; and we should take especial care not to read into the ancient theories conceptions which are essentially modern.

There is, however, a more serious defect in Greek science than this irrepressible habit of disproportionate speculation. It is that the Greek attitude towards Nature was to a large extent irrational, not merely in the riotous efflorescence of Neo-Platonism but even in the greatest philosophers of the classical period. Classical scholars may possibly regard this statement as heretical, but it would be easy to give chapter and verse to

confirm it. Indeed, Prof. Lynn Thorndike, in his excellent "History of Magic and Experimental Science," has already observed that Greek science was riddled with superstition, magic, astrology, and occultism of all kinds: "we cannot explain away the vagaries of the *Timæus* as flights of poetic imagination or try to make out Aristotle a modern scientist by mutilating the text of the *History of Animals*." Hellas bequeathed to civilisation the priceless gift of logical deduction, but lacked the spirit of modern science. "Everything," said Thales, "is full of gods."

Lastly, Greek science made no effective use of experiment, even if it did not actually despise it. The technical ability of Greek craftsmen is undeniable, and we are certain, therefore, that the philosophers could have found plenty of material for experiment if they had but realised its importance. This realisation was, however, not vouchsafed to them; nor, in fact, did it permeate the body scientific until comparatively recently. Even so late as the eighteenth century, we read, the professor of chemistry at the Jardin des Plantes never soiled his fingers with chemicals—he left that to an inferior personage, the demonstrator.

Having said the worst of Greek science, we can the more readily agree that its chief theory, that of atoms, is free from the gravest of the three defects enumerated above; for on its physical side it cannot in any legitimate sense be described as tainted with superstition. The atomic theory, especially perhaps in the form given to it by Democritus, has undoubtedly a right to be regarded with reverence by men of science, for although the modern theory is related to that of the Greeks much as a man is related to one of his simian ancestors, the continuity is unbroken from Leucippus to Dalton. Mr. Cyril Bailey's fine study of atomism will consequently be of as great interest to men of science as to students of the humanities; and the former will particularly welcome the restrained way in which he makes his comparison between the ancient and modern theories. "Ancient speculation," he frankly admits, "is a very different matter from modern research: at its best it rested in the main on *a priori* reasoning, and though observation and even experiment may have given some knowledge of detail, they had little place in the development of the larger fundamental theories. And not only do methods differ, but the fundamental conceptions of the atom in the ancient theory and modern chemistry are widely divergent." To this 'gesture' it would be churlish not to reply with an equally frank admission that Newton and Dalton ultimately owed their inspiration to Leucippus, Democritus and Epicurus, and that but for the speculations of ancient Greece the modern theory may never have seen the light. It is, in truth, a pleasure to be able to follow Mr. Bailey through the pages of his story without feeling that we are swerving from our allegiance to those two geniuses who established the atomic theory as we know it.

Mr. Bailey first describes the antecedents of atomism and then passes on to Leucippus, who, he says, regarded himself, and was generally considered in antiquity, as a mediator between the Eleatic Monism of the successors of Parmenides and the Pluralism of Empedocles and Anaxagoras. The atomic theory, as conceived by its founder, Leucippus, was "a reconciliation of those many antinomies which had sprung up in the course of earlier discussion, the One and the Many, change and permanence, division and continuity, the senses and thought." Democritus elaborated the theory into a more or less universal system. Receiving it from Leucippus as a rather crude and tentative speculation, he left it in a highly developed and strengthened form: "with him, Atomism as such reached its highest development in Greece." In the hands of Epicurus, to whom more than half the book is devoted, the atomic theory became even more complex, and although the physical hypotheses which it expounds are of extremely great interest, the scientist cannot bring himself to approve of such devices as the postulation of a 'swerve' in the path of the atoms, in order to escape from the determinism of Democritus. It is of course in this and similar respects that the modern theory differs so much, not merely in form but also in spirit, from the great scheme so lucidly and beautifully described by Lucretius. That free will has its explanation in the deviation of atoms from a rectilinear path is conceivable, but as a scientific hypothesis it is merely useless. Dalton's theory is very much simpler than that of Epicurus, because it assumes less and attempts to explain less; yet in point of fact it has explained much more.

It would be an impertinence for us to offer any opinion upon Mr. Bailey's conclusions from the literary point of view; but from that of science we may thank him for an unusually clear exposition of the birth and early life of one of the greatest of scientific theories. His book must be for many years the most authoritative on the subject, and, unlike many 'authorities,' it is a delight to read.

E. J. HOLMYARD.

Solutions and Heat Engines.

Gases and Liquids: a Contribution to Molecular Physics. By Dr. J. S. Haldane. Pp. xv + 334. (Edinburgh and London: Oliver and Boyd, 1928.) 18*s*. net.

THIS volume originated in the attempts of the author to apply current conceptions of osmotic pressure to physiological processes. He appears to have been led on from one subject of physics to another, and to have found difficulties at every step. The source of these difficulties is apparently to be sought in a tendency to take the elementary statements in text-books as representing the best knowledge on a subject, whereas in all such elementary instruction it is usually necessary to strip the subject bare of all complications. It may perhaps quite rightly be urged that this simplification is carried to excess, and that it does often mislead a student. For example, van 't Hoff, in his desire to show that for dilute solutions there was a close analogy between the laws of osmotic pressure and those of gases, concentrated attention on such cases and bent all his energies to demonstrate this analogy in all its details and the consequences of it. By doing this he was able to show that the resemblance between the two phenomena was so complete, not only qualitatively but even quantitatively, that there could be no doubt that osmotic pressure and gas pressure were due to the same cause. But at the same time the consideration of more complicated cases was left on one side, and such cases were often forgotten.

Of course, when concentrated solutions are considered, there are difficulties, just as there are for gases; but this does not take away the importance of the truth that the gas theory of osmotic pressure is the only theory from which it has been possible to calculate the pressure. Moreover, any other theory which may be put forward as an alternative explanation must not only explain the pressure but must at the same time *explain away* the effects that must arise from the molecular bombardment. However, Dr. Haldane will have none of this. The theory to him "is inherently unintelligible." He resuscitates the old idea that the pressure goes the wrong way. He will see that his objection is invalid if he will consider that the effect of the bombardment is to tend to expand the volume of the solution, and that therefore if water can flow in through a membrane it will do so.

Similarly, Dr. Haldane is 'up against' van der Waals: "van der Waals' interpretation of his equation is, however, not only very improbable, but . . . would make it impossible to extend the dynamical theory to the phenomena observed in liquids." "The theory of van der Waals treated gases as if they were already liquids, and it could thus give no account whatever of condensation to the liquid form, or of a critical temperature."

Statements such as these are not of rare occurrence, but may be taken as characterising Dr. Haldane's attitude towards his subject. It is when he comes to consider Carnot's principles and the ideal engine by which Carnot demonstrated them that his antagonism to physical conceptions is most conspicuous and startling. He makes much of the fact that it is not possible to make such an ideal engine. The valid conclusion to draw is that no real engine will have an efficiency so great as that demanded by Carnot (and by those who transformed his views to suit the law of conservation which was unknown to Carnot). Dr. Haldane claims to show "that existing kinds of heat-engine can, as a matter of fact, work far more efficiently between two temperatures than a Carnot engine." We fail to follow how he comes to this conclusion, especially as in the engines described by him the formula which he himself gives indicates only *half* the Carnot value for a given pair of temperatures. There is some confusion here which requires further elucidation. But assuming the validity of Dr. Haldane's claim, we would commend it to the attention of central heating engineers, for there should be commercial profit in it.

The Geology of Southern Africa.

Geologie der Erde. Herausgegeben von Prof. Dr. Erich Krenkel. *Geologie Afrikas.* Von Prof. Dr. Erich Krenkel. Zweiter Teil. Pp. xii + 463-1000 + Tafeln 22-37. (Berlin: Gebrüder Borntraeger, 1928.) 45 gold marks.

SOUTH AFRICA is of special geological interest from its simplicity and symmetry of structure, its instructive series of pre-Palæozoic rocks, its Karroo formation, with a succession of terrestrial deposits ranging from the Carboniferous to the Jurassic, and with important fossils, glacial beds, and vast lava sheets, the clues given by its Cretaceous beds as to the arrangement of ocean and continent in the South Atlantic region during the Upper Mesozoic, and its unique mineral deposits of diamonds, gold, platinum, and chromium, and its vast stores of coal. The second volume of Prof. Krenkel's "Geologie Afrikas" has been appropriately devoted to South Africa, which, owing to its unity, is well adapted to monographic

description. The area described lies south of the Lower Zambezi, and farther west is bounded in general by the southern watershed of the Congo; the book therefore deals with Northern and Southern Rhodesia, all the Union of South Africa, and Mozambique, of which the treatment is proportionately briefer than the rest.

The country consists of a high interior plateau bounded by a belt of lowland which contains many marine deposits—Devonian and Carboniferous in the Cape, and Cretaceous and Kainozoic in Natal, Mozambique, and along the western coast. Marine rocks have often been reported on the plateau, and some of pre-Palæozoic age are accepted by Prof. Krenkel on lithological evidence which is perhaps inconclusive; the only strong case is for some beds containing fragments identified as *Eurydesma* near Keetmanshoop, which were described as marine by Schroeder in 1908; in view of the significance of this occurrence, and the fact that reports of marine fossils from other localities, as from the Otavi Dolomite, have not been confirmed, a full account of the fossils from this bed would be useful. The boundary between this coastal belt and the plateau has been generally known as the Great Escarpment, and Prof. Krenkel in his interesting chapter on South African physiography has renamed it the Rogerstufe, after the head of the Geological Survey of South Africa.

This volume has the advantage of following Dr. du Toit's "Geology of South Africa," 1926, but it shows full evidence of independent preparation. The two works are on somewhat different lines, which make them usefully complementary. Instead of the abundant photographic plates which illustrate du Toit's volume, the chief illustrations provided by Prof. Krenkel are a valuable series of excellent geological sketch maps and sections. The opinions of the two authors are most in conflict over the bearing of South Africa and South America on Wegener's view that the Atlantic was formed by the westward drift of America. Dr. du Toit is a strong supporter of that theory. Prof. Krenkel, on the other hand, declares (p. 613) that the mountain systems of the two areas differ in form, in the nature of their folding, their tectonic divisions, age, and geographical arrangement, and holds that owing to these differences the composition of these mountains of similar material is of no weight as evidence of their original connexion.

Prof. Krenkel agrees with Dr. du Toit and differs from the late Prof. Schwarz and others as to the age of the Waterberg System, which he places in the Palæozoic; he refers to the presence of some impressions that have been regarded as crinoid stems, but the evidence for them should be quite distinct to be admissible in view of the other indications that these beds are of terrestrial origin. Prof. Krenkel's account is especially valuable in dealing with South-West Africa, for which Kaiser's great monograph was not available to Dr. du Toit.

The chapter on the economic geology is brief in proportion to the rest; the description of the mineral deposits includes the platinum lodes which are the latest addition to South African mineral wealth, and promise a welcome source of supply of that sparse and necessary metal.

The bulk of the volume is occupied by detailed descriptions of South African geology, which are full and clear and accompanied by well-selected bibliographies. The work contains less original matter than the first volume, which included areas which Prof. Krenkel had investigated personally; but it will form an indispensable work of reference to those interested in African geology.

Our Bookshelf.

The Development of the Human Eye. By Ida C. Mann. (Published for *The British Journal of Ophthalmology.*) Pp. x+306. (Cambridge: At the University Press, 1928.) 36*s.* net.

As Sir John Parsons has made clear in his foreword, this is no ordinary book or compilation, but a record of original observation on a subject of great scientific interest and practical importance. For several years, at meetings of the anatomical and various ophthalmological societies, Dr. Ida Mann has been giving demonstrations on the development of one or another feature in the human eye, which attracted particular attention by reason of the fullness of the evidence submitted and the lucidity of her exposition of the facts and their meaning.

The admirable treatise Dr. Mann has written is based upon Prof. Ernest Fraser's collection of human embryos. Her treatise provides the most complete account we have of the histogenesis of the human retina, lens, vitreous and their investing membranes, and material for the correct solution of scores of doubtful issues, which within the compass of a mere review it is not possible to enumerate. Particular mention must be made of the 241 illustrations, the great majority of which are the author's own draughtmanship, remarkable alike for their clearness and adequacy, as well as for their artistic charm. The Cambridge University Press has done full justice to Miss Mann's drawings, which have been reproduced on a generous scale. The book forms a valuable addition to our knowledge in such an attractive form that it is certain to become a standard work for the student to read

and the practitioner to consult. It has a useful bibliography.

The directors of the *British Journal of Ophthalmology* are to be congratulated on promoting the publication of a treatise which not only reflects the greatest credit on the author and the Medical School at St. Mary's Hospital, but also adds distinction to British ophthalmology.

Dizionario di sinonimi e composti chimici con relative formole e pesi molecolari e le terminologie : chimica, farmaceutica, alchimistica. Per Prof. Calisto Craveri. Pp. vi + 316. (Milano : Ulrico Hoepli, 1928.) 35 lire.

THIS book is divided into two parts, the first and larger of which is composed of a list, in alphabetical order, of upwards of 30,000 terms, consisting mostly of the Italian names of chemical compounds, together with their synonyms. Included also are short accounts of the origin and meaning of such words as acetification, acid, balsam, compound radicals, cupellation, extractives, liquation, refining, saponification, spirit, substitution, vitriol, etc. Some of the commoner alchemistic and pharmaceutical terms are also explained. The second part comprises two lists of the names, formulæ, and molecular weights, (1) of those inorganic compounds, and (2) of those organic compounds, for which no synonyms exist.

A great amount of labour must have been expended in the compilation of this volume, but the results cannot be described as other than highly unsatisfactory. The first part may be of some interest to the student of chemical history, but throughout the book frequent errors occur in the formulæ and in the molecular weights. Even the molecular weights of such simple substances as sulphurous acid, fuming sulphuric acid, and aluminium phosphate are incorrectly given, and that of alumina is written 012·20 ; aluminium carbonate and aluminium fluoride are allotted wrong formulæ. The symbol of boron is given as both Bo and B, and that of fluorine as both Fl and F. Moreover, in many instances, for example on pp. 110-111, the items are arranged out of order.

The book would need very thorough revision before it could be recommended.

British Museum (Natural History) Catalogue of the Pontian Bovidæ of Europe in the Department of Geology. By Dr. Guy Ellcock Pilgrim and Arthur Tindell Hopwood. Pp. xii + 106 + 9 plates. (London : British Museum (Natural History), 1928.) n.p.

THE authorities of the British Museum of Natural History are to be congratulated on the form in which they are now issuing the catalogues of their palæontological collections. These now come out singly, each one dealing with a particular group or subject, in a bound volume very convenient both for handling and reference.

The latest to appear is an account by Dr. Pilgrim and Mr. A. T. Hopwood of the Pontian Bovidæ of Europe as far as the subfamilies Gazellinæ, Pseudotraginæ, Bubalidinæ, Hippotraginæ, Cervicaprinæ, and Tragelaphinæ. In the preface, Dr. Bather, lately Keeper of the Geological Collections, utters a hope that this memoir is but the first of a series to deal with the rich collections of Pontian mammals in the Museum—a hope that will be shared by all workers in this field. While the catalogue deals chiefly with the actual specimens in the Museum, due reference is made to types in foreign collections, so that the usefulness of the publication is enhanced. The bulk of the work is of course a descriptive account of the species, with their diagnostic characters and a list of the material, thus fulfilling the primary duty of a catalogue, but there is, in addition, a short introduction which gives information of the classification followed, and hints at some of the difficulties which are involved in the handling of incomplete material. There is a full and useful list of works consulted, and the illustrations are adequate.

No price is stated on this volume, as it is in some. It would be well to give this information as a uniform custom.

Dacia : an Outline of the Early Civilisations of the Carpatho-Danubian Countries. By Vasile Pârvan. Pp. xi + 216 + 16 plates. (Cambridge : At the University Press, 1928.) 7*s.* 6*d.* net.

THIS little volume has been published as a permanent memorial of the late Prof. Pârvan's visit to Cambridge in 1926, when he delivered a short course of lectures on the civilisations of the Carpathian and Danubian countries. Himself a native of Moldavia, where he was born in 1882, he was imbued with " a strange instinct for its Latinity." Although he showed at an early age a high attainment in pure scholarship, he devoted himself with untiring energy to the prosecution of excavations in the little-explored regions of Rumania. Detailed accounts of the results achieved by himself and the school of young men whom he gathered around him were published in a periodical, *Dacia*, which he founded himself ; but his most comprehensive account of Carpatho-Danubian archæology was published under the title " Getica." Of this work the present volume is in effect a summary, covering the period from the middle of the Bronze Age down to and including the intrusion of the Romans. For those who are unable to consult the larger work, which unfortunately has not been translated, this little book, dealing with an at present obscure subject, will be invaluable.

The Glands of Destiny (A Study of the Personality). By Dr. Ivo Geikie Cobb. Pp. vii + 295. (London: William Heinemann (Medical Books), Ltd., 1927.) 7*s.* 6*d.* net.

THE subject of this volume is of sufficiently intimate a character to command a wide circle of interest, especially as general as well as special terminology is used and a glossary is provided. The general reader will find much useful information and also much to interest him of a slightly speculative nature. A good case is made out for placing the factors which combine to form the ensemble connoted by the term ' personality ' on a more definite physiological basis rather than on a vague psychological elaboration.

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.*]

What Happens during an Electron Jump?

THE Bohr theory showed its inadequacy most when the above question was asked. After describing the motion of an electron with minutest detail in all of its many orbits, a deafening silence answered him who inquired how the electron got from one orbit to another. The most one could say was that it suddenly disappeared, and simultaneously reappeared in an outer orbit, or vice versa.

Now, I believe the Schrödinger theory has implicitly tied up with it the answer to this question. Pauli's interpretation (cf. Jordan, *Z. Physik*, **40**, 811) that the expression

$$|\psi_{(q)}|^2 dq$$

represents the probability that the electron has a co-ordinate lying between the values q and $q+dq$ has led to the idea, permeating the quantum mechanics, that the electron, in tracing out its path, can go almost anywhere, but that the positions where it is most often found trace out the Bohr orbits. In other words, the electron orbit represents a cloud in space, the centre of gravity of which is the locus of a Bohr orbit. The Schrödinger condition, that ψ be finite throughout all of space, is then intelligible as meaning that the probability of the electron being at any position in space must be finite. If this is true, then what does the intensity rule for a spectral line mean in terms of this interpretation?

It has been shown—can we say experimentally?—that the intensity of a spectral line or the probability of a spontaneous electron jump, is proportional to the square of the matrix element,

$$q_{nm} = \frac{\int q\rho(x)\psi_n(x)\psi_m(x)dx}{\sqrt{\int\rho(x)[\psi_n(x)]^2dx \cdot \int\rho(x)[\psi_m(x)]^2dx}}$$

(Schrödinger, *Ann. Physik*, **80**, 465; Born and Jordan, *Z. Physik*, **34**, 886). Let us disregard the denominator of this expression (introduced for normalisation purposes) and focus our attention on the product of ψ_n by ψ_m.

If an electron in state n happens to occupy a position x_1 at a certain time and can occupy that position x_1 with more or less probability while belonging to energy state m, then there is a probability of absorption of light, provided the photon comes along at that particular instant. If the same electron belonging to energy 'orbit' n occupies a different position, x_2, at, say, a different time and it could occupy that position x_2 just as well (more or less) while belonging to energy state m, then we have a greater likelihood of its absorbing a photon. For if the photon did not come along while the electron was at x_1, it might get there while the electron was at x_2. So the total probability of the electron undergoing a 'jump' will be the summation of the probabilities of the ability of the electron to occupy identical positions in the two states, over all the different positions it might occupy.

This leads us to the conclusion that in an electron 'jump,' *the electron does not jump*. It does not change its position. It does not disappear suddenly and reappear simultaneously in another place. At most, it undergoes a change in momentum and obeys a new force law, in much the same manner that a vibrating molecule behaves after absorbing light. According to the Franckian explanation (*Trans. Faraday Soc.*, **21**, 536) the nuclei vibrating about an equilibrium position r''_0 suddenly discover, immediately following the electronic excitation, that their equilibrium position is now no longer r''_0 but a different one (that is, r'_0) and so they have to vibrate according to the new law of force. In the case of an electron 'jump,' the electron suddenly experiences a momentum change by a Compton effect, and its natural motion thereafter is of a different type from what it was before the absorption of the photon because it has gained more kinetic energy.

I am well aware that I shall be criticised for discussing a phenomenon which, so far, is unmeasurable. But it seems to me this new interpretation of an electron transition removes the necessity for the tacit neglect of this most interesting question; it hushes the accusation of inconsistency in physical theory, in this one particular at least; it aids us in a more complete visualisation of atomic processes; and, at the same time, it does not violate Heisenberg's uncertainty principle.

D. S. VILLARS.
University of Illinois,
Urbana, Ill., U.S.A.

The Boundary of the Solar Chromosphere.

IN analysing photographs of the flash spectrum it is customary to measure the lengths of the chromospheric arcs on the negative, and to deduce therefrom the heights to which various elements rise in the chromosphere. The H and K lines of calcium are always found to rise the highest, and their extent fixes the boundary between the chromosphere and the corona. One would very much like to know photometrically whether the intensity of H and K light is really falling off rapidly at this apparent boundary; or whether it fades out slowly and extends appreciably beyond. Since 1897 the view seems to have prevailed that it does not. In that year Young wrote: "The photograph also seems to make it certain that hydrogen, helium, and calcium, though brilliantly conspicuous upon the plate in the images of the prominences, are *entirely absent from the corona*, a result agreeing with that deduced from similar photographs made in 1893, but only recently published. It is quite clear that the earlier observations (referred to on pages 261 and 262 of 'The Sun') were misleading from the fact that the apparatus did not sufficiently guard against the effects of illumination of the air by light from the prominences" (*Astrophysical Journal*, **6**, 155). By illumination of the air is meant scattering of light in the earth's atmosphere.

