NATURE

SATURDAY, DECEMBER 15, 1923.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.

NO. 2824, VOL. 112]

The Problems of Pasteurisation.

IN the recent National Milk Conference convened by the National Clean Milk Society at the Guildhall, London, the problems of pasteurisation which formed the subject of articles in NATURE for January 27 and February 3 of this year were discussed. Pending the publication of fuller reports, it would appear that not much additional knowledge has been acquired from experimental or other investigations since those articles appeared. Opinion in the Conference differed widely as to the wisdom of pasteurisation of cows' milk under present conditions. Thus, Prof. H. E. Armstrong maintained that the Ministry of Agriculture and the Ministry of Health were working against the public interest by "patting pasteurisation on the back," while not forcing those who heated milk to tell the public what they had done with it. With the emphasis laid in this statement on the desirability of making it compulsory to declare the fact of pasteurisation and the temperature at which it is undertaken, when commercially practised, all hygienists will agree; but they would scarcely agree with the possible inference that regulated pasteurisation of milk is an evil. Other hygienists, like Profs. J. M. Beattie and H. R. Kenwood, favoured the practice of pasteurisation, the first named summarising his views in the words that pasteurisation, properly carried out, at a constant temperature somewhat higher than that at present in use, would bring about the destruction not only of tubercle bacilli but also of all other important pathogenic organisms.

The problem of pure milk is complicated by the desirability of cheap milk, and of increase in the per capita consumption of milk from about a quarter of a pint daily to at least three times this amount. Clean milk is necessarily expensive. The dangers from relatively uncleanly milk are reduced to a minimum by efficient pasteurisation. At the same time, improved sanitation of milk is extremely important even when pasteurisation is contemplated; while conversely, even clean milk produced under rigid conditions may occasionally cause disease unless it is pasteurised.

Neither method of approach to improvement can be neglected. Dairy and milk sanitation is important; but, for the efficient protection of the masses of population living in large cities, pasteurisation is necessary. This pasteurisation must, however, be efficient, and to be efficient it must be controlled and always declared, in order that the circumstances in which pasteurisation has been carried out may be inspected. Furthermore, more experimental work is needed on the various processes of pasteurisation as to their relative efficiency.

Facts and Fancies in Modern Anthropology.

(1) *The Evolution and Progress of Mankind.* By Prof. H. Klaatsch. Edited and Enlarged by Prof. A. Heilborn. Translated by J. McCabe. Pp. 316. (London: T. Fisher Unwin, Ltd., 1923.) 25*s.* net.

(2) *The Racial History of Man.* By Prof. R. B. Dixon. Pp. xvi+583+44 plates. (New York and London: Charles Scribner's Sons, 1923.) 25*s.* net.

(3) *Ancient Man in Britain.* By D. A. Mackenzie. Pp. xv+257+16 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1922.) 12*s.* 6*d.* net.

THE three anthropologists the titles of whose works are given above have approached problems relating to the origin of human races and of their civilisations by totally different routes, but all of them have this in common: they have reached their respective destinations by giving their imaginations the freest of reins. No one who examines the frontispiece of the late Prof. Hermann Klaatsch's book—his death in 1916 at the age of fifty-two robbed German science of one of its boldest exponents—would readily associate his burly body and prize-ring face with fanciful speculations regarding man's evolution. Nor do we expect Prof. Roland B. Dixon, who holds the chair of anthropology at Harvard University, to use a few measurements of the skull as fairy wands wherewith to rear wonderful anthropological castles in the air of long past ages. His castles, we fear, like those which children build on the sands, are doomed to disappear as the incoming tide of reason flows over them—but of this, more anon. There can be no doubt that Dr. Donald A. Mackenzie's imagination is a part of himself; he is a student of Celtic literature, of Egyptian mythology, of primitive folk-lore. He has that invaluable quality, denied to men of strictly scientific training, of entering the primitive human mind, seeing the world through its eyes, and understanding its modes of reasoning. He has used his gifts and training in drawing a word-picture of ancient man in Britain and the sort of life he lived.

(1) Prof. Klaatsch's book, finished and edited by his friend, Prof. A. Heilborn, and translated into English by Mr. Joseph McCabe, contains a popular account of the opinions he had formed relating to the origin of man and his mind; to the beginnings of his speech, his morals, his weapons, his home, and his societies. However much one may resent the brusque way in which this German professor has brushed aside the facts and opinions of most of his contemporaries, and the dogmatic way in which he has made assertion serve the place of reason, yet his writings demand and deserve our serious consideration. Klaatsch was trained under Gegenbaur and became his assistant. He had been assistant to Waldeyer, and from his boyhood had been a close student of Darwin and of Huxley. He came into European prominence towards the end of last century, when the late Prof. Schwalbe of Strasbourg was giving Neanderthal man the place originally assigned to him by Dr. William King—that of a quite distinct species of humanity, sharply marked off from all living varieties of mankind.

Klaatsch made the fossil remains of man—particularly of Neanderthal man—his special study, and published long and somewhat prolix monographs on them. Then he took up the study of ancient stone implements, and proceeded to sites in Belgium and England to learn at first hand their nature and antiquity. To help him to interpret the ways of ancient man in Europe he set out in 1904 to live in contact with the most primitive of living races—the aborigines of Australia. He never ceased to extol the fine gentlemanly qualities of the aboriginal Australian; he persuaded himself that he detected Indo-Germanic elements in the aborigines' speech, and took a particular delight in claiming the Australian native as the ancestral type of the European! Much of the book here reviewed is based on experience he gained during the three years spent in Australia. He returned in 1907 to fill the full chair of anatomy and anthropology in the University of Breslau, and to rush about the continent of Europe to see the latest find of fossil man. He was soon in the sand-pit of Mauer when the Heidelberg jaw was found; he was in the Dordogne when his Swiss friend, Hauser, uncovered fossil remains of man at Le Moustier and at Combe Capelle; he went to Agram to see the remains discovered at Krapina. With such a record we cannot turn down lightly the opinions of this robust and industrious German professor.

Prof. Klaatsch was a vigorous exponent of evolution, but as regards the origin of human races he held certain peculiar opinions, to which he first gave expression after making a detailed examination of the fossil remains of Neanderthal man. He found that this extinct species of mankind shared many minor characters with the gorilla, and to account for the common heritage he framed the conception that they were co-descendants from an ancestral stock of ape-men. For reasons which he never made quite clear, he linked the Negro race on to the Gorilla-Neanderthal stem. He further supposed, without a scrap of evidence, that these ancestral ape-men were in our modern sense more man-like than ape-like, and while the gorilla fell away towards apedom as evolution went on, his more fortunate cousins—the Negro and Neanderthal man—proceeded towards their higher goals. He returned to the discarded idea of

Lord Monboddo, that apes were degenerate men—or, to use Klaatsch's own expression, they represent "abortive attempts at human evolution." On the other hand, the races of Europe, Asia, and Australia, although they, too, had arisen from the same ancestral stock of ape-men, had taken a totally different route to reach their humanity, having been accompanied in part of their evolutionary journey by the ancestry of the orang—another abortive attempt at man-production. Klaatsch himself was uncertain as to which human race had its past twined with the ancestry of the chimpanzee, but some of his followers have provided its human counterpart and also one for the gibbon. Once one enters the topsy-turvy evolutionary mill of the polygenist, there is no calling a halt: the extinct forms of anthropoid apes will also require human counterparts if Klaatsch's views are sound; and as geologists will provide scores of them in the course of time, the fertile imagination of the polygenist must look forward to a busy and perplexing future.

What should we say if any one were solemnly to assure us that Spanish and Italian were speeches of diverse origin, but that as they evolved they had come to resemble each other? Those who maintain that the close structural resemblances between the Negro and the European are due to convergence, as Klaatsch did, take up an equally untenable position.[1]

It must not be thought that the whole of Prof. Klaatsch's book is given over to a discussion of the evolution of man's body and brain. Far from it: a chapter is devoted to the evolution of weapons and to the discovery of fire and the results which followed from that discovery. One result was that primitive and hairy man, sleeping by the fires he succeeded in kindling and feeding, became nude. In another chapter is given an account of the origin of clothes; Prof. Klaatsch stoutly maintained that clothes were worn at first purely as ornaments; he cites ladies' underwear as proof of his contention, but appears to have forgotten that the orang and chimpanzee find out for themselves that an old blanket or a newspaper can serve more than an ornamental purpose. Chapters are devoted to the evolution of speech, of society, of religion, of the home, and of motherhood.

All departments of anthropology are dealt with; in every section the author sets down in clear, unmistakable terms the conclusions he has reached regarding the matters dealt with in his pages. It is the author's courage rather than his judgment which is to be commended. In brief, this book of Prof. Klaatsch's is of value, not because it represents a weighty contribution to anthropology, but because it gives in a readable form the opinions held by an outstanding personality concerning the manner in which man has come by his present place in the world.

(2) Prof. Klaatsch was a polygenist; Prof. Roland B. Dixon is also a polygenist, but of a new kind. The title which he has given his book, "The Racial History of Man," seems to convey the impression that we are to be told how the Negro, the Chinaman, the European, and other well-differentiated races of mankind came into existence. His publishers have given his book all the appearance in paper, type, and binding which marks a standard work. Prof. Dixon's book is in reality a treatise on polygeny; of that he is in no doubt, for he writes:

"The acceptance of such an hypothesis, of the theory that the existing varieties of man are to be explained, not as derived by differentiation from a single ancestral form, but as developed by amalgamation of the descendants of several quite discrete types, places us squarely in the ranks of the long discredited polygenists" (p. 503).

There is no doubt that Prof. Dixon has put himself in his proper category, and we want to know how he came to fall into this position. He, like Prof. Klaatsch, is a thorough-going evolutionist: he is convinced that, in its early evolutionary history, man's ancestral stock progressed in quite an orthodox manner; it diverged, forming many branches, representatives of some of which have been found in a fossilised form in Java and Piltdown, etc. But there came a time—the date is not explicitly stated—when only eight branches—or human types—were left. We are told the names of these. There was (1) the *proto-Australoid*, cradled somewhere round the Indian Ocean; (2) the *proto-Negroid*, whose home was in Africa; (3) the *Mediterranean*, living in Asia to the east of the Mediterranean; (4) the *Caspian*—a new name for our old friend the Caucasian—living in Asia, north and east of the Caspian; (5) the *Mongoloid*, and (6) the *Palæ-Alpine*, neighbours on the central plateau of Asia; (7) the *Ural*, of uncertain nativity, but placed in the meantime in Eastern Russia; (8) the *Alpine*, also a native of Asia. For some reason, which the author does not mention, these eight primitive types of man, living in and native to diverse regions of Africa and Asia, began a great game, which can only be described as that of "anthropological chairs." They all started moving round the world, into each other's countries, and mixing in the most promiscuous way. Out of this old-world game came our modern races—Negro, Negrito, Australian aborigine, Europeans of all sorts, Egyptians, Chinamen, Red Indians, and Lapps. The difference between one modern race and another wholly depends, according to Prof. Dixon, on the proportion in which the eight original races were

[1] Klaatsch's theory was discussed at some length in the pages of NATURE of Nov. 24, 1910 (Vol. 85, p. 119).

employed in their compounding. The Eskimo, one of the most distinctive races of mankind, and marked by unmistakable Mongolian features, has nothing of the Mongol in him, according to Prof. Dixon, but is compounded from the types which make up the peoples of Western Europe, namely, the Mediterranean, Caspian, and Ural types. To the fashioning of Englishmen all the original eight primary types of mankind have been employed, including, of course, the Mongol, the proto-Negroid, and the proto-Australian.

Prof. Dixon came by his discovery in the simplest way possible. To recognise members of his original types, in any race or people whatsoever, he employed three measurements of the skull, its length, width, and height, and two of the nose, its height and width. If the head, according to his standard, was long and low and the nose broad, then the individual with such proportions, no matter what the colour of the skin, texture of the hair, proportion of the body, and general appearance might be, was a proto-Australoid; but if the nose was narrow, this alters the case: the individual is a Mediterranean. But if the head was long and high and the nose narrow, then the individual possessing such proportions must be placed in another category, that of the Caspian archetype. In discussing the distribution of the proto-Australoid type in Europe, Prof. Dixon proves its presence in Germany in neolithic times by citing two skulls of that date with particularly wide noses. In his table (p. 477) the width of the nose is given as 23 mm., the height as 48 mm., and the proportion of width to height as 57·9 per cent. But if the reader will work the sum out, he or she will find it is not 57·9 but 47·9 per cent. On this slip in his arithmetic Prof. Dixon builds his hypothesis of a proto-Australoid stock in neolithic Europe. In other cases his arithmetic may be right, but his methods and inferences have just as little foundation in fact as in the former case. Why, every anthropologist knows of families where one brother, on Prof. Dixon's scale, would be a proto-Negroid, another a Caspian, another a Mediterranean or Ural, while among the sisters of the same family might be found representatives of his remaining types.

To make quite clear the methods pursued by the professor of anthropology in Harvard University, let us suppose that the history of the various makes and types of motor-car is unknown, and that Prof. Dixon has undertaken to discover how the various types have come into existence. If he applied the method which he has employed to unravel the history of human types, he would measure the length, breadth, and height of the body of each type of car and the width and height of the bonnet, and with these measurements to work on would deduce the history of each make of car. Essential points concerning the engine, the gearing, steering, the system of ventilation and lubrication, and all the essential details which go to the proper working of a car, are to be passed unnoted. When the matter is put in this way, even those who regard cranial measurements as sacrosanct will understand the value to be attached to Prof. Dixon's account of the evolution of human races.

(3) In Dr. Donald A. Mackenzie's pages we have Western Europe pictured as a corridor leading from Egypt, or some adjacent part of Africa or Asia, to Britain. In ancient times there passed along this corridor a continuous procession of various types of men, each carrying its peculiar customs and beliefs. The Cromagnon people, in Dr. Mackenzie's account, head the procession; they came from east of the Nile, and brought to Europe and to England the religious beliefs of their native land. They were followed by the "Solutreans," who, we are told, came from about Somaliland. After them came the "Magdalenians," the "Azilians," and the "Tardenoisians." The Magdalenians, we are informed, were really Cromagnon people. The only folk who did not come the usual way and from the usual source were the "Maglemosians"; they came from Siberia to the Baltic, and brought the dog to Europe; they were blonds of the Nordic type. So far as the writer knows, only one fragmentary skull of the Baltic kitchen-midden people (the Maglemosians) has so far been found; we know nothing of a Nordic people in Siberia in early neolithic times; there are not half-a-dozen human skeletons, or fragments of skeletons, which can be ascribed to people who made the Azilian and Tardenoisian types of weapons or implements. We really know nothing of these people whom Dr. Mackenzie has made to move so briskly towards Britain in ancient times.

Perhaps it will be fairest to let him speak for himself:

"For a long period, extending over many centuries, the migration 'stream' from the continent appears to have been continuously flowing. The carriers of neolithic culture were in the main Iberians of Mediterranean racial type—the descendants of the Azilian-Tardenoisian peoples who used bows and arrows, and broke up the Magdalenian civilisation of Cromagnon man in Western and Central Europe. This race appears to have been characterised in north and north-east Africa. 'So striking,' writes Prof. Elliot Smith, 'is the family likeness between the early neolithic people of the British Isles and the Mediterranean and the bulk of the population, both ancient and modern, of Egypt and East Africa, that the description of the bones of an early Briton of that remote epoch might apply in all essential details to an inhabitant of Somaliland'" (p. 126).

For the latter part of his statement Dr. Mackenzie

has the highest authority, but, so far, the writer has heard of no one who has made and published a detailed comparison between the bones of neolithic Britons and those of modern Somalis and Egyptians. It is highly desirable that an investigation of this kind should be made, for it is difficult to believe that there is any degree of Somali blood in modern England.

ARTHUR KEITH.

The Orders of Insects.

Manual of Entomology: with Special Reference to Economic Entomology. By Prof. H. Maxwell Lefroy. Pp. xvi + 541 + 4 plates. (London: E. Arnold and Co., 1923.) 35*s.* net.

THE classification of insects has passed through many changes, and most of the systems proposed have been primarily based upon characters afforded by the wings, mouth-parts, and metamorphoses. During the last fifteen years entomology has suffered from an over-exercise of the analytic faculty on the part of morphologists. One result of their activities is seen in the increasing number of subdivisions of the class Insecta, and some eminent authorities even dismember the latter as a whole. The tendency is to emphasise differences rather than the features which groups reveal in common. In some cases the same morphological characters in different orders are not credited with proportional values. The result, as might be anticipated, is a condition of instability with no very clear conception of what is to be regarded as an order and what is not.

The foundations of the modern classification of insects were laid by Brauer in 1885. He recognised the fundamental division of the Insecta into the two sub-classes Apterygogenea (Apterygota) and Pterygogenea (Pterygota)—members of the former being primitively apterous and those of the latter winged, or in some cases secondarily apterous. Brauer also did much towards dividing the old assemblage Neuroptera into separate sections, each of ordinal value. In 1899 Sharp established a system partly modelled upon that of Brauer, and he introduced the terms Exopterygota and Endopterygota, in order to discriminate between those orders in which the wings develop outside the body, and those in which they remain internal until pupation. He further introduced the term Anapterygota to include those apterous orders which have, presumably, become secondarily wingless. This latter step, however, has the disadvantage of bringing together distantly related groups.

In 1904 Shipley adopted Sharp's system almost in its entirety, but proposed certain new ordinal names with the double object of doing away with the use of family designations for ordinal purposes, and of introducing a system in which the suffix "ptera" is extended to all orders. In the same year Börner proposed a system which recognised the same orders as Shipley (although not necessarily under the same names), with the exception that he adopted a threefold division of the Apterygota, and revived the ordinal name Corrodentia for the Psocoptera and Mallophaga. Four years later Handlirsch launched a revolutionary scheme: he no longer retained the Insecta as a primary division of the Arthropoda, and his system involved their dissolution into four classes comprising no less than 34 separate orders. In America he has found support from Brues and Melander (1915), who added the more recently discovered orders Protura and Zoraptera and, at the same time, elevated the family Grylloblattidæ to ordinal rank, thus recognising altogether 37 orders. Berlese, on the other hand, in his encyclopædic treatise "Gli Insetti" reverts to a simplified taxonomy and diagnoses but nine orders. In a few words, it may be said that centres of disruption exist in the orders Orthoptera, Corrodentia, and Neuroptera as defined by Brauer. Once a condition of equilibrium is attained with respect to these three groups we may be on the high road to something approaching unanimity.

Prof. Lefroy's book is essentially one on the orders of insects. In the preface it is mentioned that the book is based "upon the lectures given as the second of three parts of a course occupying one year of a full training in entomology." This apparently accounts for the absence of any general chapters on structure, biology, or development. On the whole, a very reasonable compromise is made between the radical tendencies of Handlirsch and undue conservatism, and some 26 orders are separately treated more or less in detail. The book is written for the student of applied entomology, and its object is to teach him how to recognise an insect in the field, to determine its sex, to learn about its habits and the methods of control, and to familiarise him with some of the more important monographs or catalogues which provide references to the literature.

The conception of the book is a good one. In carrying it out Prof. Lefroy assumes that the student is working with a collection of specimens which he can handle—illustrations are not very much believed in—and has access to the "Zoological Record," "Genera Insectorum" and the *Review of Applied Entomology* for further information. References consequently do not, as a rule, include the names of the journals concerned, and sometimes only comprise the names of the authors, along with the dates of their publications. This method has very obvious difficulties, and, although

it doubtlessly works all right in Prof. Lefroy's own department, a restriction is inevitably placed on the circle of those who might use the volume—particularly outside the British Isles. Anyway, this is the plan upon which the student is intended to proceed.

In the preparation of the volume the services of eight past or present students of the Imperial College have been enlisted—a certain number of orders having been allotted to each. The necessary information having been collected and written up, the whole was then, presumably, sifted and edited by Prof. Lefroy. This unorthodox method has its pitfalls. The various sections, each of which is devoted to a separate order, are of rather unequal merit—as might be expected—the one devoted to the Neuroptera being probably the best. Also, the book contains a number of misprints which suggest hurried proof-correcting, and contains errors which, if repeated in an examination paper, would tell considerably against a candidate. For example, on p. 10 the extra spiracles of Japyx are stated to be on the prothorax: on p. 41 the cervical sclerites are mentioned as articulating the thorax to the abdomen: on p. 87 the mandibles of the nasute caste of termites are stated to form a kind of beak through which a secretion can be exuded at will: on p. 457 Glossina is credited with dropping its larvæ one at a time while in flight.

On the other hand, almost all the families of insects are mentioned, and most of them treated separately, which, in itself, is quite an achievement: in some cases even the sub-families are enumerated and commented on. The book also contains a good deal of information not otherwise very accessible. It is admirably printed, but the price seems rather high. The four half-tone plates are excellent, and the text-figures, for the most part, serve their general purpose. A. D. I.

Photographic Science.

Photography as a Scientific Instrument. A Collective Work by A. E. Conrady, Charles R. Davidson, Charles R. Gibson, W. B. Hislop, F. C. V. Laws, J. H. G. Monypenny, Dr. H. Moss, Arthur S. Newman, Dr. Geo. H. Rodman, Dr. S. E. Sheppard, W. L. F. Wastell, Wilfrid Mark Webb, Col. H. S. L. Winterbotham. (Applied Physics Series.) Pp. vii + 549 + 21 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1923.) 30*s*. net.

OWING to the enormous advances which have been made in the various branches of science, recent years have seen the publication of numerous monographs written by specialists in one particular domain. Chemistry and physics have been well catered for in this respect, but, at all events in Great Britain, there has been no series of monographs dealing with photography, a subject which may be considered as belonging to physical chemistry. The present book, to some extent, supplies this want. It consists of fourteen chapters written by thirteen different men, each of whom is an acknowledged authority on the subject about which he writes. Although it would not be correct to describe the various chapters as monographs, since a complete description of the particular branch under consideration is not attempted, yet in each one is brought together a mass of knowledge which has hitherto been scattered far and wide in the literature, or has remained embodied as "experience" with individual workers.

The first four chapters treat of the history, optics, and chemical and physical processes of photography: they may be considered as dealing with the more purely scientific side, whilst the remaining ten chapters treat of the application of the art in various branches of science and technology.

When dealing with a book of this kind the reviewer is necessarily subject to limitations: he cannot have a knowledge of all the subjects treated, and consequently is attracted by some chapters rather than others. From the purely scientific point of view, those due to Prof. Conrady and Dr. Sheppard are especially worthy of mention. The former bases his treatment of the photographic lens system on the Abbe form of the general theory, and deals with it from the point of view of the user rather than that of the designer and computer. The properties of lens systems, and the various classes of aberrations to which lens systems are subject, are treated in a surprisingly simple manner. The practical photographer will be especially interested in "The Experimental Determination of the Constants for any Lens System," and with the explanation of depth of focus, ghost images, flare spots, etc. He will also find that a perfect lens system is impossible, the best obtainable being the result of a large number of compromises leaving always small residuals of aberration. Such knowledge is important to the purchaser, who will not then expect too much from the makers or sellers, who are generally silent on such points.

Since all the applications of photography depend on having the necessary sensitive material with which to work, it is natural that Dr. Sheppard's chapter is the longest in the book. The author has been, so to speak, "born and bred" in the subject, and, possibly because of this, in some of his publications he has been apt to forget that his readers have not the same acquaintance with the subject as he has. In this chapter, however, Dr. Sheppard has not fallen into this error, and the reviewer does not know of any other account which covers the facts so clearly and lucidly. One failing,

however, Dr. Sheppard does not seem able to overcome. Chemical equations seem to be beneath his notice; in particular, the equation representing the reaction between ferrous sulphate and silver nitrate (p. 140) contains so many errors that one cannot fail to notice them.

