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The Abrams' Cult in Medicine.

LORD BACON wrote that the "weakness and credulity of men is such as they will often prefer a mountebank or witch before a learned physician." Quacks have existed in all ages and have deluded all classes. So late as 1738 an ignorant and mercenary creature, Joanna Stephens, claimed to have discovered a remedy for dissolving urinary calculi *in vivo*. After extracting large sums of money from unfortunate sufferers, she offered to sell her remedy to the British nation for 5000*l.*, and her claims were supported by the Bishops of Oxford, Gloucester, and Salisbury, and by the Dukes or Duchesses of Rutland, Leeds, Richmond, Portland, and Gordon. A commission was appointed to consider her claims, and it included such honoured names as Stephen Hales, F.R.S.; William Cheselden, the inventor of the operation of lateral lithotomy; and Sir Cæsar Hawkins, F.R.S., Sergeant-Surgeon to Kings George II. and III. On the recommendation of the commission, an Act of Parliament was passed, and the nation handed over 5000*l.* for the recipe for the secret solvent. When Joanna disclosed the nature of her remedies they were found to consist of a powder of egg-shells and snails, and of pills which contained snails, wild carrot seeds, hips and haws, soap and honey.

Anything connected with electricity is a sure draw for the credulous. This was the principal adjunct employed by Dr. James Graham in his "Templum Aesculapio sacrum" in the Adelphi. Here, amid shining orbs of glass, plates of burnished steel, dragons breathing flame, marble statues of naked women, and celestial beds on crystal legs, he received his patients, while he consulted the Delphic oracle in the form of the lovely Emma Hamilton, then at the zenith of her beauty. The electric belt is a perennial source of revenue to the quack. Even to-day there are thousands of people—some of them intelligent—who wear iron finger-rings to charm away rheumatism. The rust on the ring is supposed to be uric acid—that dreadful bogie of the layman—working its way out of an atrabilic system with a rheumatic diathesis.

It was reserved, however, for Dr. Albert Abrams of San Francisco, who died a few months ago, to exploit the modern doctrines of kinetic physics with its electrons in the diagnosis of every kind of human suffering. For a decade his fame has been gradually spreading, and ardent disciples have carried his doctrines far beyond America, nay, even across the Atlantic to England, where some of them are making wonderful diagnoses and reaping a rich harvest from credulous people. The extraordinary claims made on behalf of Abrams are well dissected in a readable article entitled "Dr. Abrams' Box" in the June issue of *Nash's Magazine*,

by Dr. Paul de Kruif, the American bacteriologist. He has visited Abrams, and has examined his sphygmobiometer and oscillophone, which he compares to one of the ridiculously comic pieces of apparatus for committing suicide, which Heath Robinson designs with such skill. It was claimed by Abrams that he could diagnose disease by placing a drop of blood in a little box connected by some wires to resistance coils. The energy of the vibrations from the blood are said to pass through the coils to the forehead of an individual—the subject—who must face west during the proceeding. By some route not previously known to science, the vibrations are said to pass to the abdomen of the subject, where they elicit sounds when this region is tapped.

According to ordinary experience, diagnoses made in this way might be expected to have a certain degree of error, and this is borne out by some of the records published by correspondents in the Journal of the American Medical Association in the last year or two. We may quote only one. A patient sent his blood (together with five dollars) to a disciple of Abrams with a request for a diagnosis. The physioclinical laboratory returned the following: "Congenital and cryptogenic syphilis, congenital gonorrhœa, carcinoma of stomach, small and large intestine, colon, pancreas, kidneys, and bladder, epithelioma (not localised), sarcoma of spine, chronic malaria, diabetes." To comfort the patient the report added: "This may look like a formidable array of diseases to you, but it is not so bad from an electrotonic standpoint. I cannot give a prognosis without a personal examination, but if all other things are equal, your chances of recovery are very good"! (See J. Am. Med. Ass., 1923, vol. 81, p. 493.)

This sort of thing is becoming increasingly prevalent in America, and Jonathan is rolling up with his dollars to know the state of his health by the electrobiometer. Even in London, Abrams has his pupils, some of whom seem seriously to believe in the doctrines of the wizard of San Francisco. Science, however, is not concerned with beliefs except as subjects of inquiry, but with evidence; and its work, to quote Ruskin, is "to substitute facts for appearances and demonstrations for impressions." In this age of advertisement, the name of science is continually taken in vain to support claims which no scientific mind could possibly accept without most critical examination of the evidence upon which they are based. Until such evidence is forthcoming from competent and independent experts on the physical and the physiological sides, the assertions made by followers of the "Electronic Reaction of Abrams" cannot be accepted as sufficient to establish conclusions so contrary to scientific knowledge and experience.

W. B.

Fuel Economy.

(1) *A Manual of Fuel Economy: for Engineers and Others in charge of Boiler and Furnace Plants.* By C. F. Wade. (Directly-Useful Technical Series.) Pp. viii+144. (London: Chapman and Hall, Ltd., 1924.) 9*s.* 6*d.* net.

(2) *The Supervision and Maintenance of Steam-raising Plant.* By C. A. Suckan. Pp. xx+342. (London: Ernest Benn, Ltd., 1924.) 36*s.* net.

(3) *The Utilisation of Low Grade and Waste Fuels.* By W. F. Goodrich. Pp. xix+368. (London: Ernest Benn, Ltd., 1924.) 42*s.* net.

(4) *Coke and its Uses: in Relation to Smoke Prevention and Fuel Economy.* By E. W. L. Nicol. Pp. xii+134+11 plates. (London: Ernest Benn, Ltd., 1923.) 19*s.* 6*d.* net.

(5) *Pulverised and Colloidal Fuel.* By Dr. J. T. Dunn. Pp. 197+17 plates. (London: Ernest Benn, Ltd., 1923.) 25*s.* net.

THE industrial development of Great Britain during the last century was largely due to the plentiful supply of cheap fuel, and one result of this cheapness was that little attention was paid to its efficient use. It was cheaper to waste coal than to provide efficient plant and efficient supervision. The gradual but steady rise in the price of coal during the last few decades has altered the industrial conditions, and the importance of fuel economy has been accentuated by occasional actual shortage of supply as well as by the increased price. Some 40 per cent. of the coal used in Great Britain is consumed under boilers for steam-raising purposes. There are in existence power plants where the boiler-house efficiency is well over 80 per cent., but the average efficiency is probably little over 60 per cent. It is obvious that there is great scope here for improvement. While it is not to be expected that all plants can be brought up to the efficiency reached in large power stations, a very great improvement could be realised by increased supervision of boiler houses and furnaces and by educating those actually responsible for their management.

The first two books mentioned above are written with the view of assisting in this necessary education. The necessity for designing the plant to suit the fuel used, and the difficulties of obtaining complete and smokeless combustion when using raw coal of the coking varieties, are brought out. In an ideal world, such coals would either be carbonised first so as to recover the oils and other volatile products, or would only be burned in mechanically fired furnaces or those using pulverised fuel, where complete combustion is more easily obtained.

Many instruments to indicate or record the condi-

tions in the furnace and flues have been designed and are described in these books, but it is sometimes forgotten that such instruments are worse than useless unless efficiently maintained and intelligently used; the human factor is all-important and no instruments or apparatus will make up for inefficiency or ignorance on the part of the fireman.

A perusal of the books under review shows that there are still considerable differences in practice as to sampling and analysing the fuel, and it is to be hoped that practice will become more uniform in this respect. The publication by the Fuel Research Board of the recommended methods of analysis should facilitate this, and it is to be hoped that these methods will be adopted universally. Uniformity of method is essential before results by different workers can be considered comparable. It is unfortunate that the Fuel Research Board's recommendations were not issued early enough to be included in the books now being discussed.

The quantity of ash in the coal generally supplied unfortunately increased during the War period, but collieries are now paying increased attention to this important point. The presence of ash has several bad effects: in the first place, it costs as much to transport as pure coal; in the second, it has to be disposed of after the coal has been burned; and in the third place, its character, especially its fusibility, affects the design of the furnace necessary for the efficient combustion of the coal.