It is well known that the height to which spectral lines are observed to rise in photographs of the flash spectrum is often misleading, since the height depends on the intensity of the line. Of two lines arising from transitions from the same energy level of the same atom, the less intense may rise to only a small fraction of the height to which the stronger line is found to extend. The question arises: Is the apparent extent of the H and K lines any more trustworthy? This problem has become important for the more detailed application of Milne's theory of support by radiation pressure.

The recent extension of Milne's theory by Taylor (*Monthly Notices R.A.S.*, **87**, 616; 1927) throws doubt on the reality of the apparent boundary of the calcium chromosphere, which all observations agree in placing at not more than 14,000 kilometres above the limb. On the contrary, the intensity of the H and K lines is now supposed to extend far beyond this limit, fading

out very slowly. Milne has accepted with approval this extension of his theory: "The spectral observations made by Col. Stratton and Mr. Davidson at the eclipse of 1926 (Sumatra) have been analysed by Mr. P. A. Taylor. He first extended the theory so as to allow for the curvature of the sun, and then compared the observed outward decrease in intensity of the flash spectrum with the calculated decrease. It appeared that all but about one ten-thousandth of the weight of the calcium chromosphere was supported by radiation pressure" (NATURE, **121**, 944; 1928). The same point of view seems to have been taken by McCrea in his further extension of the theory (*Monthly Notices R.A.S.*, **88**, 737; 1928). So it seems worth while to consider whether the sharpness of the apparent boundary can be illusory.

Visual measurements as well as photographic are possible for the height of the $H\alpha$ line. Some observations in full daylight were made by Fox (*Astrophys. J.*, **57**, 234; 1923); under unfavourable weather conditions he found a height of 7500 km., which agrees roughly with the height 8500 km. found from photographs of flash spectra. Observations of the H and K lines by photographic methods are more difficult, but a similar rough agreement is found.

Now, Kunz and Stebbins found that the brightness of the sky near the sun was 5000 times less intense during a total eclipse than in full daylight (actually 5300 times at the 1918 eclipse and 5500 at the 1925 eclipse. *Astrophys. J.*, **62**, 125; 1925); and it seems incredible that, when the chromosphere is viewed in daylight against a brighter background, roughly the same apparent limit should be found as in a total eclipse, unless there really is a rapid decrease in intensity at this boundary.

In addition to the photographs of the 1926 eclipse (*Mem. R.A.S.*, **64**, 105; 1927), on which Taylor based his conclusions, photographs were also taken in Sumatra simultaneously by Miller and Marriott (*Astr. Soc. Pacific*, **40**, 98; 1928). They state that on their photographs "strong H and K and hydrogen emission lines due to the scattering of light in the earth's atmosphere are superimposed upon the corona spectrum and extend into the lunar disc, but no Fraunhofer lines are seen on the disc, and only a slight suspicion of continuous spectrum." In the photographs of Davidson and Stratton the slit was tangential to the disc, instead of radial, so that the extension on to the disc was not observed and does not seem to have been taken into account. It is to be hoped that in the future it will be possible to make the difficult correction for scattering in the earth's atmosphere. In the meantime it would seem best to retain Young's conclusion quoted above, and suppose that the apparent boundary is real, with a rapid falling off in intensity. To obtain this result from Taylor's theory it may be only necessary to assume that about one thousandth of the weight of the chromosphere is supported by gravity, instead of one ten-thousandth.

RONALD W. GURNEY.
Mount Wilson Observatory,
California.

The Gamma Rays of Radium.

EXPERIMENTS which have been carried out here during the past few years lead to the following conclusions.

(1) The γ-rays filtered through 1·6 cm. of lead, and issuing from a hole in a lead block, have an average wave-length not greater than 0·0081 A. or a value of $\alpha = h\nu/mc^2$ not less than 3. For these γ-rays, using the usual nomenclature, $\sigma_a = \sigma_s$ approximately and not $1/2\sigma_s$, as is usually supposed.

The distribution of the scattered radiation is approximately that given by the Klein–Nishina formula (NATURE, vol. 122, p. 398; 1928) namely,

$$I_\theta = I\frac{e^4}{2m^2c^4r^2}\left\{\frac{1+\cos^2\theta}{(1+\alpha-\alpha\cos\theta)^3}+\frac{\alpha^2(1-\cos\theta)^2}{(1+\alpha-\alpha\cos\theta)^4}\right\},$$

the symbols having their usual significance.

From this formula we deduce that $\sigma_a = \sigma_s$ approximately, and also values of α which are within ten per cent of the values found by Gray and Cave (*Trans. Roy. Soc. Can.*, vol. 31, § 3, p. 7; 1927). This means that we may use their theory with some confidence in the interpretation of cosmic ray experiments.

(2) The Dirac theory of scattering is not correct. In the γ-ray region it leads to values of α which are much too small (compare Gray and Cave, loc. cit.), the corresponding recoil electrons having only one-third the required penetrating power.

(3) The ionisation produced, in a closed vessel, by rays of high frequency having a negligible photo-electric absorption coefficient τ, is approximately independent of the material of which the vessel is made. This assumes that the rays do not react with atomic nuclei.

(4) τ for hard γ-rays varies with a power of the wave-length much smaller than the $2{\cdot}5^{\text{th}}$.

(5) The ionisation produced in a paper electroscope by γ-rays is increased by surrounding the electroscope completely by lead or brass two millimetres thick.

(6) The apparent absorption of an initially parallel beam of homogeneous γ-rays continually increases, presumably until a maximum is reached.

Making use of the above conclusions, an examination has been made of the results of cosmic ray experiments, and a further communication will be made later.

I feel that the method developed here four years ago for the determination of γ-ray wave-lengths has not been understood, doubtless because sufficient details have not been given. An outline of the method follows.

It is necessary to know:

(1) The penetrating power of the recoil electrons.
(2) The penetrating power of homogeneous β-rays.
(3) The distribution of scattered radiation, *i.e.* the variation of I_θ with θ.

It is assumed that the ionisation in a vessel of which the walls are of a substance of low atomic weight is produced by recoil electrons of energy E given by the equation

$$E = h\nu\frac{\alpha-\alpha\cos\theta}{1+\alpha-\alpha\cos\theta},$$

the radiation scattered at angle θ having a frequency ν_θ given by the equation $\nu_\theta = \nu/(1+\alpha-\alpha\cos\theta)$. If we write $I_\theta = F(\cos\theta)$, the number of quanta scattered between angles θ and $\theta+d\theta$ will be proportional to $F(\cos\theta)\,(1+\alpha-\alpha\cos\theta)\sin\theta\,d\theta$, and the number of electrons $N_E dE$ with energy between E and $E+dE$ to $F(\cos\theta)\,(1+\alpha-\alpha\cos\theta)^3\,dE$, since $\alpha\sin\theta\,d\theta = (1+\alpha-\alpha\cos\theta)^2\,dE$.

Relative values of N_E can then be obtained by putting $\cos\theta = 1, 0{\cdot}9, 0{\cdot}8$, etc., in the above expression for $N_E dE$, the corresponding values of E being found from the equation for E. This enables one to plot N_E against E. One must then allow for the fact that the smaller E is, the greater is the ionisation produced by a single electron. Making the necessary corrections, what may be termed I_E is obtained, $I_E dE$ being the ionisation produced by electrons with energy between E and $E+dE$.

I_E is then plotted against E, and a value of α is taken which will give the electrons as a whole the penetrating power found by experiment. As $\alpha = h/mc\lambda$ we can then find the wave-length λ.

It will be seen that from experiment (3), $F(\cos\theta)$

can be read directly from the curve obtained by plotting $F(\cos\theta)$ against θ. The problem, however, is simplified if we can find a formula, such as that of Klein and Nishina, which fits experimental results. An application of the method will be given later.

I have often found that work which it pleases me to think was of a pioneer character has been overlooked by other writers. I would like to emphasise the fact that most of the results given above follow directly from views developed here many years ago.

J. A. GRAY.

Queen's University,
Kingston, Ontario, Dec. 26.

Some Aspects of Hæmolysis.

MANY years ago, Sachs (*Biochem. Zeit.*, **12**, 278; 1908) showed that normal serum which ordinarily inhibits the hæmolysis of red blood corpuscles by soaps when present before the addition of the hæmolyte, accelerates this hæmolysis if it is added after the addition of the soap to the corpuscles. Later, Ponder (*Proc. Roy. Soc.*, B, **95**, 403; 1923) studied this phenomenon with taurocholate as the hæmolyte. In a recent paper we found (*Jour. Ind. Chem. Soc.*, **5**, 261; 1928) that under the conditions of the experiment used by us, no acceleration of taurocholate hæmolysis could be observed irrespective of the manner of the addition of the serum, and Ponder suggested to us, in a private communication, that this was due to the particular conditions of our experiment, and that the acceleration could be observed under different conditions.

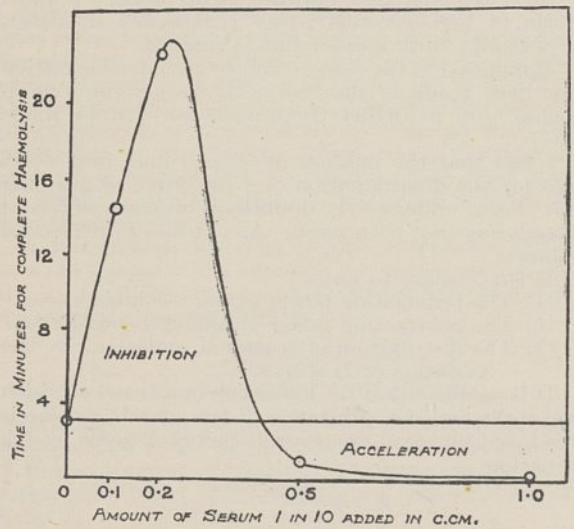

FIG. 1.—Effect of normal serum on a mixture of taurocholate and erythrocyte in isotonic saline.

We have now made a detailed study of the inhibition and acceleration of hæmolysis in presence of normal serum, and have observed that both acceleration and retardation of hæmolysis can be obtained easily in taurocholate and oleate hæmolysis by simply varying certain concentrations of the reacting substances. Since no one has yet published any data of similar nature, we desire to put on record the conclusions we have reached. In the accompanying curve (Fig. 1) we have plotted one set of results with varying amounts of serum. The quantity of the corpuscle, the total volume and the quantity of the sodium taurocholate were kept constant, but the amount of serum which was added to the cells half a minute after the addition of the taurocholate was varied. The abscissa represents the amount of serum, and the ordinate represents the time required for complete hæmolysis under otherwise identical conditions. A glance at the curve will show that we can get either an inhibition or an acceleration of hæmolysis when serum is added to a mixture of hæmolyte and corpuscle depending on the quantity of the serum.

We have also investigated the effect of the concentration of the corpuscles, of the amount of the hæmolyte added, and also the effect of the time-interval after which the serum is added, on the observed acceleration; and have found that all these factors are more or less important in showing this particular phenomenon. We have also found that normal serum is not the only substance which shows this acceleration phenomenon with oleate and taurocholate; a very dilute solution of alkali such as caustic soda can also show this behaviour with oleate and taurocholate, and we have been able to obtain almost similar curves with taurocholate and caustic soda. We consider, therefore, that in order to produce this acceleration phenomenon, it is not necessary to suppose any peculiar actions of the added serum proteins; because traces of pure alkali have been found to be equally effective, and the action of the normal serum may consist, at least in part, in changing the hydrogen ion concentration of the solution. We may add that this acceleration of hæmolysis by normal serum has been observed with taurocholate and oleate as the hæmolyte, but we have failed to get any acceleration with saponin.

K. C. SEN.
A. C. RAY.
N. N. MITRA.

Chemical Laboratory,
University of Allahabad.

Mechanism of the Swelling of Gels.

THE problem of the swelling of gels has been the subject of a great deal of research, and still there does not appear to be any clear agreement between the views of different workers regarding the mechanism of the process. To take the case of gelatin, swelling is usually attributed to an osmotic action due to the presence of a soluble form of gelatin or its salt inside the molecular network of the gel. Recent work by myself (*Proc. Roy. Soc.*, A, **122**, p. 76; 1929) on the scattering of light in agar and gelatin sols and gels seems to indicate that these systems contain, to some extent at least, colloidal micelles which act as units. None of the existing theories says anything about the changes in these micelles during swelling. The object of the present note is to indicate the usefulness of light-scattering measurements in revealing these changes.

If a piece of gelatin be immersed in water it becomes opalescent as a result of swelling. This fact seems to have escaped the notice of previous investigators. The opalescence can be clearly noted when the swollen piece is viewed against a dark background. To find out the exact significance of this observation, it is necessary to determine the changes in light-scattering during swelling. The gel used in this investigation was obtained by drying a 2 per cent gel of $p\mathrm{H} = 3$ in a suitable bottle. The results are given in the following table:

Wt. of gel.	Intensity of Scattered Light ($C_6H_6 = 1$).
3 gm.	67·7
5·64 ,,	73·3
7·86 ,,	67·6
12·54 ,,	48·9
16·40 ,,	42·9

It can be seen from the above data that the intensity of the scattered light increases at first and then diminishes as swelling proceeds.

These observations appear to me to provide a basis for the following picture of the mechanism of swelling: Swelling occurs as a result of imbibition of the solvent by the gel. We have to distinguish between two kinds of imbibition—one, in which the solvent is actually taken up inside the structure of the gel micelles. This part is held firmly by the molecules constituting the micelle owing to forces which are probably chemical in nature, and causes an increase in the volume of the micelles, and hence an increase in the light-scattering capacity of the gel. This process stops when a certain limit is reached, depending upon the cohesion between the molecules constituting the micelles. Secondly, the solvent which is still further taken into the gel remains in the intermicellary space, thus causing a dilution of the gel, and hence a diminution in its light-scattering capacity. This view is in complete harmony with the results obtained, and receives further support from the following observation:

A four per cent gelatin gel at the isoelectric point is very turbid. When this is dried in a desiccator, at first there is no change in the turbidity of the gel, but after a few weeks it commences to clear up from the top. As the dehydration proceeds, the whole gel becomes quite transparent by the time it shrinks to about two-thirds its original volume. This observation seems to be quite significant in that it shows definitely that the removal of the liquid in the earlier stages is not accompanied by any shrinkage of the micelles, while, later on, they do shrink, causing a very marked diminution in the light-scattering.

Further work on the changes in the scattering of light during the swelling of gelatin and other gels is in progress.

K. KRISHNAMURTI.
The Sir William Ramsay Laboratories of
Physical and Inorganic Chemistry,
University College, London.

Resistance of Wheat Varieties to Bunt (*Tilletia caries*).

A VARIETY of wheat, Sherman (*T. vulgare* Vill.), stated to be resistant to bunt, has been grown at Cambridge for the past five seasons. It has been tested for resistance or susceptibility to the fungus *Tilletia caries* (DC.) Tul. (=*T. tritici*). (Bjerk.) (Wint.). It was previously tested in 1923 at Moro. Ore. U.S.A., by the Cereal Investigation Board. The percentage of bunt then obtained was 1·1. In 1924–1926 it was very heavily contaminated by me at the rate of one part of crushed bunt balls to 25 parts of wheat. At the 1925 harvest, the percentage of bunt present was 1·01, at the 1926 harvest 1·6. It thus seemed evident that Sherman was very highly resistant to the disease.

In 1926 the wheat was re-sown and one-half of the seed was contaminated with Little Joss bunt and the other half with its own bunt, that is, Sherman bunt. At harvest in 1927 the percentage of bunt respectively in the two plots was as follows: Sherman with Little Joss bunt, 8·1 bunted ears; Sherman with Sherman bunt, 85·7 bunted ears. It is perhaps necessary to explain that the figure 8·1 is very high, having regard to the fact that the variety was contaminated with Little Joss bunt. The reason is probably that in hand-threshing the Sherman wheat it was slightly contaminated with its own bunt. Very often in apparently clean ears there is a bunted grain, especially in certain varieties. In threshing, the ears of clean Sherman wheat selected for propagation may have been accidentally contaminated in this way. The difference in the two cases, however, is so extremely great that the main conclusion is not obscured. In all cases the percentage of bunt was obtained by taking a count of a thousand ears, and the plots were sown the same day and under identical soil conditions.

Other wheat varieties, notably Ridit, Turkey, Hussar, and Berkeley Rock, known to be resistant to *T. caries*, have since been broken down by the same method of treatment. In one case Berkeley Rock was contaminated in 1927 with Little Joss bunt, and at harvest it produced 1·6 per cent of bunted ears only; contaminated with its own bunt it produced 91·1 per cent of bunted ears. In all cases the wheat was contaminated with spores until it was literally black, a spore load known to be sufficient to produce maximum infection.

In the same way that the plant breeder may select a unit from a population of a variety for resistance to a certain pathogen, so the destructive mycologist may select a pathogen from an analogous population to which a given host is susceptible.

Since the main results and conclusions of this investigation will not be published for some time, it is believed that this preliminary note upon the subject will be of value to workers engaged in the selection or hybridisation of wheat varieties for resistance to bunt.

W. A. R. DILLON WESTON.
School of Agriculture,
Cambridge.

Blue Rock Salt.

I WAS glad to learn from his interesting letter in NATURE of Jan. 26, p. 130, that Mr. F. C. Guthrie has verified our observations on the thermoluminescence of natural blue rock salt, which were published in the *Sitzungsberichte der Akademie der Wissenschaften in Wien* (II. *a*), **132**, 261, 1923, in collaboration with Miss M. Belar. Since then many samples of rock salt from various localities have passed through our hands, with the result that blue or violet pieces invariably show thermoluminescence, whilst colourless ones in general do not, only some very impure and opaque white pieces being an exception. It is scarcely to be doubted that the increased energy-content of the blue rock salt was acquired through absorption of some radiation, most likely of radioactive origin.

I would like to direct the attention of those interested in the subject to my two reports in the *Zeit. für Physik*, **20**, 196 (1923), and **41**, 833 (1927), on the work done in this Institute on the artificial and natural coloration of salts, and to my more recent communications to the Vienna Academy (*Wiener Ber.* (II. *a*), **136**, 43, 435, 679, 685; 1927: **137**, 409; 1928. *Wiener Anzeiger*, **274**, 1928; **8**, 1929) on this subject.

The results given in the last-mentioned note seem of more general physical, mineralogical, and technological interest, bearing, as they do, on the much-discussed question of recrystallisation, so I take the opportunity of stating the principal ones here explicitly: in pressed rock salt, which, as I have shown, turns rapidly black under radium radiation, and blue on subsequent exposure to daylight, there appear under prolonged radium treatment lighter yellow regions which expand from day to day. Cleavage in such regions shows the pressed salt to be perfectly recrystallised. There is definite evidence that the radiation not only offers a convenient way of showing the progress of recrystallisation, but also actually promotes it. These observations may give a clue to the explanation of some curious morphological details in natural blue rock salt, on which subject more will be said in a future communication to the Vienna Academy.

KARL PRZIBRAM.
Institut für Radiumforschung,
Vienna.

The Absorption Spectrum of Vitamin D.

WITH the assistance of Mr. R. G. C. Jenkins and Miss C. Fischmann, we have now fully confirmed the theory suggested previously that the ultra-violet irradiation of ergosterol produces three substances in succession (Webster and Bourdillon, *Biochem. J.*, **22**, 1223; 1928: *J. Soc. Chem. Ind.*, **47**, 1059; 1928). Of these, the first shows intense absorption for wave-lengths between 2500 A. and 2900 A., and great anti-rachitic power. The second shows intense absorption at 2400 A., and no antirachitic power. The final product (or products) has little or no appreciable absorption and no antirachitic power. We are now convinced that the first substance is vitamin D, for the following reasons:

(1) In a prolonged series of experiments we have studied solutions formed by the irradiation of ergosterol, under various conditions and in various solvents, and after removing the unchanged ergosterol (by treatment with digitonin) have measured the specific absorption between 2700 A. and 2900 A. and the antirachitic activity of these solutions. We have found satisfactory quantitative agreement between the two properties over a wide range, intense absorption being accompanied by great antirachitic activity, and solutions with smaller absorption showing correspondingly weaker activity.

(2) By further radiation of such solutions through a filter of alcoholic cobalt chloride (thus excluding radiation of wave-length less than 2600 A.), we have obtained solutions showing very slight absorption at 2700-2900 A., but intense absorption at 2400 A. These solutions showed no antirachitic activity when tested in doses which would have revealed one five-hundredth of the original activity.

T. A. WEBSTER.
R. B. BOURDILLON.
National Institute for Medical Research,
Hampstead, N.W.3,
Feb. 5.

Spectrum of Doubly Ionised Bromine.

FOLLOWING the method of locating spectra by the horizontal comparison method described by Dr. Saha and Mr. Majumdar (*Indian Journal of Physics*, vol. 3, Part I.; 1928), I have been able to classify the spectrum lines of doubly ionised bromine. We take the series of elements As^{++}, Br^{++}, . . . Y^{++}; the spectrum lines due to the transitions $[xN_2(0_1 \leftarrow\!- 0_2)$, $x = 0$ for As^{++} and 6 for $Y^{++}]$ have been obtained for As^{++} by Lang, and Y^{++} by Millikan and Bowen. From these it is quite easy to extrapolate the corresponding lines of Br^{++}. They were located at $\nu = 28000$ for the ^4PD group, and at 31000 for $^4P\bar{P}$ due to the transition $[2N_2(0_1 \leftarrow\!- 0_2)]$ of Br^{++}.

A strong group of lines in this region was obtained by Bloch and assigned to Br^{++}. I had not much difficulty in finding out the whole term system. Some of the lines are given; $^4P_2D_3$, 28063; $^4P_3\bar{P}_3$, 31497 and $^4P_2S_2$, 33096; $^2P_2{}^2\bar{P}_2$, 29995. In addition, the lines due to $2N_2(0_2 \leftarrow\!- 0_3)$ transition have also been obtained.

SURESH CHANDRA DEB.
Physical Laboratory,
Allahabad, Dec. 22.

Spectrum of Doubly Ionised Krypton.