The photographic methods used in astronomical photography are described by C. R. Davidson, and Dr. Moss gives a valuable selection of examples of the application of photography to physical investigations. "Photomicrography" is covered in two chapters, J. H. G. Monypenny dealing with its application in metallurgical and engineering research, whilst Dr. Rodman, in a more popular manner, describes its application in histology, bacteriology, and pathology. There is necessarily some duplication in these chapters, and, as is not to be wondered at, differences of opinion. Similar remarks as to overlapping hold with respect to the chapters on "Photographic Surveying," by Col. Winterbotham, and on "Aeronautical Photography," by Major Laws. The differences in view-point obtained are, however, all the more instructive.

Mr. Wastell describes the various colour processes, from that of Lippmann to the latest form of kinematography in colour; and Mr. Hislop deals with the application of photography to various printing processes in monochrome and in colour. The last two chapters deal with the "Technics of Kinematography" and "The Camera as Witness and Detective."

The book is a valuable one, and should be of interest not only to specialists in photography, but also to the public in general. T. S. P.

Our Bookshelf.

The British Pharmaceutical Codex, 1923: an Imperial Dispensatory for the Use of Medical Practitioners and Pharmacists. (Published by direction of the Council of the Pharmaceutical Society of Great Britain.) New and revised edition. Pp. xx + 1669. (London: The Pharmaceutical Press, 1923.) 30*s.* net.

THE British Pharmaceutical Codex was compiled by a committee of experts, working under the direction of the Council of the Pharmaceutical Society, and was intended to afford to pharmacists and physicians a ready means of obtaining trustworthy information concerning drugs and medicinal preparations in general use throughout the British Empire. It has fulfilled its purpose well. Works of this type, however, quickly lose their value, and, notwithstanding the publication of supplements in 1915 and 1922, a new issue was overdue. The text of the book bears on every page evidence of thorough and careful revision, and it is now well abreast of pharmaceutical and medical practice. Among the new monographs that attract attention is that on acriflavine. Here the constitution and preparation of this important antiseptic are explained, and a full page is devoted to an exposition of its advantages in medical and surgical treatment, the form in which it is best prescribed, and the synonymy of its derivatives, euflavine, homoflavine, and proflavine. Chloramine-T and the chlorinated antiseptics, eusol, Dakin's solution, and Daufresne's solution, are similarly discussed. The thoroughness evident in these monographs characterises the whole work, and it is just this that makes the Codex so valuable and trustworthy. Under the heading "Curationes" a general description of surgical dressings and the methods by which they may be tested is given; it is curious to note that the lint of the Codex is composed entirely of cotton, whereas the presence of cotton was formerly considered objectionable on account of its supposed irritating nature. Insulin, thyroxin, and other drugs of very recent origin find a place in the work. The list of test solutions and microscopical stains is a very restricted one, and scarcely justifies its title. The whole work is remarkably free from errors, and the committee entrusted with its preparation may be congratulated on the success of their efforts. It is to be hoped that the Council will not, from motives of economy, unduly delay the appearance of a new edition, so that the book may always be kept well up-to-date.

Vom Gleitflug zum Segelflug: Flugstudien auf Grund zahlreicher Versuche und Messungen. Von Gustav Lilienthal. (Volckmanns Bibliothek für Flugwesen, Band 15.) Pp. 159. (Berlin-Charlottenburg: C. J. E. Volckmann Nachf. G.m.b.H., 1923.) 2.50 marks.

"EINE Kritik meiner Arbeiten nur vom grünen Tisch aus, ohne meine Experimente und Messungen nachzuprüfen, lehne ich von vornherein ab." This is the beginning of the last paragraph in the book by Herr Gustav Lilienthal, the brother and collaborator of the famous Otto Lilienthal. He is led to take up this uncompromising attitude because, he claims, the results of his lengthy and laborious measurements have already been criticised in a manner suggesting that they have not been properly examined and understood.

Herr Lilienthal discusses the old problem of soaring or sailing flight. He maintains that the present form of aeroplane is due to the misdirection of effort caused by the War, when aeroplanes were required at once and in as large numbers as possible, with the result that the type then known became standardised for all purposes and all nations. The author's view is that the modern aeroplane, in which the wings do the sustaining while an engine is used for propelling, is an imitation of the beetle rather than of the bird. He hopes that the effect of the revival of gliding will be to cause the aeroplane to approximate more to the bird form, with the wings supplying the propulsion as well as the sustentation.

Meanwhile, Herr Lilienthal discusses how the sailing flight of certain birds is possible. He claims to have established experimentally that the wind supplies the work required for sailing flight, by means of its property of making bodies suspended in it turn through about 4° upwards. Further, the camber in a bird's wing produces an eddy below the wing, with the result that the work supplied by the wing is used for both sustentation and propulsion. It is difficult to see why

a horizontal wind should produce the 4° turn which Herr Lilienthal claims to have measured, but it is a suggestion worthy of consideration, and one that may lead to interesting developments. S. B.

Les Principes de la physique. Par Dr. Norman R. Campbell. Traduit et adapté en Français par Mme. A. M. Pébellier. (Nouvelle Collection Scientifique.) Pp. xix+200. (Paris : Félix Alcan, 1923.) 8 francs.

A TRANSLATION into French of Dr. N. R. Campbell's book entitled "Physics, The Elements," was suggested to the author by M. Émile Borel, who had been called upon for a notice of the volume in the *Revue philosophique*. But the length of the original imposed the necessity for considerable abbreviation ; one-third only of this smaller book is a textual translation, the rest is an abstract, the developments of several pages being sometimes reduced to a few lines. Mme. Pébellier has carried out both the paraphrase and the translation, and her difficult task seems to have been performed most efficiently. The book is rendered more interesting, especially to the English reader, by the preface contributed by M. Borel. He emphasises the great importance of the treatise, arising from the fact that the author is an experimental physicist, and moreover an English physicist. Experimental and theoretical work correspond to different forms of activity, and perhaps to different forms of thought. Continental physicists, whether they are French, German, or Italian, are perhaps less purely physicists than the English. It may at least be affirmed that the latter have certain particular qualities, qualities which sometimes shock the savant of the Continent but in practice produce remarkable results. M. Borel proceeds with an interesting discussion of the language of physics, which he regards as intermediate between the exact language of mathematics and the vaguer language of the vulgar tongue, in which words have only a *statistical* definition. In its new form Dr. Campbell's work should appeal to a wide circle of readers.

The Poulsen Arc Generator. By C. F. Elwell. Pp. 192. (London : Ernest Benn, Ltd., 1923.) 18*s*. net.

As there are more than 20,000 kilowatts of arc transmitters in use to-day, it is highly probable that they will remain in use for many years to come. The British Post Office adopted a 250 kw. Elwell-Poulsen arc generator for the first link of the Imperial Wireless Chain connecting Leafield with Cairo. These two stations are now in operation at two-thirds of the cable rate. The same type of generator is also used at Northolt for communication with the Continent. The Dutch Government is installing a 2400 kw. Poulsen arc, the largest in the world, in Java, to enable it to communicate directly with its colonies. As the author points out, it is the one good system which is not covered by a multitude of patents thought by many to be employed to dictate the terms and conditions under which the other systems may be used. The book begins with a historical introduction, due stress being laid on Duddell's discovery of the musical arc. The arc generators are then described, and finally clear descriptions are given of the methods and apparatus used for signalling and the application of the generator to radio-telephony.

Clinical Laboratory Methods. By Prof. R. L. Haden. Pp. 294+5 plates. (London : H. Kimpton, 1923.) 18*s*. net.

THE author of this book has adhered strictly to his object of presenting methods of carrying out clinical laboratory work without in any way discussing the interpretation of the results. The volume is therefore essentially a manual for the laboratory worker. The various tests are described briefly, but with attention to every practical detail, and references to original articles are provided with most of the descriptions. The author has limited himself as a rule to one method for each quantitative estimation, apparently with the rather narrow view that one method is suitable in all circumstances. The examination of gastric contents differs considerably from the examination generally carried out in Great Britain, and no consideration is given to the fractional test meal. The illustrations, with the exception of those of blood cells, are very good. Making allowance for slight differences in terminology, the clinical pathologist will find in this book a clear description of the laboratory methods in general use.

Textile Chemistry : an Introduction to the Chemistry of the Cotton Industry. By F. J. Cooper. Pp. ix+235. (London : Methuen and Co., Ltd., 1923.) 10*s*. 6*d*. net.

MR. COOPER'S book covers a good deal of ground in a brief but clear fashion. It reads more like a note-book than a text-book, but is obviously the work of a number of years of teaching, and should be useful to students in technical schools, for whom it is intended. Besides the elementary chemistry which serves as an introduction, the author discusses its applications to the textile industry, and among other things the natural fibres, the chemistry of coal, oils, industrial waters, sizes, bleaching, dyeing, and mercerising. Those engaged in teaching the subject will find the book useful and helpful. There are a few minor inaccuracies : a "base" need not contain a metal (p. 66) ; nitric oxide is not absorbed by sulphuric acid (p. 69). The descriptions of experiments are not always adequate, and some of them (as that shown in fig. 119) can scarcely have been tried successfully.

Radio Telegraphy and Telephony. By Prof. E. W. Marchant. Pp. ix+137. (Liverpool : University Press of Liverpool, Ltd. ; London : Hodder and Stoughton, Ltd., 1923.) 6*s*. net.

A VERY large number of books on radio telegraphy and radio telephony have recently been published. Many are of little use to the general scientific reader because they are too elementary ; others fail because they are too technical, the authors revelling in technical terms which are in general very vaguely defined. Prof. Marchant seems to have hit on the happy mean in this little volume. The science is accurate, the descriptions are good, and the information is up-to-date. To make assurance doubly sure the author has added a glossary giving good definitions of the technical words used in the text. This book can be recommended to the reader who wants to understand the principles utilised in radio telephony, broadcasting, and directional radio signalling.

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.*]

Some New Commensals in the Plymouth District.

WHILE collecting by digging on the shore at Millbay, Salcombe, in April this year, I found three consecutive pairs of Synapta and a polynoid worm living together, and at the same time three distinct associations of the brittle star, *Ophiocnida brachiata*, and a small mollusc. These finds led to five later

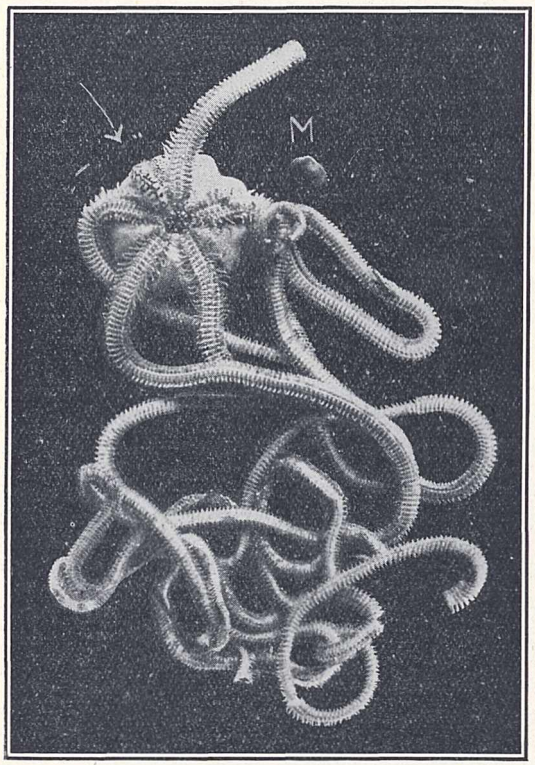

FIG. 1.—The brittle star, *Ophiocnida brachiata*, with the polynoid, *Harmothoë lunulata*, clasping and curving over the disc, opposite the arrow head and alongside the projecting arm which is broken off short; and the mollusc (M), *Montacuta bidentata*: three animals living associated together buried in muddy sand at Salcombe. × *ca.* ⅔. (From a photograph by Mr. R. S. Clark.)

monthly visits during the best spring tides, and resulted in the observations given below.

The polynoid, *Harmothoë lunulata*, was found in muddy sand at Salcombe on adjacent beds with six different animals belonging to two different phyla and four different classes, but the more interesting point is that the size of the polynoids forms on the whole an increasing series approximately as follows: *Harmothoë lunulata*, a few to 10 mm., with *Ophiocnida brachiata*, and curved round the disc or over the mouth (Fig. 1); *H. lunulata* (var. *synaptæ* St. Joseph), 15 to 20 mm., with *Synapta inhærens* and *S. digitata*, and also occasionally with *Phascolosoma pellucidum*. On the same beds occur larger specimens of a polynoid somewhat different in general appearance from the small *Harmothoë lunulata* just mentioned, but they appear to be merely later-growth stages of the same species, and agree generally with the var. *nigra*, Alæjös. Specimens of this form about 20 to 30 mm. were taken with *Phascolosoma vulgare*, and of 35 to 50 mm. with *Amphitrite Edwardsi*. Further work will be required to put this last observation on a secure basis, but the animals can only be obtained by special search in small numbers at considerable intervals of time. There is little doubt, however, that this species of Harmothoë at Salcombe starts life commensally with Ophiocnida, and changes its mate as it grows bigger and requires more accommodation in the burrow provided by the messmate, until it finally consorts with polychætes up to 30 cm. long, such as *Amphitrite Edwardsi*.

Harmothoë lunulata was also taken at the mouth of the River Yealm with *Synapta inhærens*, and will no doubt later be found in the same association in Plymouth Sound.

During the same expeditions the almost constant association of the mollusc *Montacuta bidentata* [1] with *Ophiocnida brachiata* was confirmed. The mollusc in this case is frequently found in numbers just below or above the disc, and occasionally under an arm in company with *Harmothoë lunulata* young. The same mollusc was taken also but less frequently with the Gephyrean, *Phascolosoma pellucidum*, and occasionally with Nereis. With this Gephyrean, however, was found fairly constantly the messmate *Lepton Clarkiæ*,[1] which was fairly frequently present in groups of 4 to 7, and sometimes attached to the skin of the blood-worm.

On both shores at Salcombe another Harmothoë sp. B, not yet identified, was taken in tubes with one, and not in tubes with other species of Nereis. The same species was taken by careful work also in Rum Bay, Plymouth Sound, alongside or under the tentacles of *Amphitrite gracilis*, *Polycirrus aurantiacus*, and another species of Polycirrus, and at the same time *Harmothoë marphysæ* was rediscovered with *Marphysa sanguinea* in Plymouth Sound after a long lapse of years. The same Harmothoë sp. B was also taken with Nereis in beds at the River Yealm. It is an interesting fact that Sir Ray Lankester took a similar polynoid under the tentacles and in the tubes of *Terebella* (*Polymnia*) *nebulosa* at Herne so long ago as 1865.

The frequency with which the associates mentioned above occurred apart from each other was noted during the collecting work, and found to be low except in the case of *Phascolosoma pellucidum*, which occurs in thousands in a few square yards of ground.

In none of these cases of association or commensalism can a reason for it be asserted with any certainty. The frequent occurrence of polynoids, however, at the bases of the tentacles of polychæte commensals, as Polycirrus, or in or near the grooves of other polychætes, as Amphitrite, Nereis, Chætopterus, or the grooves of Ophiocnida, suggests the pilfering or scavenging of food-material. In the cases of Montacuta and Lepton it is clear that food-material is abundant in the burrows they inhabit, as their shells are often covered with Polyzoan polyps, and in addition various Foraminifera are not uncommon in the mouths or in the region of the burrows.

Indeed, the variety of associates of some commensals suggests, on the other hand, that an inhabited burrow may be simply and mainly a harbour of refuge, which is used so frequently that the inhabitants learn to know and tolerate each other, while at the same time not necessarily depending directly in any particular way on each other for food.

J. H. ORTON.

The Laboratory, The Hoe, Plymouth,
November 8.

[1] I am much indebted to Mr. R. Winckworth for the determination of these species.

Conductivities of Aqueous Salt Solutions.

IN the course of an investigation carried out during the last two years on the transference numbers and conductivities of certain aqueous salt solutions, we have come across a simple relation which appears to us of interest and importance.

The specific conductivity of an electrolyte (κ) as usually measured, refers to one *centimetre cube* of the solution. We found it desirable, when working with concentrated solutions, to compare figures given by volumes of electrolyte containing always *one gram of water*. If the solution in question contain x grams of salt per thousand grams of water, and is of density d, then the volume of solution containing one gram of water is $\frac{1000+x}{1000d}$. Multiplying this term by κ, we obtain a magnitude which we will denote by κ', which is the conductivity between electrodes one cm. apart of an amount of the solution containing one gram of water. At high concentrations, the viscosity of the solution is a factor which cannot be neglected. Making the simplest assumption, *i.e.* that conductivity and fluidity are proportional, we arrive at a corrected conductivity,

$$\kappa' \text{ corr.} = \frac{1000+x}{1000d}\kappa\eta.$$

Multiply by 1000, and we have the conductivity under the same conditions due to an amount of solution containing 1000 grams of water. If now this be plotted against x/M or the weight molar concentration (mols per thousand grams of water), the result is a curve which, in the cases of potassium, sodium, and lithium chlorides, becomes nearly linear after x/M has exceeded 0·5-1, and remains so up to the limit to which we have so far carried our measurements (x/M = 3 to 5, depending on the electrolyte). We have plotted the conductivity, density, and viscosity data of other observers for certain other solutions, and have obtained similar results.

Expressed verbally—if a thousand grams of water are put between electrodes one cm. apart and one of the salts in question gradually added, the increase in conductance of the cell (corrected for viscosity change) brought about by dissolving, say, an extra one-tenth gram equivalent of salt is nearly independent of the concentration of the solution when a certain limit of concentration has been exceeded. The slope of the curve is given by

$$\frac{(1000+x)\kappa\eta}{d\frac{x}{M}}.$$

A curve of the same slope is got if the molar fraction of the salt in the solution is plotted against the conductance (corrected for viscosity and measured between electrodes one cm. apart) of a mol of solution: that is, within the limits mentioned, the corrected conductance of a solution is practically proportional to the ratio salt molecules/total molecules.

This relation, obtained by considering, not, as is customary, the conductance of a fixed weight of salt to which increasing amounts of water are added, but the conductance of a fixed weight of water to which increasing amounts of salt are added, would appear to have considerable implications in several directions for the theory of strong electrolytes. These will be considered, and the data more fully presented, elsewhere.

We have written this preliminary note as a result of reading recently a paper published some months back by Linde (*Zeitsch. Elektroch.* 29, 163, 1923) and not previously noticed, as its title did not indicate any particular bearing on our work. In this paper the author has plotted $\kappa\eta$ against $\frac{100x}{1000+x}$ (*i.e.* the specific conductivity corrected for viscosity against the weight percentage of the salt in the solution) for aqueous lithium and calcium chlorides solutions up to very high concentrations (far higher than any we have so far measured). He finds a linear relation up to 30 per cent. lithium chloride and 20 per cent. calcium chloride respectively, after which the curves bend. The essential difference between his method of plotting and ours is that we take into our conductance expression the density of the solution. If his curves are modified in this way, the changes in direction at the high concentrations become far less marked, and their courses at more moderate concentrations, whilst becoming somewhat less linear, closely approximate in type to those found by us for solutions of lithium chloride and other salts.

A. J. ALLMAND.
L. NICKELS.

University of London,
King's College, Strand, W.C.2,
November 25.

The London Fogs of November 25-27, 1923.

THE accompanying graph (Fig. 1) shows the hourly variation in the quantity of suspended impurity, that is, sooty matter, in the air of London (Westminster), which was chiefly responsible for the recent smoke fogs. This curve shows clearly that the maximum density of the smoke fog occurred about mid-day, and there was a rapid increase in density which coincided with the period of lighting up of fires in the morning. The figures from which the curve is plotted were obtained from my automatic recorder, designed for the Advisory Committee on Atmospheric Pollution. When a large number of days are averaged and

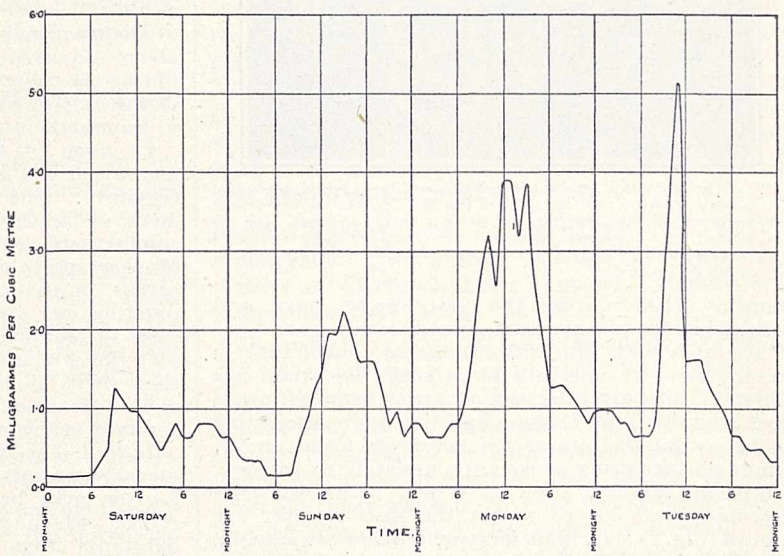

FIG. 1.—Suspended impurity in the air of Westminster, November 24-27, 1923.

plotted, the distribution over the 24 hours is similar but more uniform, and it can even be seen that the maximum is reached later on Sundays than on weekdays (Eighth Report Advis. Comm. on Atmos. Pollution, p. 30).

Records taken in Westminster by my impact apparatus at the height of the recent fogs showed about 50,000 solid particles per cubic centimetre, and very little indication of water drops. These particles averaged a little more than 0·5 micron in diameter, and there was a tendency to a rounded, kidney shape, with a fair number of small transparent spheres of about the same diameter.

With reference to the cause of the "London Particular," the view is generally held that a London fog consists of condensed water particles dirtied by smoke and oily hydrocarbons (Carpenter, "London Fog Inquiry," 1901–2), and this view follows naturally from the fact that during London smoke fogs there is very often a dense water fog in the surrounding country. There are, however, certain indications which point to a different conclusion and suggest that a London smoke fog, such as we have experienced recently, occurs at the same time as the surrounding water fog, not because it is a result of the latter, but because of the conditions which favour water fog. I have, therefore, been forced towards the view that the smoke fog of London does not consist of water particles dirtied by smoke, but almost entirely of smoke particles alone. In support of this are the following facts:

(*a*) During the recent fogs when the sun was visible at all it appeared as a red ball, thus pointing towards the presence of finely divided suspended matter, and not towards large water globules.

(*b*) Records taken by my impact method during London smoke fogs show little evidence of water drops, which, if present, would be obvious; but there are always immense numbers of small smoke particles.

(*c*) It is not unusual in coming up to London from the country during foggy weather to find a dense white fog in the country, with a limit of visibility of perhaps 50 yards, giving place to a yellow fog in London with a greater limit of visibility; thus, while a large amount of smoke can always be detected, there must be a great reduction in the quantity of water in the London fog, since in spite of the smoke addition visibility improves.

(*d*) The air over London is warmer than in the country surrounding, and although the combustion of large quantities of fuel supplies a certain amount of water to the air, it seems probable that condensation of water in London to form fog would normally be much less than in the surrounding country. There are about 17,000,000 tons of coal burnt per annum in London, and assuming a wind of 2 miles per hour and an inversion of the lapse rate of temperature at about 400 feet, a condition likely to be met with during foggy weather, this amount of coal would keep the air immediately over London about 13° F. warmer than in the surrounding country.

(*e*) The hourly incidence of suspended impurity, as shown in the curves, varied exactly with the darkness and apparent density of the fogs as judged by the eye.