Economy of our fuel resources can also be effected by the use of lower grade fuels of which large quantities are available, but there are limits to the possibilities in this direction. It must also be remembered that the cost of the ultimate heat units or power that result from the original fuel depends to a considerable extent on the cost of transport to the point of application and on the "availability" of the fuel when delivered. It may therefore be true economy to convert fuel into other forms of fuel or of energy of higher availability before transportation.

(1) Mr. Wade's Manual is intended as a guide to the elementary principles of fuel economy in furnaces, especially boiler furnaces, and gives an outline of the subject which he hopes will be of use to the busy works' engineer in improving the efficiency of his plant. It should meet the purpose for which it is intended. The author has deliberately described proprietary articles and apparatus which he has used successfully, and points out that they are only used as illustrations and that other apparatus can produce equally good results. There are a few questionable statements, as when it is assumed that all the ash from pulverised fuel is discharged from the chimney top, and that coal dust and air in the supply pipes necessarily form an explosive mixture. There are a few misprints which will doubtless be corrected in a second edition, and the reviewer has failed to find Fig. 14 which is referred to in the text. It would increase the usefulness of the book if references were given to sources where the various points mentioned are dealt with in greater detail.

(2) Mr. Suckan's book is far more ambitious than (1), but is not so successful. The author quite rightly directs attention to the need for "the new type of engineer which is coming into being—namely, the combustion engineer or technical chemist," but why does he call this individual an "engineer chemist"? Combustion engineer seems a far more suitable title. The portions of the book dealing with chemistry and physics are badly expressed and misleading. The author advocates most elaborate records, analyses of fuel, etc., and a staff of chemists that could only be justified on a very large plant, but the methods of coal analysis, which are given in great detail, would, if followed, lead to some curious results. The more practical portions of the book, dealing with maintenance and repair of plant, contain valuable hints from the author's experience.

(3) Mr. Goodrich's work on low-grade fuels is excellent. It deals with colliery waste, lignites, peat, coke breeze, town refuse, and wood and miscellaneous waste, and discusses the conditions under which they can be used. There are still many cases where refuse is being burnt to waste simply as a means of destruction without any effort being made to utilise the heat produced: this is pure waste.

Fine coal or colliery waste can often be utilised profitably in the form of briquettes, but obviously the ash content must not be too great. It is generally realised that this can be reduced by suitable washing or blending, or both, but the question of the fusion temperature of the ash has generally been overlooked. This can be controlled to some extent by blending. For domestic purposes an easily fusible ash is desirable, as this results in a solid ash or clinker instead of a light powdery ash. For industrial use, on the other hand, a high fusion point is desirable, as a rapid production of clinker is troublesome. The book concludes with excellent chapters on furnaces and firing, on steam boilers and boiler-house equipment, and on boiler-house control and the training of firemen.

(4) Mr. Nicol is the fuel expert to the London Coke Committee, and his book deals with the utilisation of coke, a form of fuel the advantages of which often have not been appreciated at their proper value. This has been to some extent due to a lack of proper grading of the coke by the producers, and to an unnecessary amount of water being used for quenching purposes. The importance of these points is emphasised by Mr. Nicol, and is now realised by most of the larger gas

undertakings. This should lead to a greater use of coke, and the demand for this product should keep pace with the growing demand for gas.

(5) Dr. Dunn's book on pulverised and colloidal fuels is an excellent exposition of principles, and "does not pretend to describe every form of plant on the market." The advantages of pulverised fuel have led to great developments in America and on the Continent, and have attracted considerable attention in Great Britain. The advantages in the direction of completeness of combustion, ease of control, low standby losses and low labour costs, are undoubted, but individual circumstances must decide whether the use of pulverised fuel is advantageous in any particular case, and if so, which system is the best to adopt. This book will be of great value in deciding these questions in practical cases. Colloidal fuel is a compromise between solid and liquid fuels, and the comparatively small portion of the book devoted to the subject shows clearly the conditions under which it can be useful.

The Origin of Ores.

The Geology of the Metalliferous Deposits. By Dr. R. H. Rastall. (Cambridge Geological Series.) Pp. xii + 508. (Cambridge: At the University Press, 1923.) 21*s.* net.

DURING the last few years very much good work has been done on the genesis of ore deposits, and the Transactions of the various scientific and technical institutes interested in this branch of study contain numerous papers bearing upon it. A critical work upon this subject was therefore really overdue, and the thanks of all its students can fairly be claimed by Dr. Rastall for the admirable manner in which he has filled the gap in our literature. The last English work on this subject was that by Thomas and MacAlister, published in 1909, and it is no disparagement to the earlier authors to say that Dr. Rastall's work shows a very marked advance upon their book; to a great extent this advance is due to the combined work of many hands, and shows how much the methodical study of the genesis of ore deposits has occupied the thoughts of modern geologists. The writer of this review wrote in 1896 that "in the records of our geological society, communications treating of the geology of ore deposits are conspicuous but by their absence," and it is a pleasurable reflection that to-day this statement no longer holds good. Not only have geologists devoted themselves to the study of metallogeny for its own intrinsic importance, but they have also learnt that the time given to this province of geology has advanced the science as a whole; they have found out that the deposition of metallic minerals is only a highly specialised form of certain other geological phenomena, and that the study of ore deposition throws much light upon a very large section of geology, and that perhaps the most difficult to understand.

Dr. Rastall divides his work into two parts, in the first of which he deals with the principles underlying the formation of metalliferous deposits, while in the second he describes briefly a large number of such deposits. It need scarcely be said that the first is incomparably the more important part. It begins, as it should do, by a careful and well-written discussion of the physico-chemical principles that underlie the changes which a molten magma undergoes on cooling, and touches briefly, perhaps rather too briefly, upon the connexion of pneumatolytic action therewith. Indeed, both here and in the later chapters dealing with metallogenesis and mineral formation, the writer holds that Dr. Rastall somewhat undervalues the part played by pneumatolysis, whilst admitting that the question is still an open one. For example, take such a statement as this (p. 12): "It would perhaps be too much to say in the present state of our knowledge that all primary ore-deposits are of igneous origin, but this is a view which may very likely be established as a result of future work." It would require a very severe—perhaps an undue—stretch of the imagination to refer the red hæmatite deposits of Cumberland to an igneous origin; even if the opinion, which is steadily gaining ground, that the iron was derived by leaching from overlying Triassic rocks, be ultimately disproved, the view that the iron was brought in at a quite low temperature in aqueous solution can scarcely be controverted, and there is no evidence at all for suggesting an igneous origin for these deposits.

Throughout Dr. Rastall seems inclined to discriminate too sharply between segregations from molten masses and pneumatolytic deposition. These forms of action surely pass by insensible gradations one into the other, although we may have at one end of the scale such a simple segregation as Smålands Taberg and at the other such occurrences as the Carlsbad twin pseudomorphs of Cassiterite from Wheal Coates, where all suggestion of segregation is naturally excluded. Again, his reluctance to accept a hydrothermal origin where any other theory can be maintained leads Dr. Rastall to the view that the Mansfeld copper schist (p. 258) was "formed by reduction and precipitation of copper compounds in water of peculiar composition, probably very rich in decaying organic matter. The copper and other metals must have been leached out of the surrounding rocks by meteoric waters, and concentrated in this lake or shallow sea." He does not even mention the other theory that the copper was introduced by hydrothermal agency, long after the consolidation of the schists, the copper-bearing water

flowing upwards through the very numerous faults that intersect this bed. This theory has now entirely displaced the older one, which Dr. Rastall espouses, in the opinion of such competent critics as Richard Beck, whilst it is, moreover, the only one which explains the fact, now apparently generally admitted, that these schists are richest in copper in the neighbourhood of these faults.