THE spectrum of doubly ionised krypton has been under examination by me for some time past. It seems evident that the strong group of lines about the wave-length 3250 belong to Kr^{++}. A preliminary attempt has revealed a number of regularities. I give below three sets of terms A, B, and C, which have so far been obtained. The strongest lines are obtained from the terms $A \rightarrow B$, and probably represent the transition $3N_20_1 \rightarrow 3N_20_2$. The other transition, $3N_20_2 \rightarrow 3N_20_3$, etc., may appear as $B \rightarrow C$.

		A		
0	716·6	2910·8	3346·2	3861·4
	4968·9	4998·9	6122·8	8100·9
		B		
	30800·0	33360·2	33770·1	35187·6
	35553·8	35857·6	35982·1	38407·6
	38825·3	39795·6	40385·1	40418·1
	40473·2	42741·7	43145·5	43602·9
		44122·6	45407·0	
		C		
	64619·2	65807·2	68156·7	68240·5
	69625·3	70519·0	75473·7	

I wish to record my heartiest thanks to Dr. P. K. Kichlu, who has always taken a kind interest in my work and has helped me with many valuable suggestions.

D. P. ACHARYA.
B.N. College, Patna,
Dec. 19.

Further Triplets of Trebly Ionised Arsenic (As IV).

SAWYER and Humphreys (*Phy. Rev.*, **32**, 580; 1928) have identified three triplets due to the combination of the term $4s4p\ ^3P$ with $4s5s\ ^3S$, $4s4d\ ^3D$, and $4p^2\ ^3P$ of the spectrum of trebly-ionised arsenic. In the course of the study of the spectrum of arsenic under different conditions of excitation, I have found two more triplets due to As IV, the details of which are as follows:

	λ.		ν.	Δν.
$5sS_1 - 5pP_2$	3109·01	(5)	32155·4	816·5
$5sS_1 - 5pP_1$	3190·00	(3)	31338·9	262·0
$5sS_1 - 5pP_0$	3216·90	(2)	31076·9	
$4dD_1 - 5pP_0$	2461·37	(3)	41615·5	261·7
$4dD_2 - 5pP_1$	2453·93	(4)	40738·6	138·6
$4dD_1 - 5pP_1$	2445·61	(1)	40877·2	816·3
$4dD_3 - 5pP_2$	2417·49	(5)	41352·6	202·3
$4dD_2 - 5pP_2$	2405·72	(2)	41554·9	
$4dD_1 - 5pP_2$	...		...	

Taking Sawyer and Humphreys' value, 199087 for $5sS_1$, the values of $5pP_{012}$ are 168010, 167748, 166932. The observed and calculated positions of the second triplet agree closely.

K. R. RAO.
Imperial College,
South Kensington, S.W.7.

Super-cooled Water.

THE viscosity of water has been determined down to − 9° C., at which temperature it is quite fluid, and I was surprised to find that water drops suddenly chilled (without crystallisation) to − 17° became hard —that is, true water glass. In Beilby's "Aggregation and Flow of Solids" (1921), p. 195, we find: "When a small drop of water was placed on a glass slip which had previously been cooled to − 12° it instantly froze and became like a hemispherical lens, perfectly transparent and colourless. Under the microscope it showed no signs of crystalline structure. . . ." The term 'froze' is a little ambiguous, but from the context can only be taken to indicate hardening.

Thus there appears to be a great change in the properties of super-cooled water between − 9° and − 12°. It seems unlikely that this phenomenon should have escaped notice up to now, but I can find no reference to it.

LEONARD HAWKES.
Bedford College,
Regent's Park, N.W.1.

The Total Solar Eclipse of May 9.

ON May 9 the sun will be totally eclipsed for a period up to more than five minutes in a belt which crosses land in Sumatra, Kedah, Siam, Cambodia, and the Philippines. The length of totality and the good field of stars in which the sun is placed at totality, make this eclipse one of the best for further examination of the law of displacement of stellar images through the bending of rays of light passing close to the sun. The value of the deviation predicted by Einstein was confirmed by the British observers in 1919, and by the Lick observers in 1922; but there have been indications of slight deviation from the formula proposed by Einstein for the displacements of the stellar images, and several expeditions are putting the Einstein experiment in the forefront of their programmes. The main subjects of other researches are spectrophotometry of chromosphere and corona, direct photography of the corona to examine structure and internal motion, interferometer observations for exact wave-lengths of coronal lines and rotation, photometry and studies of polarisation.

In Sumatra, which is to see a total solar eclipse for the third time this century, there will be two or three expeditions. A Dutch expedition, including Dr. Minnaert, who was successful in Sweden in 1927, will probably go to the north-east coast near Idi. They will study the solar radiation near and through totality, and the spectrophotometry of the chromosphere and corona. The party may be joined by a German expedition from Potsdam, which will attack the Einstein problem with an astrographic telescope and also with a cœlostat with two camera tubes—taken out to Sumatra by Dr. Freundlich in 1926. The German expedition will also aim at securing improved wave-lengths for the coronal lines by using a spectrograph of high dispersion and will work on the relative intensities of these lines. An American expedition under Prof. Miller, of Swarthmore College Observatory, will also attack the Einstein problem, will take a number of direct photographs with a tower telescope of 62 ft. focal length for coronal structure, and will try for exact wave-lengths of the corona by the use of an interferometer. This expedition will probably be at or near Idi on the north-east coast of Sumatra.

In Kedah, a Malayan State, there will be a British expedition, probably at Alor Star. Dr. Jackson, of the Royal Observatory, Greenwich, will carry out the Einstein experiment with a cœlostat feeding a 7-inch lens of 21-ft. focal length, while Dr. Carroll and Dr. Aston, from Cambridge, will work on spectrophotometry with a moving plate spectrograph and on motion in the corona by means of an interferometer, applying the method used on the Orion nebula by Fabry and Buisson. Direct photography of the corona with a 6-inch lens of 45 ft. focus, and through colour screens with short focus cameras, will also be carried out.

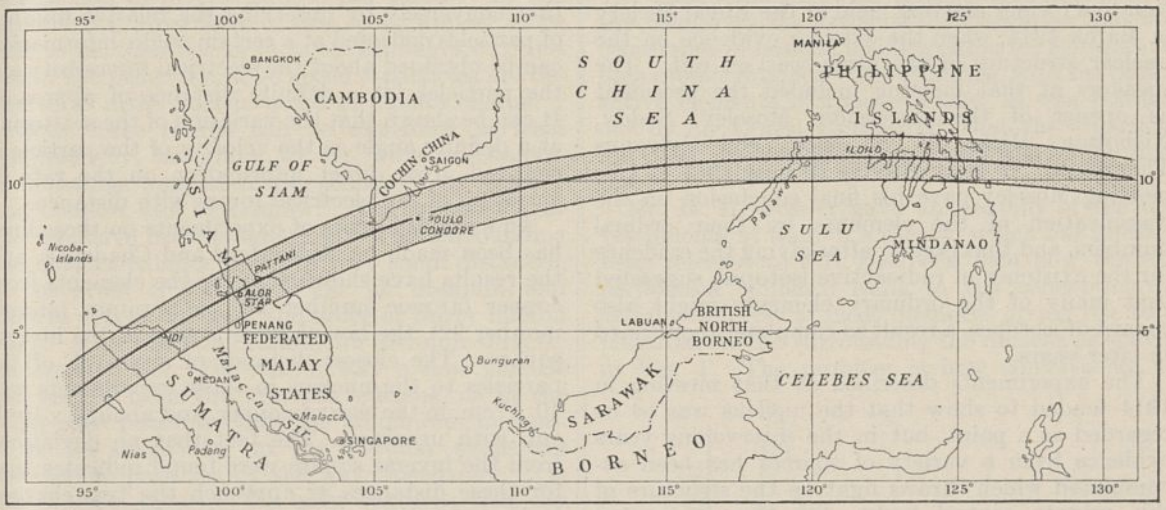

FIG. 1.—Track of total solar eclipse of May 9, 1929.

The other British expedition—Prof. Stratton, of Cambridge, with Mr. Melotte, of Greenwich—will repeat the study of the relative intensity of the *H* and *K* lines and the infra-red triplet of ionised calcium by means of a Littrow grating spectroscope, in order to test Milne's theory of the chromosphere, and will also repeat the Einstein experiment, using the Greenwich astrographic telescope and the mounting prepared for the Christmas Island eclipse of 1922. Direct photographs of the corona will be made with the 4-in. lens of 19-ft. focal length belonging to the Royal Irish Academy but used at a succession of eclipses, and the flash spectrum will be obtained with this instrument and with a direct-vision prism lent by the Royal Observatory, Edinburgh. In addition, a polariscopic study of the corona will be made with the Nicol prism used in the past by Prof. Newall. Dr. Royds, of Kodaikanal Observatory, Profs. Kibble and Barnes, of Madras, Col. J. Waley Cohen and Mr. E. G. Barton are expected to join this party. The last-named has been travelling in China and Burma since the

eclipse of 1926, where he was a member of the British Expedition to Benkoelen.

In Kedah or Siam there will probably also be an American expedition from Harvard, Prof. Stetson and Mr. Weld Arnold, with a programme of photometry—absolute and relative—and direct photography of the corona; and near Khoke Bhode, in Siam, there may also be a German expedition from Kiel and Göttingen. Their programme will include photometry and spectrophotometry of the chromosphere and corona and a search for faint coronal lines with a spectrograph of high light-gathering power.

On Poulo Condore, an island off the coast of Cambodia, there will be a French expedition from the Bureau des Longitudes. Coronal photometry and the Einstein experiment will form the main programme. At Iloilo, in the Philippines, a German expedition from Hamburg will be established with a programme including objective prism flash spectra and direct photography of the corona with a series of exposures of different lengths. It is possible that Anderson's apparatus may also be taken to the Philippines by a joint American and Norwegian expedition, mainly from the Naval Observatory, Washington.

The weather prospects along the whole belt are reasonably good, and with so many parties so well spaced along the belt of totality, it may be hoped that important results will be obtained in the whole field of eclipse problems of present-day interest.

The Structure of Atomic Nuclei.

IN opening the discussion on atomic nuclei, held at the Royal Society meeting on Feb. 7, the president, Sir Ernest Rutherford, directed attention to a former meeting, held at the Royal Society in March 1914, when the existing evidence on the nuclear structure of the atom was set out. The speakers at that meeting included the president as opener of the discussion, Moseley, Soddy, Nicholson, Hicks, H. S. Allen, and Sylvanus Thompson. It is of interest to note that at this meeting Moseley gave his final conclusion on the classification of the elements by their ordinal numbers, and that Soddy, after giving the evidence for the existence of radioactive isotopes, suggested that many of the ordinary elements might also consist of isotopes, a result so completely confirmed in later years.

The experiments described at that meeting in 1914 tended to show that the nucleus was to be regarded as a point, but in the intervening years evidence from a variety of sources has been accumulated which throws light on the structure of this minute central body. Sir Ernest directed attention to the three main lines of attack: the measurements of the masses of atoms, the evidence from collisions of α-particles with nuclei, and the evidence provided by the natural disintegration of the radioactive elements. He emphasised that, while many nuclear phenomena have been observed and investigated in the last decade, only one way of influencing the nucleus directly has been discovered. Although many attempts have been made to disintegrate the elements artificially, the only agents which have as yet accomplished this are the α-particles emitted by radioactive bodies. The α-particles are helium nuclei with energies as high as seven million electron-volts, and, when their direction of impact on an atom is central, they can penetrate the atom and collide with the nucleus, thereby disintegrating it.

One of the most fruitful lines of investigation has proved to be the observation of the deflection α-particles suffer when they pass near the nucleus but yet do not disintegrate it. This scattering, as it is termed, is due to the electrical forces between the α-particle with two elementary charges, and the nucleus with Z elementary charges, where Z is the atomic number. The α-particles which penetrate closest to the nucleus are most deflected, so that conversely by observing the relative number of particles deflected at a certain angle, information can be obtained about the electrical forces between the particles for a definite distance of approach. It can be shown that the variation of the scattering at a definite angle as the velocity of the particle is changed gives direct information on the rate of variation of the electrical forces with distance.

An extended series of experiments on these lines has been made by Rutherford and Chadwick, and the results have shown that for the elements from copper (atomic number 29) to uranium (atomic number 92), the law of force is that of the inverse square. The closest distance of approach of the particles to the nucleus in these experiments was 10^{-12} cm. in the case of copper, and about 4×10^{-12} cm. with uranium. The fact that no deviations from the inverse square were found indicates that for these distances of approach the two charged bodies are acting as points, and no information can be deduced about the dimensions of the nucleus except that it must be smaller than these distances. With lighter elements quite different results are obtained. Owing to the smaller nuclear charges, the α-particle can approach much nearer to the nucleus and marked deviations from the scattering expected on the inverse square law are observed. The most natural explanation of the results is found to be that, at very close distances, attractive forces come into play varying rapidly with the distance. The experiments are not as yet sufficiently definite to determine the rate of variation in detail. Debye and Hardmeier have attempted to put the existence of these forces on a physical basis by suggesting they are due to distortion or the mutual polarisation of the colliding particles. It appears that this hypothesis can give a general explanation of the scattering by light elements.

An extremely important application of these scattering experiments is obtained by considering the results with uranium. On ordinary views, part at least of the energy of the α-particle ejected from the uranium nucleus must be due to the repul-

sion of the inverse square law forces. If its entire energy is attributed to this cause, a minimum estimate will be obtained for the distance at which the inverse square force of repulsion begins to be appreciably diminished by the attractive forces. The calculation yields a value of 6×10^{-12} cm.; this is in complete disagreement with the scattering result already quoted, which showed that the inverse square field extended down to a distance of less than 4×10^{-12} cm. This impasse is avoided if we may make use of the wave-mechanics.

Dr. J. Chadwick described a similar phenomenon which is found to occur with aluminium, which is almost at the other end of the table of elements. Aluminium is one of the elements which can be disintegrated by the impact of α-particles, and, as would be expected, the probability of disintegration decreases as the speed of the α-particle is decreased. Measurable disintegration, however, is still observed with α-particles of such low speed that the scattering observed in other experiments is still due to inverse square law forces. In one experiment, α-particles of this speed appear to be able to hit the nucleus so as to disintegrate it, but yet in the other the same speed α-particles are deflected as if the nucleus acted as a point charge.

Both these results can be explained at least qualitatively, according to the wave-mechanics, in a manner suggested independently by Gurney and Condon, and by Gamow. It is supposed that the repulsive inverse square law field surrounding the nucleus extends down to very small distances, of the order of $0{\cdot}7 \times 10^{-12}$ cm. for uranium, and rises to a peak value of the order of thirty million volts. The scattering results are therefore directly understandable. The reason why a slow particle can escape from the uranium nucleus, or in the other case penetrate into the aluminium nucleus, is to be sought for in the peculiar properties ascribed to particles by the wave-mechanics. On the classical theories, the only way a particle can pass from one region into a second separated from the first by a potential barrier is by surmounting the barrier. On the wave-theory, however, there is a finite probability of the particle passing through the potential barrier although its energy may be far less than the peak value.

Several points of exceptional interest have been discovered in connexion with the artificial disintegration of the elements. With the exception of lithium, beryllium, carbon, and oxygen, all the elements up to potassium can be disintegrated by the α-particles of radium-*C* (energy seven million electron volts). Particular attention had been directed to the energy relations occurring in the collision. For example, it is found that protons are knocked off the aluminium nucleus with energies as high as 1·4 times that of the incident α-particle. The experiments of Blackett have shown that in the process of artificial disintegration of nitrogen, while a proton is knocked off, the α-particle appears to be captured. If this is also the case in the disintegration of aluminium, it is possible to deduce from the experiments that what may be termed the heat of the reaction is not constant, but varies over a comparatively wide range. The obvious suggestion is that the masses of all aluminium nuclei are not identical.

The elements of odd atomic number give protons of greater range than those of even atomic number, and this distinction between the two classes was emphasised by Dr. F. W. Aston in connexion with his experiments on the isotopic constitution and masses of the elements. While the even atomic numbers often have many isotopes (tin has eleven), the elements of odd atomic number appear never to have more than two.

Valuable evidence on the stability of the elements is provided by the accurate measurements of their masses by the mass-spectrograph. The mass of a nucleus is in general found to be less than the sum of the masses of the protons, α-particles, and electrons of which it is supposed to be constituted. This disappearance of mass represents an emission of energy in its formation, or conversely, that energy must be supplied to disintegrate it. The measurements so far carried out support both the results on the artificial disintegration and the occurrence of natural disintegration for elements of high atomic number. For example, with the radioactive elements it appears likely, as was pointed out by Sir Ernest Rutherford, that the α-particle has more mass inside the nucleus than when it is free.

Mr. R. H. Fowler gave an account of the developments of Gamow's theory, which has already been referred to. It has been seen how the experimental evidence leads to the conception of attractive forces at close distances giving rise to a potential barrier surrounding the nucleus as shown in Fig. 1. The problem is how constituents of

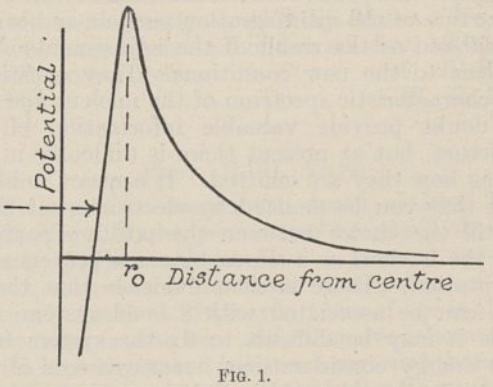

FIG. 1.

the nucleus such as α-particles which are inside this nucleus can escape, when their energy as represented by the arrow is insufficient to take them over the peak. An α-particle inside such a nucleus is not to be considered as a material particle executing some kind of orbital motion, but as a wave motion filling the whole of the space. The wave-length is determined by the momentum of the α-particle, and as a rough illustration, the stable states are those in which some type of stationary wave system exists. If the potential barrier were infinitely thick or high, it would be possible to have a true stationary wave motion and the

system would be permanently stable. With a finite barrier, the wave motion on the new mechanics is found to be a damped vibration coupled with an issuing wave which penetrates the barrier. The exact optical analogy is a wave incident at an angle greater than the critical angle on a surface only a few wave-lengths thick. In this case it has been shown experimentally that a small amount of the wave penetrates the surface. The issuing wave in the nuclear problem must be interpreted as showing that the α-particle has a possibly small, but yet finite chance of escape from the system with the same energy that it has inside the nucleus. This is in itself the explanation of radioactive disintegration, but the calculation can be pushed much further. It will be seen from Fig. 1 that the greater the energy of the α-particle the smaller the thickness and height of the potential barrier it has to penetrate, and the greater should be the chance of escape, that is, disintegration. This is the well-known Geiger-Nuttall law connecting the energy of the ejected α-particle with the transformation constant. Considering the provisional state of the theory, an excellent quantitative account can be given of the observed connexion between the energies of the α-particles and the transformation constants. The distance r_0, about $0{\cdot}7 \times 10^{-12}$ cm. for heavy nuclei, may be looked on as the size of the nucleus, and it is found necessary to allow this to decrease as we go down the series. This is, of course, reasonable.

It has as yet not been possible to include the nuclear electrons in this theory, or to attempt an account of the β- and γ-ray phenomena. The evidence on this subject was described by Dr. C. D. Ellis. The γ-rays are high frequency electromagnetic radiations emitted immediately after the departure of the disintegration particle and can be considered as the result of the adjustment of the nucleus to the new conditions. They constitute the characteristic spectrum of the nucleus and will no doubt provide valuable information on its structure, but at present there is difficulty in deciding how they are emitted. It appears unlikely that they can be emitted by electrons, but there is still the choice between the positive particles and the nucleus as a whole by some process such as rotation. There is clear evidence that the γ-rays can be associated with a level system, and while it may be difficult to fix the system from pure energy considerations, measurements of the intensities should enable a decision to be reached.

A phenomenon indicating a coupling between the nucleus and the outer electronic structure has been observed by G. H. Aston and Ellis. The energy of the excited nucleus is not always emitted in the form of radiation; it is sometimes converted inside the same atom and leads to the ejection of an electron from the atom. If the probability of this happening were to vary smoothly with the frequency, the process would be similar to the actual emission of the energy from the nucleus and reabsorption by the electrons. The two systems cannot be considered distinct in this way, since the probability of conversion is found to oscillate rapidly in ascending the scale of frequencies.

Prof. O. W. Richardson pointed out that spectroscopic evidence has an important bearing on the question whether the nucleus is in rotation. He described an *a priori* argument which makes it probable that the nuclei of the elements must in many instances be rotating. In the case of hydrogen, the result of this argument is almost a certainty. A universe is imagined which at a certain instant consists of one electron and one proton, and these unite to form an unexcited hydrogen atom with the emission of radiation. The spectroscopic evidence is overwhelming that in the ground state of an atom each extra-nuclear electron has half a quantum of angular rotation. If the postulated universe is to obey the principle of the conservation of angular momentum, the nucleus of the hydrogen atom must have acquired half a quantum of angular momentum in the opposite sense. An improbable but interesting alternative is that the emitted radiation preserves the conservation of momentum by having a sufficiently high degree of elliptical polarisation.

There is good spectroscopic evidence that the nuclei of a number of elements are rotating and have a quantised angular momentum. This is shown from the magnetic field resulting from this rotation, which causes the hyper-fine structure of the spectral lines of many atoms. A sufficient analysis has already been made for bismuth and cæsium to indicate the exact number of quanta on the nucleus. The spectroscopic evidence of the alternating intensities in the band spectrum of hydrogen, and the specific heat of hydrogen gas, when interpreted according to the wave-mechanics, also definitely require the proton to have half a quantum of angular momentum.

Obituary.

DR. H. J. H. FENTON, F.R.S.

THE death of Dr. H. J. H. Fenton, formerly lecturer and demonstrator of chemistry in the University of Cambridge, will be regretted by many generations of Cambridge men, for he taught in the University for more than forty years, and of the numbers that have attended his lectures there can be few who did not receive a lasting impression from his teaching.