Doubtless in the early morning the conditions which cause a water fog in the country also cause a similar fog in London, if not so dense; but as the day advances the smoky fires add their soot and heat to the air, the latter evaporating the water and the former replacing it by soot.

Fires are notoriously smoky shortly after lighting until they get well heated up, and we find, as a rule, that the smoky London fog commences in the morning about the time of fire lighting and dies away gradually as the fires become well established; while it is usually at a minimum between midnight and early morning. If the natural ventilation over the city fails to carry away the smoke produced, there is sufficient evolved in the morning in three or four hours to provide Londoners with the densest smoke fog they have ever experienced. Such a fog contains 5 or 6 milligrams of soot per cubic metre, and this can be easily supplied by the 40 or 50 tons of soot evolved per hour by the chimneys of London.

Assuming the correctness of the above, we may draw the following inferences:

(1) The air over London being warmer than its surroundings, water fogs will be fewer or less dense during the day than in the country.

(2) The "London Particular" can be entirely prevented by abolishing smoke.

J. S. OWENS.

47 Victoria Street, Westminster, S.W.1,
December 4.

Upper Air Conditions after a Line-Squall.

METEOROLOGISTS are indebted to Wing-Commander L. W. B. Rees for some very valuable observations during two aeroplane ascents at Cranwell (Lincs.) on October 19, showing the change which took place in upper-air conditions during the passage of a "line-squall" or, in the phraseology of Bjerknes, a "cold front." Observations of this kind are sufficiently rare, and the features exhibited by the present ones are so specially interesting that it seems very desirable to lay some emphasis on them.

The accompanying diagram (Fig. 1) shows the details of the records. The first ascent (dotted line) commenced at 9.15 A.M., and was made in front of the line-squall in the "equatorial air," the origin of which has now been traced back, on the charts in the Meteorological Office, to a low latitude. The figures against the curve show the relative humidity at various levels, the corresponding number of grams of water vapour per kilogram of air being given in brackets. It is necessary to remark that the report of cloud and rain encountered is not inconsistent with the apparently unsaturated condition of the air, for the cloud was not necessarily continuous throughout the thickness indicated, and, further, the instruments were read on the way up when the clouds were only just commencing to thicken and form rain. No rain reached the surface until 10 A.M. The line-squall occurred at 10.5 A.M., marking the arrival at the surface at Cranwell of the "polar air" which has been traced back to the neighbourhood of Greenland. The usual line-squall features were recorded—heavy rain, sudden veer of wind from S.S.W. to W., and sudden fall of temperature of 9° F. All the rain, 2·1 mm., occurred between 10 A.M. and noon, and presumably fell through the undercutting wedge of colder air from the "equatorial air" above. The second ascent (full line) commenced at 2.15 P.M. in response to a request by wireless telegraphy from the Forecast Division of the Meteorological Office, Air Ministry, where the first record had been received and the weather charts showed how valuable another would be.

The second record shows that the aeroplane left the ground in the "polar air" and penetrated the "equatorial air" above, but what is particularly striking is the extreme dryness of the intermediate layer extending from about 5000 ft. to 9000 ft. When a sharp discontinuity is absent between two different air currents the effect is usually attributed to mixing at the interface, but the present intermediate layer some 4000 ft. thick cannot possibly have been a

"mixing layer," for it contained a much smaller proportion of water vapour per mass of air than the layers above and below. The following considerations suggest that it belonged purely to the lower current and was, indeed, the only genuine "polar air" surviving over Cranwell.

Let the shaded figure (*a*), in the inset diagram, represent, schematically only, a vertical section (vertical scale much magnified) of a "tongue" or "globule" of cold air which has not long since penetrated from a cold source into a warmer environment. Subsequent translation and lateral spreading under gravity may lead to a condition, now at a distance from the cold source, represented by fig. (*b*), the line-squall taking place, say, at the right-hand edge. A contribution to the study of such motion has been made by Exner [Sitzungsber. Akad. Wiss. Wien, IIa, 127, 1918, pp. 795-847]. In the transition the air at A descends to C, while the surface air remains at the surface, so that the higher a layer was originally the more it is warmed adiabatically. Hence

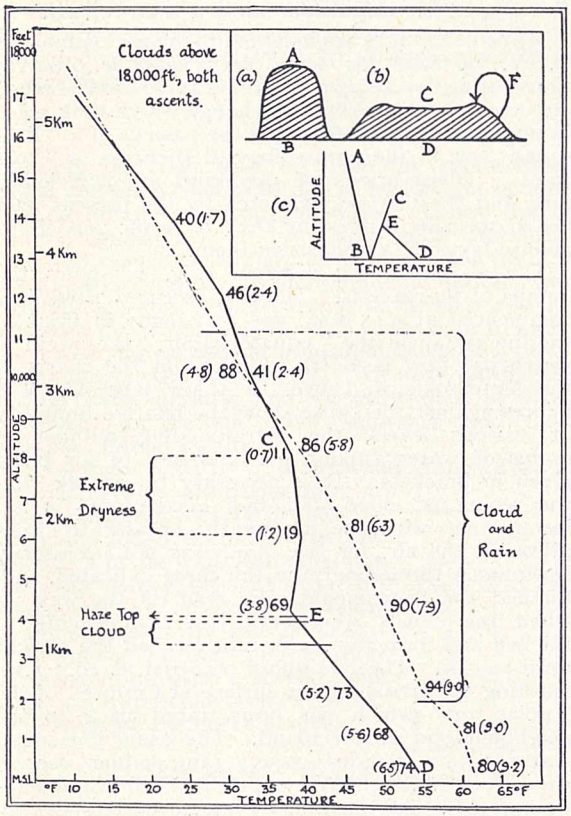

FIG. 1.

if the original lapse-rate, represented by AB in fig. (*c*), is less than the adiabatic, as is reasonable for air cooled mainly from the surface in high latitudes, it will become, from this cause alone, more remote still from the adiabatic, like CB, where AC is the slope of the "dry adiabatic." A more precise mathematical treatment of such a change of lapse-rate has been given by Margules (Exner, "Dynamische Meteorologie," 1917, p. 80). Any change of pressure, at a given level, during the transition would produce effects which would not appreciably modify that demonstrated. The sinking of the globule thus tends towards greater stability and therefore to oppose turbulence. But in passing over a relatively warm surface such as the Atlantic the cold air mass would receive heat from below, and this would be diffused upwards as far as the turbulence originating at the surface is able to penetrate in the face of the stabilising action of the sinking. A lapse line like CED would result, where E is the upper limit of mixing.

In the present case there is clear evidence of the upper limit of turbulence in the "haze-top" reported at about 4000 ft., and the layer ED in the main diagram was accordingly the one which had been warmed from below; it possessed the "dry adiabatic" lapse-rate of temperature indicative of thorough mixing, and was fairly humid, with cloud at the top, owing to water vapour, evaporated over the Atlantic, having been stirred up at the same time as the layer was warmed. The layer CE, on the other hand, was, on this view, one which had succeeded in remaining non-turbulent, and was really the only genuine "polar air" which reached Cranwell, still possessing the original low polar water vapour content and, neglecting radiation, its original potential temperature. This view is strengthened by remarking that, although the moderate decrease of humidity and small rise of temperature indicated by the upper parts of the two records may be explained, using a Hertz diagram, by supposing the "equatorial air" to have ascended, lost some moisture as "cold front" rain, and descended again, as suggested at F in fig, (*b*), no such explanation can be applied to the extremely dry layer discussed above, for the air would have to be taken to an unreasonably great height, and would also arrive back with far too high a temperature. It does not seem, therefore, that the intermediate layer can have been evolved out of the "equatorial air," and these interesting records are accordingly to be interpreted as showing that the air of polar origin over Cranwell was in all probability a "tongue" or "globule" about 9000 feet thick with the lower half partially "depolarised." Subsequent weather charts suggest that it was soon replaced again by a warmer air current right down to the surface.

Such pairs of records as this, near "cold fronts," are uncommon, the nearest approach amongst those published in the Daily Weather Reports being in the issues of October 14 and 15, 1921, two ascents at Baldonnell (Dublin) having exhibited similar features to the present. They are also important as bringing into prominence the existence well within areas of cyclonic activity of "dry inversions," the occurrence of which is more commonly associated with the margins of anticyclones.

M. A. GIBLETT.
Meteorological Office,
Air Ministry, Kingsway, W.C.2,
November 14.

Experiments on *Ciona intestinalis*.

IT is remarkable that in all the statements that I have seen by Dr. Kammerer or Prof. MacBride concerning the increase in length of the siphons in Ciona following amputation, no measurements are given. As I have recently made measurements on a number of specimens in order to obtain some data indicating the natural variation in the proportional length of the oral siphon, I should be glad if Prof. MacBride would inform us whether Dr. Kammerer has published, or whether he possesses unpublished, any measurements of the siphons in his specimens before and after amputation, and in the offspring which inherited the increased length.

I find it difficult to understand what Prof. MacBride means by the words "the reaction is of the animal as a whole." It may be a fact that amputation of both siphons results in the growth of longer siphons, and of the oral siphon alone in the growth of a siphon of the same length as before, but I do not see how

the " reaction of the animal as a whole " explains the fact.

Prof. MacBride has a photograph of an operated Ciona and a normal one side by side. What is the proportional length of the oral siphon in a " normal " Ciona, and what was that length in the operated siphon before operation and after regeneration?

J. T. CUNNINGHAM.

East London College,
Mile End Road, London, E.,
November 24.

Mrs. Hertha Ayrton.

IT must be a matter of pain and surprise to many readers of NATURE that Professor Armstrong should have written such an article as that which appears on p. 800 of the issue of December 1.

I was privileged to know, with the intimacy which is only possible to a doctor, both Prof. and Mrs. Ayrton during many years. He was my patient until he died—prematurely in one sense, but in another he lived long, and accomplished more than many men who live to extreme old age. It seems almost sacrilege to speak of their married life, or of the perfect sympathy and companionship which distinguished it; it is difficult to understand how any one professing to have been their friend could suggest that they were " an ill-assorted couple."

No woman could have nursed her husband with more untiring, unselfish, and tender devotion. Of their scientific work I leave others to speak; there will surely be many who will vindicate their memory in this respect. But as an old and intimate friend I am well qualified to protest against the heartless comments upon the private life of a very noble woman of whose living presence we are so recently bereaved. The Latin races respect their dead friends with an emotion we can at least respect. The Day of the Dead, held in reverence probably surpassing anything in the Christian ritual, has scarcely passed this year, and yet Prof. Armstrong can write such an article upon his dead friends. Surely for the rest of his life he will regret not having declined that " appeal " for an obituary notice. H. H. MILLS.

21 St. Mary Abbot's Terrace,
Kensington, W.14,
December 3.

The only comment I can possibly make on the above is, that the writer must be strangely lacking in sense of humour.

When I used to tell my friends that they were " ill-assorted," knowing this full well and knowing me, they did but smile. As did Mrs. Ayrton—when, to terminate one of our fruitless discussions on the woman as man, I sometimes said: " We will admit you are 'up to us' (apart from being yourselves), when you are regularly engaged as chefs and produce one to go down to posterity with Soyer."

May I here note the need of a correction in my article—the insertion of the accent over the first *e* in Mélisande? So beautiful a name should not be reft of the least shade of its charm.

HENRY E. ARMSTRONG.

Zoological Bibliography.

LEST it should be assumed from my friend Dr. Bather's communication to NATURE of December 1, page 794, that my letter was premature, let me state that my communication was forwarded to NATURE at the express wish of the Conference of Delegates and with the concurrence of the various officers of the British Association, who were present at the time.

There is no misunderstanding whatever as to the wishes of the representatives of the numerous scientific societies present in regard to the size of publications, and if Dr. Bather will consult such a publication as Collins's " Authors' and Printers' Dictionary," issued by the Oxford University Press, he will find that demy-octavo is slightly less than the measurements he gives, namely, $8\frac{3}{4} \times 5\frac{1}{2}$ in., and this is the size which that particular committee recommends to all societies publishing annual reports, etc. T. SHEPPARD.

The Municipal Museums, Hull.

Micelles and Colloidal Ions.

MR. W. B. HARDY in his letter to NATURE of October 13, p. 537, entitled " The Micelle—A Question of Notation," advocates the conception of the colloidal ion and postulates that the ideas of other workers coincide with his own, so that merely a question of nomenclature is involved; nevertheless, in his opinion, it is positively wrong to refer to a colloidal ion as a micelle.

It will be shown in a paper by Miss M. E. Laing which we hope to publish in an early number of the *Journal of Physical Chemistry*, that all movement in an electric field can be summed up in a single formula which applies equally to ions, diaphragms, gels, suspensions, micelles, etc., and governs the movement of any such charged constituent relative to the solvent. The experimental evidence shows that there is a gradual transition from uncharged or isoelectric colloidal particles, through those which are very slightly charged, such as the neutral micelle in soap solution or the particles in a gold sol, to those which are much more highly charged, like the ionic micelle of soaps, and then to the true ions which are fully charged.

Now comes the question of nomenclature. There is no question as to the fully charged ion where this coincides with the chemical unit. In soap solutions, however, there is a sharp distinction between the behaviour of the single crystalloidal molecules or ions and their respective aggregations, the neutral and ionic micelles, which, for example, can be held back by an ultrafilter.

It would seem as repugnant to designate an aggregate of soap ions containing substantial proportions of undissociated soap and of solvent a " colloidal ion " as it would be to call aggregates of hydrated neutral soap, which are probably the structural basis of soap jellies, " colloidal molecules," although one is as logical as the other. I have called each of these aggregates a micelle, and have described their electrical condition by adding the prefixes neutral and ionic respectively. The term micelle is customarily employed in a similar sense in contemporary French and German science. JAMES W. MCBAIN.

Dept. of Physical Chemistry,
University of Bristol.

Biography of Richard A. Proctor.

WE are at present engaged in the preparation of a " Memoir " of the late Richard A. Proctor, and to assist us in our work we should be deeply grateful for the loan of any letters which readers of NATURE may have received from him. We will carefully preserve the letters and return them as soon as possible.

S. D. PROCTOR-SMYTH.
MARY PROCTOR.

9 Orchard Road, Altrincham, Cheshire,
December 3.

The Treatment of Disease by Artificial Light.

PHOTOTHERAPY, or the treatment of disease by light, was first prominently brought to the notice of the medical profession by the work of Finsen in 1895. He demonstrated that the rays of the visible spectrum, and also those invisible radiations which we call ultra-violet rays, have varying therapeutic qualities. He showed that the exclusion of the ultra-violet rays from the skin of patients suffering from smallpox cut short the secondary fever characteristic of this disease, and diminished the suppurative stage, and, thereby, shortened the duration of the illness and lessened the risk of ugly scarring. On the other hand, he proved that the local application of concentrated actinic light had a powerful influence on certain affections of the skin, particularly on the common type of cutaneous tuberculosis known as lupus vulgaris. Before his death he had already appreciated the value of a more general application of light, namely, the exposure of the whole body to radiation.

In his earlier experiments with concentrated light, Finsen used the sun; and a simple apparatus consisting of a large hollow lens containing a blue solution was the means by which the actinic rays of light were brought to a focus upon the skin. Even with a blue medium used as a filter it was found necessary to interpose a cooling apparatus at the focus of the lens. This apparatus consisted of a small circular chamber with quartz faces through which a current of cold water constantly circulated. In addition to its value as a method of preventing excessive heating of the part, this apparatus was also used as a compressor to render the area under treatment bloodless, as it had been found by experiment that the actinic rays penetrated a blanched skin, whereas in that through which the blood was circulating the red colouring matter of the blood prevented the passage of the blue and ultra-violet rays. In Denmark, as in other countries in northern latitudes, the number of days on which the sun could be utilised was so limited that Finsen soon abandoned the sun as an illuminant and substituted powerful electric arc lights.

Following on Finsen's discovery, a number of workers in this field devised other forms of illuminant, and several lamps of high actinic power became available.

It is interesting at this point to consider the work of Rollier at Leysin. For more than twenty years he has been treating cases of tuberculosis, particularly in children, by exposing the surface of the body to the alpine sun, and his efforts have achieved a striking success. At first it was believed that the air of the high altitude was the determining factor in the admirable results obtained, but it has since been shown that it is the light which is the important agent. Rollier's success stimulated others in this branch of phototherapy, and at the Treloar Homes at Alton and Hayling, Hants, Sir Henry Gauvain has shown the practical value of this measure, even in this climate, in the treatment of tuberculous disease of the bones, joints, and skin. More recently, Reyn, in Copenhagen, has shown that the carbon arc light can be used as a substitute for the sun, and that the results of an electric light bath are as efficient as the sun bath.

The treatment of disease by artificial light, therefore, must be considered from two points of view. First, the local application of the radiations to the diseased focus, and second, the application of light to the whole of the surface, which for convenience we may call the "light bath." First, the local application of light to a diseased area; here we find two methods in use, one in which the light is concentrated by means of lenses, and the other in which reliance is placed on the intensity of the actinic radiations, without concentration.

LOCAL TREATMENT BY CONCENTRATED LIGHT.—The typical apparatus for treatment by concentrated actinic light is the Finsen lamp, or its modification the Finsen-Reyn lamp. The essentials in these are a powerful carbon arc with an automatic adjustment to approximate the carbons as they burn away. The light from the arc is focussed through a series of rock-crystal lenses in a tube containing distilled water. The rays are focussed on an area the size of a shilling, and at the focus is placed the combined compressor and cooling apparatus with a cold-water circulation described above. This type of apparatus is used mainly in the treatment of the form of tuberculosis of the skin known as lupus vulgaris. After an hour's application of the concentrated rays an inflammatory reaction occurs in the skin. The inflammation is so acute that a blister forms which may take several days to a couple of weeks to heal. It is interesting that this reaction does not begin till about six hours after the treatment. Repeated applications are usually necessary to destroy the effects of the invasion of the skin by the tubercle bacillus, but in 60 to 70 per cent. a permanent cure is obtained, many of the patients treated having been watched for twenty years.

In the original Finsen apparatus the current used is 70 volts and 50 amperes. It is therefore advisable to use a transformer when the available current has a high voltage, say 240 to 220. The carbons used are: positive, cored, 25 mm. in diameter and 12 inches long; negative, solid, 18 mm. in diameter and of the same length. By this apparatus four patients can be treated simultaneously.

In the Finsen-Reyn lamp the illuminant is of the scissors type, the current employed being 70 volts, 20 amperes. The positive carbons are cored 12 mm., the negative solid 10 mm. in diameter and 8 inches long. These lamps can be worked from the lighting mains, say of 240 volts in series, with appropriate shunts. One patient only at a time is treated with each Finsen-Reyn lamp.

LOCAL TREATMENT BY UNCONCENTRATED LIGHT.—The most convenient type of apparatus for the local treatment of diseased areas of the skin by unconcentrated light is that devised by Kromayer. It consists of a U-shaped envelope of rock crystal containing mercury vapour. This is surrounded by a second envelope with a rock-crystal window. Between the two envelopes, which are fitted in a metal box, cold water circulates, to absorb the heat rays. The window of the apparatus is pressed firmly against the area of skin to be treated, the pressure being of value in rendering the skin bloodless, and thus increasing the penetration of the ultra-violet rays. The apparatus is fixed on a mobile stand, and can be used off any ordinary

direct electric lighting circuit. On a 240 volts circuit the current used is 3·5 amperes with 120 volts across the arc. It will be noted that a water supply is necessary, a circulation of four pints per minute being required.

LIGHT BATH TREATMENT BY THE CARBON ARC LIGHT.—The experience of Reyn of Copenhagen, confirmed by other observers, is that the best illuminant is carbon arc light. The spectrum of the carbon arc more nearly approaches that of the sun than does that of mercury vapour, and in the experience of the London Hospital, this is further increased by the use of carbons with a tungsten paste core, tungsten giving a spectrum of great richness in ultra-violet rays.

The installation is very simple. A large carbon arc lamp, working at 50 amperes and 70 volts, is suspended from the ceiling at three to three and a half feet above the floor. Around this, at a distance of from three to four feet, the patients, nude, are seated on stools. The whole of the body is exposed, first the front and then the back, the sittings being of half an hour's duration at first, and these are gradually increased up to four hours a day. When the front of the body is under treatment the eyes are carefully protected by a thick mask. The tungsten paste cored carbons used are (+) cored, 25 mm., (−) solid, 18 mm., both 12 inches long.

GENERAL TREATMENT BY MERCURY-VAPOUR LAMP.—The apparatus consists of a quartz lamp or "burner" containing mercury vapour, behind which are placed reflectors of various shapes. The lamp is mounted on a stand which permits its being placed at an appropriate height. It is worked off any direct electric current, and is inexpensive to run. The practical life of a "burner" is, in the larger types, about 1000 hours. A very high actinic illumination is obtained. The patient lies or stands while under treatment, usually at a distance of about three feet, but with the larger model supplied by the Hewittic Electric Company, the maximum distance at which a patient is sensible of the radiation is eighteen feet. At the beginning of the treatment the exposures are given to small areas, and both the area and the duration may be gradually increased until the whole of the back or front of the body is exposed for half an hour. An inflammatory reaction, redness, slight vesication with subsequent desquamation, are common, and after a series of exposures, the skin in the majority of patients becomes strongly pigmented. Several of these lamps may be placed in a suitable apartment, the patients being allowed to move about. The mercury-vapour lamp has been used with success in the treatment of tuberculosis of the skin, glands, bones, and joints. Care is required in the dosage, and it is advisable to estimate the intensity of the actinic rays by a chromo-actinometer. This is specially necessary when a new "burner" is installed.

It has been shown that rickets can be prevented in animals fed on a ricket-producing diet if the surface of the body is exposed to the radiations from a mercury-vapour lamp, and there is an important field of usefulness for this form of radiotherapy carried out with due precautions in the treatment of early rickets in children.

CONCLUSION.—The sphere of usefulness of the light bath is being explored in several directions. A committee appointed by the Medical Research Council is studying the biological action of light, and several valuable investigations have been made. Among others it has been demonstrated that the bactericidal power of the blood of animals can be greatly increased by the exposure of the animal to actinic light. Clinical observation shows that there is a remarkable effect upon the metabolism of the human subject; dull, lethargic patients rapidly become bright, cheerful, and active. The body weight increases in many instances. Chronic tuberculous affections of the skin, mucous membranes, bones, and joints heal rapidly. Other chronic processes, such as rheumatoid arthritis, have also been benefited. The value of light in the prevention and treatment of rickets has been noted above. A course of treatment usually lasts three to five months. Patients whose skin pigments well usually do best, but there is no evidence to show that it is the pigmentation which is the curative factor. At present it can only be considered an index. Evidence so far points to the actinic rays producing some possibly chemical change in the blood which gives it greater power to destroy bacteria and their products.

Some Aspects of the Physical Chemistry of Interfaces.[1]

By Prof. F. G. DONNAN, C.B.E., F.R.S.

IN recent years a great deal of attention has been paid by chemists, physicists, and physiologists to the phenomena which occur at the surfaces or interfaces which separate different sorts of matter in bulk. Things could happen in these regions which did not occur in the more homogeneous and uniform regions well inside the volume of matter in bulk. A surface or surface layer represents a sort of thin cross section which can be probed and examined much more readily than any part of the inside bulk. The living organisms of plants and animals are full of surfaces and membranes. What can happen at surfaces is therefore a matter of great importance for the science of living things.

An essential characteristic of the ordering or arraying of molecules and atoms which seems to occur at surfaces may consist in *special orientation*. In the chemical and physical actions occurring in a volume of liquid the bulk of which is large compared with its surface, the molecules or atoms probably move towards each other with every sort of orientation. Should, however, some special orientation be characteristic of interfaces, then it is clear that such interfaces will exhibit new phenomena due to this special sort of arraying. Moreover, if we are dealing with molecules which are ionised into electrically polar constituents, or which, if not actually dissociated, can be treated as electrically bi-polar, it follows that, if orientation occurs at interfaces and surfaces, then electrical double layers and electrical potential differences may be set up at such boundaries.