It need scarcely be said that the points here alluded to are not serious blemishes and in no way detract from the general level of excellence of the work; they indicate at the most where divergences of opinion are to be found, and such must necessarily occur when a science is in the making—and where Dr. Rastall might perhaps do well to write somewhat less positively than he does, especially in view of the very recent elevation of the subject of which he treats to the rank of a branch of science. For example, he says (p. 157): "No occurrence of tin and tungsten is known in connection with basic rocks"; there is, however, one such case on record, namely, in the Akénobé mining district, Japan, which has been fully described by Takeo Katô in the Journal of the College of Science of the Imperial University of Tokyo of May 10, 1920.

The author is at his best when tracing the various geo-physical and geo-chemical phenomena that took part in the formation of ore deposits; he is on less secure ground when he leaves the domain of scientific geology and discusses the technical and economic aspects of his subject. To take but one example, his statement (p. 86) that it is "the sheet-like or tabular, vertical or highly-inclined veins or lodes, which yield the greater part of our supply of the precious and base metals, except iron," would have been quite correct, say, half a century ago, but does not represent the facts as they exist to-day. The contribution which mineral veins make to the world's output of copper is insignificant, and in the case of tin is perhaps even less; as regards lead and zinc the statement may be correct or not according to the definition of veins which is accepted; it is certainly not correct as regards gold, and probably not in the case of silver. There was a time when vein mining was the most important branch of the metalliferous mining industry, but this is no longer the case. For one reason, as Dr. Rastall himself has shown, the upper zones of most metalliferous deposits are the richest, and as a vein has a horizontal area in cross-section far smaller than that of an ordinary massive deposit, it follows that for the extraction of equal quantities of mineral, the richer portion of the vein must be exhausted the more rapidly, whilst at the same time mining operations will attain greater depths and therefore be more costly. Simultaneously there have been such improvements in mining technology that it is now economically more advantageous to work a large, low-grade deposit than a small, richer one. It is to the mining of huge masses that the miner of to-day looks for maintaining the greatly increased output of metals that the last half-century has witnessed, and it is to these that the miner will have to look in the future.

Little need be said about the second portion, the descriptive section, of Dr. Rastall's book. Any criticism here would have to be directed towards the method of classification by metallic contents which he has adopted. His selection of this purely economic basis of classification contrasts oddly with the highly scientific tone of the first portion. It is a method which has of late been adopted by several writers on this subject, and has the merit of simplicity. It has, however, the great drawback that it brings under one head mineral deposits of very different kinds, which have, moreover, to be mined by entirely different methods. Thus Dr. Rastall gets into one group, that of the metasomatic iron ores, the irregular masses of Cumberland hæmatite and the bedded ironstone of Cleveland, which have in fact but little in common, and would have been better placed in different categories. It may be added that his treatment of the bedded ironstones leaves a good deal to be desired; for example, he does not distinguish genetically, as he should do, between the carbonate ores of Cleveland and the brown hæmatites of Lorraine. From his discussion of the oolitic ironstones it would appear that he is not acquainted with the classical work of Prof. L. Cayeux, "Les Minerais de fer oolithique de France," published in 1909.

While there are therefore some gaps to be filled and, naturally, a good many respects in which opinions will differ widely from those of the author, Dr. Rastall is to be congratulated upon having produced a work which constitutes a very important contribution to the science of the subject under discussion. It sheds much light upon many obscure points, and will assuredly afford material for much illuminating controversy; it is works such as this that help to elevate the study of ore deposits, begun on purely utilitarian grounds, to the dignity of a true science. HENRY LOUIS.

The Soybean: a Crop of the Future.

The Soybean. By C. V. Piper and W. J. Morse. (Agricultural and Biological Publications.) Pp. xv+329. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 20*s*.

THE soybean, also known as the soya or soja bean, is a plant with very great agricultural and industrial possibilities, and although it is not grown in Great Britain to any extent, it has figured more and

more largely in American agriculture of recent years. The plant is a native of Eastern Asia, its wild form being still found in China, Manchuria, and Korea. As a foodstuff it has been of prime importance in China and Japan since ancient times; to a great extent it supplies the population of these countries with the nitrogenous food needed in the diet. Some idea of its importance in the Far East is conveyed by the fact that the 1921 crop in Manchuria exceeded 4,500,000 tons, while in Japan more than one million acres are grown annually.

A large part of the Manchurian crop is exported, but prior to the Russo-Japanese War in 1904, the exports were mainly to Asiatic countries, particularly Japan. During that war, the local demand greatly increased the production of the crop throughout Manchuria. After the withdrawal of troops, however, it became necessary to find new markets for the surplus beans. Trial shipments were made in about 1908 by Japanese firms to several English oil mills. The suitability of the seed for oil and oilcake was quickly recognised, and orders for large consignments were given. The trade grew rapidly, extending to other European countries and to America. The fact that the seeds were called beans prevented them from having a wider market at the beginning of the large importations, since in Germany, France, and Austria, oil seeds were on the free list, but beans were subject to a tax. This was, however, soon rectified, and the monopoly in the trade of soybean products was taken from England. In 1914 more than two million tons of soybean products were imported into Europe. In the United States the soybean has, until recently, been grown mainly as a forage crop, but it is now being extensively grown and imported for use as a source of oil and cake, and attempts are being made to popularise it as a human food.

The volume under notice deals exhaustively with the soybean in all its aspects—commercial, botanical, agricultural, chemical, industrial, and gastronomic. The botanical history of the plant is a particularly involved affair, which is discussed in detail, and in the clearing up of which one of the authors has played a leading part. It is interesting to note that the great Linnæus blundered in that he confused the soybean with the mung bean, and it is a queer outcome of the application of botanical rules, and an illustration of the tangled nature of the botanical history of the plant, that the botanical name finally adopted after many vicissitudes, namely, *Glycine max*, under the International Rule, or *Soja max* under the American Rules, perpetuates the blunder Linnæus made, and necessitates using a common Oriental name for the mung bean as the specific title of the soybean.

After a careful summary of the agricultural history of the plant, its culture, harvesting, and storage are discussed. Being a leguminous plant, it grows best—unless well supplied with combined nitrogen—only under conditions favourable to a plentiful development of root-nodules, and since there is a special strain of nodule bacteria peculiar to this plant, it cannot be grown successfully in land which has not previously carried the crop unless specially inoculated with its own strain of bacteria. Without doubt many of the earlier failures with this crop were due to lack of proper bacteria. Apart from its growth for seed, the crop is being increasingly grown in America in admixture with such crops as cowpeas, sorghum, Sudan grass, and especially maize, as a forage crop for pasture, hay, or ensilage; it is also an excellent green manure. Much depends on the variety grown. Upwards of 800 different varieties, embracing widely varying characteristics, have been tested by the United States Department of Agriculture. The most important of these are described. Although the plant is better adapted to the climatic conditions obtaining in the American cotton and corn belts than to those of Great Britain, it is possible that some of the early varieties could be successfully cultivated here.

In composition the seed of the soybean is remarkable for its high protein (up to 46 per cent.) and fat (up to 24 per cent.) content, and for the almost complete absence of starch. The protein of the soybean is very similar to that of cow's milk in its composition and properties, being sometimes known as "vegetable casein." Many attempts have been made to develop the use of "vegetable milks" made from the soybean in Europe and America, but without much success, although it is largely used in the Far East both in the fresh state and after being "condensed" in the same manner as cow's milk. It also forms the basis of several kinds of bean curd or vegetable cheese (*tofu*) which are so extensively used throughout the Orient. The oil extracted from the soybean belongs to the semi-drying class, and it now finds extensive application in the manufacture of soap, glycerin, paint, and, after refining, of lard and butter substitutes. The cake or meal remaining after the oil is extracted is a most valuable product, and is used widely for feeding dairy and fatting stock.