Henry John Horstmann Fenton was born at Ealing in 1854. After having been educated at Magdalen College School, Oxford, he went to King's College, London, where he studied chemistry under Bloxam, and at the end of his course acted as demonstrator. About this time the Cloth-workers' Company instituted an exhibition in physical science tenable for three years by a non-collegiate student at Cambridge. The first award

of this exhibition was made to Fenton, and he entered the University of Cambridge in the Lent Term, 1875. He afterwards gained an entrance scholarship at Christ's College, where he was admitted in May 1876. After the relative freedom of his London course he chafed at the discipline then imposed on undergraduates, with the result that he not infrequently came into conflict with university and college authorities. He took the Natural Sciences Tripos in 1877, and was placed in the first class; among his contemporaries placed with him in this class were Adam Sedgwick the zoologist, Bower the botanist, and Alex Hill, afterwards master of Downing.

Fenton was soon appointed an assistant demonstrator by Liveing, and when the then University demonstrator of chemistry, John Wale Hicks, of Sidney Sussex, afterwards Bishop of Bloemfontein, retired, W. J. Sell was appointed to succeed him, and an additional demonstratorship of chemistry was instituted by the University and the post assigned to Fenton.

This was in the days of the old Chemical Laboratory, which stood on the east side of the site of the former Botanic Garden and afterwards served as part of the Pathological Laboratory. Several of the colleges then had their own chemical laboratories, and these were run in competition with the University laboratory. This competition continued for many years after the erection in 1887 of the new University Chemical Laboratory in Pembroke Street, though in an ever-lessening degree as the college laboratories one by one were given up. The greater part of the teaching in the University laboratory was carried out by Sell and Fenton, and in spite of their different temperaments the two men worked together in harmony until their association was terminated by the death of Sell in 1915.

Fenton's lectures were for many years an outstanding feature in the instruction given in the University Laboratory. He took immense pains in their preparation, and although in lecturing he affected an air of boredom and a somewhat indolent manner, actually he delivered them with very great care, and he was extraordinarily successful in stimulating the interest of the abler men. He was scrupulous in avoiding dogmatism, and he endeavoured, so far as possible, to present every subject as a debatable question on which there were diverse views to be discussed. The value of his lectures was greatly enhanced by the informal discussions which he encouraged; at the close of every lecture a number of eager young men would come down to the lecture table and discuss with him, often for half an hour or more, the questions in which he had aroused their interest.

The course of experimental work in general and physical chemistry which Fenton devised to illustrate his lectures was very carefully thought out, and during the 'eighties, and even later, the type of laboratory work being done by his class was probably unique. Of his books, his "Notes on Qualitative Analysis," which was widely used, and his "Outlines of Chemistry," of which Part I. only was published, are best known.

Although Fenton's chief interest always seemed to lie in general and physical chemistry, the greater part of his original work was carried out in organic chemistry and his most important investigations centred round dihydroxymaleic acid. He was led to the discovery of this compound in a curious way; whilst demonstrating one day he found that a student amusing himself by mixing a number of reagents selected at random had obtained a remarkable purple coloration. Fenton realised at once that the observation was one that should be followed up, and he found that the colour was due to the iron derivative of an oxidation product of tartaric acid. Several years later he succeeded in the difficult task of isolating this product, and showed that it was the previously unknown compound, dihydroxymaleic acid. In a series of elegant investigations, carried out in part with the assistance of his students, he described numerous interesting transformations of this substance, and also established the value of hydrogen peroxide in the presence of iron salts as an oxidising agent.

Fenton was elected into the Royal Society in 1899, and served on the Council of that body from 1913 until 1916. He was made an honorary fellow of his College in 1911. He was naturally a shy man and was exceedingly sensitive to chaff or criticism; he endeavoured to conceal his shyness by assuming a certain *hauteur* which tended to repel some of those who would have sought his friendship. He had a very strong sense of fairness, but his pertinacity in defending views in which he was in a minority of one sometimes made him a difficult member of University bodies. He married in 1892, Edith, daughter of George Fergusson of Richmond. He left no children. He gave up his lectureship in 1924 and went to live at Hove, but the last years of his life were greatly clouded by illness. He died in a nursing home in London on Jan. 13, at the age of seventy-four.

C. T. H.
W. H. M.

PROF. R. H. YAPP.

WE regret to record the death on Jan. 22 of R. H. Yapp, Mason professor of botany in the University of Birmingham, after a year of suffering borne with heroic fortitude and patience. His untimely death at fifty-seven years of age is all the more tragic as the new and extensive laboratories, which he had planned with such care and thoroughness, had only just been opened before he was taken seriously ill, and he was thus unable to complete a number of investigations which had been temporarily laid aside for the exacting duty of supervising the erection of the greatly needed new department.

Richard Henry Yapp was born in the village of Orleton, in Herefordshire, in 1871, and was educated at a school in Hereford, and later at Nottingham. After spending some years in the firm of Messrs. Alexander and Duncan in Leominster, he entered St. John's College, Cambridge, as a scholar, and graduated with first class honours in botany in 1898. Elected to the Frank Smart Studentship

at Gonville and Caius in 1899, he was appointed botanist to the University of Cambridge scientific expedition to the Malay States under the leadership of Mr. W. Skeat. Of the interest aroused in him by this expedition he always spoke with warm recollection, and the material collected formed the basis of several investigations published in the *Annals of Botany*.

In 1904, Yapp was appointed to the chair of botany in University College, Aberystwyth, and during the ten years of his tenure of that professorship he reorganised and extended the botanical department, and enriched its museum with many specimens collected in the Malay States and in South Africa, during his visit to that country with the British Association in 1905. From Aberystwyth, Yapp went to Queen's College, Belfast, and in 1919 to the University of Birmingham. In all three places he threw himself with vigour into the teaching and reorganising of his department, and by his active interest in the general welfare of the college or university to which he was attached, he invariably gained the confidence and esteem of his colleagues, and was trusted as a clear-sighted adviser. Though this brought him many and exacting duties, he managed to accomplish a considerable amount of research work which was latterly of a physiological and ecological nature.

While still at Cambridge, Yapp had become interested in the fens, and spent many holidays studying the peculiarities of their vegetation. As a result of these studies he published a detailed account of the vegetation of Wicken Fen, dealing more particularly with the relation of the plants to soil moisture. This was followed by a critical account, structural, physiological, and developmental, of the foliage of the meadow-sweet (*Spirea Ulmaria*), as bearing on the problem of xeromorphy in marsh plants. In this question of the water-relation of plants his interest continued to the very end, and during his last illness he was busy editing the English translation of Prof. Maximov's book on this subject, and also writing up voluminous notes of investigations carried out by himself some few years ago.

While at Aberystwyth, Prof. Yapp became interested in the various plant associations of the Dovey estuary, and made a special study of the vegetation of the salt marshes. Detailed accounts of this investigation were published in the *Journal of Ecology* in 1917 and 1921. These ecological studies necessitated the consideration of the general inter-relationships of plants in vegetation, and led to the publication of two critical papers on the "Concept of Association" and the "Concept of Habitat" respectively. Had he been spared to work out other important ideas for which he was collecting evidence, Prof. Yapp would have still further enhanced his reputation as a careful observer and a clear thinker. In recognition of his ecological work he was elected president of the Ecological Society in 1921, and he was looking forward with eagerness to presiding over the botanical section of the British Association at the meeting in Glasgow last autumn, when his fatal illness necessitated his resigning the presidency of the section. Though aware of the probable fatal termination of his illness, he never lost courage, and continued as long as it was possible to work at the completion of some of his botanical investigations.

Yapp possessed a clear and orderly mind, and had the ability to present lucidly and tersely the information he wished to convey. Good evidence of this is afforded not only by his published researches, but also by the success of his small text-book on botany published by the Cambridge University Press. He leaves a widow, who tended him with touching devotion during his prolonged and painful illness, and two children, a son and daughter. By his death the University of Birmingham loses a valued teacher, and science an ardent investigator and a gifted botanist. His botanical colleagues will remember him as a genial friend, of innate modesty and of singular personal charm.

FRÄULEIN GERDA LASKI.

FRÄULEIN GERDA LASKI, who was one of the few women to succeed in making a name for herself in the realms of the exact sciences, died in Berlin on Nov. 24. Coming of a well-to-do family in Vienna, her attention was liberally directed from the first towards the arts and sciences, a fact which, combined with a natural vivacity and affectionate temperament, endowed her with great versatility, and added in no small degree to the charm of her personality.

Fräulein Laski studied for her doctorate in Vienna at the Physical Institute under Prof. Ehrenhaft, and her first published work—on submicroscopic particles—was a direct result of the intellectual circle in which she was placed. After a period at Göttingen (where Debye then was) she became assistant in the Physical Institute of the University of Berlin, where she was introduced by Rubens to the experimental technique of infra-red research. This subject had attracted her during her sojourn in Göttingen, and, broadly speaking, it remained her chief interest to the end. In 1924, Fräulein Laski was chosen to take charge of the department of infra-red research in the Kaiser Wilhelm Institute für Faserstoffchemie at Dahlem.

In addition to various publications dealing with her own investigations (such as the long wave-length spectrum of mercury vapour, the infra-red spectra of chlorates and bromates, and of cellulose), Fräulein Laski contributed the article on infra-red research to vol. 3 (1924) of the "Ergebnisse der exakten Naturwissenschaften." Her last work comprised a couple of chapters, "Special Methods for Measurements in the Infra-red" and "Thermo-electricity" for the Geiger-Scheel "Handbuch der Physik."

Fräulein Laski's death while in the prime of life has removed a talented research worker, and at the same time many will regret the passing of a colleague who had endeared herself to a wide circle of friends.

News and Views.

METEOROLOGICAL statistics justify, on the whole, the selection of Aldwick, near Bognor, as the place of convalescence for His Majesty the King, when it is borne in mind that sunshine is the element of greatest importance in such a case. Bognor lies within the only strip of the south coast of England where the general average daily duration of sunshine in the month of February exceeds three hours. The contrast between the figures for this Sussex watering-place and those for St. James's Park are most striking for mid-winter, but even in this month, with its lengthening days, the relative amounts are not far short of three to one. In March the ratio is reduced to almost exactly two to one, and by April the advantage of the seaside place is reduced to 45 per cent. The particular merit of the climate of the Sussex coast is that it combines a low average rainfall with its abundant sunshine, and in this respect has a great advantage over the southern coasts of Devon and Cornwall. On the other hand, the south-west coast has a slightly higher mean temperature, due to the fact that it is more frequently under the influence of the mild southerly or south-westerly winds of the Atlantic, at the same time that the south-east of England is meteorologically one with the Continent during a spell of the cold easterly type of weather. A curious fact—perhaps not widely recognised—is that in spring the warmth derived from artificial sources in London on the one hand, and the influence of the cold sea upon the coastal climate on the other, are sufficient to make St. James's Park actually warmer than Bognor when shade temperature alone is considered. The difference amounts to about a degree and a half.

CENTRAL Europe is in the grip of an intense anticyclone, and over northern Russia pressure exceeds 1044 millibars, which is 30 millibars above the normal for the month. Usually during February the axis of high pressure lies to the south, over Switzerland and the Balkan highlands, and the greater part of Europe comes under the influence of rather mild westerly and south-westerly winds from the Atlantic. Under the conditions existing at present, however, pressure is highest in the latitude of the Baltic, and winds are easterly over almost the whole of Europe, from the Black Sea and the Alps to the North German coast. The anticyclone is an offshoot of the great winter anticyclone of Siberia, and the source of the air is away in central Asia. Reports in the press quote some extraordinarily low temperatures, such as − 67° F. at Ivanov-Voznesensk, north-east of Moscow, and perhaps even lower at other places in central Russia, − 40° F. near Vilna in Poland, − 31° F. in Silesia, − 24° F. in Belgrade, and − 15° F. in Berlin. The last, if correct, is the lowest temperature recorded during more than a hundred years' observations in that city, the previous lowest having been − 13° F. in 1850 and 1855.

THE lowest temperatures hitherto recorded near Moscow are probably not below − 50° F., and the low minima quoted above are not confirmed by figures in the *Daily Weather Report*. The western Baltic is freezing, and many ships are fast in the ice. Vienna is also intensely cold, and the Danube is frozen for 1200 miles. The cold extends across south-eastern Europe to Asia Minor and Syria, and there have been several heavy falls of snow in the Balkans, associated with a deep depression which occupied the eastern Mediterranean at the end of January and beginning of February. The deep drifts have blocked the railway line to Constantinople, and three Simplon express trains with a number of passengers have been snowed up for a week in Thrace.

IN response to the invitation of the Royal Institution, representatives of many scientific and technical societies met in the famous lecture theatre in Albemarle Street on Feb. 5, to consider the preliminary arrangements for the celebration of the centenary of Faraday's great discovery of electromagnetic induction, which he made on Aug. 28, 1831. Sir Arthur Keith was in the chair, and in opening the proceedings reminded those present that the Royal Institution was not only the scene of Faraday's labours, but it was also for more than half a century his home. Sir William Bragg, director of the Royal Institution, said that the proposed celebrations had been in mind a long time, and in choosing the particular discovery of August 1831 they were recalling one of Faraday's most important discoveries, on which rested a vast body of scientific and industrial development. The occasion would give the nation an opportunity of realising the contributions to science and industry during the last hundred years. It was unlikely there would be another occasion so favourable, and if made a success, the centenary would encourage the people to go on with their work and brighten the whole outlook of the nation.

AMONG the speakers was Sir Ernest Rutherford, who not only approved the suggestions but also pointed out that in 1931 occurs the centenary of the birth of James Clerk Maxwell, who in a sense was Faraday's interpreter and put into mathematical form the latter's views. Col. K. Edgcumbe, president of the Institution of Electrical Engineers, Sir John Snell, Sir William Pope, Mr. D. N. Dunlop, Sir John Reith, Col. W. A. Vignoles, and Prof. J. L. Myres all promised the co-operation of the societies they represented. Prof. Myres made the interesting announcement that the officers of the British Association were prepared to recommend to their Council that the centenary meetings of the Association of 1931 should be held in London, and said they would be glad to do everything in their power to ensure that not only the intellectual descendants of Faraday himself, but also the large public interests which benefited from the applications of those discoveries, should be represented. The meeting approved the appointment of two small committees to deal with the scientific and industrial sides of the celebration, which Sir William Bragg announced would probably take place in the third week of September 1931.

Two donors, who desire to remain anonymous, have each presented the London Hospital with a gram of radium for work on cancer. Following so soon after the generous gift of radium to the King Edward Hospital Fund by Sir Otto Beit, these gifts are adequate testimony to the conviction that is gaining ground of the good results which follow the use of radium in the treatment of cancer. Conditions were laid down by Sir Otto Beit that his radium should be loaned to centres where the study of radiation questions is carried out on scientific lines. One of the London Hospital donors has supplemented his gift by an additional £13,000, which is to be invested and the income from it used in running a radium laboratory. The radium and the endowment are to form a trust known as the Freedom Radium Trust, and this Trust is to be managed by a committee of three 'governors,' who have power to co-opt members of the honorary surgical staff. The number of cancer cases treated at the London Hospital is 800-1000 a year, and steps are being taken for complete records of all the cases which will be treated under these new opportunities.

A PROJECT to perpetuate the memory of the late Drs. Peach and Horne has been recently inaugurated in Edinburgh. Benjamin Neeve Peach died in January 1926, and his lifelong friend and fellow-worker, John Horne, followed him in May 1928. In response to a widely expressed desire that the eminent services rendered to geology by these two distinguished men of science should be recognised in some appropriate form, a representative committee was convened and has now decided to take steps to raise a joint memorial. The committee, which is under the chairmanship of Prof. R. A. Sampson, includes delegates from the Geological Survey of Great Britain, the Royal Scottish Museum, the geological departments of the Scottish universities, and the following scientific societies with which Drs. Peach and Horne were most closely associated: Royal Society of Edinburgh, Royal Scottish Geographical Society, Royal Physical Society of Edinburgh, and the Geological Societies of Edinburgh and of Glasgow. The committee proposes, with the concurrence of the authorities concerned, that the memorial shall take the form of a bronze plaque to be placed in a suitable position in the Royal Scottish Museum, Edinburgh, and of a commemorative inscription upon some conspicuous rock-face or boulder at one of the classical geological localities in the north-west Highlands. A fund has been opened to defray expenses, and the committee has appointed Mr. M. Macgregor, Southpark, 19 Grange Terrace, Edinburgh, to receive and acknowledge all contributions.

NEWS of another find of skeletal remains of early man in Africa is to hand. It is reported that during quarrying operations in Springbok flats in the northern Transvaal, fossil bones of man have been found in conjunction with the remains of an extinct gigantic buffalo. According to the Pretoria correspondent of the *Times*, in a dispatch which appeared in the issue of Feb. 9, the skull, long bones, and parts of the hands have now been found, but most of the vertebral column and the entire pelvis are missing. The skull and the other bones have been much broken, as if the hunter had been trampled by the buffalo. It is stated that the remains are those of a large-size man not closely related to the negroid type. The marked supra-orbital ridges of Rhodesian man are absent; but the lower jaw, though protuberant, has only a small chin, while the teeth are said to resemble those of Rhodesian man. This description would scarcely appear congruous with the attribution which is stated to have been put forward with confidence that the remains are of the Cro-Magnon type, and a possibility which is hinted that they may prove to be more primitive seems very likely.

DR. BROOM is reported in a later dispatch as regarding the Springbok man as proof of the existence of a primitive pre-negroid type in South Africa, and as establishing the hitherto doubtful standing of the Boskop skull. Whether this be the case or not, the find certainly seems likely to prove of very considerable importance. The absence of the supra-orbital ridges would clearly distinguish these remains from those of Rhodesian man, and they would thus add another to the early physical types which appear in the south of the continent. This range of type, of which unfortunately at present there is no evidence to fix the chronological sequence, would be in harmony with the archæological evidence which, according to the latest analysis, points to a succession of infiltrations into the sub-continent from the north.

ON p. 262 of this issue, we publish a summary account of Miss Garrod's recent presidential address to the Prehistoric Society of East Anglia, in which she gives a 'new view' of prehistory. It has for some time been evident that the results of archæological discovery outside the western European area could be brought within the classical order of de Mortillet only with increasing difficulty. This has perhaps been most impressed upon archæologists by the discoveries of Fathers P. P. Licent and Teilhard de Chardin in China. A full and exhaustive report on these discoveries has been issued by the Institut de Paléontologie humaine of Paris. M. Boule and the Messrs. Licent and Chardin themselves alike agree in regarding their discoveries as of vital import in the interpretation of the succession of palæolithic cultures in the West. Both geology and palæontology are now held to point to parity of conditions within a range extending from China to western Europe. Yet cultures which in the West appear in chronological succession, in the East appear to co-exist. Middle and Upper Palæolithic are combined. Hence such distinguished archæologists as M. Boule, the Abbé Breuil and Prof. Obermaier are coming to regard the succession of cultures in the West as a localised and peculiar condition due to a series of incursions from a centre of dispersion for which they look to Asia. It is interesting to note that the account by M. H. Martin of Solutrean frescoes found in a rock shelter in the valley of the River Roc (Charente) and the deductions he draws therefrom favour Miss Garrod's view as to the extent to which the Solutrean penetrated the

West. It is clear that Miss Garrod's plea for extended exploration in extra-European areas does no more than justice to the situation.

IN spite of a substantial reduction in its income, the Empire Cotton Growing Corporation is continuing its scientific research in the cotton plantations (see NATURE, Nov. 5, 1927, p. 645, and Mar. 10, 1928, p. 362). The quarterly report of the Executive Committee, which met on Jan. 23, makes this quite clear, as the following items show. The jassid-resisting strains of cotton evolved at the Barberton Experiment Station have reached the stage of rapid multiplication for distribution to the farmers, and are fully maintaining the high opinion formed of them. A number of them have been found to be early maturing —always a matter of first importance with regard to insect pests in warm climates. Similar work has now been undertaken in Southern Rhodesia, and there is already a promise that cotton growing will shortly enter into regular rotation with other crops. Considerable attention has been directed lately to the important research work being done in the Sudan. A committee was formed in this country to overhaul this work, and its decision was most favourable to its high scientific character.

SPECIAL studies are being made by the Empire Cotton Growing Corporation on the black arm disease of cotton, with the result that a very definite correlation has been observed between this fungus and soil temperatures. By regulating the time of planting to periods when the soil temperature is unfavourable to the development of the fungus, it is hoped that a considerable measure of control will result. A fresh appointment has been sanctioned to assist the pathologist in his work. Research in Nyasaland has sufficiently advanced to justify the opening of a station on the west side of the lake. Here the country appears to be specially suited for cotton growing, and will shortly be rendered accessible by the extension of the railway from Blantyre to the lake. Meanwhile, the research station in Trinidad is getting into its stride, and important papers have been and are being published in both the genetic and physiological sections. The papers issued have won warm eulogies from scientific men in Great Britain, in the United States, and on the continent of Europe.

IN the second lecture of his course on "The Early History of X-rays," delivered at the Royal Institution on Feb. 7, Sir William Bragg said that, like many other physicists of the same period, Röntgen was interested in the electric discharge in all the new forms which were being given to it by improvements in technique and especially by the increasing efficiency of the means for producing high vacua. Crookes, Hittorf, Lenard, and others had shown the marvellous properties of the so-called cathode rays. An additional factor in the discovery was the results of investigations with various phosphorescent substances. All the circumstances were therefore in favour of the discovery being made, and to Röntgen fell the honour of being the first to grasp the significance of an effect that others must have occasionally seen, and indeed did see about that time. His discharge tube was wrapped in black paper; yet one of these phosphorescent materials was set glowing when the discharge was made to pass. He also observed with curiosity that it made no difference whether the cardboard sheet on which his fluorescent material was spread was held with its back or front to the bulb. He assumed that a kind of ray, hitherto unknown, was emanating from the bulb. From that he went on to discover all the principal features of the rays and presented them in a paper of singular lucidity and order. All over the world delighted workers repeated his experiments. In Great Britain, J. J. Thomson, Campbell Swinton, Schuster, Porter, Jackson, and others helped in the rapid development of a new technique. The wonder of X-rays is now widespread, but the savour of the marvel of those first experiments will never be forgotten by those who had any part in them.