[1] From the presidential address delivered to Section B (Chemistry) of the British Association at Liverpool on September 14.

The field of force surrounding an attracting molecule may in reality be very "irregular," and may be specially localised around certain active or "polar" groups. Its region of sensible magnitude may be very variable and relatively small compared with molecular dimensions. The chemical constitution of the molecule is now regarded as determining the varying nature of the field of force surrounding it, so that parts of the molecule possessing high "residual chemical affinity" give rise to specially powerful regions of force. In this way the older "physical" theories of cohesion according to central forces with uniform orientation have been to some extent replaced, or at all events supplemented, by "chemical" theories according to which the attractive force-fields are highly localised round active chemical groups and atoms, are relatively minute in range, and can be saturated or "neutralised" by the atoms or groups of neighbouring or juxtaposed molecules.

W. B. Hardy has been the chief pioneer in the development of these newer theories, having been led thereto by his researches on surface tension, surface films, composite liquid surfaces, and static friction and lubrication. If γ_A be the surface tension of a liquid A, γ_B that of another practically immiscible liquid B, and γ_{AB} the interfacial tension at the interface A/B, then the quantity $W = \gamma_A + \gamma_B - \gamma_{AB}$ represents the decrease of free surface energy, and therefore the maximum work gained, when a surface of A is allowed to approach normally and touch a surface of B at constant temperature. Comparing different liquids A with water as a constant liquid B, Hardy has shown that the quantity W is extremely dependent on the chemical constitution of A, and is especially high when A contains the atomic groups characteristic of alcohols, acids, and esters. Thus, for such saturated substances as octane, cyclohexane, CS_2 and CCl_4, the values of W at ordinary room temperature lie between 21 and 24. Compare with these values the following:

(*a*) Introduction of a hydroxyl group:

Octyl alcohol . . .	46
Cyclohexanol . . .	51·4

(*b*) Introduction of a carboxyl group:

n—Caprylic acid . . .	46·4
Oleic acid . . .	44·7

The natural inference from results such as these is that the cohesional forces are essentially chemical in origin and that they depend in large measure on the presence of "active" atoms or groups of atoms, namely, those possessing strong fields of "residual chemical affinity"; in other words, powerful and highly localised stray fields of electrical or electromagnetic force (or of both types). The existence of such atoms or atomic groups is strong presumptive evidence of the unsymmetrical fields of force postulated by Hardy and therefore of the molecular orientation at surfaces.

This question of the orientation of molecules at the surfaces of liquids has been greatly extended in recent years by a detailed study of the extremely thin and invisible films formed by the primary spreading of oily substances on the surface of water. In a continuation and development of the work of Miss Pockels, the late Lord Rayleigh showed many years ago that when olive oil forms one of these invisible films on water there is no fall in surface tension until the surface concentration reaches a certain very small value. He made the highly interesting and important suggestion that this concentration marks the point where there is formed a continuous layer just one molecule thick. In the case of olive oil, he found this critical thickness to be 10^{-7} cm., and concluded that this number represented the order of magnitude of the diameter of a molecule of the oil. This method was greatly developed by Devaux.

Although these researches had firmly established the theory of the formation of a unimolecular surface layer and therefore of the existence of a *new "two-dimensional" phase of matter*, we owe it to I. Langmuir to have made a very important advance by connecting this conception with the ideas of chemically active groups and molecular orientation. Influenced, no doubt, by the ideas of Hardy, Langmuir reasoned that the formation of these primary unimolecular films must be due to the presence of active groups in the molecules, which are attracted inwards towards the water and thus cause the long open chain molecules of the fatty acids to be oriented on the water surface with their long hydrocarbon axes vertical and side by side.

Working by means of the method of Devaux, Langmuir put these ideas to the test of experiment, and determined the internal molecular dimensions of a unimolecular layer. Calculation of the average distance between two adjacent carbon atoms in the three acids gave the value $1{\cdot}4 \times 10^{-8}$ cm. This distance must be of the order of magnitude of the distance between the centres of the carbon atoms in the crystal structure of a diamond, which is now known to be $1{\cdot}52 \times 10^{-8}$ cm.

These regularly oriented and unimolecular surface films on water have been recently investigated in a very detailed and careful manner by N. K. Adam, who has improved the method employed by Devaux and Langmuir. From a closer analysis of the relationship between the force of surface compression and the surface concentration (expressed as area occupied per molecule), he has shown that a distinction must be made between the close packing of the polar or active end groups (head groups) of the molecules and the subsequent close packing of the hydrocarbon chains.

Some interesting results have also been obtained in Sir William Bragg's laboratory by Dr. A. Müller. In these experiments layers of crystallised fatty acids on glass plates have been examined by an X-ray photographic method. From these results it appears that the unit cell is a long prism, the cross section of which remains constant for the substances investigated, whilst the length of the prism increases linearly with the number of carbon atoms in the molecule. The increase in length of the unit prism per carbon atom in the molecule is found to be $2{\cdot}0 \times 10^{-8}$ cm. Since it appears likely that there are *two* molecules arranged along the long axis of each unit cell (prism), it would follow that the increase in the length of the molecule per carbon atom added is $1{\cdot}0 \times 10^{-8}$ cm. Comparing this result with the value for the distance between the carbon centres in the diamond lattice, it would appear that the carbon atoms in the long hydrocarbon chains of the higher saturated fatty acids are arranged in a zig-zag, or more probably in a spiral or helix.

If this be the case, the closer packing or compression of the juxtaposed molecules in the unimolecular films, as revealed in the investigations of Devaux, Langmuir, and Adam, may be to some extent explained by the straightening out of these zig-zags, or perhaps by the "elastic compression" of the helices.

As pointed out by Langmuir, the question of the formation of unimolecular surface films can be attacked in a different manner. It is known that gases or vapours can be condensed or adsorbed by solid and liquid surfaces. The question then arises, does the formation of primary unimolecular films ever occur in such cases? It will be recollected that Hardy made the suggestion that the formation of the primary unimolecular film in the spreading of oily substances on water might be due to adsorption from the vapour. In order to examine this question, Mr. T. Iredale has recently measured in my laboratory the fall in the surface tension of mercury caused by exposing a fresh mercury surface to vapours of increasing partial pressure. The excess surface concentration q of the adsorbed vapour can then be calculated by means of Gibbs's formula

$$q = -\frac{\rho d\gamma}{dp},$$

where γ = surface tension, and ρ and p denote the density and partial pressure of the vapour respectively. Working with the vapour of methyl acetate, Iredale found in this way that at a temperature of 26° C. and a partial pressure of 62 mm. of mercury, $q = 4{\cdot}5 \times 10^{-8}$ gm. per square centimetre of surface. From this result we can readily calculate that there are $0{\cdot}37 \times 10^{15}$ molecules of methyl acetate adsorbed per sq. cm., and that the area per molecule is 27×10^{-16} sq. cm. As under the conditions corresponding to this calculation the molecular surface layer was probably not quite saturated (in the unimolecular sense), we may expect the value found to be of the same order of magnitude but somewhat greater than the values found by Adam for the cross section of the head group of the higher saturated fatty acids (25×10^{-16}) and of the esters (22×10^{-16} for ethyl palmitate and ethyl behenate). We may, therefore, say that Iredale's results appear to indicate the formation of a primary unimolecular layer built up by adsorption from the vapour phase.

Langmuir has measured the adsorption of a number of gases at low temperatures and pressures on measured surfaces of mica and glass, and has arrived at the conclusion that the maximum quantities adsorbed are always somewhat less than the amounts to be expected in a unimolecular surface layer. E. K. Carver, who has measured the adsorption of toluene vapour on known glass surfaces, has arrived at a similar conclusion. The view that the *maximum* adsorption from the gas phase cannot exceed a unimolecular layer has, however, been much criticised.

Let us now consider another type of formation of surface layers at the surfaces of liquids—namely, the case where a substance dissolved in a liquid concentrates preferentially at the liquid-air or liquid-vapour interface. Gibbs, and later J. J. Thomson, have shown that if a dissolved substance (in relatively dilute solution) lowers the surface tension, it will concentrate at the surface. That such a phenomenon actually occurs has been qualitatively demonstrated in the experiments of D. H. Hall, J. von Zawidski, and F. B. Kenrick and C. Benson, by the analysis of foams and froths. In 1908 S. R. Milner used the same method in the case of aqueous solutions of sodium oleate, and arrived at a mean value of $1{\cdot}2 \times 10^{-10}$ gram mols. excess concentration per sq. cm. of surface. In the case of dilute solution, we can calculate q, the amount concentrated or "adsorbed" in the surface per sq. cm. (excess surface concentration), and Milner calculated from Whatmough's data for aqueous solutions of acetic acid that the "saturation" value of q is $3{\cdot}3 \times 10^{-10}$ mols. per sq. cm., from which it follows that the area per molecule in the surface is 50×10^{-16} sq. cm. In a similar manner, Langmuir has calculated from B. de Szyszkowski's data for aqueous solutions of propionic, butyric, valeric, and caproic acids that the surface area per molecule adsorbed in the saturated layer is equal to 31×10^{-16} sq. cm., while Harkins has arrived from his own measurements for butyric acid at the value 36×10^{-16} sq. cm.

In 1911 Dr. J. T. Barker and I made a direct determination of q for a solution of nonylic acid in water. For a practically saturated surface layer it was found that q was about $1{\cdot}0 \times 10^{-7}$ grm. per sq. cm., or $3{\cdot}1 \times 10^{14}$ molecules per sq. cm. From this result it follows that the surface area per molecule is 26×10^{-16} sq. cm.

These values are not very different from the values found by Langmuir and by Adam for the oriented unimolecular layers of practically insoluble fatty acids resting on the surface of water. That in the present case some of the values are larger might easily be explained on the ground that these adsorption layers are partially, or completely, in the state of "surface vapours." For Adam and Marcelin have recently made the important discovery that the unimolecular surface films investigated by them may pass rapidly on increase of temperature from the state of "solid" or "liquid" surface films to the state of "vaporised" surface films, in which the juxtaposed molecules become detached from each other and move about with a Brownian or quasi-molecular motion.

It is, indeed, highly probable that the molecules which are concentrated in the surface from the state of solution in the liquid phase are not in quite the same situation as the molecules of practically insoluble substances which are placed *on* the surface. In the former case the molecules are still "dissolved," so that they will be more subject to thermal agitation and less able to form a juxtaposed unimolecular layer. They may also be "hydrated." Nevertheless, the agreement as regards order of magnitude in the values of the surface area per molecule in the two types of case is certainly very suggestive and significant.

Let me now direct attention to another very interesting phenomenon relating to the surfaces of liquids and solutions—namely, the existence of an electrical potential gradient or potential difference (P.D.) in the surface layer. The liquid-gas interface offers the simplest case of such interfaces, so the investigation of the potential differences which may exist at this interface is a matter of fundamental interest. In 1896 F. B. Kenrick developed,

on the basis of earlier experiments of Bichat and Blondlot, an electrometric condenser method for the comparative determination of the gas-liquid P.D.'s. The results which he obtained show that substances (such as the aliphatic alcohols and acids) which concentrate at the surface produce a very great change in the surface P.D., whilst highly dissociated univalent inorganic salts, such as potassium chloride, do not. The results obtained by Kenrick have been much extended by an investigation carried out with the same type of apparatus by Prof. T. Thorwaldson in my laboratory. The general result of these experiments can be described in the following terms :

Consider the system :

Aqueous solution of KCl (conc. = c) A	Air	Aqueous solution of KCl (conc. = c) B

The positive potential of A will be equal to that of B. If we now add to the solution B a small quantity of a substance S (generally a non-electrolyte or weak electrolyte) which has a strong tendency to concentrate at the air-B interface, it is found that the positive potential of A rises markedly above that of B, the value of the quantity, positive potential of A minus that of B, varying with the concentration of S in the way that is characteristic of adsorption phenomena. What is the interpretation of this phenomenon ?

Quincke has shown that a bubble of air in water placed in an electrical potential gradient travels towards the anode—*i.e.* the bubble behaves as if it were negatively charged. From this it would follow that the P.D. at the air-water interface is such that the *negative* half lies towards the air side. As an electrolyte such as potassium chloride is negatively adsorbed at an air-liquid surface, it is probable that a P.D. of the character indicated by Quincke's experiment exists at the A-air interface. If we accept this conclusion, it follows that the effect of S is markedly to *reduce* this P.D. (or to reverse it). Now the P.D. at the air-water interface is probably due to the existence of a double layer containing hydroxyl ions on the outside and hydrogen ions on the inside, or to oriented water molecules regarded as electrical bi-poles. If S is a non-electrolyte (or a substance which possesses little self-ionisation), we can understand why its concentration at the surface could result in the reduction of this P.D.

Within the last few years H. A. McTaggart has made a number of experiments on the electric cataphoresis of gas bubbles in aqueous solutions and other liquids. He finds that aliphatic acids and alcohols in aqueous solution reduce the surface P.D., and that this effect runs parallel with their influence on the surface tension of water. He also finds that acids reduce the P.D. These results may be regarded as a corroboration of those obtained by Kenrick. McTaggart has found that the nitrates of tri- and tetravalent cations have a powerful effect in not only reducing but even reversing the P.D. (*i.e.* the bubble becomes positively charged). His experiments also show that polyvalent negative ions, such as the ferrocyanide ion, act in the opposite direction to the polyvalent cations—*i.e.* they increase the negative charge on the bubble or diminish a previously existing positive one.

The subjects which I have been discussing have an interesting bearing on the formation and stability of foams and froths. If air be violently churned up with water, only comparatively large bubbles are produced, and these quickly rise to the surface and burst. If now a very small quantity of a substance which concentrates at the air-water interface be added, an almost milk-white " air emulsion " of small bubbles is produced, which rise to the surface and produce a relatively durable froth. It is clear that the diminution in interfacial tension facilitates the subdivision or dispersal of the air. The existence of the surface layer will also confer a certain amount of stability on the resultant froth, since it will give rise to forces which resist the thinning of a bubble wall. Any sudden increase in the surface will produce a momentary diminution in the concentration or " thickness " of the surface layer, and hence a rise in surface tension, which will persist until the normal thickness or concentration is readjusted by diffusion of molecules from the inside volume—a process which in very dilute solution will occupy a perceptible time.

(*To be continued.*)

Obituary.

Dr. Alexander Gleichen.

THE sudden and unexpected death of Dr. Alexander Gleichen on October 21 is reported from Berlin. Born at Niederschönweide on September 23, 1862, Dr. Gleichen commenced his higher education at the Neu-Ruppiner Academy, and later studied mathematics and natural philosophy at the University of Berlin. After passing his final examination at the University of Kiel, he became an assistant and then a head teacher at the Kaiser-Wilhelm Academy. At the same time he acted as " Privatdozent " at the Technical High School of Charlottenburg, where he lectured upon geometrical optics, a subject with which his name will always be associated. He also lectured upon mathematics at the Helene Lange College for Women.

Dr. Gleichen's academic career terminated in 1904, when he was called to the German Patent Office, with which he was connected until the end of 1918. While thus occupied, he was able to produce the *Archiv für Optik*, and later to act as editor of the scientific and technical sections of the optical and mechanical central journal. From 1919 until his death Dr. Gleichen was engaged in the scientific work of the C. P. Goerz optical establishment, where the opportunity was afforded him of applying his special knowledge of ophthalmic theory to the satisfaction of the ever-increasing demands of the spectacle industry.

Beyond Germany, Dr. Gleichen is best known as a writer of optical text-books of particular value to the student whose object it may be later to apply his knowledge to the practice of the art. This combination of theory and practice is most marked in his " Schule der Optik," published in 1914, and in his " Theorie der modernen optischen Instrumente " of 1911. The latter

book was, in 1918, translated into English under the auspices of the Committee of the Privy Council for Scientific and Industrial Research. The "Schule der Optik" has been translated into Spanish. As a theoretical treatise, his first work, published in 1902 and later translated into French, the "Lehrbuch der geometrischen Optik," is generally regarded as his most valuable legacy to the literature of optics.

The long list of Dr. Gleichen's books and contributions to scientific journals and societies is indicative of a life the leisure hours of which were exclusively applied to the study and expression of the science to which he was devoted; and yet it was characteristic of Dr. Gleichen that he was never too absorbed in his own affairs to appreciate the needs of others and was ever ready to leave his desk to assist a fellow-worker.

JAMES WEIR FRENCH.

MR. G. D. MAYNARD.

THE untimely death of George Darell Maynard at the age of forty-seven has removed another of the small company of medical biometricians which lost Dr. Goring in the pandemic of influenza and Dr. R. J. Ewart this year. Maynard did not enter the field of statistics until he had had wide clinical experience, and at the time of his death he was in active medical practice.

The first notable contribution by Maynard to medical statistics was a paper on anti-typhoid inoculation published in the sixth volume of *Biometrika*, and he contributed four other memoirs to that journal, the last of which was published this year. He was the author of three of the memoirs issued by the South African Institute for Medical Research. The first of these, "An Enquiry into the Etiology, Manifestations, and Prevention of Pneumonia amongst Natives on the Rand recruited from Tropical Areas" (November 1913), is perhaps his most important contribution. Apart from the critical appraisement of the value of inoculation, the section of the memoir which examines the evidence in favour of the view that pneumonia is an infectious disease is a strikingly original piece of work.

Maynard was the first writer to propose statistical criteria of infectiousness, and his treatment of "runs" of cases is very suggestive, while his use of time intervals shows that he had grasped a notion which has since been developed by various mathematical statisticians. The joint memoir (with Dr. G. A. Turner) on "Bantu Natives" (1914) is a careful piece of biometry, and the same may be said of his biometric study of the typanosomes of sleeping sickness (1915). Maynard's work on the correlation of the death-rates from cancer and diabetes (*Biom.* vii. 276) was one of the first applications to the problem of cancer of the calculus of correlations and contains a great deal which is valuable and suggestive. As, except during a brief period, his research work was the product of a scanty leisure, and he never enjoyed access to a first-rate collection of statistical literature, the range and accuracy of his contributions are remarkable. His loss, at the zenith of his powers, is a serious blow to science. M. G.

MR. T. F. CHEESEMAN.

BOTANY in New Zealand has sustained a heavy loss by the death of Mr. Thomas Frederic Cheeseman, Curator of the Auckland Museum. Thomas Kirk had been entrusted with the writing of the "Students' Flora" of New Zealand, but it was cut short by his death in 1897. The half-finished volume being brought out by the Government in 1899, was followed in 1900 by a commission to Mr. Cheeseman to draw up a complete flora of the Dominion, at the same time he was set free from his duties of Curator. He had begun his researches in 1870, embracing the whole region from the Kermadec Islands to Otago. The result appeared in 1906, entitled "Manual of the New Zealand Flora," and is regarded by those who have used it, as one of the best local floras in existence. This volume being completed, its author turned his attention to a series of plates in illustration, selected by Mr. Cheeseman, but drawn and lithographed in England under the care of Mr. W. Botting Hemsley, F.R.S., which were worked and sent to New Zealand, where the text was printed, and the book published at Wellington in two quarto volumes.

At the last anniversary meeting of the Linnean Society, the award was made to Mr. T. F. Cheeseman of the gold medal, its highest award, which was received for him by the High Commissioner. It was a matter of the highest gratification when received, but a few months later, news came that his death had occurred in October last, unexpectedly, though he was known to be far from strong. He had read the proof of his revised "Manual" as far as the end of Monocotyledons.

For years Mr. Cheeseman had worked alone, without a botanical companion, his knowledge being entirely due to reading and observation. He was gifted with extraordinary patience, sound judgment, and calm common sense; gentle and lovable, he had a quiet sense of humour, betrayed by the twinkle in his eye. Mr. Cheeseman, who was born in Hull in 1846, had been a fellow of the Linnean Society since 1873.

B. D. J.

WE regret to announce the following deaths:

Canon T. G. Bonney, F.R.S., emeritus professor of geology in University College, London, on December 10, aged ninety.

Lieut.-Col. H. H. Godwin-Austen, F.R.S., on December 2, aged eighty-nine.

Dr. L. Grunmach, a member of the Physikalisch-Technischen Reichsanstalt, Berlin, and Privatdozent in physics at the Berlin Technical College, on October 23, aged seventy-two.

Prof. J. Harkness, Peter Redpath professor of pure mathematics in McGill University, Montreal, aged fifty-nine.

Col. C. Swinhoe, distinguished by his work in entomology, on December 2, aged eighty-six.

Prof. C. C. O. R. Tigerstedt, professor of physiology in the University of Helsingfors, Finland, author of works on the physiology of the blood circulation, on December 2, aged seventy.

Sir Frederick Treves, Bart., formerly Hunterian professor of anatomy and Wilson professor of pathology at the Royal College of Surgeons, Serjeant Surgeon to King Edward VII. and to the present King, on December 7, aged seventy.

Prof. D. T. Wilson, since 1903 a member of the department of astronomy of the Case School of Applied Science, Cleveland, Ohio, who was known for his work on the perturbations of the minor planets, on October 12, aged sixty-one.

Current Topics and Events.

AT a very successful dinner given by the Institute of Chemistry at the Hotel Victoria on Monday, December 10, with Mr. A. Chaston Chapman, the president, in the chair, some notable speeches were made relating to the work of chemists, both in times of war and of peace. The dinner marked the 46th anniversary of the foundation of the Institute, and Mr. Chapman rightly stressed the influence which this body has had in promoting a high standard of knowledge and conduct on behalf of its members, and the services it has rendered to the community. The number of fellows, associates, and registered students now reaches a total of more than 5000, so that the Institute may claim to be of real significance to national progress. Lord Haldane, in proposing the toast of the Institute, referred to some of the developments of industry brought about by the applications of science, and he mentioned particularly the establishment and growth of the Imperial College of Science and Technology as a sign of the changed attitude of British people towards science since the days when we let Hofmann go to Berlin instead of retaining him in Great Britain. To the neglect of the vital necessity of science to national prosperity, and to lack of industrial oversight, must be attributed the loss of the coal-tar industry and its related branches. In the early days of electrical engineering also, we let other nations surpass us in the production of machinery and appliances and the employment of electric power, though we were the first to stake out claims in these fields. Though the relation of science to progressive industry is close and effective, almost no reference was made to it in the speeches and addresses with which we have been overwhelmed in the last few weeks through the General Election. The late Lord Salisbury once lamented that, while the work of the statesman, the politician, the soldier, or the leader of men, however great and however fortunate, is of necessity but transitory—what is accomplished by one man being undone by another—the work of the scientific discoverer or inventor has a permanent place in civilisation. Lord Haldane expressed the hope that, as a result of the Election, Parliament will be more interested in the diffusion of knowledge than Parliaments have been in the past, and we trust that whatever party takes the reins of Government in hand will remember that creative science may be made a most potent means of growth of the manufactures and trade of a modern state.