Although the soybean in some form or other is eaten at practically every meal by rich and poor alike in the interior of Oriental countries, it has thus far been but little used in the West as an article of human food. Not the least diverting parts of this book are the two chapters devoted respectively to a description, with plentiful illustrations, of the many and varied processes adopted in the East for the preparation of *tofu* or soybean curd, *natto*, *hamananatto*, *yuba*, *miso*,

shoyu; and to recipes for the preparation of table dishes adapted to Western tastes, in which are to be found such intriguing names as soybean mush, soybean spoon bread, and soybean stuffed peppers. If the soybean still fails to become popular as a foodstuff, it will not be the fault of the authors of this book.

Two other chapters of the book deal, one with the structure of the seed, and one with the diseases of the crop. It is, however, scarcely fair to the 400 or so authors whose names appear in the selected bibliography that the page-heading of this last chapter should also figure over the succeeding bibliography, thus: "Enemies of the Soybean." No other errors of any importance have been noticed in the book, which is very well printed and produced. It is difficult to suppose that there is much information of any consequence relating to the soybean which has escaped inclusion. H. J. PAGE.

Our Bookshelf.

Handbuch der Geologie und Bodenschätze Deutschlands. Herausgegeben von Prof. Dr. Erich Krenkel. In drei Abteilungen. Abteilung 2: *Regionale Geologie Deutschlands. Geologie von Württemberg nebst Hohenzollern.* Von Prof. Dr. Edwin Hennig. Pp. vi+217-383+5 Tafeln. (Berlin: Gebrüder Borntraeger, 1923.) 8*s.* 4*d.*

THE first part of Prof. Hennig's Geology of Württemberg was noticed in NATURE of November 17, 1923, p. 717. The present part deals with the Cretaceous and Kainozoic divisions, with the volcanic and tectonic geology, and with some features of special geological interest. One of the last chapters describes some of the more remarkable of the Württemberg fossils, including the Natheim coral reef, the great Liassic crinoids with their 50-feet stems and 300,000 arms, the well-preserved Medusæ, some early mammals, some Pliocene apes, and ichthyosaurs which retain the skin and show the outline of the body and fins.

The Kainozoic sequence begins with the Upper Oligocene, the marine Lower Oligocene not having gained entrance to the district. The Aquitanian freshwater beds are followed by a Lower Miocene marine series, during which was formed a well-known Miocene cliff with numerous pholas borings. Middle and Upper Miocene are represented by freshwater beds, and the Lower Pliocene by the sands of Frohnstetten, famous for Deinotherium. The tectonic geology is of interest, as the country lies at the northern foot of the Alps and east of the rift valley of the Rhine, as to the age of which it gives important evidence. The earth movements began by an uplift in the Cretaceous which expelled the Jurassic sea from the neighbourhood of the Upper Rhine. The rift valley faulting began after the Lower Oligocene and lasted until after the Lower Pliocene. These subsidences were accompanied by volcanic eruptions which formed, amongst other features, the numerous embryo-volcanoes well known by the description by Branca. The earth movements in Württemberg were partly on lines parallel to those of the Upper Rhine, with others nearly at right angles to its trend. The volume concludes with a bibliography devoted mainly to the more recent literature, and gives a catalogue of the maps. This monograph should be very useful from its concise description of an especially interesting German province and its excellent series of maps and illustrations.

Allen's Commercial Organic Analysis. Editors: Samuel S. Sadtler, Dr. Elbert C. Lathrop, and C. Ainsworth Mitchell. Vol. 1: Introduction, Alcohols, Yeast, Malt and Malt Liquors, Wines and Potable Spirits, Neutral Alcohol Derivatives, Sugars, Starch and its Isomerides, Paper and Pulp Testing, Aliphatic Acids. Fifth edition, revised and in part rewritten. Pp. viii + 796. (London: J. and A. Churchill, 1924.) 30*s.* net.

THE previous edition of this work was completed in 1914 and a supplementary volume appeared three years later. The text published over forty years ago has expanded to six times its original size, embracing nine volumes with nearly 6000 pages. The work has been a boon to the industrial analyst, and the fact that a new edition is being issued suggests that the publisher has been justified in his earlier enterprise.

The same ground, broadly, is covered in volume 1 as in the previous edition, except that lactic acid is now included. Many sections have been revised by new authors, generally keeping close to the old text. The section on "paper" has been rewritten. To the possessor of an earlier edition of a scientific book the question of purchase of a new edition is always a matter of some consideration, especially with expensive books. In the case of "Allen's Analysis," much might be said for the development of a fixed standard edition with small supplementary additions at regular intervals. In this way the work could more readily be kept up-to-date and the lines of progress easily followed.

Two minor points may be mentioned—(1) Several misprints from the last edition still remain uncorrected, and (2) the tables of physical constants, etc., have been printed in a very small type, which would make their frequent use a tiresome operation. The joint American and British editors, however, are to be heartily congratulated on the volume as a whole, which fully maintains the high standard of the previous edition.

JOS. REILLY.

Plan Reading and Quantity Surveying. By C. F. Dingman. Pp. viii+201. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 10*s.*

THIS book gives a description of the method adopted by the author for arriving at the quantities of materials and labour required in the construction of buildings of moderate size, as deduced from the drawings and specification. It deals entirely with American practice, which in some respects differs considerably from that adopted in Great Britain. For many years past the practice of British quantity surveyors has been to a great extent standardised by such well-known books as Leaning's or Banister Fletcher's. This process of standardisation has been facilitated by the fact that in Great Britain quantities are almost invariably prepared either by or for the architect, who issues copies to intending contractors. In the United States,

each contractor prepares his own quantities in his own way. A comparison of the two systems is given by the author as an appendix, where the British system is termed the "Quantity System," and it is evident that American architects as a body are in favour of its adoption. There is little doubt that the system leads on the whole to efficiency and economy in tendering.

The illustrations are clear, the book is well arranged, and, making allowance for national differences in technical terms, is easily followed by a British architect. Arbitrary allowances for waste and cutting, varying with locality, are evidently the cause of much trouble and uncertainty, and are likely to remain so until some standard can be agreed upon, such as that recently published by the Surveyors' Institution, which will probably become universal throughout Great Britain.

There appears to be no universally adopted system of "abstracting" and "billing," with the accompanying checks on clerical errors, and this probably accounts for the omission of such instruction from the book.

E. E. M.

Faune de France: Diptères anthomyides. Par E. Séguy. (Ouvrage publié sous les auspices de M. Basil Zaharoff au bénéfice de l'Office Central de Faunistique: Fédération française des Sociétés de Sciences naturelles.) Pp. xi + 393. (Paris: Les Presses universitaires de France; Paul Lechevalier, 1923.) 60 francs.

THIS work forms a valuable addition to the parts that have already appeared in that excellent series the "Faune de France." In dealing with the Anthomyidæ, M. Séguy has selected a group of insects of great taxonomic difficulty, and one comprising a very large number of species. He interprets the family in its widest sense, and divides it into the Anthomyiinæ and Gasterophilinæ. The former sub-family includes the families Anthomyidæ and Muscidæ of the older dipterists. The Gasterophilinæ are composed of the single genus Gasterophilus, which has so often been regarded as an aberrant member of the Œstridæ. M. Séguy has evidently carried out his task with scrupulous care: all the genera and species are dealt with in tabular form, accompanied as a rule by more detailed diagnoses. The biology of the family is also recognised, and, wherever information is available, some reference at least is made to the larval habits of the various species. More than 800 figures portray practically every feature of importance to the systematist, and the book concludes with a full bibliography. We can cordially recommend it to the notice of all British dipterists, since it deals with an important group of insects concerning which there is no comprehensive treatise available in the English language.

The Dravidian Element in Indian Culture. By Dr. G. Slater. Pp. 192 + 7 plates. (London: Ernest Benn, Ltd., 1923.) 10*s.* 6*d.* net.