IN his Friday evening discourse, delivered at the Royal Institution on Feb. 8, Mr. C. E. R. Sherrington discussed "Recent Problems of Rail Transport at Home and Abroad." The retail and short distance nature of the rail traffic of Great Britain, he said, prevents the adoption of many methods used abroad, but the employment of labour-saving device—the corollary of high wage rates—is extending widely. Advocates of the Channel Tunnel scheme should not forget that the size of rolling stock in England is more limited in dimensions than that of Continental railways, while the practical difficulties experienced with steel sleepers abroad, such as the undesirability of using them with slag ballast, should limit their use at home to the time when they become a financially profitable improvement. The reinforced concrete sleeper is an alternative to steel, and can be more easily insulated where track circuits and automatic signals are required. The progress in signalling has resulted in the use of the day colour light signal, widely developed on the Southern Railway of Great Britain. Its universal adoption is to be expected in view of its penetrative power through fog, for automatic train control has not yet achieved that degree of infallibility which warrants the enormous cost of its application; this cost in the United States has often been more than £400 a mile. Freight service has been speeded up by the use of the rail-brake, now being installed for the first time in England at March, London and North Eastern Railway.

SINCE radio broadcasting was started five years ago its growth has been remarkable. Difficulties, however, are continually arising, which can only be overcome by persistent scientific research. In *Discovery* for February, Sir John Reith points out that the main difficulty arises from the fact that to-day there are nearly three hundred stations in Europe trying to broadcast on a wave band which is barely sufficient for a hundred. At the international conference at Geneva, Great Britain was allotted ten exclusive frequencies. Had it not been for the rapid growth in the number of stations, this arrangement might have sufficed. The actual result, however, is that the so-called exclusive frequencies are being encroached on

continually. Two years ago the nine main stations of the B.B.C. had an uninterrupted range of twenty miles for reception, and the relay stations had a range of five miles. Owing to interference, these ranges are now reduced to five and one and a half respectively. The radio engineers, therefore, are forced to erect a limited number of high power stations instead of the comparatively numerous low powered stations at present in use. The proposed new stations also will have two transmitters, each capable of operating on different frequencies, so that separate programmes can be transmitted simultaneously. The experimental results already obtained at the Daventry station (5GB) have proved eminently satisfactory. The first of the new high power regional transmitters is being built at Brookman's Park, near London. It will be in operation in the autumn of this year. Preliminary steps are being taken to erect high power stations to serve the north of England, Scotland, Wales, and the west of England. These will probably be completed in 1930. Until the regional scheme is ready, temporary measures are being taken to supply those listeners served by relay stations. It has to be remembered that the interference from distant stations increases after sunset, and so after dark the service of a station sharing a wave-length is decreased.

DR. B. A. KEEN, assistant director of the Rothamsted Experimental Station, has been giving talks through the British Broadcasting Corporation from September last on "The Why and Wherefore of Farming." The B.B.C. has now published, as part of this course, two pamphlets illustrating and amplifying the work. These pamphlets, giving a list of books to be read, and further work to be undertaken, should be in the hands of every agricultural student and teacher. They contain an admirable series of photographs, designed not merely to show the fundamental scientific character of farming but also to demonstrate the extent to which modern improvements have resulted in increased supplies of food and other commodities produced from the land. Especially instructive to the townsman are the illustrations of the improvements that have been effected in the types of plants grown. In the second pamphlet, to accompany the course this spring, are many excellent photographs of typical English farming scenes and operations, and few will wish for anything better in the way of illustration than these. Included at the end of each are instructions for the performance of simple experiments illustrating some of the more important subjects dealt with in the lectures. Appropriately enough, portraits of Jethro Tull and John Lawes form the respective frontispieces. From every point of view the object aimed at seems to have been achieved. The lectures have been illustrated in a most interesting way; further work on each has been suggested; the names of the books supplying the information have been supplied, and a scheme of simple practical work has been elaborated. The two slight pamphlets, because of the care expended upon their production, form a very interesting complement to Dr. Keen's lectures, and afford an illustration of the useful educational work which radio communication can accomplish.

THE rapid growth of domestic electrical installations during recent months has greatly strained the resources of the meter departments of supply stations. In addition, there is no general agreement as to the type of tariff which is most equitable for the consumer and the supply company. The general principles laid down by John Hopkinson many years ago still hold good, and it is probable that the universal application of a two-part tariff to small users is only a question of time. The difficulty that has to be overcome in all the methods hitherto suggested lies in convincing the consumer that the method of charging is an equitable one. In a paper read by J. L. Carr to the Institution of Electrical Engineers on Feb. 1, an account was given of electric meters with special reference to those which are used to record in some particular way depending on the tariff system adopted. Practically all types of meters depend on their so-called permanent magnets remaining always the same. It is now well known that cobalt steel makes excellent permanent magnets. But some makers, probably on account of the cost, still use the older types of magnet, which from the point of view of remaining permanent leave much to be desired. Sooner or later every electric meter is called upon to withstand the effects of a temporary overload due to the development of some accidental fault on the circuit. Every time a fuse blows, for example, there is a heavy overload. It is well known that this may partially demagnetise the 'permanent magnets' and thus alter the rate at which the meter rotates for a given current. The present rapid extension of the use of domestic appliances connected to all parts of the house mains will doubtless increase the frequency of short circuits. Hence the effect of these on the rate of the meter is becoming important. The present standard specification, namely, that the rate should not be affected when a current thirty times the normal is passed through it for half a second, is not sufficiently stringent.

THE present year being the jubilee year of Pope Pius XI., the Pontifical Academy of Sciences (Nuovi Lincei) has decided to offer a prize of 10,000 lire, to be awarded for the best critical dissertation on the physical theory of quanta. The prize is open to al except the ordinary members of the Academy, and dissertations, which must be unpublished, are to be submitted before Oct. 31 next. Three typewritten copies, in either Latin, Italian, French, English, German, or Spanish, must be supplied. Authors may give their own names or they may furnish a distinguishing motto, which must be repeated on a sealed envelope containing the name. The award will be made, on the recommendation of a special committee nominated by the committee of the Academy, at the inaugural meeting of the next academic year in December next.

DR. F. C. WHITMORE, head of the Department of Chemistry at Northwestern University, Evanston, Illinois, has been appointed Dean of the School of Chemistry and Physics at the Pennsylvania State College as from July 1 next. Dr. Whitmore succeeds Dean G. L. Wendt, who has been appointed assistant

to the president of the College in charge of research. Dr. Whitmore was director of the second session of the Institute of Chemistry, held at Northwestern University last summer, and during the year 1927–28 he was chairman of the Division of Chemistry and Chemical Technology of the National Research Council. He is the author of volume 3 in the monograph series published by the American Chemical Society, namely, "The Organic Compounds of Mercury," published in 1921, and was editor-in-chief of vol. 7, published in 1927, of the annual series entitled "Organic Syntheses."

THE twenty-fourth annual report of Leicester Museum and Art Gallery refers to the good work done by the Director, Dr. E. E. Lowe, in his "Report on American Museum Work," and mentions that a new wing, to cost about £6800, will soon be available. This extension will be used for exhibition space, and will contain also a students' research room and a muniment room. During the year little change was made in the exhibited collections, some of which are still cramped for lack of space, but evening lectures, guide-demonstrations, and special Christmas lectures were much appreciated. More than a quarter of a million visitors entered the Museum, and the running of the Museum and Art Gallery cost £7182, £6873 of which was contributed by the rates.

A FEW years ago the Deeside Field Club, with its headquarters in Aberdeen, published as an experiment *The Deeside Field*, designed to interest the naturalist and the general reader in the many different aspects of Deeside life. The success of the experiment led to the appearance of three further parts, the last of which, recently published, contains a district miscellany of wide interest and high standard. Archæology is served by articles on pygmy flints, the first found in Scotland, a compendium of Deeside castles, and a discussion of Pictish symbols; natural history by accounts of the glacial geology of the Cairngorms, and of the rarer wild flowers of the valley; history by descriptions of Lumphanan and Durris; and there are many topical articles on old industries, the valley's painters, and so on. The Club is performing a useful service in encouraging research into these different sides of the development of the Dee valley and its people, and in giving the results permanent record. Its highly successful field excursions are no less useful in fostering acquaintance with a wide range of local interests, most of which have behind them more than local significance.

IT is announced in *Science* that the Penrose medal of the Geological Society of America has been presented to Dr. J. J. Sederholm, director of the Geological Commission of Finland.

THE Galton Anniversary Dinner of the Eugenics Society will be held at the Rembrandt Hotel, Brompton Road, on Saturday, Feb. 16, at 7.15 P.M. The Galton Lecture will be delivered by Major Leonard Darwin, who will take as his subject "The Coming of Age of the Eugenics Society."

As announced in our issue of Dec. 8, p. 898, the annual general meeting of the Chemical Society will be held at Leeds on Mar. 21. The presidential address, entitled "Co-operation in Science and Industry," will be delivered by Prof. J. F. Thorpe in the Great Hall of the University at 4.30 on that date.

AN earthquake of moderate intensity was recorded at Kew Observatory at 17 hr. 23 min. 9 sec. G.M.T. on Feb. 1. The epicentre is estimated to have been in Afghanistan. A message from Bombay states that a shock was felt in Delhi. Another disturbance was recorded at 0 hr. 9 min. 59 sec. G.M.T. on Feb. 2. The epicentre was 4640 miles away, probably in Mongolia.

THE following have been elected officers of the Royal Astronomical Society for the present year: *President:* Dr. A. C. D. Crommelin; *Vice-Presidents:* Sir Frank Dyson, Dr. E. B. Knobel, Prof. H. F. Newall, and Rev. T. E. R. Phillips; *Treasurer:* Mr. J. H. Reynolds; *Secretaries:* Prof. Herbert Dingle and Dr. H. Knox-Shaw; *Foreign Secretary:* Prof. H. H. Turner.

THE Ministry of Health has issued a memorandum, arranged on the same plan as in former years, of the costs incurred at residential institutions for the treatment of tuberculosis (Memo. 122 B/T.). The information given should be of substantial assistance to authorities in enabling them to secure economical administration of their institutions.

WE have received from the author, Mr. F. E. Corrie, a pamphlet on "Iodine for Livestock" (De Gruchy and Co., Ltd., 45 Mitchell Street, E.C.1). He has collected a large amount of information upon the value of iodine in the breeding and rearing of livestock, and describes methods whereby it may be fed to stock.

A BRIEF account of outstanding features of the Indian Science Congress held in January 1928 at Calcutta appeared in our issue of Mar. 10, 1928, p. 401. The *Proceedings* of the Congress have now been issued as a paper-covered volume of 420 pages by the Asiatic Society of Bengal, 1 Park Street, Calcutta. The volume contains the addresses of the president, Dr. J. L. Simonsen, and the sectional presidents and abstracts of most of the papers presented. There is a subject and author index.

THE Chemical Engineering Group of the Society of Chemical Industry has recently published vol. 9 (1927) of its *Proceedings*. It contains twelve papers dealing with various aspects of chemical engineering and covering a wide range. Three of the papers are concerned with lubrication and lubricating oils and another discusses the oil-pollution question at sea. Thermo-electric and resistance pyrometry in industry, the production of power from town's refuse, the importance of chemistry to the engineer, moulding machines for cast iron, fire extinguishers, the manufacture of fibrous cellulose, spray drying and the desiccation process of beet sugar manufacture, are considered in the remaining papers.

THE usual bound volume, representing the Annual Report (for 1927) of the Smithsonian Institution, has recently been issued (Washington, D.C.: Government Printing Office, 1.75 dollars). In addition to the formal report of the expeditions and other activities of the Institution, there is the customary appendix, occupying fully three-quarters of the volume, which consists of brief accounts, by leading workers, of scientific discovery in particular directions. Many of the articles are original; one, by Sir James Jeans, is a reprint of the supplement to our issue of Dec. 4, 1926, entitled "Recent Developments of Cosmical Physics"; others, again, are translations. Such translations will be welcome to many scientific workers who are not at ease with a foreign language or do not see foreign periodicals regularly. The present volume includes "The Centenary of Augustin Fresnel," by E. M. Antoniadi (from *L'Astronomie*), "Is the Earth Growing Old?" by Prof. J. F. Pompeckj, and "The Origins of the Chinese Civilisations," by Henri Maspero (from *Annales de Géographie*).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the department of civil engineering, architecture, and building, and a lecturer in metallurgy, each at the Bradford Technical College—The Principal, Technical College, Bradford (Feb. 23). A junior scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Feb. 23). A secretary (male) of the City of London School—The Town Clerk, Guildhall, London, E.C.2 (Feb. 25). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Feb. 28). A lecturer in mining engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Mar. 2). A Lady Carlisle research fellow for research in classics, mathematics, philosophy, history, economics, or natural science, and a research fellow in some branch of chemistry or biology, each at Somerville College, Oxford—The Secretary, Somerville College, Oxford (Mar. 6). A professor of mechanical engineering at the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (Mar. 16). A chemist in the Main Drainage Department, Public Works Ministry, Egyptian Government—The Director General, Main Drainage Department, Public Works Ministry, Cairo, Egypt (April 30). A full-time teacher in electrical engineering at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley. A junior assistant (male) under the Directorate of Ballistics Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

THE SUNSPOT CYCLE.—Mr. H. W. Newton gave a short address on this subject at the January meeting of the British Astronomical Association. The average daily number of spots reached a maximum in 1928, but as regards areas, the curve of activity has two peaks, one in 1926 and one in 1928, with a slight depression in 1927. The average latitude of spots, which was 14° in 1928, was considered as an indication that the maximum is now past. Ten spot groups were visible to the naked eye during 1928.

Mr. W. M. H. Greaves spoke on the correlation of spots and magnetic storms: the close resemblance between the spot curve and the curves of diurnal variations has long been known, but the research in which he has been engaged deals with the connexion between particular spot groups and magnetic storms. Spots on the limb appear to have little influence, but a large number of storms can be associated with particular spots near the central meridian, or with active regions where spots had recently been present.

POSSIBLE RETURN OF DENNING'S PERIODICAL COMET OF 1894.—The new comet discovered by photography at Bergedorf on Jan. 17 last has been observed also at the Yerkes Observatory on Jan. 4 and 12, and a preliminary computation of the orbit leads to the inference that it may be a return of Denning's comet of 1894. The latter comet was observed for a short period only and its periodic time was deduced as 7·42 years. The small comet now visible gives undoubted evidence of being periodical and one of the Jovian group, with a time of revolution approximately 6·83 years or 6 years and 249 days. Quite possibly planetary perturbations may have altered the period in the interim of thirty-five years since 1894. In any case, the comet appears to have eluded rediscovery at four returns to perihelion, namely, in 1901, 1908, 1915, and 1922—but several of these occurred at very unfavourable times, when the comet was unsuitably placed.

It is now stated to be of the eleventh magnitude, and to be slowly declining in brightness, but it has not passed its perihelion. Only large telescopes can deal with it effectively, but photographic means will be employed to follow the object for some time yet.

DRAWINGS OF THE MILKY WAY.—Two beautiful delineations of the Milky Way have just been published. Mr. Easton contributes to *Mon. Not. R.A.S.* for December two charts of the northern Milky Way which were photographically reduced from hand drawings; these in turn were made from a careful study of all the available photographs, the latest addition to these being the volume of Prof. Barnard's plates, edited by E. B. Frost and M. J. Calvert. The charts are reproduced in negative, and the contrast has purposely been somewhat exaggerated in order to facilitate detection of structure. A system of faint curved streamers extending to the Pleiades is of special interest.

The other work is a study of the southern Milky Way, by A. Pannekoek (*Annals of Lembang Observatory*, Java, Vol. 2, Part I.). His work was entirely visual, the brightness of different regions being compared by Argelander's step method. The reproduction is in negative, and is on a larger scale than Mr. Easton's; there are three charts, each covering 60° of galactic longitude, and key charts with reference numbers, which serve as a guide to the measures of brightness of the different regions that are given in the Introduction. The work also contains a few photometric measures of the Gegenschein and the greater Magellanic cloud.

Research Items.

PRE-PALÆOLITHIC IMPLEMENTS.—In vol. 5, pt. 3, of the *Proceedings of the Prehistoric Society of East Anglia*, Mr. J. Reid Moir has some further remarks on the archæological contents of the Forest Bed at Cromer. In 1926 and 1927 he again examined the remarkable spreads of flints exposed at low tide at Cromer, East and West Runton, and at Sheringham. It was noted that the flints differ in character at the different sites. On the Cromer site were found a number of black unchanged flints, obviously not due to human action; but among these are a number of flakes which do show a clearly defined bulb of percussion. These are due to the action of visitors and children searching for shell-fish, when either they are broken as slabs of rock are turned over or dropped to make them break. Although the fortuitously made bulb can generally be distinguished from the type of bulb shown by the ochreous specimen, there are some which are comparable. It is thought that these may be explained by an incomplete detachment in flaking which has afterwards jarred off. It is pointed out that no ochreous specimens occurred among the spreads of flint uncovered by the great storms of 1927–28 and bulbous flakes were conspicuous by their absence. It is also pointed out that some of the ochreous flints collected in 1927 bear evidence of glacial action in the form of striations on their flaked surfaces. It may not be out of place to direct attention in this connexion to some remarks by Mr. C. E. Vulliamy on the subject of tertiary man in *Man* for January. He points out that the rostro-carinate is one of the commonest forms produced by natural agency, and further, that while the flints attributed to human agency agree in size with the naturally shaped flints on their respective sites, prehistoric man must have gone to an immense trouble to produce an implement not too well adapted to his needs when there were innumerable natural forms ready to hand which would have served his purpose as well or better.

PREHISTORIC POTTERY AT MALTA.—The archæological section of the annual report of the working of the Museum Department, Malta, during 1927–28, contains several items of interest which are worthy of more than passing mention. Curiously enough, however, one of the most interesting observations arises out of the investigation of modern and not prehistoric material. In July 1927, during the levelling of ground outside the Porta Reale, Valletta, a number of potsherds were unearthed. These were fragments of household ware, mostly Sicilian, of the beginning of the seventeenth century. Among them were a number of fragments of large vessels, amphoræ jars, basins, bottles, etc., with thick walls and smooth outside surface. This ware was covered with a red slip on which elaborate designs in white line had been painted with a brush; but in some cases the slip was white and the lines red. This ware is North African rather than Sicilian, and was in common use in Tunis and Algeria in the seventeenth century. It is common on old sites in Malta and Gozo, in one case at least on a site corresponding to a Roman horizon. Dr. Gobert, who is studying this ware in Tunis, considers that it is a survival of a prehistoric industry. At Tarxien, which produced a number of smaller antiquities during the year, some interesting potsherds were found, of which one is of extreme importance. This is a fragment of a reddish-grey colour of a fine paste free from grit, the surface being smooth and hand polished. It is part of a plate exquisitely decorated with incised lines which are filled with red pigment. A border is composed of chevrons with a dot in the centre, and representations of trees and bulls are shown. Two profiles of bulls are preserved, one giving the horned head and shoulders, the other the body without the head. It is said to be the most beautiful piece of ware found at Tarxien, or indeed anywhere in Malta.

FREEMARTIN AND A FREEMARTIN-LIKE CONDITION IN SHEEP.—Mr. J. A. Fraser Roberts and Dr. A. W. Greenwood (*Jour. Anat.*, vol. 63, pt. 1, 1928) describe an undoubted bovine freemartin of extreme type in which the modification in the male direction was more pronounced than in any previously described case. The animal possessed a penis, traversed by a urethra which terminated in a vulva. There was no trace of a scrotum. In the second case the authors describe a freemartin-like condition in a sheep twin. This is specially interesting in view of the doubt which has been expressed as to the existence of the freemartin condition in sheep. The lamb described was a twin, but the sex of the other twin is unknown. The anatomy of the lamb was extremely similar to that of typical bovine freemartins, and the authors conclude that it was a freemartin of the bovine type. They suggest that a comparison of the bovine freemartin and developmental mammalian intersexes provides evidence for the view that the latter are genetic males and suggests possible criteria for a recognition of the genetic sex of mammalian intersexes. Even in the most extreme freemartin cases where the internal genitalia are almost completely male, there is no suggestion of the formation of scrotum or of prepuce where the penis of the male ends. This points to the fact that these structures do not develop in the genetic female. There is therefore good reason to suppose that a range of individuals that include cases showing these structures are genetic males.

GROWTH AND SEX IN THE LIMPET.—Dr. J. H. Orton (*Jour. Marine Biol. Assoc.*, November 1928) records observations which lead to the following conclusions: that *Patella vulgata* is not an ordinary dicœcious species, that most, if not all, individuals are male at the first sexual maturity, that change of sex from male to female may occur at the age of one year and at any time afterwards, and that the occurrence of old males indicates the possibility of the existence of two kinds of males, one pure and one protandric. Spawning at Plymouth may extend from August to March in different seasons with a maximum about January to February. The conditions controlling breeding and spawning are unknown. Many limpets settled and grew on the cement piles of a new wharf constructed at Plymouth, hence the maximum age of these limpets was known. It was found that at an age of about one year, limpets grew to lengths of 26-35 mm. in 1912 and to at least 11-27 mm. in 1913; and at an age of two years to at least 53 mm. in 1911-13, and to 47-49 mm. in 1912-14. The shells were of the mid-tide-level type and were low, broad, and rather thin. It is considered that such growth in length is unusual and is correlated with the habitat and favourable climatic conditions. Seasonal shell growth is briefly discussed; a post-breeding shell-growing period is general in spring and early summer, but it is not known whether a mid-summer resting period is general among individuals more than one year old. Investigations into the cause of variation in shell-height indicate that height is determined probably entirely by the degree of exposure of limpets to desiccation—the drier the habitat the higher is the shell. Limpets submerged at neap tides have a relatively uniform low shell; those exposed at high-water neaps have a relatively high shell, which is

higher in the drier than in the damper situations, apparently irrespective of exposure to wave-action.