A LECTURE on "The Application of Science to the Fishing Industry," delivered by Prof. Stanley Gardiner at the Leeds Fisheries Exhibition in September last, has been printed and distributed. It is, primarily, a good account of the points of contact made between science and the fishing industry, and secondarily, a candid criticism of the trade. The author criticises the trawling gear, the handling of the fish, the methods of preserving the fish and the business enterprise of the trawler owners. There are fish near our coasts, he says, which we do not know how to catch. The "Scotch-branded salt herring" is described as "an appalling product, the world's taste for which has assuredly passed." But in 1913 we exported nearly 9 million cwt. of cured herrings, while we imported only about 900,000 cwt. of all kinds of canned fish, salmon included. The fact is that no way of dealing with the enormous potential catch of herrings is practicable except that of curing in salt. The next kind of cured fish that is condemned is the "Newfoundland air-dried salt cod" (much of which comes from the Scottish north-east coast). It would be as easy, the author says, to pack and export this fish brine-frozen; and doubtless it would, but for the very great difference in cost between the very cheap air-drying and the very expensive brine-freezing, to say nothing of the additional cost of transporting and refrigerating the whole cod. The methods of the canners are criticised; thus the author has "failed to discover any British-canned, smoke-cured haddock"; though these were certainly on the market in 1919. The importance of finding the plankton contents of the water as a guide to the place where to shoot herring nets is urged on the experienced skippers of drifters; but though this is sound enough from a scientific point of view, we are not surprised to learn that practical fishermen are "left cold" by scientific work of this kind. It is doubtful whether such criticism, however friendly, is the best way to persuade fishermen and trawler owners of the helpfulness of scientific research.

AT a meeting of the Optical Society, held at the Imperial College of Science and Technology, South Kensington, on Tuesday, November 27, Dr. M. von Rohr, of Jena, delivered the 1923 Thomas Young oration. The date was the 123rd anniversary of the delivery by Thomas Young of his famous Bakerian lecture "On the Mechanism of the Eye." The subject of the oration was "Contributions to the history of the spectacle trade from the earliest times to Thomas Young's appearance." The lecturer divided the subject chronologically into six parts. The first period beginning in the 13th century extends to the invention of printing, about 1448; comparatively few spectacles were then in use. The second period, relating principally to the growth of the South German spectacle factories from about 1450 up to 1620, is much better known. At about the same time Venice must have been another important centre of spectacle manufacture, for in the early days of the telescope (the Dutch form and the terrestrial telescope, both made of single, unachromatised lenses) Venetian craftsmen were supplying these instruments; but of Venetian spectacles proper only some casual hints are ascertainable. In both these centres "near" spectacles (for reading and working only) were made. Notable developments took place in Spain from about 1560 up to 1710: distance-spectacles fastened to the head were worn everywhere, even in the highest circles of Spanish aristocracy, and were introduced to China and Japan by Spanish Jesuits. The chief development between 1640 and 1740 was the production of cheap nose spectacles in Nuremberg. The spectacle grinding optician arose in the 18th century. The

greater accuracy indispensable with achromatic objectives (invented by Chester Moor Hall in 1733 and put on the market by John Dollond after 1758) placed the London spectacle maker proper on a much better footing than his Nuremberg competitor working with bad tools and to a very small degree of accuracy.

MR. A. BACHELLERY, the Chief Engineer of the French Midi Railway, read a very interesting paper on the electrification of this railway at a joint meeting of the Institution of Electrical Engineers and the Société des Ingénieurs Civils de France (British Section) on November 22. The Midi Railway of France extends in the southernmost part of that country from the Atlantic Ocean to the Mediterranean along the snow-covered Pyrenees, sending off branch lines up most of the valleys of that chain of mountains. In France the standard type of traction current is direct current at 1500 volts, and the standard type of primary current is three phase at 50 frequency. The electric energy is produced at two hydro-electric stations, in one of which the water has a fall of 2300 ft. The pressure is generated at 60,000 volts, but for long-distance transmission it is converted to 150,000 volts, which is the highest pressure used in Europe at the present time. The economies effected by the use of electric traction are notable. The hydro-electric energy is much cheaper than the corresponding energy obtained from coal. Substantial economies on engine shed and repair shop expenses have been effected by electrification. The steep grade on the Bayonne to Toulouse line which took a steam locomotive 34 minutes to climb is now climbed in 13 minutes. The railway company also finds it very profitable to supply electric energy to villages in the neighbourhood of the transmission lines. It intends to electrify 2000 miles of road. The Paris-Lyons-Mediterranean and the Paris-Orleans companies are also electrifying 3800 miles of line. The latter company is constructing a 300 mile 150,000 volt line from the Dordogne power plants to Paris. It will be seen that main line electric traction is making satisfactory progress in France by standardised methods. The English traction engineers who spoke in the discussion agreed practically with the author's conclusions. We have reasons for believing that, before long, main line electric traction in Great Britain will make considerable advances.

As a result of the fire which followed the great earthquake in Japan on September 1, nearly the whole of the collection, amounting to 700,000 volumes, in the library of the Tokyo Imperial University was destroyed. We are glad that an organised effort is to be made by the British Academy to repair this loss. At a meeting of representatives of learned societies, publishing houses and other bodies concerned with the publication and use of books, held on Monday, December 10, at the Royal Society, with Lord Balfour, as president of the British Academy, in the chair, an executive committee was appointed to organise the collection of works for the restoration of the Library. In a letter to Sir Israel Gollancz, secretary of the British Academy, the president of the Tokyo Imperial University states that most of the works destroyed belong to the domains of literature, philosophy, commerce, statistics, and similar departments of the humanities and social science. The Institutes of Physiology and Pharmacology have also lost nearly all their books, but no reference is made by the president to the position of other science libraries, so that we hope it may be assumed that they have, in the main, escaped damage. The vice-chancellors of British universities have already taken some steps towards the supply of books for the Tokyo Imperial University Library, but the appeal to be made by the British Academy will no doubt reach a much larger circle of sympathisers, and we are sure that all British learned institutions, as well as numerous individuals, will respond generously, in money or suitable literary gifts, to the effort to be made to repair the immense losses which the University has experienced.

DURING the coming season the work of the British School of Archæology in Egypt at Qau will be continued. In particular, search will be made for the source of the ancient human remains, found last year by Mr. Brunton, which are held to belong to the Palæolithic Age. Further explorations will be carried out in the cemetery in which the oldest Coptic MS. of St. John's Gospel was discovered, and the prehistoric cemeteries to the north will be worked in the hope of further discoveries of the ripple pottery and its associated styles. The papyrus of the Gospel of St. John has now been completely opened, photographed, and mounted. It is not only the oldest Biblical Coptic MS., but it is older than any Greek MS. of the Gospel with the exception of the Vatican MS. It is to be edited as a publication of the School by Sir Herbert Thompson, while the manuscript itself is to be placed in the collection of the British and Foreign Bible Society.

NEWS from the Norwegian expedition in the *Maud*, which is drifting across the Arctic Ocean, has appeared in the *Times*. The reports were sent out by the *Maud's* wireless installation and received by the Spitsbergen Radio station. In March 1923 the *Maud* was in lat. 74° 2′ N., long. 170° 20′ E., and was drifting north-west. In September its position was lat. 76° 16′ N., long. 163° 30′ E., when a long-continued north-west gale set in and drove the ship and pack-ice towards the south, with a result that in the end of October it was in lat. 75° 10′ N., long. 159° 30′ E. The current in that part of the polar basin is reported to be from the north-north-east, thus disposing of the likelihood, which was never strong, of extensive land to the north-east of the De Long islands. The *Maud* would appear to be drifting towards the New Siberia Islands, and if it should succeed in passing to the north of that group, will traverse an interesting and unknown part of Arctic Seas, but there is little prospect of the drift taking her to a high northern latitude. Conditions proved unfavourable for the use of the aeroplane. Throughout the summer, there was much mist and the temperatures were low. The floe offered few safe landing-places. Several trial flights were disappointing, and the last one resulted in serious damage to the aeroplane. Scientific

observations from the ship, especially current measurements, have been continued. Captain Wisting reports the death of Mr. Syvertsen, the ship's engineer.

IT is announced in the *British Medical Journal* that the French Minister of Public Instruction has introduced a bill for the purpose of awarding to Madame Curie a pension of 40,000 francs per annum, in recognition of her scientific work. It is proposed that the pension shall be conferred on December 28, the twenty-fifth anniversary of the announcement of the discovery of radium by Madame Curie and her late husband.

THE annual Exhibition of Scientific Apparatus organised by the Physical Society of London and the Optical Society will be held at the Imperial College of Science, South Kensington, on Wednesday and Thursday, January 2 and 3. The Councils of these Societies invite members of the Faraday Society to attend the Exhibition. Admission is by ticket only, for which application must be made to the Secretary of the Faraday Society.

A COTTON Research Botanist is required at Lyallpur, Punjab, by the Indian Central Cotton Committee, whose duties will consist of investigations with a view of improving local and American cotton schemes. Candidates should possess high qualifications in cotton-breeding and plant-physiology, and apply, with full particulars of age, education, training, and experience, by, at latest, December 24, to the Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1.

AT the request of the Local Committee arranging the meeting of the British Association at Toronto next year, the Council of the Association has changed the date of the meeting from September to August 6-13. The main party will leave England about July 25; and the excursion tour will be after the meeting instead of before it. The new arrangements will, we believe, be preferred to the old by most of the members who propose to attend the meeting, which is likely to be large and successful, as many members of the American Association also intend to take part in it. The British Association will meet in Southampton in 1925, and has received an invitation from the University and city of Oxford to meet there in 1926, which will in due course be presented to the general committee.

THE gold medal of the Royal Scottish Geographical Society has been awarded to Dr. Hugh Robert Mill, and the Livingstone gold medal to Dr. Marion I. Newbiggin, in recognition of their distinguished service in geographical research and exploration. In presenting the medal to Dr. Mill, Lord Salvesen, president of the Society, referred to some outstanding points in Dr. Mill's career. For eighteen years he was chairman of Trustees and Director of the British Rainfall Organisation and editor of "British Rainfall" and *Symons's Meteorological Magazine*, while for seven years he was one of the British representatives to the International Council for the Study of the Sea. He has made noteworthy contributions to geographical research and literature. Referring to Dr. Newbiggin, Lord Salvesen spoke of her services as editor, since 1901, of the *Scottish Geographical Magazine*, and of her many works on biological and geographical subjects.

THE first Experimental Report to the Atmospheric Corrosion Committee of the British Non-Ferrous Metals Research Association will be presented and discussed at a meeting of the Faraday Society to be held on December 17, at 8 P.M., in the rooms of the Chemical Society, Burlington House, W.1. The very comprehensive series of field tests and laboratory experiments described in the Report were carried out by Mr. W. H. J. Vernon on behalf of the Committee. Persons interested in the subject desirous of attending the discussion may obtain a ticket of admission from the secretary of the Faraday Society, 10 Essex Street, London, W.C.2.

AT one time planters were usually at least part owners of the estates that they cultivated, but now most of them are simply salaried employees of London companies. In the report of a sub-committee appointed by the Incorporated Society of Planters upon salaries, general conditions and terms of service on rubber estates in the Malay Peninsula, etc. (Kuala Lumpur, 1923), the rubber planters of Malaya, a numerous body of Europeans, suggest the restoration of the old rate of pay (reduced during the recent slump), and the granting of leave as in Government service at a definite rate, with free passages home for planter, wife, and children. The climate is trying, leave every few years is needful, and cost of travelling has greatly increased. If the prestige of the white man is not to suffer, and the quality and efficiency of the planters to be kept up, something must be done to improve the present conditions.

A PARAGRAPH has recently appeared in the technical press referring to a violent explosion which set fire to and sank the British steamer *Otterburn*. The paragraph stated that the disaster was thought to be due to the explosion of barrels of chlorate of potash. Mr. W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers, informs us that there appears to have been no chlorate of potash on board the ship, but that there was a parcel of chloride of potassium. The transport of dangerous substances is always a matter of difficulty, and it is particularly undesirable that the difficulties should be added to by blaming unnecessarily what is known to be a dangerous substance.

THE Scientific Novelties Exhibition last year in aid of King Edward's Hospital Fund for London, at King's College, Strand, W.C. 2, proved so successful that a similar exhibition has been organised for the approaching Christmas vacation. Demonstrations and experiments illustrating modern scientific discovery and research will be in progress 2-5 P.M. and 6-9 P.M. daily throughout the period when the Exhibition is open, December 29-January 9. In addition, a number of distinguished scientific workers are giving their services as lecturers. Every day there will be four or more lectures; among the subjects dealt with in this way are: tuning forks, Egyptian mummies, flame, acoustics of buildings,

atoms and electrons, muscular exercise, giant and dwarf stars, monkey glands, the Himalaya, astronomical evidence bearing on Einstein's theory, the fuel of the future, and new uses of silica in industry. The full time-table of lectures and tickets in advance can be obtained from the secretary of King Edward's Hospital Fund for London, 7 Walbrook, E.C. The unusually wide scope provided by the lectures and demonstrations in both pure and applied science, and the authority given by the names of the lecturers and those associated with the Exhibition, should prove an attraction which it is to be hoped will be of even greater financial assistance to the hospitals of London than the Exhibition of last year.

NOVEMBER was abnormally cold this year in many parts of England, and in places the month was said to be colder than any previous November on record, a feature perhaps greatly due to the short period of observation. Using the meteorological observations at Greenwich Observatory for the civil day, published by the Registrar-General in his weekly return, and comparing with similar observations available from 1841, it is seen that the month's temperature was not unique. The mean temperature for the month was 38·8°; since 1841 there have been three years, 1851, 1871, and 1879, with a lower mean than November this year; the lowest was 38·0° in 1871. The mean of the maximum or day readings was 44·2°; since 1841 there have been three Novembers with a lower mean maximum, in the years 1871, 1879, and 1919, and the lowest was 43·2° in 1871. The mean of the minimum or night readings was 33·3°; there were also three years, 1851, 1871, and 1910, with a lower mean minimum than this year; the lowest was 32·4° in 1851 and 1910. The lowest shade temperature in November was 22·7° on November 26 and 23·4° on November 8; there have been ten Novembers since 1841 with a lower temperature, but only two with a temperature below 20°; the lowest was 18·3° in 1890. The lowest radiation temperature at Greenwich in November this year was 14·0° on November 12 and 14·1° on November 8; there have only been five Novembers since 1856 with a lower radiation temperature; the lowest was 9·1° in 1908.

A DISPATCH from the Belgrade correspondent of the *Times* published on December 6 records some interesting discoveries at Doiran and Mitrovitsa. At Doiran, the ruined town situated on the lake of the same name, which formed part of the Bulgar front line in Macedonia during the War, workmen have brought to light large columns of white marble, presumably part of a temple, well-preserved marble tablets with finely carved reliefs of the heads of six Greek gods, a quantity of coins, and a vase so large that two men can stand in it with ease. This last should be comparable with the enormous Græco-Roman vase found on the Struma, which stood in the gardens of the French Military Club at Salonika in the latter years of the War. At Mitrovitsa two Roman graves were found on the site of the old Roman Sirmium, once the metropolis of Illyricum. Of these, one contained the sarcophagus of a girl of 14 years of age. The bust of the girl and her brother are represented in relief. The names in the Latin inscription suggest that the girl was a Pannonian, possibly living under the Emperor Marcus Aurelius in the third century A.D. The sarcophagus had evidently been plundered and contained nothing but the skeletal remains.

Our Astronomical Column.

RECOVERY OF D'ARREST'S COMET.—This periodic comet was not seen at the 1917 return, and experienced large perturbations by Jupiter in 1920 (minimum distance from Jupiter 0·50). Two nearly identical computations of the perturbations were made: (i.) by Mr. F. R. Cripps, (ii.) by A. Dubiago and A. Lexin of Kasan. Their respective dates of perihelion were 1923, Sept. 14·12 and Sept. 14·715; the other elements of (ii.) were ω 174° 1·5′, Ω 143° 31·7′, i 18° 3·9′, ϕ 38° 1·1′, μ 534·783″, equinox 1925·0.

In spite of these accurate forecasts, search was vainly made for the comet during July, August, and September. However, on Nov. 10 at 11^h 50^m S.A.S.T., Mr. William Reid, of Rondebosch, Cape Town, well known for his cometary discoveries, found a comet the approximate position of which was R.A. 21^h 30^m, S. Decl. 28° 30′. His description was: "Fairly large, very faint, slightly brighter in middle, no nucleus. It appeared like a faint star-cluster with many stellar points." A position on Dec. 1 at 9^h 21^m G.M.T. was telegraphed: R.A. 22^h 39^m 32^s, S. Decl. 25° 16′.

These positions leave no doubt that the object is D'Arrest's Comet, which has presumably brightened physically since the summer. The date of perihelion deduced from the observations using elements (ii.) is Sept. 15·15 G.M.T. The following ephemeris is for Greenwich midnight:

	R.A.	S. Decl.	log r.	log Δ.
Dec. 16.	23^h 22^m 16^s	21° 36′	0·2304	0·2000
,, 20.	23 32 48	20 33	·2369	·2147
,, 24.	23 43 16	19 29	·2436	·2293
,, 28.	23 53 12	18 24	·2500	·2435
Jan. 1.	0 2 56	17 20	0·2565	0·2576

As the distances from sun and earth are rapidly increasing, the comet is not likely to be seen for long. Its recovery is a matter for great satisfaction, as it was in danger of being permanently lost. The present observations will enable accurate predictions to be made for the next two apparitions; the Jupiter perturbations are small in the revolution now commencing.

INTERESTING CEPHEID VARIABLE.—Señor Comas Sola, of Barcelona, discovered, in April last, an interesting variable star in R.A. 15^h 14·2^m, S. Decl. 8° 11′. Harvard College Observatory Bulletin 791 describes a photographic study of the star, which shows that it is a periodic variable with sharp maxima, the period being approximately 0·369 day. It is a Cepheid of the "cluster" type; the extreme range of magnitudes is from 10·8 to 12·5, which is noted as larger than usual for this type. The Bulletin gives a series of suitable comparison stars for the variable, the magnitudes of which are from 7·8 to 12·8. The galactic co-ordinates are 322° +38°.

Research Items.

JĀBIR IBN HAYYĀN.—In a paper in the Proceedings of the Royal Society of Medicine, 1923, vol. 16 (section of the History of Medicine), p. 46, Mr. E. J. Holmyard has collected the information we possess relating to Jābir ibn Hayyān, the most celebrated chemist of Islam. He appears to have lived during the latter half of the 8th century A.D. His birthplace is unknown, but he lived at Kūfa for at least part of his life, perhaps also at Bagdad. He was a voluminous writer, but most of his works are lost. Mr. Holmyard gives a list of the works of Jābir ibn Hayyān, with ninety-two titles. Whilst primarily a chemist, he wrote also on medicine, geometry, astronomy, philosophy, optics, and poetry, was interested in mysticism, and his writings show that he was a man of fine intelligence. The chemical writings indicate an extensive practical knowledge of the usual chemical operations, which he attempted to explain, and the theory of the composition of metals from sulphur and mercury found in the Latin writings of "Geber." Mr. Holmyard leaves open the difficult question as to the identity of the latter with Jābir ibn Hayyān, but he shows conclusively that the arguments so far adduced to prove the contrary are often incorrect and are wholly inadequate.

PINK AND BLUE FLOWERS.—Dr. W. R. Gelston Atkins has a very interesting contribution to the problem of colour in flowers in a paper upon the pink and blue flowers of the Hydrangea in the Scientific Proceedings of the Royal Dublin Society, vol. 17, pages 201-210. It appears that the pink form is usually found in soils with a P_H of 6 or more. Above P_H 7·5, pink flowers appear to be the rule, while blue flowers predominate in more acid soils. Examination of the flowers shows that difference in colour is not due to a difference in reaction of the flowers themselves, but experiment showed that pink flowers contain far less iron than blue ones. In the more alkaline soils ferric salts are no longer available to the plant, and Dr. Atkins's work seems to give good grounds for thinking that difference in colour of these flowers depends in some way upon the greater availability of the iron to the plants growing in the more acid soils.

PLANT PHYSIOLOGY AND VITALISM.—Prof. Walter Stiles, of Reading, makes a brief contribution from the point of view of the plant physiologist to the discussion in progress in the pages of *Scientia* for November upon the subject of vitalism and mechanism. His main theme appears to be that both morphology and physiology seem to be in agreement at the moment that the most hopeful line of attack upon the problem presented by the form and structure of the organism is along the lines of development. The species may be regarded as a special physico-chemical aggregate of substance which provides a definite range of possibility in the final form and structure of the mature organism, depending upon conditions both external and internal prevailing during its development. Engaged in the task of tracing the connexions between this original species substance, the conditions under which it develops and the structures to which it gives rise, physiology is so far from having solved even its most immediate problems, even in those cases where there is little reason to doubt that greater understanding will show that a physico-chemical explanation is adequate, that it has as yet paid little attention to the more abstract question as to whether a closer acquaintance with the complexity of the living organism will find the machinery of physics and chemistry insufficiently resourceful.

THE PAMIR EARTHQUAKE, 1911.—In a paper recently published in the Quarterly Journal of the Geological Society (vol. 79, 1923, pp. 237-245), Mr. R. D. Oldham urges that the Pamir earthquake of February 18, 1911, was the cause and not, as the late Prince Galitzin considered, the result of the great landslip which occurred at the same time (NATURE, vol. 111, p. 682). The disturbed area of superficial earthquakes, as in the Ischian earthquake of 1883, is always small; that of the Pamir earthquake was more than 200 miles in diameter, while the region of destructive intensity was at least 40 miles in length. The earthquake was followed by after-shocks, and numerous landslips occurred in other parts of the central district. Moreover—and this is the most important point—the great landslip occurred close to the east end of that district. Mr. Oldham thus concludes that the earthquake was of deep-seated origin, though he regards it as possible that the unusual development of the surface waves may have been due in part to the landslip.

COMAGMATIC REGIONS AND WEGENER'S HYPOTHESIS.—Prof. H. S. Washington has completed his studies of the lavas of the Hawaiian Islands by an account of the succession of olivine-basalts in Kilauea, and by a general summary of his analytical results (*Amer. Journ. Sci.*, vol. 206, p. 338, Oct. 1923). The inclusions brought up from the depths are lumps of peridotte and picrite, and nothing whatever has been found to justify Wegener's suggestion that the Pacific volcanoes are built over residual crust-blocks left behind by drifting continents. Prof. Washington directs attention to this point in a paper on "Comagmatic Regions and the Wegener Hypothesis" (Journ. Washington Acad. Sci., vol. 13, p. 339, 1923), and he cites a number of cases in which the igneous rock-types, in districts regarded by Wegener as having been formerly united, differ markedly on opposite sides of the Atlantic. The Triassic plateau-basalts of the later Karroo series resemble those of S. America, from Brazil to Argentina; but such islands as occur in the S. Atlantic contain sodic and not sodic-calcic (basaltic) lavas (p. 346). An example of two identical comagmatic regions, separated by oceanic waters, appears in the description of "The Dolerites of King George Land and Adelie Land," by Dr. W. R. Browne (Australasian Antarctic Exped., Sci. Rep., Ser. A, vol. 3, pt. 3, 1923). The resemblance between the igneous series in Tasmania and that in the region due south of it in Antarctica appears to be complete. Prof. Washington has sought such identity in vain in his study of the opposed coasts of the North Atlantic.

WEATHER OF AUSTRALIA.—A report of the Meteorological Service of the Commonwealth of Australia has just been issued for the year 1921–22 by Mr. H. A. Hunt, the Commonwealth Meteorologist. Like many other meteorological and scientific establishments in different parts of the world, the funds available for the work are not sufficient to allow of desirable and much needed extension. The author has pointed out the direct monetary value derived by the general public and special trades and employments from the

activities of the Weather Bureau and its weather forecasts. There are many industries helped by rainfall, while others are hindered. Weather changes such as heat and cold, fog, hail, and squally conditions are referred to as influencing general trade and journeyings. In confirmation of good work done, reference is made to the death roll of the pearling fleet in Western Australia; the lives lost in 1887 numbered 200, while in 1910 the deaths had decreased to 40. For the improvement of flood and storm warnings as well as the ordinary forecasts for the general public, reports are badly required from more land stations as well as from ships at sea. The Government Meteorologist deplores the want of funds for the purchase of instruments required for observational work. Data are available for aviators, but funds are required for their publication, and tracks of hurricanes and storms in Australia and the neighbouring sea, in the South Pacific, for which data exist, require printing for the guidance of navigators. There are 484 climatological and 5922 rainfall stations distributed throughout the Commonwealth and the immediate neighbourhood. Pilot balloon ascents for upper air research during the year numbered 1049; the observations show great turbulence of the atmosphere in the Melbourne region, owing to Melbourne being situated largely in a basin, almost surrounded by hills.