DR. SLATER'S interesting study of the relation of the Aryan and Dravidian elements in Indian culture seeks to show by a closely reasoned argument that the Dravidian element in fact is of preponderating importance. He maintains that the culture of the conquered agriculturists permeated every department of life of their culturally less advanced but, in the military sense, more efficient overlords. The bias of the native of India, wherever possible, favours Aryan descent, and this has tended to obscure the facts. Dr. Slater admits there are neither very ancient buildings nor manuscripts of Dravidian origin, and that this militates against his theory. But in the case of two characteristic products of Indian culture, philosophy and the religious system, he argues *inter alia*, as regards the first, that both mental constitution and material conditions were in favour of its origin among the Dravidians, while in the case of the second he holds that the Brahman is the priest magician who existed originally among the Dravidians only. The position of the Brahman at the head of a hierarchy of caste among a race of warriors is indeed anomalous, but that does not necessarily make it easier to accept an origin from among a subject people.

Calculations in Heating and Ventilation. By Dr. G. S. Coleman. Pp. xix + 255. (London: Longmans, Green and Co., 1923.) 15*s.* net.

DR. COLEMAN'S book has been designed to meet the requirements of students taking advanced courses in heating and ventilating. Many such students are imperfectly prepared in the scientific principles involved, and most require revision in mechanics and physics. Accordingly the first fourteen chapters are devoted to the fundamental laws. The remainder of the book deals with the special practical problems, such as heat transmission through building materials, methods of heating, temperature and humidity control, fans, boilers, and fuels. There are many worked-out examples, and there is a collection of exercises at the end of each chapter. The reader is supposed to be acquainted with the actual details of appliances, or to have access to this information; hence all the illustrations are diagrammatic. The matter in the volume is well and clearly put, and the mathematical knowledge required by the reader is a minimum. The book will thus be welcomed alike by teachers and students, to whom it cannot fail to be of service.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1923. Edited by Dr. M. Epstein. New Series. Pp. xi + 325 + 183. (London: Longmans, Green and Co., 1924.) 30*s.* net.

THIS record of the year's history at home and abroad follows the well-known lines and fully maintains the standard that has made it a unique volume of reference. Part I., which comprises about two-thirds of the book, deals with the political history of Britain, the Empire, and foreign countries. No event of significance seems to be overlooked, and the chapters are models of lucidity and impartial records of facts. Part II. combines a chronicle of events, the obituary of the year with short biographies, and articles on literature, science, art, finance, commerce, and law in 1923. The review of the year's advances in science occupies only ten pages, divided nearly equally between the biological and physical sciences; it is extremely condensed, but appears to omit no achievement of outstanding importance. Among the public documents printed in full in this volume is the constitution of the Republic of China, which in many of its provisions shows a remarkable acceptance of Western ideals.

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.*]

Problems of River Pollution.

IT will, I think, be of interest to Mr. Richmond (NATURE, May 10, p. 676) to know that the Ministry of Agriculture and Fisheries has recently organised a Scientific Advisory Committee to assist the Standing Committee on Rivers Pollution which was set up in 1921. The Committee consists of Dr. H. T. Calvert, Mr. J. H. Coste, Dr. H. H. Dale, Mr. W. B. Hardy, Mr. G. B. Kershaw, Prof. E. W. MacBride, Sir Robert Robertson, Dr. E. J. Salisbury, and myself, with Dr. E. S. Russell and Dr. E. C. Jee of the Ministry's scientific staff, and Mr. Harold Wilkin (43 Parliament Street, S.W.) as secretary. The Committee represents a considerable variety of interests and expert knowledge which will, it is hoped, bring together the many points of view from which this complex question of river pollution has to be regarded. Preliminary discussions have resulted in a provisional programme of work which the Committee desires to pursue along two main lines.

(1) The direct investigation of specific cases of pollution has already been carried out on a pretty extensive scale throughout the country under the Standing Committee, partly by rapid general surveys of river waters effected mostly by the energy of Dr. Jee, and partly by the physiological testing of effluents, etc., on fish at the station which was established by the Road Tarring Committee on the banks of the Itchen at Alresford in Hampshire. Dr. Jee's work has met with a ready response in a number of places from the local health authorities, fishery organisations, manufacturers, and the like, and with its further prosecution over a wider area should do much to alleviate local contamination, especially by way of preventing moderately polluted rivers becoming worse. It is also hoped with the aid of the Government Chemist and physiological testing to dissect harmful effluents and ascertain the poisonous constituents, and also to assist manufacturers to work out methods of rendering the discharges from their works innocuous. Apart from its immediate practical importance, this line of multiple observational inquiry will lead to an accumulation of data from which some general rules regarding the relation of fish life to pollution may be deduced. It should also be mentioned that in this as in the rest of its programme the Committee is as much interested in " coarse " as in " sporting " fishes.

(2) The more general problem of the effect of pollution on fishes is doubtless at bottom a question of the balance of the different forms of animal and vegetable life under particular environmental conditions. Unfortunately in Great Britain the ecology of streams and rivers has as yet scarcely been touched upon by biological workers : the facts which can be ascertained by direct survey are as little known as the individual biology of the various components of the fauna and flora. Starting with fishes as an orientation, it seems evident that the relation of fishes to temperature and oxygen supply and their food at different stages of growth, and the foods of these fish-foods and the ways in which they are affected by changes in the composition of the water and by their biological surroundings, must be ascertained before any understanding of the fundamentals of the pollution problem can be had. For a beginning, therefore, the Committee hopes, if the necessary working staff can be obtained, on one hand to make a complete biological and chemical survey of a selected river above and below a definite source of pollution, and on the other, to investigate analytically under experimental conditions the life histories and controlling circumstances of members of the fauna and flora which seem to be important (*e.g.* some Algæ, Gammarus, some Mollusca).

There is in Great Britain no fresh-water biological station where all this inquiry might centre. The problem is one of great complexity in which the co-operation of a number of specialists is needed. Very valuable work is being done by a few investigators—Dr. Rushton for the Salmon and Trout Association, Miss Meek at Cullercoats, Miss Carpenter in Wales, and others. The Committee would welcome any assistance. With so much work waiting to be done which will give a certain yield it is difficult to choose particular questions. There are, however, two which seem especially open to attack. Biological surveys of rivers and streams in relation to pollution might well form a corporate work of natural history societies and field clubs in which botanical and zoological specialists of all kinds could join with advantage : individual work in limited groups (for example, crustacea, mollusca, insects) would also be most useful if it were correlated with definite pollution. There should be a scale of biological indices of pollution. Another line where accurate knowledge is wanting is the food of fishes—all kinds of fishes, in different places, at different stages of growth and at different seasons. The answer can be had if the co-operation of anglers can be secured : it is a question of evacuating the stomachs of a sufficient number of fishes immediately they are caught and preserving the contents until they can be identified through the scientific staff of the Ministry.

One way and another, therefore, it is hoped to do something to prevent the further progressive deterioration of our rivers, deplorable æsthetically, recreatively, biologically, and from every other aspect, and perhaps to undo some of the harm which has been already done. The correspondence columns in NATURE during the past year show that there is a widespread interest in the matter, which would happily culminate in the provision of the adequate means for the study of fresh-water biology which are so badly needed in Great Britain. A. E. BOYCOTT.

Medical School,
University College Hospital, W.C.,
May 18.

I HAVE read with considerable interest the letters on the above subject by Profs. Meek, Lewis, Drs. Orton, Pearsall, and others. The question of river pollution is a very large one, bristling with many difficulties. When the legal and technical obstacles of defining pollution have been overcome, one is still confronted with the greater difficulty of measuring it. It should be realised that pollution is only relative, and that the development of even unicellular phytoplanktonic species is dependent upon mineral constituents, and that these mineral constituents are largely determined by the vehicle of pollution.

Usually the amounts of nitrogenous and oxidisable carbonaceous matter are regarded as the chief chemical attributes of a polluted liquid. It is quite conceivable, however, that a liquid may be seriously contaminated, but may contain neither of these elements in objectionable quantity. It should be recognised primarily that pollutions differ essentially *inter se*, and therefore each investigation should be conducted with reference to the special type of pollution suspected, and the chemical attributes of

the polluting substance. As an example of this, the discharges from lead, iron, coal, and gannister mines differ very materially. There is, however, a certain similarity in the effects produced by the three latter types of discharge, which are usually acid and ochrey, and are characterised by a very reduced flora and fauna.