LOBSTER CULTURE.—*Naturen*, No. 10, for October 1928 contains an interesting popular survey by Mr. Alf. Dannevig of the history of lobster culture and of his experiments on rearing lobsters in Norway. His account of the experiments has already been noticed in our columns (Aug. 18, 1928, p. 253). In the present paper the growth of the lobster fisheries is traced from the beginning of the seventeenth century to our own times. Clear diagrams showing various statistics and figures of the larval stages as far as the fourth or 'lobsterling' stage are given, and photographs and figures of the experimental apparatus. In 1928 upwards of fifty thousand young were reared to the lobsterling stage, representing 34 per cent of the larvæ used for the experiments.

VITICULTURE: SCION AND STOCK INFLUENCE.—Whilst viticulturists will find much valuable information in the "Memorandum upon Viticultural Research," by D. Akenhead, published as E.M.B. 11, by the Empire Marketing Board, November 1928, horticultural investigators in general will find in it a very temperate analysis, with full citations of the literature, of the conflicting statements as to the influence of scion and stock upon one another in vine culture. The introduction of the *Phylloxera* to Europe, upon American vines imported because of their resistance to *Oidium* —when an insect that had seemed to be a relatively harmless leaf parasite developed as a scourge of the root system upon the old-established European varieties, at least in the southern part of their range—made the practice of grafting susceptible and valuable European varieties upon resistant American root stocks the immediate step to take to preserve the viticultural industry in southern Europe. Graft propagation then developed very rapidly, and upon a scale which rendered the provision of suitable root stock material a problem of great difficulty. The result has been an interminable controversy as to the effect of the introduced root stock upon the yield of well-known vine varieties, both in quantity and quality, and upon the length of life of the old-established varieties in the plantation. This report gives very concise data as to the conclusions reached by experienced nurserymen of the chief vine-growing countries in Europe, and by experimental stations both in the United States and Switzerland. The influence of scion upon root-stock is less evident to the practical man, though equally important in practice in the end, and has received less attention, but does receive consideration in observations upon strains relatively resistant to lime chlorosis.

THE INSECT-CATCHING MECHANISM OF THE BLADDERWORT.—Dr. Alexander Skutch has performed a valuable service for botanists in bringing together, in the *New Phytologist*, 27, 261-297, December 1928, the literature dealing with this interesting problem. It will be news to most botanists that in four different countries, different observers, independently, within the space of fifteen years, recorded observations which give a direct clue to the method by which the insects are trapped. It now appears that the entrance of the insect is associated with a sudden change in volume of the bladder, which must be regarded as under tension, as a result of its method of growth, and the opening of the valve, itself still a matter of difficulty to understand, is accompanied by a rapid inrush of water which carries the insect with it. Some delay in observing the phenomenon is probably due to the fact that if the plant is taken out of water, most of the taut bladders 'spring' with an entry of air into the bladder. When this plant is observed afterwards, no further trapping of insects is likely to be seen upon it for some time. The conditions determining the entry of water into the closed bladder are an interesting subject of investigation. It appears that the closed bladder is sealed osmotically, the whole bladder being covered with a cuticle that behaves as a semi-permeable membrane. As a result it is very difficult to plasmolyse the cells of the bladder by immersing it whole in strong concentrations of inert substances, as the cells are able to withdraw more water from the liquid in the bladder. It also remains a problem to what extent the entrapped insects are killed and digested by the fluid of the bladder or the peculiar hairs lining the inner walls. Green organisms, such as *Euglena*, have been seen to live and multiply within the bladder; on the other hand, colourless organisms like *Paramœcium* seem to die more rapidly than under normal conditions.

GOLGI BODIES IN THE HIGHER FUNGI.—Prof. S. R. Bose, of Calcutta, writes to NATURE that, in view of Prof. Gatenby's letter in the issue of Dec. 3, 1927, he has re-examined the higher fungi, using Bowen's method. He then finds that Bowen's "osmiophilic platelets" are nothing but mitosomes, and (the bigger ones) the discoplasts of Dangeard. These are the mitochondria, greatly changed by swelling and vesiculation due to the action of the osmic acid in the fixative. As Guillermond has recently pointed out (*C. R. Soc. Biol.*, **98**, pp. 368–371, Feb. 1928), osmic acid, so satisfactory a fixative with animal cells, is very irregular in its action on the cells of higher plants. Prof. Bose finds that in the basidia of the higher fungi, no rod-shaped structures are seen, but only a number of round vesicular bodies. These are metachromatic corpuscles within the vacuoles of the basidia. They appear in almost the same position in the basidia on vital staining with neutral red. Prof. Bose directs attention to the fact that Dr. D. R. Bhattachargee, working on vertebrates at Allahabad, has concluded "that the Golgi bodies and vacuoles (vacuome) are homologous structures" (*Allahabad University Studies*, 1927–28). Dr. Viswa Nath, of the Punjab University, has also stated (in *Q.J.M.S.*, October 1928) that "the solid granular Golgi elements are artifacts produced by the excessive precipitation of metallic silver or osmium inside the vacuoles."

FLOODING OF THE DANUBE.—In a study of recorded Danube floods in an article in *Matériaux pour l'étude des calamités* for July–September 1928, L. Brandl shows that specially calamitous floods occurred four times during the nineteenth century, once in the eighteenth century, and at longer intervals in most previous centuries. Allowance must be made, however, for the incompleteness of earlier records and the liability of flooding to be less noteworthy when population was less dense along the river. The natural causes of the floods are shown to be twofold, the formation of ice-barriers and excessive rainfall. Ice-barriers were more frequent in past times before the river was regulated and its channels deepened. Then there is a record in the fourteenth century of an ice-barrier near Vienna which lasted seventeen weeks and caused the river level to rise six to eight metres. An ice-barrier below Bratislava in 1922–28 affected the level of the river many miles higher up. Protective and preventive works include the reinforcement of the river banks and the construction of dikes such as the one that protects Vienna.

INTRUSIONS OF SOUTH-EASTERN ICELAND.—In the *Quart. Jour. Geol. Soc.*, pp. 505-535; 1928, a detailed description is given of the main plutonic intrusions

of south-eastern Iceland by Miss H. K. Cargill, Dr. Leonard Hawkes, and Miss J. A. Ledeboer. The intrusions are found to be replacive stocks with steep sides and domed roofs, and no visible floor. Many are composite, being composed of gabbro with granite and/or granophyre; the biggest, however, Slaufrudal, is of granite rock alone. Where the outcrops are elongate in plan, the longitudinal direction coincides with the strike of the regional dykes. The suite of rocks is similar to that common elsewhere in the Brito-Icelandic or Thulean Province. Intermediate types are unimportant. The authors record a 'diorite,' but its description suggests that it is intermediate as a result of mixture of two magmas rather than as a consequence of differentiation. It is deduced from other evidence that two magmas, basic and acid, co-existed, but the extreme magmas are interpreted as products of differentiation which operated continuously throughout the history of the igneous cycle. No process which could produce such magmas is suggested. Intrusion of acid magma beneath Iceland is regarded as having saved Iceland from the general collapse of the North Atlantic plateau which occurred during the latter half of the Tertiary period.

INDIAN RAINFALL.—The Indian Meteorological Department has completed an important work on Indian rainfall. It is a summary of Indian rainfall for the fifty years 1875–1924, and constitutes the second part of the twenty-fifth volume of the *Memoirs* of that Department. The preface gives a brief history of rainfall measurement in India and explains how the present work, which was begun by Sir Gilbert Walker in 1913, was made possible by Sir John Eliot's introduction many years ago of a uniform system of measurement involving the use of gauges of standard pattern, tested before issue by the Department. The most important part of the undertaking was the construction of a table showing the rainfall for each of the many divisions and sub-divisions into which the country has been divided for climatological purposes, expressed as a percentage of 'normals' based on records obtained up to the end of 1910. As a method of arriving at an understanding of the causes of the variations, whether 'casual' or periodic, in the rainfall of India, an undertaking of this kind—involving the isolation of one meteorological element from the many others to which it is related—is of small value in proportion to the labour involved. It is rather in studies of the influence of that rainfall on the growth of crops and on public health, and as an aid in planning schemes of irrigation, that its real value must be sought; for these purposes the volume is well adapted, and inquirers should have no difficulty in obtaining in a minimum of time information that has been gained by the labours of many workers throughout two generations.

IONISATION BY COLLISION.—Many of the sources of uncertainty in quantitative measurements of ionisation by electronic impact are avoided by a device described by A. v. Hippel in a recent issue (No. 24) of the *Annalen der Physik*. Instead of passing into stationary gas, the electrons are shot at right angles through a beam of atomic particles which is issuing from a reservoir at the appropriate high temperature into a highly evacuated space. The products of ionisation pass on with the still unionised components of the beam, and are analysed in a receiving chamber by a mass-spectrograph, or by a simple electrical system. So far the method has been tried only with a beam of mercury atoms, and the results obtained are not in complete accord with those obtained by other methods which had previously been accepted as substantially accurate, but the use of atomic rays instead of gas or vapour should make it possible to study in a relatively straightforward way a considerable number of refractory substances which would otherwise be very difficult to investigate.

COUNTING SCINTILLATIONS.—During the course of an investigation of the various factors involved in the counting of α-particles by the method of scintillations, which is described in the January issue of the *Proceedings of the Royal Society*, J. Chariton and C. A. Lea have obtained some results of great interest in connexion with the mechanism of the human retina. Considered as a detecting instrument, it has long been recognised that the eye is extremely sensitive, but the figures now given are very striking. It appears that, in the most favourable circumstances, a skilled observer requires only some twelve quanta of green light, with a total energy of about 5×10^{-11} erg, to excite the sensation of vision. The optimum conditions for reception occur when the flashes follow one another regularly, and so can be directed to that part of the retina which is most sensitive; the passage of the nerve impulses to the brain should also have been facilitated by previous abstention from food, or treatment with a tonic drug such as strychnine, whilst the area stimulated should be small, possibly not more than a single retinal element. The duration of the flash is immaterial, so long as it is spread over a period of less than about a hundredth of a second. Another important point discussed is that of the nature of the feeble scintillations sometimes produced by β-rays; it has been shown that each flash corresponds to the simultaneous incidence of several β-particles on one of the small phosphorescent crystals, in sharp contrast to the scintillations due to α-rays, where in the majority of cases of practical interest each flash registers the impact of a single α-particle.

A NEW COLORIMETER.—Part 5 of volume 29 of the *Transactions of the Optical Society* contains a description of the new colorimeter devised by Mr. W. D. Wright in order to carry out some researches on colour vision for the Medical Research Council, and in particular to determine for a large number of observers the locus of the spectral colours in the colour triangle. The new instrument utilises three of the spectral colours as the three primaries of the triangle. They are combined by reflecting prisms placed in the spectrum, which return the three colours along their paths of incidence to a reflecting prism which deflects them out of that path to the photometer, where they fill half the field. The other half is occupied by the colour to be matched, which is also obtained from the spectrum. Variations of intensity of the light of any colour is produced by the introduction of a neutral tinted gelatine wedge which may, if found too variable, be replaced by a black glass wedge. The instrument in its present form occupies a considerable space, but it could be simplified and reduced in size if required for industrial purposes.

VITAMIN B.—It has been suggested by Jansen and Donath that vitamin B is a glyoxaline derivative, and Y. Sahashi has commenced the preparation of a series of glyoxaline derivatives in order to study their effect upon the polyneuritis of pigeons. The first compound to be prepared was 4 (or 5) glyoxaline-ethyl-methyl-carbinol, which brings about a temporary cure of polyneuritis and in this respect resembles 2-6-dioxyquinoline. After 7-10 days, however, the pigeons invariably died. This work is described in the December issue of the *Abstracts* of *The Bulletin of the Institute of Physical and Chemical Research, Tokyo.*

Remarkable Clouds at High Altitudes.

By Prof. CARL STØRMER.

BETWEEN 1871 and 1892 some very remarkable clouds were seen both in England [1] and in Norway. These clouds, which before dawn or after sunset were characterised by their brilliant prismatic colours, were especially studied by the late Prof. H. Mohn.[2] Visual observations in England in 1885, and by Prof. Mohn in 1892, made it very probable that their altitude was exceptionally great, but no certain conclusion could be drawn from these visual observations.

I saw these clouds in the year 1890 and made very careful observations of their forms and colours, but after 1892 I did not see them at all in spite of a very careful watch. It was not until Dec. 27, 1926, that I saw them again. That afternoon I was unable to determine their height, but some days later, on Dec. 30, I succeeded in taking two pairs of simultaneous photographs of them from my two aurora stations, Bygdö and Oscarsborg. The measurement and calculation of these photographs gave heights between 26 km. and 30 km. above the earth.[3]

On Jan. 13 of this year the clouds were again seen, both in the early morning and in the evening. I was fortunate enough to have my two stations, Oslo and Oscarsborg, in action immediately after sunset, and a long series of more than ninety simultaneous photographs were taken from both stations. These give unique material for determining the exact height and situation of these remarkable clouds.

FIG. 1.—Nacreous clouds to the west, seen from Oslo.

FIG. 2.—Photograph taken from Oslo.

I myself conducted the photographic work from the astronomical observatory, and simultaneous photographs were taken in Oscarsborg by my assistant Hafnor by orders over the telephone. My assistant in Oslo was Tveter.

The best photographs were taken so late that the stars were visible, which allowed us to measure and calculate the height and situation of the clouds in the same manner as I have done in the case of the aurora borealis.[4] In fact, the clouds remained luminous until three hours after sunset.

[1] See NATURE, vol. 33, pp. 220 and 486.

[2] "Perlemorskyer," *Christiania Videnskabsselskabs Forhandlinger* for 1893, and "Irisierende Wolken," *Meteorologische Zeitschrift*, March 1893.

[3] "Photogrammetrische Bestimmung der Höhe von irisierende Wolken (Perlmutterwolken) am 30. Dec. 1926." *Geofysiske Publikasjoner*, vol. 5, No. 3. Oslo, 1926.

[4] *Geofysiske Publikationer*, vol. 1, No. 5. Oslo.

FIG. 3.—Photograph taken simultaneously with the preceding one (Fig. 2), from Oscarsborg.

Fig. 1 is from a photograph taken from Oslo just after sunset, through a red filter on panchromatic plates. The most luminous parts shone in beautiful colours like mother-of-pearl.

One of the best pairs of simultaneous photographs was taken at 16 h. 40 m. 30 s. G.M.T. to the west. Fig. 2 and Fig. 3 are reproductions of the photographs taken from Oslo and Oscarsborg. The colours had then disappeared, but the clouds were still visible among the stars. In the photographs the star Atair is seen near the centre, ζ Aquilæ to the right, and the constellation Delphinus up to the left.

Along the outlines of the clouds we have chosen fourteen points, the positions of which are seen on the diagram Fig. 4.

As the distance separating the aurora stations is about 27 km., the parallax was great, which gave a very trustworthy determination of height.

The result was as follows :

Point.	Height.	Point.	Height.
1	25·3 km.	8	24·3 km.
2	25·6 ,,	9	23·4 ,,
3	26·1 ,,	10	24·5 ,,
4	25·1 ,,	11	23·1 ,,
5	24·8 ,,	12	23·0 ,,
6	22·4 ,,	13	23·9 ,,
7	24·3 ,,	14	22·3 ,,

Thus we have the same order of altitude as the clouds photographed on Dec. 30, 1926.

As Prof. Mohn had already found, these remarkable clouds are associated with an atmospheric depression to the north of Oslo, giving typical Föhn from the mountains in the west and north with high temperature and clear weather. In this way it has been possible to have a view upwards through a cyclone in that part which is generally obscured by clouds and rain. It may be possible that the iridescent or nacreous clouds are much more common over the ascending part of a cyclone, but that they are in general invisible, except in the case where a Föhn makes that part transparent so that the nacreous clouds can be seen.

The preparation of the whole material obtained may give a good deal more information about these remarkable clouds.

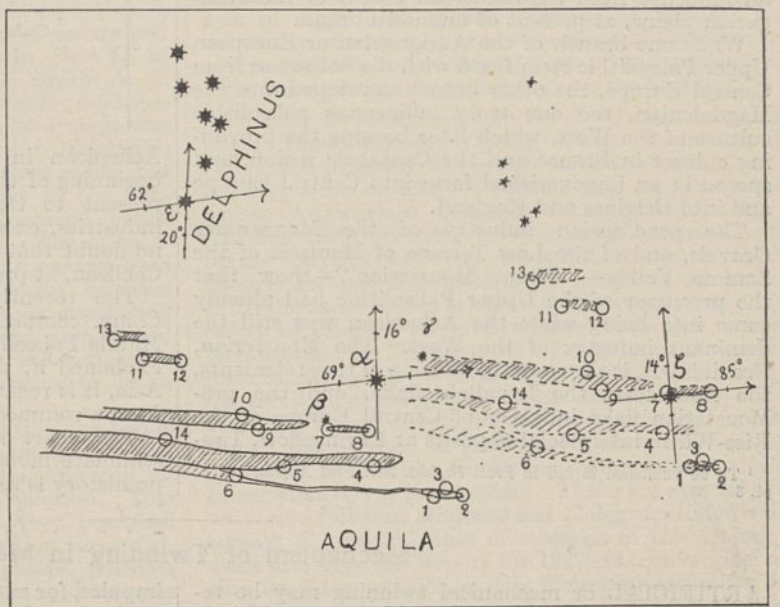

FIG. 4.—The clouds as seen from Oslo are shown by complete lines and as seen from Oscarsborg by dotted lines; corresponding points have the same number. For each star two directions are marked: The vertical circle and the great circle through the star and the point K where the direction Oslo to Oscarsborg meets the sky (direction of parallax). On these directions are marked the height above the horizon and the angle between the direction of the star and of the point K.

New and Old Views in Prehistory.[1]

IN her presidential address, recently delivered to the Prehistoric Society of East Anglia, Miss D. A. E. Garrod reviewed the present position of research in prehistory.

Now that research is spreading far beyond the confines of western Europe, it is clear that the classic sequence of culture periods, from the Chellean to the Magdalenian, cannot be applied to all regions in its entirety. Mortillet's classification represented the sequence in time of a certain number of palæolithic cultures, seen, as it were, in section over a very limited area of the earth's surface, but that classification records only the order of arrival in the west of a series of cultures, each of which has originated, and probably passed through, the greater part of its existence elsewhere. The time to find a new classification appears to have come.

An attempt is made to restate the evidence in a chart (Fig. 1) showing the relations of the palæolithic cultures of Europe. The Upper Palæolithic is divided into two branches—the Capsian and the Aurignacian—here regarded as separate offshoots from a common stock at present unknown. This view is at variance with that hitherto accepted; but it is suspected that the centre of dispersal of the Upper Palæolithic cultures may have been in Asia rather than in Africa. Evidence from the Caucasus, from Syria and from Palestine, points to an Aurignacio-Mousterian industry, though its association with the Galilee skull classifies the culture of the Zuttiyeh Cave as Mousterian despite its mixed character. The contact of Mousterian and Aurignacian in Palestine is, evidently from the characteristics of both, earlier than that of Abri-Audi. It is tentatively suggested that in Palestine the centre of dispersal is not far off and that the evidence is slightly in favour of the French Aurignacian being derived from the East rather than North Africa. As regards the Solutrean of the West, the evidence points to it being merely an influence from the Solutrean people of the Hungarian plains, at present of unknown origin.

While one branch of the Aurignacian or European Upper Palæolithic stem fused with the Solutrean from Central Europe, the other branch developed into the Magdalenian, the one truly indigenous palæolithic culture of the West, which later became the prevailing culture in France and the Cantabric region, and spread in an impoverished form into Central Europe and into Belgium and England.

The pre-Capsian industry of the Manzanares Gravels, and of the Low Terrace of Moutiers of the Somme Valley—"Warm Mousterian"—show that the precursor of the Upper Palæolithic had already come into being while the Acheulean was still the dominant industry of the West. The Mousterian, Breuil holds, is the result of a fusion of three elements, the Acheulean, the Levallois flake, and the pre-Mousterian flake industry of Central Europe of the Riss-Würm interglacial deposits at Ehringsdorf, Taubach, and Krapina. As Chellean and Acheulean are not found in Central Europe, this pre-Mousterian must take their place and go back to the first interglacial. Presumably the Heidelberg jaw belongs to an early phase of this. It is possible that the culture of High Lodge, Mildenhall, which presumably belongs to a Riss-Würm interglacial, the estuarine culture of Clacton and the Swanscombe deposits may be derived from the Central European culture. According to Breuil, the second element of the Mousterian proper, the Levallois flake, persisted throughout the Riss-Würm inter-glaciation until it coalesced with the Acheulean in the Combe Capelle industry at the beginning of the last glaciation. It is impossible at present to trace further back these contributory industries, except the Acheulean; but there can be no doubt that it develops without a break from the Chellean, at present of unsolved origin.

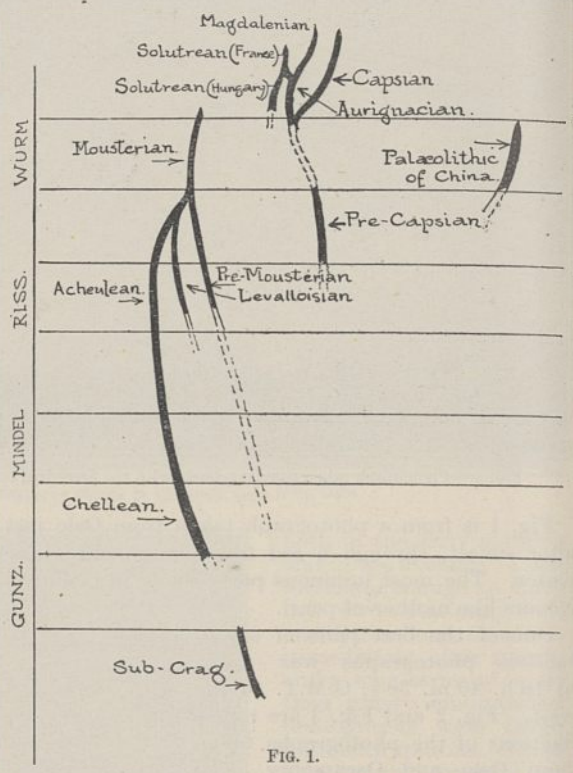

FIG. 1.