NEW DISSECTING MICROSCOPE.—Messrs. R. and J. Beck, Ltd. (Cornhill, E.C.3), have submitted one of their crescent dissecting microscopes for our inspection. The base consists of a heavy crescent-shaped casting with a central pillar for the lens and end-pieces supporting the hardwood hand-rests and thick glass stage. The lenses, which may be either simple or achromatic, are carried in a swinging arm fitted to a solid rod which moves up and down the central pillar by a rack and pinion for focussing, the milled head actuating this being set at a convenient angle. The range of motion is more than three inches. Below the stage and swinging in gimbals is a mirror, one surface of which is silvered; the other is of opal white glass. The hand-rests are very comfortable and the whole instrument is very stable, so much so that it can be used as a compound microscope by attaching a microscope body to the swinging arm.

ACTION OF SODIUM ARSENITE ON PHOTOGRAPHIC PLATES.—When commercial sodium arsenite is applied to a photographic plate it renders it developable, and so, apparently, produces the same change in it as exposure to light does. Lüppo-Cramer suggests that the change is of the nature of the production of traces of an unstable complex, which provides the necessary starting places for initiating the action of the developer. Mr. Walter Clark of the British Photographic Research Association maintains that this suggestion is wrong and that the evidence which he brings forward in a recent communication (*British Journal of Photography*, November 23) is in favour of his contention that the developable condition is brought about in this case by the action of the arsenite "on material other than silver bromide which is present in or adsorbed on the silver halide grain." Mr. Clark finds that a preliminary treatment with chromic acid "lowers to an enormous degree the sensitivity of a plate to arsenite solution," and argues that the formation of complexes would not be affected by this treatment. He finds that sodium arsenite of the formula $NaAsO_2$ (or NaH_2AsO_3) does not react with silver bromide; he gives the characteristic curve produced by treating the plate with the arsenic solution for increasing times, the equivalent of increasing exposures to light, and other interested details connected with this subject.

MÜLLER X-RAY SPECTROGRAPH.—The now numerous applications of X-ray spectrometry are provided for in a new X-ray spectrograph designed by Dr. Müller and constructed by Messrs. Adam Hilger, Ltd. (75a Camden Road, N.W.1). The instrument is described in a pamphlet of a scientific quality and accuracy which merit high praise. Dr. Müller's instrument is of simple design, and possesses an accuracy sufficient for the great majority of work. It provides for the oscillation of the crystal by means of a clockwork motor, the normal working conditions being about 40 oscillations per hour through an angle of about 12°. Insulated levelling screws and a protective lead screen are provided. The spectrograph is available for any of the three standard methods. For the Bragg method (single crystal) the slit consists of two brass blocks 26 mm. long, which are clamped at a known distance apart. The plate holder is designed to take plates $4\frac{3}{4}$ in. $\times \frac{3}{4}$ in. For the Debye method, a powder holder is mounted in place of the crystal carrier. The slit is replaced by a brass block containing a circular aperture 1 mm. in diameter, which points at the powder holder and fits into an aperture of a circular camera, 6 cm. in diameter, bearing a photographic film. A small further change makes the instrument suitable for taking photographs by Hull's method for powders. The spectrograph should prove very useful to crystallographers for information on lattice structure, to chemists for analysis of materials used as X-ray targets, to metallurgists for the investigation of the crystalline structure of metals and alloys, and to radiologists for measuring X-ray wave-length and composition.

LUMINESCENCE OF BORON NITRIDE AND CALCIUM TUNGSTATE.—Under certain conditions of preparation boron nitride lights up when brought into contact with the edge of a flame, and fluoresces in the same spectral region under the action of cathode rays. Herr E. Tiede and Frau H. Tomaschek describe experiments in the *Zeitschrift für Elektrochemie*, July 1, 1923, which show, first, that the methods of preparation which give active material are those which favour the crystallisation of the boron nitride, and second, that an examination of active and of inactive material, by the Debye and Scherrer X-ray method, proves that the active material is crystalline, while the inactive is amorphous. The first of these authors and Herr A. Schleede describe experiments with calcium tungstate, very pure specimens of which may give intense blue fluorescence under the action of X-rays, with no trace of phosphorescence afterwards. A minute amount of impurity reduces the fluorescence, and produces phosphorescence, the intensity and period of which is strongly influenced by the nature of the impurity and the method of preparation, as in the case of the sulphide "phosphores." The fluorescence depends on the temperature at which the substance is prepared, no effect being produced with cold preparations, and the intensity increasing up to the highest temperature used, 1100° C. An X-ray examination showed that the active material was crystalline, the interference lines becoming more and more marked as the temperature of preparation was raised. An old specimen, prepared in the cold three years ago, which originally showed no fluorescence, was found to fluoresce strongly, and when submitted to X-ray examination proved to be strongly crystalline.

Loud-speaking Telephones.

THE Institution of Electrical Engineers and the Physical Society of London had a joint meeting on November 29—Dr. Alexander Russell, the president of both societies, being in the chair—to discuss the problems connected with "Loud-speakers for Wireless and other Purposes." The meeting aroused extraordinary interest owing to the popularity at the present time of loud-speakers in connexion with broadcast reception, and several hundreds of members were unable to obtain admission into the lecture theatre of the Institution of Electrical Engineers.

Prof. A. O. Rankine discussed the general principles involved in the accurate reproduction of sound by means of a loud-speaker. He pointed out that there has been a sudden great public demand for a good instrument, and that the solutions given have practically all been obtained by the method of trial and error. Stated roughly, the problem is how best to secure that sounds emitted in one place may be a sufficiently faithful copy of sounds emitted in another.

The difficulty of the problem lies in the fact that the reproduced sounds must be of considerable intensity. If we are content with feeble intensity in reproduction there are already available sufficiently good loud-speakers. It appears on theoretical grounds that to procure reproduction absolutely perfect in the physical sense—as distinct from the acoustical—is not feasible owing to the variety of transformations necessary in practice.

There is first the amplification of the electrical fluctuations; in the second place, there is the process whereby the current excites corresponding variations of air pressure; and thirdly, there is the treatment of the aerial vibrations after they have been created. So far as the amplification of the electrical waves is concerned, it is found that the more thermionic amplifiers used the more difficult it is to get exact reproduction. The second question, the transformation of a portion of the electrical energy into sound energy, is a very wide one. It may be transformed by electromagnetic, electrostatic, or thermal means, and each method provides a different field for investigation. Lamb has stated that the simple harmonic type of vibration has the pre-eminent position in mechanics because it is the only type which retains its character absolutely unchanged when it is transmitted from one system to another. We can conclude, therefore, that sounds cannot in general be reproduced with perfect precision. All that can be done is to avoid too great changes in the character of the vibrations. Scientifically it is convenient to dissect these vibrations into their harmonic components.

In aiming at loudness there is a temptation to resort to resonance effects in order to secure it. For example, in the majority of telephone diaphragms there are natural frequencies within the frequencies of the sounds used. The corresponding components therefore get preferential treatment. This can be remedied to a considerable extent by damping the diaphragm, but unfortunately this reduces its general sensitivity. An alternative plan is not to reduce resonance but to confine it to values beyond the upper limit of audibility, or at least as far in that direction as practicable. Another plan is to choose mechanisms of very low natural frequencies, but there are theoretical reasons for considering this method not so desirable.

The method is used, however, in a device perfected by Siemens and Halske. It consists of a strip of thin metal foil suspended between the poles of an electromagnet as in the Einthoven galvanometer. The plane of the foil is parallel to the magnetic field, and the incoming telephonic current flows through the foil. This responds by mechanical movements perpendicular to its plane, and is the equivalent of the ordinary telephonic diagram. Its fundamental natural period is two seconds, and it is said to operate without a horn.

In Prof. Rankine's opinion, horns should, whenever possible, be dispensed with owing to their resonant character. The ideal sound resonator would be spherical in shape and excited in such a way that it imparts to the neighbouring air symmetrical fluctuations of pressure. For speech transmission, all room reflections should be damped out both at the sending and at the receiving stations. A large number of listeners, however, appear to be asking for echo effects. In his opinion, when loud-speakers are used, echoes and reverberations should be eliminated at least at one end. In broadcast opera, where transmission already unavoidably has this effect, the listening room should be draped much in the same way as the transmitting room usually is draped.

Prof. C. L. Fortescue considered that, with properly designed valves, no serious distortion was due to the amplifier. In the later stages of the amplification, however, it is necessary to use valves having a considerable power output.

Mr. E. K. Sandeman gave a valuable demonstration of the relative importance of each frequency region in the audible spectrum. By suitable wave filters he cut off all the vibrations with frequencies less than 500 transmitted to a loud-speaker. He showed that the effect on the intelligibility of the speech transmitted from another room was not appreciable, but the "naturalness" of the speech was notably impaired. When all frequencies greater than 1700 were eliminated by filters, the speech was scarcely intelligible. This might be considered as the lowest limit for commercial speech transmission. He proved that the intelligibility was much the same when all frequencies above 1500 were cut off as when all frequencies below 1500 were cut off. Simple and interesting methods of testing speech transmission were given.

Dr. W. H. Eccles compared the advent of broadcasting news and speeches in the history of the world to the advent of the printing press. Whether for good or ill, it had come to stay. Loud-speakers could be used to broadcast political speeches to very large audiences. He mentioned a case in America where a speaker was plainly audible, by means of these devices, to an audience of 700,000.

Mr. G. A. Sutherland, who discussed "auditorium acoustics and the loud-speaker," pointed out that uniform loudness is associated in practice with the absence of curved walls. Curved walls always produce main and subsidiary foci, and are a menace to good acoustics. More satisfactory hearing is likely to be obtained by distributing an audience into a number of small rooms with a loud-speaker in each than by attempting to accommodate them all in a large hall. The presence of an audience is very effective in reducing reverberation. A sure indication that a room is suffering from excessive reverberation is given when increasing the loudness of the sounds increases the distortion. When a loud-speaker is too rich in higher-pitched notes the presence of a large audience has a corrective effect.

Mr. S. G. Brown gave a successful reproduction, by means of his "Frenophone," of a portion of an opera that was being broadcasted by 2LO, the London Broadcasting Station. This instrument has

a rotating glass disc and a steel-backed cork pad which rests in contact with its surface. The cork is linked to a loud-speaker movement, and a telephone receiver presses on the back of the cork. The frictional drag thus varies and works the device.

Capt. Eckersley exhibited a French loud-speaker which gave very satisfactory reproduction. He said that the solution of the problem depended on the loud-speaker at the receiving station. He stated that if properly magnified the signals transmitted by the London Broadcasting Station would give perfectly satisfactory reproduction of speech and music.

Although the meeting started at 5.30 and went on to 9.45, with an hour interval for dinner, the interest of the audience never seemed to flag. The speakers were unanimous in agreeing that the perfect loud-speaker had still to be invented.

Congress of the French Society of Chemical Industry.

"THE exchange of international thought is the only possible salvation of the world," words used by Thomas Hardy, form the text of two recent articles by John Galsworthy in the *Times*. Something more than an exchange of thought internationally is required—close personal acquaintance and direct exchange of opinion are the real needs. It was with this idea in mind that several of us attended the conference of the Société de Chimie Industrielle in Paris on October 21-26—and the game was more than worth the candle, if only as giving the opportunity of appreciating French *politesse* and their incomparable ability as social entertainers. No more is to be said for them than for ourselves as organisers of an effective gathering of scientific workers: they are as unfortunately subdivided in their interests as we are; as little prepared as we are to overcome the evils of the gross specialisation and narrowness of outlook which to-day retard the progress of science within its own ranks and in public esteem. The conference met at the Conservatoire National des Arts et Métiers in fifteen sections, and in each section the programme was disjointed.

The proceedings were opened by a reception on the Sunday evening at the Hôtel Majestic by the president and his wife, M. and Mme. Paul Kestner, a noted name in French chemical industry, which carries us back to the first sulphuric-acid chambers and the discovery of racemic acid, the foundation upon which Pasteur built his colossal edifice. An exquisite musical and terpsichorean entertainment was provided, in which a most refined sense of proportion and sobriety was displayed.

The session was opened on the Monday morning by the president, supported by the Minister of Commerce. An address was then given by M. Menozzi, director of the Agricultural School at Milan. The intention was to make agriculture the primary subject of the conference. After this some of the sections got to work. In the evening, foreign delegates were entertained at dinner by the "Bienvenue Française"—a society which exists with the object of promoting amicable relations between foreign visitors to Paris and the French; the society appears to owe its success largely to Mme. Juvenel, a lady not only full of energy but also gifted with irresistible charm of manner. The dinner was followed by a most perfect musical entertainment in miniature.

On Tuesday there was more sectioning, and in the afternoon a lecture by Prince Giorno Conti on his boric-acid works. Dr. Herbert Levinstein was the chief morning dish—the heroic and collected reader of a long historical statement of the development of the British dyestuff industry, in a French which all the English-speaking members of the audience—who were in the majority—could understand without difficulty. His courage was much admired.

At the closing meeting, on the Wednesday, Sir John Russell gave an address on the relations between the organisms in the soil and its fertility, lecturing with his accustomed fluency; this was much appreciated. In the evening a great banquet was given at the Hôtel Palais D'Orsay.

Thursday morning was spent in visiting the works of M. Potin, who has large grocery stores in Paris, where the fining of *vin ordinaire* is carried out on a large scale. Then the party proceeded to the chocolate works of M. Menier, on the banks of the Marne, where they were entertained at lunch before inspecting the factory. A more perfectly appointed establishment cannot be conceived. On Friday there was an excursion to Rheims. The cathedral was first visited, under the guidance of his Eminence Cardinal Luçon, a man of wonderful vigour though eighty-four years old. In the course of his address, he most solemnly assured us that the cathedral was never used as a post of observation. The manufacture of champagne was then studied in the vaults of Messrs. Pommery and Greno, after which the party was entertained at lunch by the firm. In the afternoon we were motored across the rolling chalk plain on which Rheims is situate to the Hiedsieck vineyard and the Moulin de Verzenay, whence we could see the whole extent of the great battlefield. Much has been done towards restoring the cathedral; the roof is rebuilt, and Rheims itself is half rebuilt. Cathedral and town are a moving spectacle—stark witness of the brutality and barbarism of the German invaders. With such evidence before one, it is impossible not to understand the bitterness of French feeling—to excuse them almost any action in self-protection. Rheims cathedral will long remain a certain proof that the world can never allow German "civilisation" to be the dominant factor. The French are but asking for honourable treatment—for at least part of that which is due to them; but they can obtain no evidence of their enemy's willingness to fulfil his obligations. M. Vidal, the assistant-secretary for technical education, who presided and spoke with wonderful eloquence and convincing sincerity at the Rheims luncheon, was most definite in his assertion that France was entirely pacific in intentions; and the same assurance came from other prominent speakers during the week.

Whatever the value of the meeting in technical respects, socially it was a very great success, and we left it wiser men. French was spoken in many styles, and not a few of our hosts showed themselves to be masters of English; still, the need to cultivate a knowledge of each other's language was ever before us. To think internationally we must understand one another better; true understanding is greatly helped by meetings such as that now described, and it should be regarded as the duty of scientific workers to avail themselves of these opportunities. It is significant that we have a Galsworthy telling us that the future is with science, not to destroy but to save. We need to be up and doing. The public will not come to us, the Press is not with us; it is for us to go forward. The French

are clearly a people of wonderful courage and energy; they are constructive; they are willing to be governed and have a government; the whole nation is at work. The downfall of Germany is due to the destruction of its government: only the appearance of a Bismarck can save it. We may well take warning. We seem to show no constructive power; the politicians are at fault, without imagination, without outlook; our moral attitude towards work, in all classes, is unsound. Unless our science can be made effective we shall soon be nowhere.

HENRY E. ARMSTRONG.

The Present Position of the Ergot Problem.

AMONG well-known drugs, ergot has always occupied a peculiar position. A parasitic fungus, which after many disastrous epidemics was recognised as a scourge, ultimately became the chief medicament of the obstetrician. The numerous attempts of the nineteenth century to isolate its active constituents now appear of little value, but the fundamental discovery by Tanret in 1875 of the crystalline alkaloid ergotinine, $C_{35}H_{39}O_5N_5$, still stands out. Unfortunately this substance does not produce the characteristic effects of ergot to any considerable extent; much later a second alkaloid, ergotoxine, $C_{35}H_{41}O_6N_5$, discovered simultaneously by Barger and Carr in Great Britain, and by Kraft in Switzerland, was, however, found by Dale to have a powerful physiological action, and to produce, for example, the characteristic gangrene. The subsequent discovery, by Barger and Dale, of small amounts of powerfully active, non-specific amines in ergot extracts led some clinicians, particularly in Germany, to substitute these amines for ergot, and to neglect the specific alkaloids.

Attention has been recently again focussed on the latter by A. Stoll, of Basle, who gives in *Die Naturwissenschaften* for August 17 and 24 a résumé of earlier researches and of his own work. In certain varieties of ergot Stoll has discovered two new crystalline alkaloids of the formula $C_{33}H_{35}O_5N_5$. One of these, ergotamine, was found by Spiro to resemble ergotoxine in action, and more recently Dale and Spiro, in a joint paper, declared ergotamine and ergotoxine to be pharmacologically identical. There are therefore no complications on the biological side. Ergotamine can be converted into a less soluble and less potent isomer ergotaminine, which in some respects is analogous to Tanret's ergotinine. Stoll has thus discovered a new pair of alkaloids, showing great similarity to the older pair. The physiologically potent member of each pair has the same action, a finding which, according to Stoll, also results from unpublished experiments of Rothlin. Chemically the new pair are also closely related to the old, by colour reactions, decomposition products, optical rotation, etc. Ergotamine and ergotaminine both differ from ergotinine by C_2H_4, and from ergotoxine by C_2H_6O, the elements of a molecule of ethyl alcohol.

Yet all attempts to convert one pair of alkaloids into the other pair have failed, and for the present they may be regarded as homologues. From some specimens of ergot Stoll obtained only ergotamine, from others only ergotoxine; sometimes both alkaloids were isolated. Yet the identity of the action of these two alkaloids is remarkable, and without parallel among homologues. Are they perhaps both formed from a common precursor by the different methods of extraction employed? Are they perhaps converted into the same active substance in the body? Their puzzling relationship certainly deserves further investigation, which is, however, rendered difficult by the scarcity of suitable material, greatly accentuated by the War.

This seems to be the present position of the ergot question. The résumé under review deals in a useful manner with the older work, and shows how during the last two decades our knowledge of the active principles of ergot has been placed on a solid foundation, largely through English and Swiss work. Most of the investigations of the last century the writer dismisses as valueless. His own important contributions are of the kind we might expect from one who was associated with Willstätter in the study of chlorophyll.

Clothes Moths and their Control.[1]

AMONG entomologists there are well known to be two very common moths the larvæ of which are destructive to fabrics; namely, the case-making clothes moth (*Tinea pellionella* L.) and the webbing clothes moth (*Tineola biselliela* Hum.); the tapestry moth (*Trichophaga tapetzella* L.) is much less frequent but is occasionally destructive. In the case-making clothes moth, the larva makes a portable habitation out of its silk, together with fragments of the material upon which it feeds. It withdraws completely into the case when resting, but when feeding or moving it protrudes its head and foremost body-segments. Pupation also takes place within the case, which is sealed up and anchored to the fabric or other object. The webbing clothes moth is the most abundant species of the three; its larva does not construct a portable case, but spins silken tunnels wherever it crawls over the material which it is consuming. When fully fed it constructs a silken cocoon intermixed with particles of fabric and excrement; this pupal shelter, therefore, is quite different from that of the species previously mentioned. In the rarer tapestry moth the larva constructs silk-lined burrows through the substance of the material which it infests.

[1] Clothes Moths and their Control, by E. A. Back. U.S. Dept. of Agric. Farmer's Bull. 1353, July 1923. 28 pp. with 21 figs.

In general, the larvæ of clothes moths feed upon wool, fur, feathers, hair, and all fabrics manufactured from them. It will therefore be realised that they may be found attacking not only clothing but also carpets, rugs, furs, upholsteries, stuffed animals, brushes, felts in pianos, and the like. The moths are relatively short-lived; they take no nourishment and are in themselves harmless. Their eggs are laid upon or between folds of fabrics or within the meshes of the latter. They are readily crushed by brushing, etc., and are very fragile. Under average indoor conditions they hatch in about a week, this period being subject to lengthening or shortening according to temperature. The larvæ are relatively long-lived and require from about fifteen weeks to two years to complete their development. Much depends upon the nature of the material upon which they are feeding and the temperature conditions under which they exist. The pupal, or resting, period varies from about eight days in warm summer weather to a month or more in winter. In the British Isles the moths are commonest between June and October, and their larvæ are feeding the great part of the remainder of the annual cycle.

Methods of dealing with these pests are numerous. Fabrics that are well brushed or beaten every two weeks are seldom seriously affected: exposure to

direct sunlight is also a valuable measure. Articles of clothing that require to be stored are immune from attack if sealed down in paper bags, or very securely wrapped in several layers of quite unbroken newspaper. Naphthalene, in the form of flakes or balls, should be placed among the clothing thus fastened up. It also acts as a deterrent when placed in drawers or cupboards, but is not entirely effective under such conditions. Paradichlorobenzene appears to be as valuable as naphthalene, but camphor is decidedly less effective.

On a large scale, the cold storage of furs, carpets, and furniture is the most certain of all preventives, and this method is coming more and more into use. Extensive infection of carpets, upholsteries, etc. in large houses, hotels, etc. may need fumigation in order to eradicate clothes moths completely. An effective remedy, which is also non-injurious to furniture, fabrics, plate, or other household goods, is the application of hydrocyanic acid gas. Its manipulation requires the services of an intelligent person who understands the dangers of its use and knows how to administer it. Carbon tetrachloride is also effective, and has the advantage over hydrocyanic acid gas in being neither explosive nor inflammable. Fumigation with sulphur is a well-known remedy, but there is some danger from fire in its application, while it has a bleaching effect on many delicate fabrics, wallpaper, etc., besides tarnishing metals. Carbon disulphide is also recommended, but its vapour is inflammable. Dry heat is now recognised as an effective agent in killing insects. All fabrics will be freed from pests in a very short time if exposed to a temperature of 130° F. Lower temperatures have been found effective against clothes moth larvæ; the latter when exposed in an incubator at 128°, 120°, and 110° F. died in 6, 11, and 31 minutes respectively. Fabrics dipped in water heated to 140° F. will be found to contain no living eggs or larvæ of clothes moths.

It may also be mentioned that there are a number of worthless remedies against these insects, including powdered sulphur, hellebore, and borax; also lavender flowers, cayenne pepper, reasonable strengths of tobacco powder, and other substances are of no value in keeping away these insects. A. D. IMMS.

Science in Agriculture.

THE somewhat belated appearance of the annual report of the Rothamsted Experimental Station for the year 1921–22 does not deprive it of the perennial interest which must always attach to the doings of this institution. For historically, Rothamsted can claim to be almost the earliest example of the benefits that result from the application of science to industry. From the economic point of view, the discoveries of Lawes and Gilbert take a very high rank in the history of scientific achievement. The most remarkable feature of the early work of Rothamsted was the success with which field and laboratory work were combined. With the ever-growing complexity of all regions of knowledge, it has become increasingly difficult to maintain this tradition. The refinements (the application of statistical methods may be instanced) which modern field research demands, and the revolution in many of the fundamental conceptions of science, are two factors. On the applied side, another obstacle is the smaller apparent margin for improvement in the practice of modern husbandry. Whereas the discoveries of the early workers were productive of changes in farm practice of the order, in terms of economic results, of 100 per cent., in these days, improvements are only possible to the extent, as it were, of 10 per cent.