In the discussion of the subject one is compelled to consider the form of pollution which is most prevalent, that is, sewage. Although many trade wastes differ materially from sewage, yet their admission into sewers and their general amenability to similar treatment often places the two, or rather a mixture of the two, in a single category. This type of pollution is characterised by the presence of much oxidisable carbonaceous and nitrogenous matter, and has as its antithesis aeration. It will be sufficient, therefore, to deal with this general type.

Since 1910 the West Riding of Yorkshire Rivers Board has continuously made biological investigations in connexion with the sewage polluted streams occurring in the West Riding. Although there is no stream of any great length within this area, yet the conditions for studying the biological entities occurring in waters more or less intensely polluted are almost ideal. It was found that, with this type of pollution, the flora and fauna of a stream bore indelible evidence of the intensity of the pollution, and were in fact a most useful index, even though the source of pollution was obscured. It was also noticed that the more characteristic organisms could be readily divided into three ecological groups depending upon the intensity of the pollution in which the organisms develop.

For convenience the characteristic organisms may be arranged, according to the decreasing intensity of the pollution, into the following three groups or classes: (1) Polysaprobes; (2) Mesosaprobes; (3) Oligosaprobes. An account of this biological classification was given in the *Journal of Economic Biology*, October and December 1914, vol. ix., under the title of "A Contribution to the Biology of Sewage Disposal."

Other biological investigations were conducted with regard to purification processes, trade complaints, poisoning and preservation of fish. In some instances it was found that certain organisms were specific for a given pollution. Ecological studies were also made in some of the smaller streams receiving definite pollution from which they eventually recovered. Broadly speaking, aquatic ecology seems to have a great advantage over its terrestrial counterpart, as there is only one factor to be taken into consideration, namely, the type and intensity of the pollution.

Although *Scientia longa, vita brevis* may be perfectly true, yet one feels that the efficient study of this subject necessitates a knowledge of both the aquatic flora and fauna (including bacteriology). On the whole, microscopic forms afford perhaps the best evidence, and of the two the floral evidence seems more trustworthy under the present conditions of the West Riding streams. The availability of considerable chemical analytical skill is also desirable.

As an example of the importance of one of these branches it has been shown that salmon-disease is apparently endemic amongst coarse fish, even when far removed from salmon streams. It seems, therefore, highly probable that this endemic condition amongst the coarser fish may be responsible for the epidemic outbreaks among the Salmonidæ of our rivers.

There are still several obscure factors which doubtless affect the life-history and distribution of many of our commoner species; there is therefore undoubtedly a wide and fruitful field for future investigators. Since the cessation of hostilities great advances have been made on the biological aspects of pollution and purification. Although the Royal Commission on Sewage Disposal suggested that sewage polluted liquids might be disposed of by adequate dilution, I should like to take this opportunity of pointing out that dilution is an unsatisfactory remedy for pollution, which should be replaced at least by partial purification.

J. W. HAIGH JOHNSON.
West Riding of Yorkshire Rivers Board,
Wakefield.

Radial Velocities and the Curvature of Space-time.

RETURNING to my letter on this subject published in NATURE of April 26, p. 602, I should like, in the first place, to amend an erroneous formula given in the last section of that letter. Through a bad slip of the pen, the earth's velocity component V was subtracted from v_0, the star's integration constant, instead of being deduced from the whole effect cD which, to a high degree of approximation, represents the total radial velocity of the star relatively to the sun at the moment of observation. Ultimately, the correct formula, readily obtainable by applying a local Lorentz transformation to the observer's world-line and confounding a factor $1+v_0V/c^2$ with unity, is, instead of (3), p. 603,

$$D = \pm\sqrt{\frac{r^2}{R^2}+\frac{v_0^2}{c^2}} - \frac{1}{c}V.$$

Here D is the effect as observed from a terrestrial station. In fine, the usual formula for "the reduction to sun" is, apart from immeasurably small terms, the correct one. Thus also the equality $c(D_1 - D_2) = V_2 - V_1$ should hold not only for $R=\infty$ but also for any finite value of the radius, and it can be considered as sufficiently verified by numerous previous spectrograms.

At the same time, we see that no amount of spectrograms of the same object taken at different times, *i.e.* with different values of V, can enable us to disentangle the star's constant from the expression $r^2/R^2+v_0^2/c^2$.

The question of the reduction to sun being thus settled, let us henceforth denote by D the reduced Doppler effect, as in all previous formulæ, so that

$$D^2 = \frac{r^2}{R^2}+\frac{v_0^2}{c^2}. \quad . \quad . \quad . \quad . \quad (1)$$

The only possible method of eliminating the unknown v_0 (apart from simply neglecting it for very distant objects) must, so far as I see, be based on statistical considerations, and can be described as follows. Since v_0 is constant throughout the individual history of a celestial object, while its r is varying, it is reasonable to assume that the average v_0^2 for one group of objects is the same as for another group, placed at another distance, provided the objects in each group are numerous and picked out at random. Thus, if the two groups are distinguished by the suffixes 1, 2,

$$\overline{D_1^2} - \overline{D_2^2} = \frac{1}{R^2}\left(\overline{r_1^2} - \overline{r_2^2}\right), \quad . \quad . \quad . \quad (2)$$

which is an equation for R. It is hoped that this method of determining the world-radius will turn out to be practicable with objects less distant than the globular clusters. But the necessarily numerous data required are not yet at hand. In the meantime, and only for the sake of illustration, it may be mentioned that if our previous ten objects are divided into two groups of five (much too precarious),

the value of R yielded by (2) does not differ materially from those given before. The numerical details will be found in the writer's forthcoming book on relativity.

The next point to be considered is that the distances of the Magellanic Clouds adopted in my previous letters were in the meantime increased considerably by Shapley. According to his latest estimate (Bull. 796, Harvard College Observatory) the distance of the Lesser Cloud is 25,000 and that of the Greater Cloud 35,000 parsecs, and even these "must be considered provisional." The corresponding two items of the set (1) of $R \doteqdot r:|D|$ values given in the last letter must, therefore, be much increased, and the ten values, derived from the clusters N.G.C. 5024, 5272, 6205, 6333, 6341, 6934, 7078, 6218 and the Lesser and the Greater Cloud, become ultimately

$$6{\cdot}7,\ 6{\cdot}7,\ 2{\cdot}2,\ 6{\cdot}7,\ 4{\cdot}7,\ 5{\cdot}7,\ 9{\cdot}1,\ 4{\cdot}8,\ 10,\ 7{\cdot}8\times10^{12} \quad (3)$$

with a mean of $6{\cdot}4\times10^{12}$ astronomical units. The correlation of all the available r and D values is now represented by the accompanying graph (Fig 1),

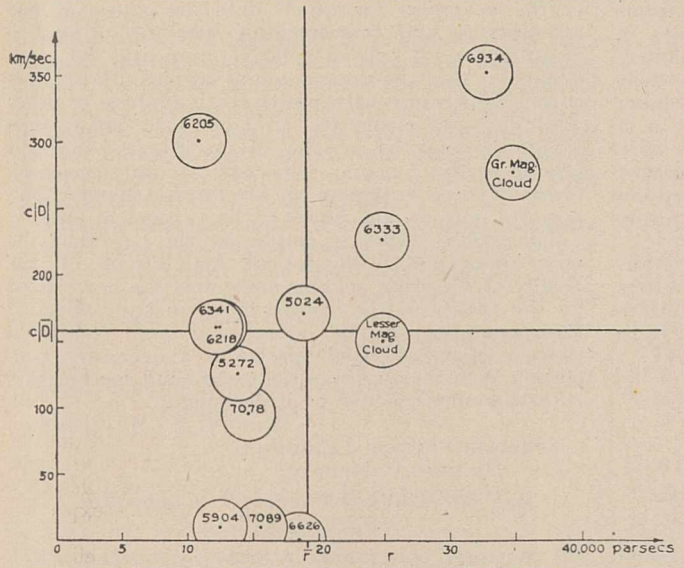

FIG. 1.—Radial velocities and distances of eleven globular clusters and the Magellanic Clouds.

which is to replace that given in the last letter. The additional axes, crossing near N.G.C. 5024, are drawn through the point the co-ordinates of which are the means of those of the thirteen objects, in accordance with a familiar correlation device. The radii of the circlets are certainly smaller than the P.E. of most of the data. That there is at all a correlation, of the type $D^2=f(r)+v_0^2$, is testified emphatically enough by the almost complete absence of circlets in the right lowermost quadrant, while the actual distribution of the circlets makes a correlation of the particular form (1), with an R not exceeding 7 or 8×10^{12} astr. units, fairly plausible.