The recently discovered palæolithic culture of China, combining the characters of the Upper and Middle Palæolithic, but not typical of either, may be explained if, the centre of dispersion being Central Asia, it is regarded as related to the West by descent from a common stock.

The chart is purely tentative and intended to stimulate investigation in those great regions where prehistory is as yet unknown.

[1] To be published in full in *Proc. Prehist. Soc. East Anglia*, vol. 5, pt. 3.

Mechanism of Twinning in Metals.

ARTIFICIAL or mechanical twinning may be regarded as the result of a movement within a crystal by which the orientation of the atoms, in a band bounded by parallel planes, becomes a mirror image, with respect to these planes, of the orientation of the atoms in the unchanged matrix on either side. If such a twin band is to result from a mechanical impulse, for example, from an impulsive shear tending to depress the matrix on one side of the band with respect to that on the other, this relative movement of the material on either side of the planes bounding the twin band must be accompanied by a uniformly graduated or 'wheeling' movement of the atoms within the bounding planes.

The problem is to examine, for a given lattice, the different ways in which a movement of this kind may occur, and to decide which of them is likely to be produced most easily. The mechanism of twinning in the body-centred cubic lattice forms the subject of Part I. of a paper recently published ("The Mode of Formation of Neumann Bands," by S. W. J. Smith, A. A. Lee, and J. Young, *Proc. Roy. Soc.*, A, vol. 121, No. A788, Dec. 3). If a 'wheeling' movement of the atoms within the bounding planes is to take place in such a way that the twin relationship between the band and the matrix is to be produced, the line in which the plane containing the 'wheeling' atoms meets the twinning plane must be an axis of symmetry for the atomic distribution in the plane. The angular 'wheeling' movement during twinning is determined by the angle between the twin plane and the atom or 'wheeling' plane. The larger the acute angle between the possible twin plane and the possible atom plane the smaller is the angular movement required to produce the twin orientation of the band with respect to the matrix.

Examination of the conditions of twinning in the body-centred cubic lattice shows that the form of twinning most likely to occur is that of the type in which the twinning plane is $\bar{1}12$ and the atom plane is $1\bar{1}2$. By symmetry, the same type of twinning will occur with $1\bar{1}2$ as twin plane and $\bar{1}12$ as atom plane. During the transition from the initial configuration to the twin configuration the movement of the atoms produces a temporary increase in the 'width' of the band of the matrix in which the twinning occurs. Half-way through the twinning movement the 'openness' of the structure is at its maximum, and the atoms lie midway between two forms of the body-centred configuration. In this position the slightest bias, forward or backward, will tend to make the system move, under the operation of interatomic forces alone, forward towards the twin lattice or backwards towards the original one.

The markings produced in iron by shock were discovered by Neumann in 1850, and since then a number of investigators have studied the nature and mode of formation of these bands. In Part II. of their paper referred to above, S. W. J. Smith, A. A. Lee, and J. Young furnish indisputable evidence that the bands are twins. By X-ray analysis it was found that the hexahedral meteorite (Coahuila) with which most of the experiments were made, has a body-centred lattice, similar to that of the constituent—kamacite—to which the Neumann bands in octahedral meteorites are confined. The orientation of the cubic lattice of a meteorite having been determined, the geometrical relationship between the bands and the matrix was found by measuring the direction of the bands on polished and etched sections parallel to various faces. In the meteorites examined the Neumann bands were found to lie on {112} planes.

Direct evidence that the material within the bands is in twin orientation with respect to the matrix was obtained by examination of the figures produced by etching with copper ammonium chloride. This etchant in dilute solution produced very beautiful flat-bottomed etching figures (negative crystals), bounded by rhombic-dodecahedral planes, whereas dilute nitric acid produced long ridges and troughs with {100} planes on their sides. The simplest way of deciding whether the twin relationship exists between the orientation of a band and that in the adjacent matrix is to make a section of the material perpendicular to the {112} plane, to which the band is parallel, and to compare the pits produced simultaneously on band and matrix. In such a case the twin relationship is demonstrated by the fact that the etch-pits in the band are mirror images of those in the matrix.

Some difficulty was experienced in photographing the pits because of the different focus required to show the symmetrical contour and the facets, but, despite this difficulty, some very conclusive photographs at high magnification (× 1680) were obtained by selecting an intermediate focus. Etch-pits in a number of bands and in the adjacent matrix were examined and photographed, and by this means the twin relationship was established. The movement involved in the formation of Neumann bands was determined from the displacement produced when the track of one band was crossed by another formed at a later time.

University and Educational Intelligence.

CAMBRIDGE.—The prize of £30 from the Gordon Wigan income for physics and chemistry for a research in chemistry has been awarded to J. G. A. Griffiths, of Emmanuel College, for an investigation on the photochemical decomposition of glyoxal.

Two noteworthy contributions to the subject of medical education have recently been published. One was the eleventh series of "Methods and Problems of Medical Education," issued by the Rockefeller Foundation, N.Y., dealing for the most part with special departments (eye, nose, children, etc.) of hospitals and universities in the United States and Europe, their construction and organisation. The second was a special Supplement to the *Lancet* (Jan. 5), containing a review on medical education in the United States and Canada by the editor, Sir Squire Sprigge. He makes no attempt to formulate conclusions, but directs attention to two fundamental divergencies worthy of further inquiry. In Great Britain the tendency is to divorce the hospital from the university and to regard the former only as an adjunct to university education, but in America and Canada the medical school is an integral part of the university, which controls the teaching given in the hospital.

IN the Departments of Textile Industries and Colour Chemistry and Dyeing of the University of Leeds, the progress of research work has been stimulated by a recent grant of £3000 a year for four years by the Clothworkers' Company of the City of London, enabling the University to institute a lectureship in textile physics and two assistantships and eight fellowships and scholarships for graduate students. With the same object in view the University has conceded to selected research workers attached to the laboratories at Torridon of the British Research Association for the Woollen and Worsted Industries, the privilege of reading for higher degrees at the University. These developments have quickly borne fruit: the number of graduate workers in the Department of Textile Industries being nearly three times what it was last session. There are also 80 per cent more full-time students and 13 degree students as against 5. Several lines of research in this Department are, says the Report for 1927–28, converging to give an interpretation of the molecular structure of wool. These are: physico-chemical research on the gel structure of the wool fibre, a survey of the elastic properties of a number of wools at various humidities and temperatures up to 100° C., and investigations of the plasticity of wool, and the dependence of rigidity on relative humidity.

Calendar of Patent Records.

February 16, 1807.—A patent was granted to Charles, third Earl Stanhope, on Feb. 16, 1807, for a construction of ship that would withstand submarine bombs and similar attacks. Lord Stanhope was the friend of Robert Fulton, and was partly responsible for Fulton being called to England from France during the Napoleonic wars to demonstrate the possibilities of his submarine boat for war purposes.

February 16, 1904.—The 'stepney wheel,' the first successful solution to the puncture problem of the modern motor-car, was invented by Thomas and Walter Davies, and patented by them on Feb. 16, 1904. The name of the wheel was derived from the address of the inventors, Stepney Street, Llanelly.

February 20, 1806.—The first canal lift as a substitute for the ordinary lock was erected at Tardebigge, near Bromsgrove, on the Worcester and Birmingham Canal. It was the invention of John Woodhouse and was patented by him on Feb. 20, 1806. The lift consisted of a wooden tank 72 ft. long, 8 ft. wide, and 4½ ft. deep, which was hung on a series of chains passing over cast-iron wheels 13 ft. in diameter. The tank weighed 64 tons when filled with water and was counterbalanced by masses of brickwork on timber platforms hanging from the other ends of the chains. It is said that the lift could be raised or lowered by two men in three minutes. The arrangement soon, however, fell into disuse and has since been replaced by a long flight of locks. A few other such lifts were erected, but did not survive long, and the lift system did not become successful until hydraulic operation was introduced about 1870.

February 22, 1904.—The 'thermos flask' was introduced under the English patent of Reinhold Burger of Berlin, which was dated Feb. 22, 1904. The invention consisted simply in the commercial adaptation of the heat-insulated vessel employed for the first time some ten years earlier by Sir James Dewar in his scientific work on the liquefaction of gases, and the validity of the patent was challenged successfully in the Courts. No German patent was granted, but a *gebrauchsmuster* for the design had been obtained in 1902.

February 24, 1839.—The first patent to mention sulphur in connexion with the treatment of india-rubber was that granted in the United States to Nathaniel Hayward for the "combining of sulphur with gum elastic either in solution or in substance," on Feb. 24, 1839. The patent was applied for at the instigation of, and was afterwards assigned to, Charles Goodyear, who later on in the same year discovered the process of vulcanisation, though he did not obtain his patent for the invention until 1844, a few months after Thomas Hancock, who had been working in the same field, obtained an English patent.

February 24, 1881.—Among the early systems of electric traction for street railways was that known as the surface-contact system, in which studs arranged at intervals along the track were normally disconnected from the electric supply mains and were only brought into the circuit when in actual contact with the current collector on a tramcar. The first patent for this system was granted to Profs. Ayrton and Perry on Feb. 24, 1881, two months before the first commercial electric tramway (using both running rails as conductors) was opened near Berlin. The surface-contact system has been tried in various towns in Great Britain, but was never entirely satisfactory and has been superseded by the overhead system.

Societies and Academies.

LONDON.

Mineralogical Society, Jan. 15.—**A. Holmes** and **H. F. Harwood**: The tholeiite dikes of the north of England. These dikes, bounded on the north by the Acklington dike and on the south by the Cleveland dike, form an outlying part of the Mull swarm. To the Salen, Brunton, and Talaidh types, already recognised in Mull, the authors add Cleveland and Acklington types, and anorthite-bearing varieties of each. Chemical and mineral analyses are presented, and from a comparative study of the evidence it is shown that there are many features in the series as a whole which are not in accordance with the theory of crystallisation-differentiation.—**A. Russell**: On the occurrence of gold at Hope's Nose, Torquay, Devonshire. A detailed description of a remarkable occurrence of crystallised arborescent gold in calcite, in Middle Devonian limestone at Hope's Nose, where it was discovered by Prof. W. T. Gordon in 1922. Specimens have since been obtained from five distinct veins. The gold varies in colour from a bright rich gold to almost silver-white, and has a silver content of only 1·89-8·41 per cent.—**H. E. Buckley**: Crystallography of some organic compounds. Collected records of goniometric measurements on crystals of various organic compounds.

Linnean Society, Jan. 17.—**G. Enderlein**: The Copeognatha of the Seychelles. Particular attention was devoted to the booklice and allied insects in 1908, and forty-seven species, belonging to twenty-seven genera, were collected. Six families are represented, and the scaly-winged forms (Lepidopsocidæ) account for more than half the species. The abundance of Copeognatha was a feature of insect life in the Seychelles. They were collected mainly by sweeping and beating foliage in the native forests at 1000-2000 feet above sea-level, but some were taken also among non-endemic vegetation at lower levels. Ethiopian elements seem to predominate, although many groups of Seychelles insects are largely Eastern in origin.—**S. Maulik**: Chrysomelid Coleoptera of the subfamilies Eumolpinæ, Galerucinæ, and Halticinæ from the Seychelles and other islands of the western Indian Ocean. There are sixteen species, fifteen being described as new, distributed among nine genera, four of which are new to science. Twelve species were found only in the Seychelles, one in both the Seychelles and Aldabra, two in Aldabra only, and one in the Farquhar Group. The material, as a whole, indicates an endemic element in the Seychelles fauna, with some Austro-Malayan affinities, also certain forms which have probably been imported; while the relationships of the Aldabran species are with Madagascar and Africa.—**A. B. Rendle**: A remarkable West Australian subterranean orchid recently described by Dr. R. S. Rogers. The plant consists of an underground rootless rhizome in symbiotic relationship with a fungus which closely invests the decayed roots of *Melaleuca uncinata* R. Br. It lives about a foot below the surface of the ground. The flowers are borne in a dense head surrounded by an involucre of bracts which grows apparently towards the surface. The inflorescence, which suggests the capitulum of a Composite, reaches about three inches across. It is placed by Dr. Rogers in a new sub-tribe, to come next to Gastrodiinæ.—**F. E. Lloyd**: The resistance of the door of the *Utricularia* trap to water-pressure. The trap is not only self-setting, but also, if uninjured, remains permanently in the set condition, as the result of negative pressure of

water within it. The maintenance of the negative pressure depends upon the efficiency of the door. The upper surface of the threshold of the door has a peculiar epithelium of soft thick-walled compact cells forming a smooth mosaic. Across this the lower door-edge glides outwardly in resuming its normal position after the trap is sprung. But the outer two cell-rows of this tissue grow out to form a membrane providing a sort of pocket in which the middle portion of the door-edge rests, effectively closing the rift between the door-edge and the edge of the threshold against which it rests.

Optical Society, Jan. 17.—**E. F. Fincham**: The function of the lens capsule in the accommodation of the eye. The form of the anterior surface of the lenses of freshly dead animals is determined by making photographic records of the image reflected from the surface. The results show that in primates the anterior surface of the lens assumes a somewhat conical form with an area of increased curvature in the centre, when the suspensions are severed. The capsule of the primate lens has a zone of increased thickness surrounding a central thin area. The anterior lens capsule of animals of an order lower than the primates is approximately uniform in thickness, and the removal of the capsule does not cause an appreciable change in the form of the lens. The theory is formulated that accommodation consists of a relaxation of tension upon the lens by the contraction of the ciliary muscle as stated by Helmholtz. This relaxation allows the capsule to press upon the lens substance and mould it into the accommodated form. The unaccommodated lens substance is therefore in its unrestricted or natural form and not under compression as supposed in the Helmholtz theory.—**D. S. Perfect**: A double reflection level. The level was designed to assist the initial levelling of a floating system and to enable observations to be made on the constancy of level over extended periods of time. Its error may be determined by direct measurement and without reversal.—**T. Smith, J. S. Anderson, and L. C. Cordle**: Photographs of reflection caustics. Caustics formed by reflection at the surfaces of a photographic lens are described.

EDINBURGH.

Royal Society, Jan. 21.—**R. B. Mooney and E. B. Ludlam**: The thermal equilibrium between ethylene, iodine, and ethylene di-iodide. The pressure of ethylene in equilibrium with a mixture of solid iodine and solid ethylene di-iodide was measured by means of a glass-spring manometer. Observations were made at temperatures between 10° C. and 65° C. The vapour pressure of undissociated ethylene di-iodide was determined at four temperatures within the same range by the gas stream method.—**E. B. Ludlam, H. G. Reid, and W. B. Soutar**: The flame of chlorine burning in hydrogen. The flame consists of a livid white inner cone ascribed to the re-combination of dissociated chlorine atoms, and an outer blue zone which gives a band spectrum in the violet and near ultra-violet. This spectrum is provisionally regarded as due to the hydrogen chloride molecule (see NATURE, Jan. 19, p. 86).—**R. W. Armour and E. B. Ludlam**: The photochemical equilibrium between hydrogen, bromine, and hydrogen bromide. Light of very short wave-length (185 $\mu\mu$) should have a slight effect in causing the formation of hydrogen bromide from its elements. Using the aluminium spark as a source of light, at equilibrium the partial pressure of the hydrogen bromide is slightly less than 2 per cent that of the bromine. The absorption coefficient of bromine has also been measured in the ultra-violet region 254 $\mu\mu$-185 $\mu\mu$ by means of a photo-electric cell; bromine is less opaque in this region than was previously supposed.—**W. W. Taylor**: (1) The lyotrope effect and the antagonistic action of ions. The lyotrope effect is well shown in the precipitation of ferric hydroxide sol by neutral salts, although the concentrations are very small. No antagonistic action is shown by Li and Mg, or by K and Ca; the effect is *additive*. ClO_3' and SO_4'' show the opposite effect of *adjuvant* action which amounts to 50 per cent. The opalescence-temperature of a phenol-water system is affected lyotropically by equivalent solutions of salts (both for cations and anions). The lyotrope effect seems to be an expression of the water-binding power of the salt.—(2) Demonstration of a new method of determining 'free' and 'bound' water. The method follows from the above experiments on the effect of solutions on the opalescence-temperatures of a phenol-water system. Opalescence-temperatures are determined, and from these data the ratio of 'free' to 'bound' water can be ascertained, the assumption being made that the 'free' water of the solution is alone effective in this respect.—**W. O. Kermack, A. G. McKendrick, and E. Ponder**: The stability of suspensions. (3) The velocities of sedimentation and of cataphoresis of suspensions in a viscous fluid. A theoretical investigation confirmed by experiments on the sedimentation of red blood cells in the Goughian or spherical form. In both sedimentation and cataphoresis the velocity of any particular particle is retarded as the result of the presence of the other particles, so that the velocity of a particle in a suspension is less than that of an isolated particle. When a cloud of particles is subjected to cataphoresis, the rear boundary tends to be sharply defined and the front to become more and more diffuse. The reason for this is that if an isolated particle happens by chance to lag behind the general swarm, its speed is accelerated, and so it tends to make up on the others, whereas if it happens to take up a position in advance of the general swarm, the acceleration which it experiences carries it still farther ahead.

PARIS.

Academy of Sciences, Jan. 14.—**L. Lecornu**: The Clapeyron cycle.—**Maurice Fréchet**: Probable convergence.—**Mme. M. Piazzolla-Beloch**: Surfaces of the third order possessing curves with linked branches.—**S. Rossinski**: A class of couples of stratifiable rectilinear congruences.—**Radu Badesco**: A generalised Abel integral equation.—**Srivastava**: The singularities of a class of series of Dirichlet.—**B. Gagaeff**: The unicity of a system of orthogonal functions invariant relatively to the differentiation.—**Alex. Froda**: The maxima and minima of uniform functions of real variables.—**Z. Horak**: The principles of a general theory of shock.—**J. Le Roux**: A general property of the movement of a system of material points.—**J. Kampé de Fériet**: The connexion between the absence of negative pressures and the sense of the concavity of the stream lines in the plane movement of an incompressible fluid round an obstacle.—**E. Baticle**: The curving of grooved elliptical arches.—**Mesnager**: Remarks on the note of M. Baticle.—**H. Mineur**: The rotation of the galaxy. A different result from those of Oort and of Plaskett is obtained, and the cause of this is discussed.—**Mario Bossolasco**: The ellipticity of the terrestrial equator.—**A. Guillet**: The photographic registration of an angular velocity. Application to ballistic measurements.—**L. Brillouin**: The electronic theory of metals, according to Sommerfeld, and the mean free path of the electrons.—**M. Ponte**: The diffraction of the electrons by crystalline powders. Electronic analysis.—**Marcel Cau**: The