A recognition of this fact is implied in the statement contained in the report that "the most important development of recent years has been the reorganisation of the work of the Station so as to bring it into touch with modern conditions of agriculture on one side and of science on the other: it is hoped to reorganise in the near future the farm and field work and to improve the field technique." It unquestionably adds to the difficulties of this reorganisation that it should coincide with a period when the whole economic basis of arable farming is so precarious as it is to-day. It is being openly said that arable farming, and particularly the growing of cereals, cannot be made to pay in present circumstances.

In dealing with the finance of the farm attached to the Station, the report states that "from 1920 onwards, the financial results are deplorable, and they show clearly why many of the arable farmers to-day are in their present position." The report does not specifically indicate the most promising line of investigation calculated to remedy this disastrous state of affairs, but there can be little doubt that the Department of Soil Physics, of which the assistant director, Dr. B. A. Keen, is the head, and to which precedence is given in the report, should be so regarded. Under the heading, "The Cultivation of the Soil," some account is given of investigations which promise to yield results which may indicate to the farmer methods by which the cost of cultivation can be reduced, and "costs of cultivation dominate the future of arable farming." In this connexion it may be significant that the American farmer apparently has been able to grow wheat at a profit with a yield of 16 bushels to the acre, whereas the British farmer with a return of 32 bushels is losing money. It is a reasonable deduction that it pays better to reduce the costs of cultivation than to aim at maximum production. In other words, the British farmer may still be paying court to methods the chief recommendation of which is their superior artistry.

In the section headed "The Feeding of the Plant," it is interesting to learn that "broad beans die prematurely unless they receive a homeopathic dose of boric acid in addition to the so-called 'complete' plant food." It is remarkable that a discovery parallel to that of the rôle of accessory food factors in animal nutrition should have been made in relation to plants.

The volume of purely scientific work done at Rothamsted would appear to be considerably greater than that carried on in relation to so-called applied science. As many as fifty-two scientific papers were published during the year by members of the staff. Of these, two were of Royal Society rank, namely:—"The Mathematical Foundations of Theoretical Statistics" (R. A. Fisher), and "A Quantitative Investigation of the Bacterial and Protozoal Population of the Soil" (D. W. Cutler, L. M. Crump, and H. Sandon).

The financial support which the Station now receives from the State is considerable. For the year under notice grants from the Development Fund totalling 22,030*l.* were received. In 1912 the total was approximately 3000*l.* It must be a source of gratification to the director, Sir John Russell, that so great an expansion should have taken place during his term of office.

The Quantum Equivalent in Photo-electric Conduction.

IF light of frequency ν is sent through a cold gas which does not absorb it, sensitised by admixture of a second gas which can absorb the light; and the pressure is such that the mean time between two collisions is of the same order of magnitude as the mean life of the excited state of the gas; all those spectral lines of the non-absorbing gas appear which have a smaller excitation energy than $h\nu$. On the other hand, those which require more energy than this are not seen. Results with mixtures of mercury and thorium vapours, and of mercury and silver vapours, using the light of the 2536·7 Å Hg line, agree, on the whole, closely with the above statement. The method can also be used in fixing the series relations between the lines of an element, since it allows us to determine which spectral lines can be excited by an amount of energy smaller than a given amount. Results have been obtained at Göttingen for lead and bismuth, which will shortly be published.

In a paper in the *Zeitschrift für Physik*, 17-3, August 23, p. 202, Messrs. G. Carlo and J. Franck consider the theory more closely, and describe experiments which agree with their conclusions. The sensitising gas A has, as the longest wave of its absorption series, a line of frequency ν, while the corresponding line of the fluorescing gas has the frequency ν_1. Suppose $h\nu : h\nu_1 :: 1 : \frac{3}{4}$; then if light of frequency ν is used, both ν and ν_1 will appear. The elementary act of transmission of energy from an excited atom of A to an atom of B will take place in such a way that $\frac{1}{4}\,h\nu$ is converted into energy of translation of the colliding atoms. If the temperature is so low that the kinetic energy of temperature movement is small, compared with $h\nu$, the atom receives, besides its excitation energy, the kinetic energy $\frac{1}{2}m_1v_1^2 = \frac{h\nu}{4} \times \frac{1}{1+m_1/m}$. This abnormal velocity of the excited atom of B produces a Doppler effect; the effective frequency is $\nu_2 = \nu_1(1+\cos\,\phi v_1/c)$, and this is not absorbed by the other practically resting atoms of B.

An experiment with sodium vapour, sensitised with pure argon, has verified the theory. Sodium vapour can be made to fluoresce by means of the zinc line, 3303 Å, and the sodium can also be excited directly by the D line. Conditions were so adjusted that the tube appeared equally bright with either of these sources, and the light from the fluorescing sodium, in each case, was passed through an absorption tube, containing sodium at a suitable temperature. The light excited by the D line was completely extinguished, while that obtained with the zinc line was much less weakened.

If, in a second experiment, light of frequency ν_1 passes through the mixture of gases A and B, an emission of ν from A can result only if the temperature of the gas is so high that the energy difference $h\nu/4$, which is lacking for the excitation of A, can be obtained on collision from the kinetic energy of the atoms. Experiments have been made with thallium and mercury, and with cadmium and mercury, using the Hg line 2536·7 Å. The quartz vessel containing the vapours was placed in an electric oven, which could be raised to 800° C.; and strong fluorescence was obtained with thallium. In this case it was possible that a thallium line, the excitation energy of which amounts to 5·5 volts, while the energy of 2536·7 Å corresponds to 4·9 volts only, was due to a double or step-by-step process of excitation. At 800° C. part of the atoms are no longer in the normal state; and apparently there is a 1 volt excitation step, from which, up to the 5·5 volts stage, only 4·5 volts would be required, or more than for 2536·7 Å.

With cadmium and mercury this difficulty does not arise, and the confirmation of the theory is direct. It is possible, however, to draw conclusions from the relative intensity of the lines in the fluorescent spectrum of thallium, as compared with the ordinary spectrum of this substance. The differences are ascribed to the differences in absorption, due to the presence or absence of the Doppler effect previously described; and the combined results of the two experiments seem to prove, conclusively, that quantum energy and translation energy can work together, as an elementary act, to produce excitation of the atom.

Early Methods of Oil Painting.[1]

By Prof. A. P. LAURIE.

IT is evident both from the manuscript of Theophilus and the manuscript of Eraclius that the properties of such drying oils as linseed oil and walnut oil were thoroughly understood as early as the 12th century, if not earlier.

The methods used in their preparation differ very little from the best practice of to-day. The refining and bleaching of the oil and the use of driers was well understood, nor is there any indication, in passing from those earlier recipes to those of the 15th century, that any new discovery of importance was made at the time of the brothers Van Eyck. Passing to later times, Vasari directs that pigments are to be ground in walnut oil or linseed oil, and this is all that is necessary; he recommends the use of walnut oil as less liable to darken with time.

Many recipes for varnishes are given, and, as neither spirit of turpentine nor alcohol was available in commercial quantities until the end of the 15th century, these varnishes are what we should now describe as oil varnishes, consisting of resins dissolved in hot oil. The natural balsams of the pine, resin, mastic, and sandarac, often all mixed together, were used in the preparation of these varnishes. The proportion of resinous material to oil being very high, the varnishes were consequently very sticky and had to be heated and rubbed on with the hand. Spirit varnishes corresponding to the mastic varnishes of to-day are found in 16th century and later recipes.

The evidence of the accounts preserved at Ely and Westminster show that both oil and varnish were used in painting on walls during the 13th and 14th centuries, this being the northern tradition, while the Italian tradition was the use of egg as a medium. There is no indication in these recipes of any special secret differing from what we know to-day.

These early pictures were painted on a wood panel sometimes covered with strips of linen and coated with a gesso made of parchment size and whitening or plaster of Paris which had been soaked in water until it lost its binding properties. Recent experiments carried out by Mr. Thompson at the Heriot-Watt College, Edinburgh, on an old 16th century panel have revealed the fact that this panel was coated with a non-absorbent gesso upon which a very thin layer of absorbent gesso was laid so as to ensure the binding of the oil to the surface of the gesso and, at the same time, to preserve from staining the pure white surface

[1] Synopsis of lecture delivered at the Royal Academy of Arts, London, on Wednesday, November 14.

of the gesso below. On this pure white gesso panel the picture was drawn in detail and laid out either in monochrome or partly in colour with pigments probably mixed with size. Upon this were laid the pigments ground in oil, or it may be an emulsion of varnish and egg, care being taken to paint the high lights very thinly as compared with the rest of the picture. In course of time the oil yellows and the pigments, more especially the white lead, get more translucent. By painting the picture in this way the artist ensures that the increased translucency of his white lead will correct the yellowing of the oil owing to the white light being reflected from the gesso, and that his contrast of light and shade will be maintained.

There is much more yet to be discovered as to these early methods, and the question as to whether varnish, emulsion, or oil was used, has still to be finally cleared up, but our knowledge of the general methods of procedure is growing.

The Geological Society of China.

THE Geological Society of China is one of the scientific institutions founded since the establishment of the Chinese Republic in 1911. The first two Bulletins of the Society promise well for its future. One of the first papers deals with the history of geology in China, which it carries back to early times; but it shows that independent Chinese work on the subject on scientific lines dates from 1911, when V. K. Ting and H. T. Chang returned to China from their western studies. Mr. Chang, the first president of the Society, organised a department and school of geology under the Ministry of Commerce at Nanking in 1912. The Geological Survey of China was established in 1916 with Mr. Ting as its director, and he also secured in 1918 the reopening of Mr. Chang's geological school, which had been discontinued in 1916. To Messrs. Ting and Chang is due the establishment of the promising school of Chinese geology. They have been aided by Mr. Lee, a Chinese student who was trained at Birmingham, Prof. Grabau, the well-known American palæontologist, now professor at Pekin, and Dr. Gunnar Andersson, formerly head of the Geological Survey of Sweden, and now mining advisor to the Chinese Government and director of the Geological Survey Museum.

The two Bulletins contain a valuable series of contributions to the geology of China. They include a lecture given to the Society by Prof. Berkey, of Columbia University, New York, on "the New Petrography," which attaches most importance to the mode of origin of rocks; Prof. Berkey proposes a plethora of new names such as reactionite, saturite, evaporite, disintegrationite, and recrystallisationite. The new petrology must be vigorous to sustain such a nomenclature. The section of this paper of most interest is its expression of the reaction in America against the ingenious quantitative arrangement of rocks which is often known as "the American classification." Prof. Berkey represents that classification as mechanical and misleading, and sets it aside as only a side issue in real petrology.

Prof. Grabau contributes three papers, of which the longest is on the Sinian system; he protests against the modified use of that term proposed by Prof. Bailey Willis, who, with the temporary agreement of von Richthofen, interpreted Sinian as Lower Palæozoic. Von Richthofen, however, appears soon to have gone back from that modification of his term. Prof. Grabau justly holds that the term is in that sense useless, and he applies it to the sedimentary formations in China of pre-Cambrian age. In that sense it is equivalent to the Toridonian, which, as well as the Sinian, Prof. Grabau includes in the Palæozoic.

Mr. Wong contributes a short note upon Chinese earthquakes and on the distribution of the chief seismic centres. The red beds in China are discussed in three papers. Mr. Wong shows that those in Shansi belong to two horizons, one pre-Jurassic and the other later than the Jurassic Coal Measures. Mr. Hsieh shows that in Kansu these deposits range from the Jurassic to the Kainozoic. Mr. Tan describes a marine red series of Eocene age as widely developed in Shantung, and its discovery is one of the most interesting recent additions to Chinese geology.

Three papers by students of the University of Pekin on observations during an excursion to the Nankou district add materially to the knowledge of that now classical section. Prof. Grabau describes from their collections three new species of Collenia, which he explains are based only on the external characters; in the absence of microscopic evidence it must be quite doubtful whether these supposed calcareous algæ are of organic origin. Prof. G. B. Barbour, of the Pei-yang University, Tientsin, describes an intrusive sill in Shantung which, according to his interpretation, shows the effect of gravitational differentiation. The intrusion is pre-Cretaceous, and the later folding and faulting in this region are now definitely identified as Oligocene or Miocene, as the movements are later than the newly discovered Eocene deposits and earlier than the Pliocene.

The two volumes are in English, with a title-page and contents and a summary of one paper in Chinese. Chinese characters are given of the personal names. The titles of some papers which are to be published in future bulletins suggest that the interest of this serial will be well maintained. J. W. GREGORY.

University and Educational Intelligence.

ABERDEEN.—The Senatus Academicus has awarded the following research scholarships: Fullerton scholarship in science to Mr. Charles Bisset; Robbie scholarship in chemistry to Miss Margaret F. Aitken.

A mural tablet in memory of the late Prof. James W. H. Trail, F.R.S., professor of botany in the University from 1877 until his death in 1919, has been placed in the classroom of the new Department of Botany, and was unveiled and presented to the University, on behalf of the subscribers, by Sir David Prain, on Friday, December 7. The tablet is mounted on a slab of slate. A portrait plaque in dull green bronze is surrounded by a wreath of oak leaves, acorns, and galls. It is flanked by two Brazilian palms, and a decorative panel shows other natural objects representing the varied interests of Prof. Trail. The tablet is the work of Miss Alice B. Woodward. The subscribers have also issued a memorial volume which, besides biographical and bibliographical matter, includes the "Flora of the City Parish of Aberdeen," a comparative and historical work of great detail which had occupied Prof. Trail for many years, and had been completed shortly before his death.

CAMBRIDGE.—A fellowship has been founded at Christ's College by Mr. J. Pierpont Morgan, a member of the College. This is the first addition to the number of fellowships in the College since 1682, and represents a valuable endowment all too rare in these modern times.

The Empire Cotton Growing Corporation has offered to the University a sum of 1000*l.* a year for five years to be devoted to the Plant Genetics Depart-

ment of the School of Agriculture, in accordance with a scheme that has been agreed upon by the Corporation and the Director of the Plant Breeding Research Institute.

Prof. C. E. Inglis, Prof. B. M. Jones, and Prof. G. I. Taylor have been appointed as members of a committee to make recommendations to the Trustees of the Edward Busk Studentship in Aeronautics.

Mr. E. G. D. Murray, research bacteriologist to the Medical Research Council and formerly on the staff of the War Office Central Cerebro-spinal Fever Laboratory, has been elected to a fellowship at Christ's College.

LIVERPOOL.—Applications are invited for the Campbell Brown chair of industrial chemistry. The person appointed will be required to devote his time to research work, with a certain amount of advanced teaching on the chemistry of oils, fats, and waxes other than mineral. Applications must reach the Registrar of the University before March 1 next.

LONDON.—Applications are invited for the Quain professorship of physics, tenable at University College, in succession to Sir William Bragg. They should reach the Academic Registrar, University of London, South Kensington, S.W.7, by, at latest, January 3. Applications are also invited for the University readership in statistics at the London School of Economics. The latest day for the receipt of applications by the Academic Registrar of the University is January 4.

ST. ANDREWS.—An interesting experiment is to be tried in the institution by the University Court of a series of courses of lectures to be held in University College, Dundee, for the convenience of the managing and clerical staff of the L. and N.E. Railway or of other railways. The first course to be carried out is that in railway law, Mr. James Allison having been appointed lecturer. It is intended later to hold courses in railway economics, railway geography, and railway operating.

THE following have been elected as representatives of the Universities in Parliament:—Cambridge: Sir Geoffrey Butler (U.) and Mr. J. F. P. Rawlinson (U.); London: Sir S. Russell-Wells (U.); Combined English (Birmingham, Bristol, Durham, Leeds, Liverpool, Manchester, and Sheffield): Sir Martin Conway (U.) and Mr. H. A. L. Fisher (L.); Combined Universities of St. Andrews, Glasgow, Aberdeen, and Edinburgh: Rt. Hon. Sir H. Craik (C.), Sir G. Berry (C.), and Mr. D. M. Cowan (L.); Queen's University, Belfast: Col. T. Sinclair (U.).

THE Bradford Technical College may shortly become a constituent college of the University of Leeds. It originated in weaving and designing classes at the Bradford Mechanics' Institute in 1877. The main building, finished in 1882, includes lecture rooms and laboratories of departments of chemistry, dyeing, engineering, architecture and building, biology, mathematics, and physics. A textile block, opened in 1911, includes a practical dye-house, finishing shed, special dyeing research laboratory, and a power house specially arranged for demonstration and experimental purposes. Since 1920 there have been added a new engineering block, specially equipped for advanced work and research on internal combustion engines, and union buildings with refectory and common rooms and athletic grounds.

THE provision of ten post-graduate scholarships for the session 1924–25 for overseas students at the Imperial College of Science and Technology, South Kensington, has been announced. Lord Buckmaster, chairman of the governing body of the College, made the offer to the Secretary of State for the Colonies on behalf of "private friends" inspired by the great purpose and opportunity of the College, the only educational institution in Great Britain on the governing body of which are representatives of the Dominions and India, and it has been accepted. The scholarships will be each of the value of 300*l.*, and two will be available for university students of each of the Dominions of Canada, Australia, New Zealand, South Africa, and of India. No conditions have been laid down as to the selection of scholars, this being left entirely in the hands of the Prime Ministers of the Dominions and of the Government of India.

CONTACT between the Secondary School and the community it serves is, according to the report of the West Riding Education Committee for 1922–23, conspicuous by its absence, the prevailing local opinion being that these schools are primarily, if not entirely, intended to produce teachers—this, notwithstanding that in fact less than 20 per cent. of the pupils enter the teaching profession and notwithstanding the efforts made to secure recognition by employers of the "First" and "Second" examinations. In connexion with these efforts some headmasters have, says the report, interviewed local chambers of commerce and have modified their school curricula in the light of information thus gained, in order to bring it into closer relation to local industries. The committee recently permitted its inspector in charge of secondary education to visit the United States for the purpose of studying American schools. In that country much attention has, of late, been devoted to promoting co-operation between the school and the local industries.

THE twelfth annual conference of Educational Associations will be held on January 1-11, at University College, Gower Street, London, W.C.1, under the presidency of Sir Henry Hadow. The presidential address on "The Claims of Scholarship" will be delivered on the first day of the meeting by Sir Henry Hadow. In all, some forty associations concerned directly or indirectly with education will be holding meetings and conferences. Among the papers and lectures to be given are the following, the body responsible and the date being given after the author's name in each case: "The Value of Psycho-Analysis to the Educator," by Miss Barbara Low (Montessori Society, January 1); "The Sun and Stars," by Sir Richard Gregory (School Nature Study Union, January 2); "Modern Developments in Education and the Outlook for the Future," by Mr. J. Howard Whitehouse and others (Society for Experiment and Research in Education, January 3); "School Reform," by Prof. J. J. Findlay (King Alfred School Society, January 4); "The Teaching of Hygiene and Racial Progress," by Mrs. Hodson (Eugenics Education Society and Ling Association, January 4); "Handwork and Life," by Mr. E. Young (Educational Handwork Association, January 5); "Recent Advances in the Relations of Psycho-Analysis to Education," by Dr. J. Glover (British Psychological Society, January 7); "Light and Life," by Sir Henry Gauvain (Association of Teachers of Domestic Subjects, January 8); "The Question of an International Language," by Prof. F. G. Donnan (International Language (Ido) Society, January 9). An exhibition by publishers of books, maps, etc., has been arranged as in former years, but the exhibits will be placed in the College Memorial Hall where there is more room for an adequate display. Scientific and kindergarten apparatus, etc., will form a separate exhibition.

Societies and Academies.

LONDON.

Royal Society, December 6.—E. G. T. **Liddell** and Sir Charles **Sherrington**: Recruitment type of reflexes. Isometric myograms of the crossed knee-extensor reflex examined in the purely "spinal" preparation present the features interpretable as "recruitment" very much as in the decerebrate preparation. The reflex process answerable for "recruitment" is therefore obtainable in purely spinal centres without the adjuvance of prespinal. An attempt to classify various reflexes on the criterion of presence or absence of "recruitment" is briefly entered on.—G. S. **Carter**: The structure and movements of the latero-frontal cilia of the gills of Mytilus. The structure of these cilia has been investigated by means of the micro-dissection needle. They are complex, and are composed of 10-15 simpler structures which have the form of triangular plates. In the living cilium they are placed in contact one behind the other in the plane of the beat, and together form the blade of the cilium. Their external edges are formed by fibres, which are each attached to a basal granule lying within the cell. These plates will beat independently, and it is concluded that they rather than the compound cilia form the units of ciliary action in these cells. The difference in rigidity shown by the cilium during the two phases of the beat is also shown when a motionless cilium is pushed by the needle in the two directions.—V. B. **Wigglesworth** and C. E. **Woodrow**: The relation between the phosphate in blood and urine. Ingestion by man of doses of the acid and alkaline sodium phosphates containing 1·5-2 gm. of phosphorus causes a rapid 50-60 per cent. increase in the blood phosphate, which then returns very gradually to the normal level. In the dog, phosphate is excreted rapidly by the kidneys instead. The curve of urinary excretion of phosphate runs roughly parallel to that of the blood concentration, but the former varies more widely, and is roughly proportional to the excess above a certain value in the blood. Under conditions in which the blood phosphate is subnormal, normal, or slightly above normal in amount, the concentrations in plasma and corpuscles are identical. When the concentration in the plasma rises far above normal the value for the corpuscles is always lower, whether the plasma value is rising or falling. This unequal partition cannot be explained by the formation of an organic "acid-soluble" phosphorus compound in the corpuscles, for the organic fraction of the acid-soluble phosphorus is not increased by the ingestion of phosphate.—J. B. S. **Haldane**, V. B. **Wigglesworth**, and C. E. **Woodrow**: (1) The effect of reaction changes on human inorganic metabolism. Over-breathing diminishes the phosphates in blood and urine, while carbon dioxide inhalation and sleep increase them. In acidosis caused by ammonium-chloride ingestion the urinary phosphate is increased; while the phosphate of the blood, and also its organic acid-soluble phosphorus, is diminished. Ammonium-chloride acidosis leads to an increased excretion of water, sodium, and potassium, probably owing to a partial loss of electric charge by the body colloids. This is followed by a retention. (2) The effect of reaction changes on human carbohydrate and oxygen metabolism. The alkalosis of over-breathing or bicarbonate ingestion converts the blood sugar into a highly dextrorotatory, unoxidisable form, and also prevents glucose storage; thus causing acetonuria and lowered respiratory quotients and glucose tolerance. Ammonium-chloride acidosis interferes with the storage of glucose, but not with its oxidation. Bicarbonate ingestion raises the resting oxygen consumption; ammonium-chloride ingestion usually lowers it.—J. A. **Campbell**: Concerning the influence of atmospheric conditions upon the pulse-rate and "oxygen-debt" after running. The "oxygen-debt" for 25 minutes after ceasing to run showed, under fixed conditions of experiment, a range of variation of 38 per cent. from day to day; 7-minute debts showed a range of 33 per cent., so should do as well for comparative purposes as 25-minute debts. Atmospheric cooling power had no effect on the "oxygen-debt"; the blood sent in greater volume through the skin in warm conditions is not then taken from the muscles. "Stitch" was the commonest cause of cessation of running in the subjects under observation. Pulse-rate is markedly increased under warm conditions. The oxygen tension surrounding the muscles was increased after exercise.—J. **Gray**: The mechanism of ciliary movement. IV. The relation of ciliary activity to oxygen consumption. In the absence of atmospheric oxygen, ciliary activity continues for about one hour. The whole ciliary mechanism is divisible into three distinct parts: (i.) a reaction which is sensitive to cations (particularly the hydrogen-ion), any interference with which involves a change in the rate of the ciliary beat, but only ultimately leads to a change in the amount of oxygen consumed; (ii.) a mechanism, brought into operation by the presence of an activating acid substance, which is inoperative in the absence of calcium, and in the absence of a certain critical amount of water in the cell. The events associated with this mechanism are independent of the amount of oxygen absorbed; (iii.) a reaction of an oxidative nature which is necessary for prolonged activity. The properties of the ciliary mechanism seem to form a very close parallel to those of cardiac muscle.