Dr. H. H. Plaskett, of Victoria, B.C., is now taking expressly the spectrograms of some new globular clusters, and with his generous aid, implying the sacrifice of more than a hundred night-observing hours, the writer hopes within a month or so to insert into the right-hand region of this graph three or four more circlets. These new clusters, as well as the eleven of the present graph, belong to a collection of 69 globular clusters for which the distances were estimated in 1918 (Mt. Wilson Contrib., No. 152) by Prof. Shapley.

LUDWIK SILBERSTEIN.

Rochester, N.Y.,
May 10.

The Food of Dolphins.

LES très intéressantes lettres adressées récemment à NATURE par le Dr. Johs. Schmidt (22 décembre 1923, p. 902, et 1er mars 1924, p. 310) et par le Sir Sidney F. Harmer (12 avril 1924, p. 532) m'engagent à rappeler les quelques observations que j'ai déjà publiées sur le *Delphinus delphis* dans les *Archives d'Anatomie microscopique* (t. xiii., 1912, pp. 377-400) et dans le *Bulletin de la Société zoologique de France* (t. xlvii., 1922, pp. 370-378).

Je serais heureux qu'elles attirent l'attention des naturalistes sur l'intérêt que présenteraient de nouvelles recherches relatives à la biologie de cet animal.

A Concarneau, de nombreux dauphins arrivent chaque été, pendus aux bateaux "thonniers" qui apportent aux usines de conserves de ce port les germons (*Thynnus alalonga*) qu'ils ont pêchés à la ligne au large du Golfe de Gascogne.

Les pêcheurs de sardines accusant les Delphinidés, qu'ils confondent tous sous le nom de "bélugas," de détruire leurs filets et de chasser les bancs de poissons, l'Administration de la Marine française accorde une prime de dix francs pour chaque tête de "béluga" présentée à ses agents à terre.

Aussi, les thonniers qui rencontrent souvent au cours de leurs voyages des *Delphinus delphis*, les harponnent et les hissent à bord; ils rapportent au port, pour toucher la prime, soit l'animal entier, soit sa tête seule.

C'est ainsi que j'ai pu aisément me procurer un certain nombre d'animaux de cette espèce.

Les animaux que j'ai observés ont près de 2 mètres de long et pèsent de 75 à 100 kilogs. Ce sont tous des mâles adultes. Fischer à Arcachon, avait dénombré, de décembre à avril, plus de femelles que de mâles. L'absence des femelles en été est-elle liée à une période de gestation ou de lactation, leur abondance en hiver à une saison de rut?

L'encéphale des dauphins adultes pèse environ 1·000 grammes. Si l'on calcule le coefficient céphalique de cette espèce d'après la formule de Dubois $k=\frac{e}{p^{0{\cdot}56}}$, on trouve comme valeur moyenne du coefficient k 1·6. Le coefficient céphalique de l'homme étant 2·82, celui de l'éléphant 1·25, ceux des singes anthropoïdes 0·75, le dauphin se classe donc dans l'échelle animale au deuxième rang, immédiatement après l'homme. Or, le dauphin n'a pas d'organes des sens particulièrement développés: l'œil est de dimensions médiocres, les lobes olfactifs manquent, l'oreille est réduite à ses parties interne et moyenne. J'ai cherché la cause de ce coefficient céphalique élevé: la teneur en matières grasses des centres nerveux ne m'a pas fourni de chiffres extraordinaires; par contre, j'ai remarqué la grosseur exceptionnelle des fibres nerveuses et de leur gaine myélinique.

On est encore assez peu renseigné sur la nourriture des dauphins. En 1872, Fischer avait trouvé dans l'estomac d'une femelle une quantité de *Caranx trachurus* de petites dimensions et en 1881, il indiqua comme nourriture habituelle des dauphins d'Arcachon, de petits poissons: sardines ou Caranx. En 1889, Bouvier signala dans l'estomac d'un dauphin, la présence d'un nombre considérable de têtes, de nageoires et de vertèbres de poissons. Richard a souvent observé sur la peau des traces du bec et des ventouses de céphalopodes. J'ai trouvé à plusieurs reprises, dans l'estomac, des Octopus entiers, des bras et des portions de manteaux plus ou moins

digérés et de nombreux becs. Dr. Johs. Schmidt vient de signaler ici même, dans l'estomac d'un dauphin capturé en 1910, au large de l'Espagne, en Méditerranée, la présence de 15·191 otolithes de poissons que M. G. Allan Frost a pu attribuer (NATURE, 1er mars 1924, p. 310) aux genres Scombresox, Scopelus, Macrurus. Sir Sidney Harmer vient à son tour d'attirer l'attention sur la variété des constatations relatives à la nourriture des Delphinidés et la possibilité que les dauphins cherchent à l'occasion leurs proies sur le fond.

Je signalerai à ce propos les intéressantes observations de C. H. Townsend, sur des *Tursiops truncatus* capturés au Cap Hatteras et gardés en captivité à l'aquarium de New-York (*Zoologica*, juin 1914). "The food of marine porpoises is chiefly fish and squid. . . . At Hatteras, they are known to feed largely on squeteague or weak-fish. The fact that sand has been found in the stomachs of porpoises, indicates that they sometimes feed at the bottom."

J'ajouterai que la présence d'Octopus dans l'estomac n'implique pas nécessairement que les dauphins vont jusqu'au fond chercher leur nourriture, les Octopus pouvant nager activement à certains moments et même en grand nombre. D'ailleurs, d'une manière plus générale, il y aurait lieu de reviser les notions que nous avons de l'habitat d'un grand nombre d'animaux du fond, puisque les pêches de nuit, à la lumière, que nous poursuivons depuis deux ans, M. L. Fage et moi, dans la zone littorale, nous ont révélé la nage très active de nombreuses espèces considérées comme sédentaires parmi les groupes zoologiques les plus variés.

La question de la nourriture des dauphins étant à nouveau posée par les diverses lettres publiées dans NATURE, je me propose de profiter des ressources particulières du port de Concarneau pour en faire l'objet d'une enquête étendue. R. LEGENDRE.

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Concarneau (Finistère).

The Isotope Effect in Line and Band Spectra.

IN two recent letters to NATURE (March 29, p. 459, and April 19, p. 567) Nagaoka, Sugiura, and Mishima, and again in another letter in NATURE of April 12, p. 532, Nagaoka and Sugiura have pointed out the existence of certain relations, which they ascribe to isotopy, between the positions of more or less widely separated spectral lines. The present writer is concerned with these communications mainly because they may cause confusion in regard to two letters of his own to NATURE (March 22, p. 423, and April 5, p. 489) on the isotope effect in band spectra.

Nagaoka and his associates have in effect assumed that the equations for the vibrational isotope effect in infra-red band spectra are applicable to line spectra in many cases. Their procedure is at variance with the present interpretation in terms of the quantum theory of the differences between line and band spectra. In the first letter they have assumed that a number of mercury and bismuth lines (all the mercury lines considered are well-known series lines) are due to a quasi-elastically bound nucleus-proton combination inside the planetary electron shells, but otherwise similar to a HgH or BiH molecule. In the second letter they have assumed diatomic molecules of various elements (lithium, neon, silicon, chlorine, argon, copper, zinc, bromine, and rubidium) to be responsible for the emission of a number of the spectral lines of these elements.