double refraction and dichroism of thin layers of iron obtained by distillation.—**Jean Cabannes**: The secondary radiations in the light diffused by quartz.—**Maurice Lambrey**: The ultra-violet absorption spectrum of nitrogen peroxide.—**Nathaniel Thon**: The electromotive potential and electrokinetic potential of graphite.—**M. and Mme. Lemarchand**: The application of the law of mass action to double decompositions of salts.—**H. Swietoslawski**: A new application of the differential ebullioscope. The apparatus described in an earlier communication can be applied with advantage to distinguish between a pure substance and an azeotropic mixture.—**Mlle. Germaine Marchal**: The action of silica and alumina on sodium sulphate. The decomposition of sodium sulphate at high temperatures, up to 1300° C., is accelerated by the addition of silica or alumina.—**R. Levaillant**: Neutral isopropyl sulphate and normal propyl sulphate—**P. Fallot**: The structure of the sub-Betic zone between Moratalla and the Betic zone.—**Porchet**: A method for the determination of the base of a subterranean sheet by observations of the variations of its free surface.—**Mlle. Panca Eftimiu**: The karyokinesis of *Spathularia flavida*.—**Edouard Papin**: The vesico-uteral reflex.—**Charles Pérez**: Sexual differences in the ornamentation and in the pigmentary system in *Macropodia rostrata*.—**Edouard Chatton, Mme. Marguerite Lwoff, and André Lwoff**: The prepalintomic and metapalintomic metamorphoses of the Fœttingeriidæ (ciliated).—**Mme. Phisalix and F. Pasteur**: The action of the ultra-violet rays on the virus of rabies and its rabic and poisonous antigens.—**A. Policard, S. Doubrow, and D. Pillet**: Histochemical researches on pulmonary anthracosis. Results obtained by the application of the method of microincineration to sections of lung tissue.—**R. Leriche and R. Fontaine**: The rôle of the left stellated ganglion in the determination of the crisis of angina pectoris.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—**L. Lombardi and P. Lombardi**: Measurement of the local dissipations of energy within a circumscribed part of the magnetic circuit (3). The method and apparatus previously described are found to be applicable to the measurement, with sufficient approximation, of the losses of power in a circumscribed portion of the magnetic circuit, even if these do not exceed a few watts, provided that there are available an electro-dynamometer of convenient sensitiveness, a condenser affected by slight retardation of polarisation, and a source of electromotive force approaching the sinusoid form or reactance capable of rendering the form of the magnetising current approximately sinusoid. Failure of the last condition introduces into the numerical interpretation of the measurement an error which increases with the saturation, not unlike that with which ordinary wattometric methods would be affected if the loss were referred to the maximum values of the induction in the absence of exact knowledge of the form factor of the tension applied.—**T. Boggio**: Three dimensional space curves and Ricci's homograph.—**Maria Pastori**: Commutation formulæ in the derivation of tensors. The existence is demonstrated of a general commutation formula of covariant (or intrinsic) derivatives of higher order, including, as a particular case, the known formula for the second derivatives.—**H. Geppert**: The adiabatic invariants of a differential generic system (2).—**W. Slebodzinski**: Deformations in a variety of constant curvature.—**G. Sansone**: Determination of the number of the congruences $x^2+ax+a=0$ (mod. p) having three roots with the same quadratic character modulus p.—**J. Kanitani**: A geometrical interpretation of the linear projective element of the hypersurface.—**B. Finzi**: Kutta-Joukowski's theorem. Signorini's recent demonstration of Kutta-Joukowski's theorem does not remove the exceptional case pointed out by Cisotti, which is now shown to be subordinate to the conditions of regularity at the contour.—**P. Emanuelli**: Non-central total eclipses of the sun. Of the nineteen eclipses of this type occurring between 1200 B.C. and A.D. 2100, five take place in the northern and fourteen in the southern regions, eight at the beginning and eleven at the end of the second series. In every case, with the exception of that of 261 B.C., the non-central total eclipse is either preceded by a central and followed by a partial eclipse, or preceded by a partial and followed by a central eclipse. The conditions of the nineteen eclipses are discussed.—**B. Rossi**: The distribution of electricity in conductors immersed in a homogeneous anisotropic medium. It has been shown recently that the distribution of electricity on a conducting ellipsoid immersed in an indefinite homogeneous anisotropic dielectric is independent of the dielectric homograph of the medium and coincides with that exhibited when the dielectric is isotropic. It is now found that the distribution of electricity on the surface of a conductor is not dependent on the dielectric homograph of the medium (supposed homogeneous) only when the conductor itself has the form of an ellipsoid (or, in particular, a sphere) and when other conductors are absent from the field.—**G. Gentile and E. Majorana**: The separation of the Röntgen and optical terms owing to the spinning electron, and the intensity of the cæsium lines. Fermi's potential not only permits a good *a priori* determination of all the energy levels of heavy atoms, but, given the statistical character of this theory of the atom, also allows of very exact calculation of the separation of the terms.—**L. Fernandes**: Thio-salts (7). Polythiovanadates. The author's investigations on complex thio-salts, especially on thioaquates, are extended to the products of the polymerisation of the thiovanadates; various ammonium, guanidine, and thallium salts are described.—**A. Ferrari and A. Inganni**: The importance of the crystalline form in the formation of solid solutions (3). Thermal analysis of the anhydrous systems: $MnCl_2-CoCl_2$, $CdCl_2-CoCl_2$, and $MgCl_2-CoCl_2$. These three systems exhibit miscibility in the solid state in all proportions of the components. The curves showing the temperatures at which solidification begins present neither maxima nor minima.—**E. Onorato**: The sulphur deposit of Monte Solforoso, near Scrofano, in the province of Rome.—**Enrico Clerici**: Applicability of isopyknomeric analysis to auriferous rocks. Observations made on auriferous rocks of various origins show that the presence of native gold, even in as small a proportion as 0·5 gram per ton, may be rapidly detected by means of isopyknomeric analysis.—**M. Comel**: Analysis of the oxygen absorption curve of muscle pulp as a function of the hydrogen ion concentration. Further investigations on the gaseous metabolism of frog muscle pulp in equilibrating phosphate solutions yield an oxygen absorption curve indicating three zones of gaseous metabolism, delimited by two points of inflection, the first corresponding with values of pH grouped about the neutrality point and extending, on the acid side, to the value 6·6. As lower values of pH are reached, the metabolism exhibits considerable diminution, the zone between 6·6 and 6·0 being one of medium metabolism, which ends in conditions approximating to physiological conditions. For values below 6·0, metabolism rapidly falls and becomes zero at 5·3, muscular proteins ceasing to absorb oxygen in the neighbourhood of their isoelectric point.—**L. De Caro**: Energy of growth of *Sterigmatocistis Nigra*. The

'energy of preservation' of this organism is measured directly by determining the carbon dioxide developed by the mycelium when it is transferred to a nutrient liquid devoid of phosphate. The lack of phosphate inhibits further growth, so that the carbon dioxide liberated under these conditions expresses the consumption of energy inherent to the preservation of life in the cells formed. This energy from the commencement of its formation to the 72nd hour, amounts to 1·407 Calories. Knowledge of this value allows of the calculation of the real energy of growth, which is somewhat greater than that calculated on different lines for *Aspergillus niger* by Terroine and Würmser, and is of the same order of magnitude as the energy of growth in the development of the egg.

VIENNA.

Academy of Sciences, Nov. 2.—E. A. W. Schmidt: The half-period of radium-D. About twenty-five years.

Nov. 8.—L. Moser and K. Schutt: Determination and separation of rare metals from other metals. (12) Separation of lithium from potassium, sodium, and magnesium. Better than the fluoride and phosphate methods are those which depend on the solubility of dry lithium chloride in water-free organic solvents such as iso-butyl alcohol. Lithium is separated from magnesium by precipitating the magnesium by *o*-oxy-quinoline.—E. Heinricher: Anomalous blossoms of the crown-imperial (*Fritillaria imperialis*). One race is sexually sterile, another race is sexually fertile but self-sterile.

Diary of Societies.

FRIDAY, FEBRUARY 15.

GEOLOGICAL SOCIETY OF LONDON, at 3.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Geophysical Methods in Surveying. Chairman: Sir Gerald Lenox-Conyngham. Speakers: Mr. Broughton-Hedge, Dr. W. F. P. McLintock, and others.

BRITISH INSTITUTE OF RADIOLOGY (Medical Members), at 5.—Informal Discussion on Chest.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. A. Harris: Bone Growth in Health and Disease.

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6.—H. J. Ward: Refrigeration on Shipboard.

INSTITUTE OF TRANSPORT (at Midland Hotel, Manchester), at 6.30.—C. D. Campbell: Inland Water Transport.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section, jointly with Manchester Section of Oil and Colour Chemists' Association) (at Literary and Philosophical Society, Manchester), at 7.—F. Scholefield: The Ostwald Colour System.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Discussion on the Stephan H. Tyng Foundation Prints.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with all Glasgow Chemical Societies) (at 207 Bath Street, Glasgow), at 7.30.—Prof. G. T. Morgan: Chemical Studies of Coal-Tar Products.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. G. Ritchie: Steam Storage.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Prof. J. Heyman: The Uses of Radium in the Treatment of Malignant Disease of the Uterus and Ovaries.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Discussion on Chronic Rheumatism of Joints and Muscles: Diagnosis and Treatment.—Opening Papers:—Dr. D. D. Maplas: Radiological Diagnosis; Dr. C. W. Buckley: Spa Electro-therapy; Dr. F. D. Howitt: Electro-therapy.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. E. K. Rideal: Chemiluminescence.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—Dr. E. G. Richardson: Modern Aerofoil Experiments (Lecture).

SATURDAY, FEBRUARY 16.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Beverley), at 11.15.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (at Newcastle-upon-Tyne), at 2.30.—L. H. Forster: The Lubrication of Colliery Coal Tubs.

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, University, Birmingham), at 3.—J. C. Bramwell and R. Ellis: The Crescendo Murmur in Mitral Stenosis.—Lilian M. Pickford and Dr. E. B. Verney: Renal Adaptation.—Prof. J. Barcroft and H. Florey: Comparison of Vascular Changes in Spleen and in Small Intestine.—W. V. Thorpe: A Vasodilator Substance in Heart Muscle.—I. de Burgh Daly: An Attempt to Measure the Blood Capacity of the Pulmonary Capillaries.—Demonstrations:—W. V. Thorpe: (*a*) Small Hot-Funnels; (*b*) Small Tissue Press.—J. C. Brash: Specimens from Madder Fed Animals Illustrating Bone Growth.—H. M. Fox: Constant Pressure Apparatus for Recording the O_2 Intake of Small Animals Adapted for Class Purposes.—D. L. Gunn: Apparatus for Studying the Reactions of Insects to Temperature and Humidity Changes.—I. de Burgh Daly: (*a*) A Simple Arrangement for Making the Closed Circuit Heart Lung Preparation under Negative Pressure Ventilation; (*b*) A Model Illustrating some of the Effects of Respiration upon the Pulmonary Blood Vessels.—W. R. McRobert: Siderosis of the Spleen in the Resting and Exhausted Rat.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Bullock: Music in Cathedral and Collegiate Churches (II.).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—J. C. Flugel and Miss Eve Macaulay: The Psychology of Clothes in Adults and Children: Some Results by the Questionnaire Method.

EUGENICS SOCIETY (at Rembrandt Hotel, Brompton Road), at 7.15.—Major L. Darwin: The Coming of Age of the Eugenics Society (Galton Lecture).

MONDAY, FEBRUARY 18.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Lieut.-Col. T. C. Skinner: The Ice Age: its Astronomical Cause and the Bearing of Drayson's Discovery on the Biblical Account of the Deluge.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 6.30.—G. Bird: Railway Brakes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. L. Morrison and others: Discussion on Modern High Power Rectifiers; their Development and Use.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (jointly with Society of Public Analysts—North of England Section) (at Great Northern Hotel, Leeds), at 7.15.—C. H. Manley and others: Discussion on The Preservatives Regulations, 1925-1927.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—P. E. King: Artificial Silk: its Expansion in the Textile Industries (Lecture).

HUDDERSFIELD TEXTILE SOCIETY (jointly with Huddersfield Engineering Society) (at Huddersfield Technical College), at 7.30.—Dr. W. Hatfield: The Application of the Special Acid Resisting Steels to the Textile Industry.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—H. K. Thomas: Some Investigations into the Performance of Tubular Radiators for Motor Vehicles.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. A. Gotch: Modern Banks, with Special Reference to the New Midland Bank Head Office.

ROYAL SOCIETY OF ARTS, at 8.—Sir Thomas M. Legge: Thirty Years' Experience of Industrial Maladies (Shaw Lectures) (I.).

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (and Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 8.—S. D. Forrester: Potentiometric Bromination of Naphthol Sulphonic Acids.—J. G. Mackay: The Estimation of Sulphur in Rubber.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—G. Binney: Hudson Bay in 1928.

TUESDAY, FEBRUARY 19.

ELECTRICAL ASSOCIATION FOR WOMEN (at 159 Great Portland Street), at 3.—The Construction, Use, and Maintenance of Electric Sewing Machines.

ROYAL DUBLIN SOCIETY (in Science Room, Ball's Bridge, Dublin), at 4.15.—Prof. F. E. Hackett and others: Discussion on The Changing Outlook on Physical Science.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: Evolution and the Problem of Species (IV.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Dr. A. B. Hill: The Investigation of Sickness in Various Industrial Occupations.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the Month of January 1929.—Lieut.-Col. A. E. Hamerton: Report on the Deaths occurring in the Society's Gardens during 1928.—Lilian Russell: The Comparative Morphology of the Elysioid and Æolidioid Types of the Molluscan Nervous System and its Bearing on the Relationships of the Ascoglossan Nudibranchs.—Dr. M. Evans: Some Notes on the Anatomy of the Electric Eel, *Gymnotus electrophorus*, with Special Reference to a Mouth-breathing Organ and the Swim-bladder.—C. B. Kloss: Some Remarks on the Gibbons, with the Description of a New Subspecies.—B. N. Schwanwitsch: Studies on the Wing-pattern of *Cotagramma* and Related Genera of South American Nymphalid Butterflies.—Jnanendra Lal Bhaduri: The Persistence of a Left Posterior Cardinal Vein and the Presence of an Abnormal Vein opening into the Isthmus of the Liver in an Indian Toad.—Dr. G. D. Hale Carpenter: Further Notes on the Fauna of Nkosi Island, Lake Victoria.

INSTITUTION OF CIVIL ENGINEERS, at 6.—A. H. Barker: The Electrical Heating and Ventilation of Bourne and Hollingsworth's Premises, Oxford Street.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—L. G. Payne, E. B. Bishop, and others: Debate: Are the Artificial Introduction of New Species and the Formation of New Localities for Existing Species of the British Flora Justifiable?

ILLUMINATING ENGINEERING SOCIETY (in Lecture Theatre, Home Office Industrial Museum, Horseferry Road), at 6.45.—Discussion on Various Problems in Illuminating Engineering:—S. G. Elliott: The Lighting of the New Piccadilly Underground Station.—E. Stroud: The Lighting of the Royal Horticultural Hall.—G. Herbert: The Lighting of a New Factory in London with over 1000 Units.—R. A. Ives: The Lighting of the Wembley Kinema Theatre.—L. E. Buckell: An Example of Daylight Effects obtained with Artificial Light.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—W. Cruickshank: Voice-Frequency Telegraphs.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—E. C. Evans: Fuel.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.30.—L. B. Atkinson: How Electricity does Things (Faraday Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—H. K. Thomas: Some Investigations into the Performance of Tubular Radiators for Motor Vehicles.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester College of Technology).—Dyeing (Lecture).

WEDNESDAY, FEBRUARY 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.—L. H. G. Dines: The Baker Automatic Release for Dropping the Meteorograph from a Registering Balloon at a Predetermined Height.—C. K. M. Douglas: Some Aspects of Surfaces of Discontinuity.—Dr. E. Kidson and H. M. Treloar: The Rate of Ascent of Pilot Balloons at Melbourne.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. A. Matley: The Basal Complex of Jamaica, with Special Reference to the Kingston District, with Petrological Notes by F. Higham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 6.—G. E. W. Herbert: In and Out of Bruges.

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

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: Some Unusual Aspects of Combustion in Engines and Boilers.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates) (at Queen's Hotel, Birmingham), at 7.30.—E. M. Frank: Valve Gear for High-speed Singles.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (jointly with Society of Dyers and Colourists) (at University College, Nottingham), at 7.30.—A. Stowers: Steam Storage as an Aid to Economy in the Dye-House.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Lt.-Col. K. Edgcumbe: Address.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (at Glasgow University), at 7.30.—Prof. Kendall: The Abuse of Water.

ROYAL SOCIETY OF ARTS, at 8.—J. Morton: History of the Development of Fast Dyeing and Dyes.

FOLK-LORE SOCIETY (Annual Meeting) (at University College), at 8.—Prof. R. M. Dawkins: Folk-Lore and Literature (Presidential Address).

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. R. G. Canti and F. G. Spear: Some Effects of Radium on Cell Division *in vitro*.—S. F. Fox: Some Effects of X-Rays on Cell Division *in vitro*.—F. G. Spear: An Effect of Low Temperature on Cell Division *in vitro*.—Demonstrations:—S. F. Cox: The Effect of a Heavy Dose of X-Rays on Living Cells as shown by the Dark-Ground Method.—Dr. R. G. Canti: Demonstration of Cell Division in the Living Tissues cultivated *in vitro*.

HASLINGDEN TEXTILE SOCIETY.—J. W. Pennington: The Position of Artificial Silk in Relation to the Cotton Industry.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—P. Kapitza: The Change in Electrical Conductivity in Strong Electric Fields. Parts I. and II.—R. R. Nimmo and N. Feather: An Investigation of the Ranges of the Long Range α-Particles from Thorium C and Radium C using an Expansion Chamber.—C. R. Burch: Some Experiments on Vacuum Distillation.—*To be read in title only*:—Prof. E. C. C. Baly and N. R. Hood: The Photosynthesis of Naturally Occurring Compounds (IV.).—R. Alty and B. W. Currie: Adsorption at a Water Surface (I.).—W. G. Palmer: Some Adsorption Isothermals for a Plane Platinum Surface.—B. Lambert and A. M. Clark: Studies in Gas-Solid Equilibria.—G. C. Laurence: Relative Velocities of the Alpha-Particles emitted by certain Radioactive Elements.—H. W. Thomson and C. N. Hinshelwood: The Mechanism of the Homogeneous Combination of Hydrogen and Oxygen.—E. G. Dymond and E. E. Watson: Electron Scattering in Helium.—E. T. Hanson: Diffraction and Resonance.—S. Goldstein: (*a*) The Forces on a Solid Body Moving through Viscous Fluid; (*b*) The Steady Flow of Viscous Fluid past a Fixed Spherical Obstacle at Small Reynolds Numbers.—J. Taylor: On the Chemical Interaction of Ions and the 'Clean up' of Gases at Glass Surfaces under the Influence of the Electrical Discharge.—L. Hartshorn and D. A. Oliver: On the Measurements of the Dielectric Constants of Liquids, with a Determination of the Dielectric Constant of Benzene.—J. W. Fisher: The Wave Equation in Five Dimensions.—Prof. H. M. Macdonald: The Total Reflexion of Electric Waves at the Interface between two Media.—K. Lonsdale: The Structure of the Benzene Ring in $C_6(CH_3)_6$.—Dr. E. Griffiths and J. H. Awbery: Measurements of Flame Temperatures.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. O. Rankine: Physics in Relation to Oil Finding (I.).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.—Prof. W. N. Haworth: Recent Views on the Structure of Cellulose and Starch.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates) (at Watergate House, Adelphi), at 7.25.—C. Russell: Some Notes on Gear Production.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—Dr. K. Ott: The Erection of the Mechanical and Electrical Part of the Shannon Scheme.

CHEMICAL SOCIETY, at 8.—Dr. R. G. W. Norrish: (*a*) Photochemical Equilibrium in Nitrogen Peroxide. Part II. The Dependence of Quantum Efficiency on Wave Length. (*b*) Part III. A Comparison of the Thermal, Photochemical, and Electrical Decompositions, and a General Theory of the Change. (c) Part IV. Fluorescence and Photochemical Activity.—A. T. Dann and W. Davies: The Reactions of Nitrosulphonylchlorides. Part I. The Reaction of Hydrazine Hydrate with *o*-nitrosulphonyl Chlorides.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. L. W. Hackett: Malaria-Control through Anti-Mosquito Measures in Italy.

INSTITUTION OF MECHANICAL ENGINEERS (Midland Branch) (at Birmingham).—Chairman's Address.

FRIDAY, FEBRUARY 22.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.—Dr. F. A. Freeth: The Qualifications of an Industrial Chemist.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—L. F. Stanley: The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua.—Prof. C. H. Lees: The Free Periods of a Composite Elastic Column or Composite Stretched Wire.—Dr. A. Ferguson and J. A. Hakes: A Capillary Tube Method for the Simultaneous Determination of Surface Tension and of Density.—Demonstration of a Standard Electrostatic Voltmeter and Wattmeter, used for Measurements of Alternating Currents at Power Frequencies at the National Physical Laboratory, by Dr. E. H. Rayner.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. G. W. Todd: The Relation between the Properties of Engineering Materials and their Ultimate Structures.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) (jointly with Institutions of Civil and Mechanical Engineers), at 6.15.—W. Ford: Standardisation.

ROYAL AERONAUTICAL SOCIETY (Students' Section), at 6.30.—L. T. Brown: The Napier Lion Engine.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—G. Baker: Electrical Precipitation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—G. C. Weston: Enlarging.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Dr. W. H. Hatfield: The Response of Steels at Elevated Temperatures.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7.30.—W. A. Walsh: Some Recent Improvements in Textile Machinery (Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Calderwood: The Application of the Heavy Oil Engine to Yachts and Small Craft.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Surg.-Comdr. S. F. Dudley: Human Adaptation to the Parasitic Environment.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. F. A. Bather: Lily-Stars of the Sea: How they fit their Surroundings.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).

TODMORDEN TEXTILE SOCIETY.—S. Taylor: Winding and Warping (Lecture).

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Bullock: Music in Cathedral and Collegiate Churches (III.).

PUBLIC LECTURES.

FRIDAY, FEBRUARY 15.

LONDON SCHOOL OF ECONOMICS, at 5.—C. E. R. Sherrington: Motor Transport and Urbanisation of the Countryside.

SURVEYORS' INSTITUTION, at 5.30.—G. Atkinson: Salvaging the Fleet at Scapa Flow (Lecture in connexion with the Institution of Professional Civil Servants).

SATURDAY, FEBRUARY 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Travel and Travellers in the Middle Ages.

MONDAY, FEBRUARY 18.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.15.—J. A. Spender: America and British-American Relations.

KING'S COLLEGE, at 5.30.—Prof. R. R. Gates: Botanical and Anthropological Explorations in the Canadian Arctic.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. N. M. Comber: Soil Problems.

TUESDAY, FEBRUARY 19.

BIRKBECK COLLEGE, at 5.30.—Sir Charles Oman: The History of the Coinage of England. (Succeeding Lectures on Feb. 26 and Mar. 5.)

UNIVERSITY COLLEGE, at 5.30.—Prof. Ethel M. Elderton: Growth Curves in Women from Childhood to Old Age.

UNIVERSITY OF LEEDS, at 8.—Prof. W. E. Soothill: China's Contribution to Western Civilisation.

WEDNESDAY, FEBRUARY 20.

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—L. Emanueli: High Voltage Cables. (Succeeding Lectures on Feb. 22, 26, Mar. 1 and 5.)

THURSDAY, FEBRUARY 21.

EAST LONDON COLLEGE, at 5.30.—Dr. C. H. Lander: The Burning of Fuel: Solid, Liquid, and Gaseous.

UNIVERSITY COLLEGE, at 6.—Col. G. S. C. Cooke: The Ordnance Survey—its Work and Maps.

FRIDAY, FEBRUARY 22.

LONDON SCHOOL OF ECONOMICS, at 5.—C. E. R. Sherrington: Air Transport and the Disintegration of Economic Barriers.

UNIVERSITY COLLEGE, at 5.30.—Dr. J. H. Jones: Hygiene of the Mercantile Marine. (Succeeding Lectures on Mar. 1 and 8.)

SATURDAY, FEBRUARY 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. Barnard Smith: Zermatt and its Glaciers.

EXHIBITION.

FEBRUARY 19 TO MARCH 16.

UNIVERSITY COLLEGE.—Exhibition of Recent Work in British Archæology. Public Lectures in connexion with the Exhibition:—

Tuesday, Feb. 19, at 5.30.
C. R. Peers: Archæology and the State.

Wednesday, Feb. 27, at 5.30.
Prof. R. A. S. Macalister: Recent Archæological Work in Ireland.

Wednesday, Mar. 6, at 5.30.
Dr. C. Fox: Recent Archæology in Wales and its Borders.