Association of Economic Biologists, November 16.—Mr. J. C. F. **Fryer** and J. **Davidson**: The Colorado-beetle problem. Colorado beetle was discovered in the United States in 1829; in Europe, outbreaks occurred in 1877, 1887, and 1914 in Germany, and in 1901 at Tilbury. About a hundred square miles in France, extending into the provinces of Gironde, Landes, Dordogne, and Charente Inférieure, are now infected. The beetle would probably find Britain sufficiently congenial, and would do damage at least equal to the cost of controlling its ravages by artificial means (by spraying potato crops twice yearly). It would arrive in the adult stage, and casual individuals might be expected hidden in merchandise or on board ship, particularly in potatoes from the infested area, or in agricultural produce packed in the area.—J. W. **Munro** and W. E. **Hiley**: The spruce budworm problem in Canada. The term "spruce" budworm is a misnomer for the balsam (*Abies balsamea*), the favourite host plant of the budworm, which is the larva of *Tortrix fumiferana* Clem. A brief description of the forest condition under which the budworm outbreaks occur was given, and emphasis was laid on the system of management of exploiting the eastern Canadian forests in favour of the less valuable balsam. This has caused an unduly high proportion of balsam regeneration in the cut over stands which favours the budworm. An important parasite (*Phytodietus* sp.) of the budworm was absent from these woods. Outbreaks of secondary insects and fungi follow budworm outbreaks. Of the insects, a bark-beetle (*Pityokteines sparsus*), a weevil (*Pissodes dubius*), and a longicorn beetle (*Monochamus scutellator*) are the most important. Fungi, among which the honey-fungus (*Armillaria mellea*) is the most important, spread rapidly during and after budworm outbreaks. After a budworm epidemic the balsam trees that have been

partially defoliated but not killed gradually recover, but a fresh lot of casualties occurs about four or five years after the disappearance of the budworm. These trees, which appeared to have recovered their normal amount of foliage, generally died suddenly during hot weather, and the whole of the crown died at about the same time. Examination of a large number of dead and dying trees failed to disclose any sufficient parasitic cause for the casualties. During and immediately after a budworm attack the breadth of the annual rings is very greatly reduced, and a few years after the epidemic the total thickness of the last five years' rings might be reduced to a quarter of the normal for the pre-budworm period. At the same time the leaf area of the trees has been increasing very rapidly. Thus a time is reached when, during hot, dry weather in July, the water-conducting tissue is insufficient to meet the needs of the transpiring leaves and the crown dies from lack of water. Thus death may be due to a lack of co-ordination between shoot growth and cambial activity.

Zoological Society, November 20.—Dr. A. Smith Woodward, vice-president, in the chair.—W. E. **Le Gros Clark**: Notes on the living tarsier (*Tarsius spectrum*).—Sir Sidney F. **Harmer**: Cervical vertebræ of a gigantic blue whale from Panama.—J. R. **Garrood**: Two skeletons of the cetacean *Pseudorca crassidens* from Thorney Fen, Cambridge.—Dr. Francis, Baron **Nopsca**: Reversible and irreversible evolution; a study based on reptiles.—C. **Crossland**: Polychæta of tropical East Africa, the Red Sea, and Cape Verde Islands; and of the Maldive Archipelago.—Miss Joan B. **Procter**: (1) On new and rare reptiles from South America, (2) On new and rare reptiles and batrachians from the Australian region.

Geological Society, November 21.—Prof. A. C. Seward, president, in the chair.—L. J. **Wills**: The development of the Severn Valley in the neighbourhood of Iron-Bridge and Bridgnorth; with a section on the Upper Worfe Valley, in collaboration with E. E. L. **Dixon.** The area investigated is roughly delimited by the following localities: Much Wenlock, Buildwas, Oakengates, Shifnal, Worfield, Hampton Loade, Morville. Detailed mapping of the drifts has shown, first, that the Buildwas area was as deeply eroded as now in pre-Glacial times; and, secondly, that a belief in the existence of the Iron-Bridge Gorge at that time is incompatible with the distribution of the drifts on the plateau above Iron-Bridge, and with the features of the gorge. The gorge is of late-Glacial origin, and the Worfe Vale was formerly the main drainage-line on the south-east side of the plateau. Practically the whole district was under ice at the maximum of the north-western or Irish-Sea glaciation. When retreat began, the ice-sheet separated into two lobes that remained confluent in the north. The waters of the Glacial lakes formed west and north of the watershed escaped at different times over different cols. One of these overflows is of especial importance in connexion with the origin of the Iron-Bridge Gorge: namely, the Lightmoor overflow, about a mile north of Iron-Bridge. Up to about this stage, the Worfe and its tributaries (one of which now became the Iron-Bridge Gorge) had been engaged in clearing the drift out of their valleys, and in reducing the thalweg of the trunk river to a base-level. Hereafter deposition of the "Main" Terrace of the Severn and of the terrace-like gravels of the Worfe commenced. Long after the initiation of the Iron-Bridge Gorge, ice still covered the upper Worfe Valley. When the ice retired to the north of the watershed hereabouts, Glacial Lake Newport came into being, and subsequently united with the Buildwas Lake on the retreat of the ice-front from the foot of the Wrekin. The outflow at Iron-Bridge thus increased. The subsequent rejuvenation of the Severn below Iron-Bridge was probably brought about chiefly by an elevation of the whole land relative to the sea. Stages in this rejuvenation are marked by terraces.

Royal Microscopical Society, November 21.—Prof. F. J. Cheshire, president, in the chair.—F. I. G. **Rawlins**: The miscroscope in physics. A strong plea is made for the closer union of physics and microscopy, more especially for the undertaking of work in physical optics by the amateur microscopist. Assuming the availability of an instrument fitted with Nicols, a convergent substage system and a Becké lens above the eyepiece, observations can be made of the traces of the family of isochromatic surfaces, each with its characteristic retardation. The work can be made quantitative by employing monochromatic light. If the usual means of obtaining such radiation are not at hand, Wratten filters (especially Naphthol Green) are efficient, though their range of usefulness is limited. The number of fringes observed with objectives of different numerical aperture can be represented by an exponential expression of the form $F = F_0 e^{-AN}$, where F is the equivalent focal length of the objective and N the number of fringes observed (see Rawlins, *Phil. Mag.* xliii. p. 766, and xlvi. p. 992).

EDINBURGH.

Royal Society, November 5.—T. J. **Jehu** and R. M. **Craig**: Geology of the Barra Isles. The rocks are mostly members of the Archæan complex, and these are of igneous origin, the prevalent types being biotite and hornblende gneisses. Muscovite is also present in the more acid types, and locally some of the gneisses are rich in garnets. The foliation planes usually strike N.N.W. and S.S.E., with a dip to the E.N.E. at varying angles. Intrusions into the orthogneisses occur in the form of granulites and pegmatites. The Archæan complex is affected by well-marked zones of shearing, along which mylonisation and the production of flinty crush phenomena can be traced. The macroscopic and microscopic characters and behaviour of the flinty crush material prove that these peculiar rocks are the product of mechanical stresses which at places have raised the temperature to an extent sufficient to bring about partial fusion of the crushed members of the complex, followed in certain cases by incipient crystallisation. The later dykes include olivine dolerites, crinanites, quartz dolerites, and camptonites. Evidences of glaciation are conspicuous, and prove that the ice moved over the islands from S.E. to N.W.—T. H. **Osgood**: Variation in photo-electric activity with wave-length for certain metals in air. As a source of ultra-violet light, a quartz mercury-vapour lamp was used in connexion with a monochromatic illuminator. The metal plates were tested in air at atmospheric pressure, due attention being paid to the "fatigue" which is known to take place under these conditions. The results are of interest and may be of some practical importance in connexion with the physiological effect of ultra-violet light. As the primary cause of the physiological change produced by light is probably photo-electric action, the photo-electric activity of a metal plate may serve as a means of estimating the quality and intensity of the effective radiation.—H. W. **Turnbull**: A geometrical interpretation of the complete system of the double binary (2, 2) form. The double binary form may undergo an algebraic transformation which corresponds to a generalised geometrical inversion. Here the convariants of a (2, 2) form reveal sets of

four or six lines, and special sextic curves with many simple geometrical properties, all connected with a given confocal system of bicircular quartic curves.

MANCHESTER.

Literary and Philosophical Society, November 20.—G. H. **Carpenter**: Warble-flies of cattle. The larvæ of the two common species of Hypoderma (*H. bovis* De Geer and *H. lineatum* Villers) are among the best-known parasites of domestic cattle in the British Isles, in Europe, and in North America; their economic importance is considerable on account of the damage caused to flesh and hides by the large maggots feeding just beneath the skin of the back which they perforate, and also because of the loss of condition suffered by the cattle when they "gad" in summertime to escape from the female fly approaching to lay her eggs. Observations carried on since 1905 by Carpenter and his colleagues in Ireland, by Gläser in Germany, and by Seymour Hadwen in Canada, have shown that the early life history of these insects presents some surprising features. The eggs of both species are generally laid on the legs (from thigh to hoof), rarely on shoulder or flank, never apparently on the back. By examination of the skin after egg-laying and by means of a series of experiments with calves, muzzled so that they could not lick themselves or one another, it has been demonstrated that the mode of entrance into the host's body is not by the mouth. The eggs are hatched on the hairs a few days after laying, and the tiny maggots, less than a millimetre long and provided with strong, sharp mouth-hooks and relatively formidable spiny armature, crawl along the hairs and bore their way directly into the skin. Thence they migrate upwards and forwards to the gullet-wall, the sub-mucous coat of which serves as their resting-place for some weeks or months in the course of their journey through the host's tissues to the final position in the back. The number of larval stages is still to be determined. The gullet-maggot is so much larger (up to half an inch) than the newly-hatched maggot, that it has generally been regarded as representing a second stage, but it possesses mouth-hooks of the same size and form and a spiny armature that is easily overlooked on account of the increase in actual size of the larva, so that the spines are relatively far apart. Hence Gedoelst has recently argued that there is no "moult" between the newly-hatched and the gullet-dwelling larva—only extra-ordinary growth. On the other hand, Laake concludes not only that the migrating maggot is a second instar succeeding the newly-hatched insect that bores in, but also that there is an antepenultimate instar beneath the skin, differing from the migrating maggot in the total absence of spines on the body-segments.

PARIS.

Academy of Sciences, November 19.—M. Albin Haller in the chair.—G. **Bigourdan**: A project for a French national biography.—M. **Lecornu**: Elastic couplings. A mathematical discussion of the effect of an elastic coupling between a dynamo and its motor on the steadiness of rotation. It is shown to be impossible to decide, in a general manner, whether the elasticity of the coupling is or is not favourable to the regularity of the motion of the dynamo.—Charles **Moureu**, Charles **Dufraisse**, and Philippe **Landrieu**: Remarks on the principle of a general method for determining the heat capacity of solids and liquids and its application to the determination of the water value of calorimetric bombs. The principle of the method suggested by the authors in a previous communication (*Comptes rendus*, 176, 1513) had been anticipated by Pfaundler (1869) and Swietoslawski (1909).—Gabriel **Bertrand**: The transport of copper in the gaseous state and copper-carbonyl. M. Gelinsky has explained a curious example of pseudomorphism by assuming the volatility of copper oxide. This would not appear to be the true explanation of the phenomenon. Copper oxide heated in a stream of either oxygen, hydrogen, or carbon dioxide gives no appreciable transport of the metal even after several hours. But with carbon monoxide there is produced a copper ring, apparently due to the formation of a volatile copper-carbonyl, readily dissociated on heating. The bearing of this observation on the determination of traces of copper in organic substances is indicated: with a brass burner and the material exposed to the gases from the flame, copper may be transferred from the burner to the ash. On the other hand, carbon monoxide formed during the combustion of the organic substance may carry away traces of copper.—Paul **Vuillemin**: New proof of the dystrophic origin of scyphia.—S. **Winogradsky**: The direct method in the microbiological study of the soil. The results of thirty years' work on the microbiology of the soil are, in the author's view, unsatisfactory. The conditions of culture in the bacteriological laboratory are too far removed from the conditions actually existing in the soil, and tend to form new races of organisms distinct from the types in the soil from which they were originally obtained. A scheme of culture is proposed more closely approximating to natural soil conditions.—E. **Baticle**: A mode of compensation for shrinking in concrete arches.—M. **Mesnager**: Remarks on the preceding communication.—E. **Huguenard**, A. **Magnan**, and A. **Planiol**: Research on the surplus of power of birds in flight.—M. **Delanghe**: General method for determining graphically the elements of flight of an aeroplane.—Bernard **Lyot**: Study of the planetary surfaces by polarisation. By the use of a more sensitive polarising apparatus than that hitherto employed, the proportions of polarised light from the planets has been studied. Details of 70 observations on the planet Venus are given.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1923. Observations were possible on 86 days during the quarter: the results are summarised in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—J. de **Schokalsky**: The length of the rivers of Asiatic Russia, and on the system of measuring rivers on maps in general.—Maurice **Curie**: Spark spectra in non-metals in the liquid state. Studies of spark spectra between platinum points in bromine, liquid oxygen, fused sulphur, liquid nitrogen, and fused phosphorus. In all cases a continuous spectrum was obtained. The absorption bands of oxygen were clearly shown.—E. **Brylinski**: Michelson's experiment and the contraction of Lorentz.—Léon and Eugène **Bloch**: New extension of the spark spectra of tin and zinc in the Schumann region. Tables of wave-lengths of lines and intensities are given for tin from $\lambda = 1699$ to 1305, for zinc from $\lambda = 1556$ to 1310.—R. de **Mallemann**: The electric double refraction of camphor and carvone.—Edmond **Bauer**: The change of wave-length accompanying the diffusion of X-rays.—Jean **Fallou**: A very simple method permitting the determination experimentally of the dispersion reactance of triphase alternators.—Adrien **Karl** and S. **Lombard**: The estimation of radium in the natural titano-niobates. The method is based on the removal of silica with hydrofluoric acid, fusion with potassium bisulphate, addition of sulphates of sodium and lithium to lower

the melting point, re-fusion and removal of the emanation in a current of air.—Victor **Henri**: The structure of molecules and the absorption spectra of substances in the state of vapour.—M. **Chavastelon**: The diffusion of sulphur vapour in air at the ordinary temperature. Particles of solid sulphur emit vapour at ordinary temperatures, and these diffuse only a short distance from the sulphur particle. The vapour was rendered evident by the stain on silver.—D. **Gelinsky**: The metallisation of organisms. In an attempt to determine the nitrogen in whole insects by the Dumas method, in which the insect was covered with copper oxide, combustion was incomplete. The whole surface was found to be covered with metallic copper, the effect being as though copper had been deposited electrolytically.—J. **Froidevoux**: The estimation of ammoniacal nitrogen in certain nitrogenous materials, and particularly in proteids and their products of hydrolysis.—C. **Gaudefroy**: The dispersion of double refraction in crystals.—M. **Charcot** and Louis **Dangeard**: Researches in submarine geology in the Mediterranean. Cruise of the *Pourquoi-Pas*, 1923.—E. **Rothé**: The principle of a method of exact determination of the propagation of seismic waves.—Marcel **Baudouin**: The markings on the prehistoric clay statues from the cave of Montespan, near Saint-Martory (Haute Garonne), are pittings representing Ursa major.—P. **Nobécourt**: The production of antibodies by the tubercles of Ophrydeæ.—Jean **Charpentier**: Application of the biochemical method of characterisation of galactose to the study of the composition of the pectins. The products of hydrolysis of four pectins from different plants were submitted to the biochemical method described in previous communications: in each case the crystallised β-ethylgalactoside was obtained proving the presence of galactose.—J. **Beauverie**: The circumstances which may modify the effect of the "critical period" on the yield of wheat.—E. and G. **Nicolas**: New observations on the influence of hexamethylenetetramine and of formaldehyde on the bean.—H. **Ricôme**: The intervention of gravity in phototropism.—E. **Roubaud**: The physiological condition of zootropism in mosquitoes. The views of J. Legendre (NATURE, November 17, p. 747) as to certain mosquitoes attacking animals in preference to man require modification: captivity, hunger, or deprivation of water may cause an immediate change in the habits of the insect.—H. **Barthélémy**: Physiological and experimental polysperma in the uterine eggs of *Rana fusca*.—J. **Athanasiu**: The supposed existence of a stimulating wave which is propagated in the myocardium.—M. **Nicati**: Orientation and visual sense of duration.—Jacques **Benoit**: The experimental transformation of sex by early ovariotomy in the domestic fowl.—J. **Chevalier** and E. **Dantony**: The toxic action of the insecticide principle of pyrethrum flowers.

Official Publications Received.

Sixty-first Annual Report of the Government Cinchona Plantations and Factory in Bengal for the Year 1922-23. Pp. 6+xii. (Calcutta: Bengal Secretariat Book Depot.) 8 annas.

University of Illinois: Engineering Experiment Station. Bulletin No. 137: The Strength of Concrete; its Relation to the Cement, Aggregates and Water. By Prof. Arthur N. Talbot and Prof. Frank E. Richart. Pp. 118. (Urbana, Ill.: University of Illinois.) 60 cents.

Federated Malay States. Report of the Secretary for Agriculture, Straits Settlements and Federated Malay States, for the Year 1922. Pp. 16. (Kuala Lumpur.)

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural Chemical Series, Bulletin No. 47: A Study of the Phosphates in the Island Sugar Lands. By W. T. McGeorge. Pp. 51. (Honolulu, Hawaii.)

The Transactions of the Leeds Geological Association. Jubilee volume, Part 19, 1920-1, 1921-2, 1922-3. Edited by J. H. Everett. Pp. 59+8 plates. (Leeds.) 5s.

Department of the Interior: The Dominion Astrophysical Observatory, Victoria, B.C. A Sketch of the Development of Astronomy in Canada and of the Founding of this Observatory; a Description of the Building and of the Mechanical and Optical Details of the Telescope; an Account of the principal Work of the Institution. By J. S. Plaskett. Pp. 37. (Ottawa: F. A. Acland.)

Bulletin of the American Museum of Natural History. Vol. 48, Art. 11: Classification of the Lizards. By Charles Lewis Camp. Pp. 289-481. Vol. 48, Art. 12: Avian Fossils from the Miocene and Pliocene of Nebraska. By Alexander Wetmore. Pp. 483-507. Vol. 48, Art. 13: Further Notes on the Molars of Hesperopithecus and of Pithecanthropus. By William K. Gregory and Milo Hellman. Pp. 509-530. Vol. 48, Art. 14: The Scales of the Cyprinid Genus Barilius. By T. D. A. Cockerell. Pp. 531-532. Vol. 48, Art. 15: Crocodilian Pelvic Muscles and their Avian and Reptilian Homologues. By Alfred S. Romer. Pp. 533-552. Vol. 48, Art. 16: Skull Characters of Alligator Sinense Fauvel. By Charles C. Mook. Pp. 553-562. (New York.)

United States Department of Agriculture. Department Circular 287: The Occurrence of Diseases of Adult Bees, II. By E. F. Phillips. Pp. 34. (Washington: Government Printing Office.) 5 cents.

Diary of Societies.

MONDAY, DECEMBER 17.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—W. C. Noxon: Settlement within the Empire.

ROYAL SOCIETY OF MEDICINE (General Meeting), at 5.—Drs. R. Hutchison, Fairbairn, J. Collier, E. I. Spriggs, Crichton Miller, M. Culpin, and J. A. Hadfield: Discussion—Chronic Abdominal Pain in Nervous Women.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—G. R. A. Murray and others: Discussion on Students in Electricity Undertakings.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 7.—F. E. A. Manning: The Management of a Sand and Flint Quarry.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—R. G. Collingwood: Sensation and Thought.

ROYAL INSTITUTE OF BRITISH ARCHITECTS (at 1 Wimpole Street), at 8.—R. Unwin: Higher Building in Relation to Town Planning.

FARADAY SOCIETY (at Chemical Society), at 8.—Discussion on W. H. J. Vernon's Report to the Atmospheric Corrosion Committee of the British Non-Ferrous Metals Research Association.

INSTITUTION OF THE RUBBER INDUSTRY (at Engineers' Club, Coventry Street), at 8.—Col. S. Clarke: The Position of the Rubber Tyre Industry.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Rev. W. Weston: The Influence of Nature on Japanese Character.

TUESDAY, DECEMBER 18.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—H. Faber: Agricultural Production in Denmark, 1909-13 and 1922.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—H. T. Chapman: Arterial Roads and their Effect upon Transport.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—W. Sellar: A Basis for the Explanation of Marine Gear Troubles.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—B. C. Wickison: Combination Printing.

WEDNESDAY, DECEMBER 19.

ROYAL METEOROLOGICAL SOCIETY, at 5.—W. H. Pick and S. P. Peters: Note on the Vertical Visibility (estimated looking downwards) at Cranwell, Lincolnshire, during the period February 1922 to June 1923.—Dr. H. Jeffreys: The Cause of Cyclones.—A. W. Lee: The Relation of the Circulation in the Upper Air to a Circumpolar Vortex.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. W. J. Sollas: The Method of Investigating Fossils by means of Serial Sections, and some of the Results obtained.—J. Walton: The Structure and Investigation of Fossil Plants.

ROYAL MICROSCOPICAL SOCIETY, at 7.45.—Dr. R. J. Ludford: Melanin Formation and its Relation to the Nucleolus in a Melanotic Cancer.—Dr. J. A. Murray: Reflecting Analyser for the Polarisation Microscope.

THURSDAY, DECEMBER 20.

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

INSTITUTION OF STRUCTURAL ENGINEERS, at 7.30.—J. B. Clarke: Practical Designing of Structural Steelwork: Beam Connexions and Clarke's Loading.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (at Royal Society of Arts), at 8.—Inaugural Meeting of the Kinematography Group.—W. Day: Kinematography and its Antecedents.

CHEMICAL SOCIETY, at 8.—W. E. Downey: The Relation between the Glow of Phosphorus and the Formation of Ozone.—Prof. T. M. Lowry: The Origin of Mutarotation and the Mechanism of Isomeric Change. A reply to Baker, Ingold, and Thorpe.—F. Challenger and F. Pritchard: The Action of Inorganic Haloids on Organo-Metallic Compounds.—J. F. Wilkinson and F. Challenger: Organo-Derivatives of Bismuth. Part VII. Iodo- and Nitro-Derivatives of Triphenylbismuthine.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.

FRIDAY, DECEMBER 21.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group Meeting), at 7.—A. H. Blake: Pictorial London.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. U. Williams: Fallacy of the Dropped Colon.—Dr. H. A. Harris: Some Problems in Bone Growth.—Dr. R. W. A. Salmond: The Teaching of Normal Radiography and Radioscopy.

PUBLIC LECTURES.

SATURDAY, DECEMBER 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: My Excavations in Malta.

THURSDAY, DECEMBER 20.

KING'S COLLEGE, at 5.30.—Prof. C. K. Webster: The League of Nations and Europe (League of Nations Union Lecture).