Out of a number of objections which might be raised to their assumptions, a few will be cited, as follows: (1) the observed spectroscopic frequencies of the different lines or groups of lines, the *structure* of which they explain in terms of isotopy, should, according to the same theory, consist of a fundamental and a series of approximately harmonic frequencies; actually, there are no such relations among the lines which they consider; (2) according to the quantum theory of band spectra, each vibrational frequency should be converted into a structured band due to the effect of molecular rotations (perhaps reduced to one or a few lines in the case of mercury and bismuth); (3) at least in the case of the emitters dealt with in the second letter, the observed frequencies are very much too high for the vibrations of diatomic molecules, as is shown by band spectrum data: all known molecular vibration frequencies, even for hydrogen compounds, correspond to infra-red radiation.

It seems altogether probable that such agreements as have been found with their "theory" by Nagaoka and his associates are accidental. Even the apparently excellent agreement with their formula in the case of the satellites of the mercury and bismuth lines fails, in the examples for which data are given, if one attempts to find corresponding satellites or groups of satellites, of correct relative intensity, for each isotope. Also, the assumption of six bismuth isotopes is not in harmony with positive ray analysis of other odd-numbered elements; in fact, only one isotope would be expected in view of the integral and odd atomic weight (209·0). The very accurate measurements of these writers on the satellites of mercury and bismuth lines should, however, be of much value.

The writer wishes to emphasise the fact that the very questionable theoretical foundations of the results of Nagaoka and his associates are not shared by the theory of the isotope effect in band spectra. The existence of the vibrational and rotational isotope effects in band spectra is a necessary conclusion from the quantum theory of band spectra, and is furthermore checked by experiment.

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The Effect of Naphthalene Vapour on Red Spider Mite (*Tetranychus telarius*, L.).

AFTER a long series of experiments in attempting to control red spider in cucumber houses by fumigation, it has been found possible to utilise the vapours of naphthalene for the purpose. Red spider is the worst pest with which the grower of cucumbers has to contend, and the continuous attacks year after year have made the problem of control one of prime economic importance.

The irritating vapour evolved when naphthalene is quickly heated has an almost immediate anæsthetic action on the mite, but under such conditions the foliage of the cucumber plant is liable to severe injury. By suitable adjustment of the temperature at which solid naphthalene is maintained, it is possible to kill the spider without in any way harming the plant.

For fumigation purposes, it appears that the optimum temperature at which the naphthalene should be kept lies between 30° and 46° C., the spider becoming comatose during the first 16 hours and being definitely killed within 48 hours under these conditions.

Use has been made of the hot-water pipes in cucumber houses for obtaining these temperatures, the naphthalene being first melted and smeared the

whole length of the pipes with a brush—a simple and economic method by which a thin coating of the substance is fixed like a varnish to the pipe surface. This coating cannot be removed in ordinary circumstances except by heat, so that cultural operations are not interfered with. Owing to the great difference in temperature at the two ends of a pipe occasioned by the heating system in most glass-houses, it seems that a more economic and effective method of vaporising the naphthalene is obtainable by the use of special vaporisers which are now being modelled.

It is of great interest to note that not only the adult and larval stages of red spider have been killed by the method above described, but also the eggs and resting stages have been exterminated after treatment for from 3 to 6 days according to temperature conditions.

We have realised the possibility of cucumber fruits taking up the taste of naphthalene during treatment, but such is not the case, since fruits on growing plants have not been flavoured by the substance, even after 14 days' continuous exposure to the vapours.

Since this work has been in progress it has been brought to our notice that attempts were made many years ago to utilise naphthalene for the control of red spider in vineries. The practice was abandoned at an early stage owing to the serious damage caused to the foliage—injury which was probably due to impurities in the naphthalene used, combined with unsuitable methods of vaporisation.

Perhaps the most remarkable points in naphthalene fumigation are (1) the amount of naphthalene vapour which the cucumber plant can tolerate without injury in bright sunlight, and (2) the action of the vapours upon the eggs of the Acarine.

EDWARD R. SPEYER.
OWEN OWEN.
Experimental and Research Station,
Cheshunt, Herts.

Influence of Weather Conditions on Sap and Latex Flows.

IN NATURE of April 5 appeared a letter by Mr. Folkard under the heading "The 'Bleeding' of Cut Trees in Spring." Prof. Priestley's remarks on that letter in the same issue bring out points which are of particular interest to me. Some years ago I carried out work on sugar producing palms, during the course of which I made careful measurements of the yields of sap from the cut stems of a number of wild date palms (*Phœnyx sylvestris*) throughout the cold weather. Daily records were also kept of the maximum and minimum air temperatures and the sugar content of the sap was determined. The air temperature exercises a very marked effect on the yield of sap. A rise in temperature is always followed by a falling off in yield, whereas a fall in temperature is always followed by a rapid increase in yield. Moreover, the coldest months of the year are the best from the point of view of sap yield. During these experiments the maximum day temperatures ranged from 71° to 83° F., and the minimum night temperatures from 46° to 66° F. Cloudy nights have an adverse effect on sap yield and on its quality. Newlands ("Handbook for Sugar Planters") also records that in the case of the maple tree the best yields of sap are obtained during cold clear nights following bright warm days.

Prof. Priestley's remarks on the conversion of starch to cane sugar in trees are also of interest to me. In the case of the date palm I made special efforts to obtain the sap under sterile conditions. I was able to show that such sap contained no trace of any other sugar but cane sugar. The stem of the tree itself is rich in starch, and I found on cutting down a whole tree and sawing it into seven sections that there was no special accumulation of sugar at any point in the stem. Sugar appeared to be fairly evenly distributed throughout the stem in small quantity, but this of course may have been formed from starch immediately the tissues were sawn into and exposed to the air. The wild date palm appears to me a case in which cane sugar is formed directly from starch. The above work will be found fully described in Memoirs of the Department of Agriculture in India, Chemical Series, vol. ii., No. 6.

Recently I was engaged in a study of the factors influencing the yield and composition of the latex of the opium poppy. The yield of latex was found to be considerably affected by the weather, being greater on cold than on warm nights. In this case also cloudy weather was found to exert an adverse influence on the yield and quality of latex. (Mem. Dept. Agric. in India, Chem. Ser., vol. vi., No. 2.)

H. E. ANNETT.
Agricultural Research Institute,
Nagpur, C.P.,
April 29.

Zoological Nomenclature: Official List of Certain Generic Names.

THE following generic names (with genotype in parentheses) have been submitted to the International Commission on Zoological Nomenclature for inclusion in the Official List of Generic Names.

The Secretary will delay final announcement of the votes on these names until November 1 in order to give to any zoologists, who may desire, the opportunity to express their opinions.

Protozoa: *Balantidium* Clap. and Lachm. 1858b, 247 (*entozoon*); *Endamœba* Leidy, 1879a, 300 (*blattæ*); *Giardia* Kunstler, 1882, 349 (*agilis*); *Trichomenas* Ehrenb., 1838a, 331 (*vaginalis*); *Trypanosoma* Gruby, 1843a, 1134 (*sanguinis*).

Cephalopoda: *Argonauta* L., 1758a, 708 (*argo*); *Octopus* Lam., 1799, Prodromus, 18 (*vulgaris*); *Sepia* L., 1758a, 568 (*officinalis*).

Gasteropoda: *Acteon* Montf., 1810, 314 (*tornatilis*); *Ampullaris* Lam., 1799, Prodromus, 76 (*urceus*); *Buccinum* L., 1758a, 734 (*undatum*); *Buliminus* Ehrenb., 1831 (*labrosus*); *Bulla* L., 1758a, 725 (*ampulla*); *Calyptræa* Lam., 1799, Prodromus, 78 (*chinensis*); *Columbella* Lam., 1799, Prodromus, 70 (*mercatoria*); *Helix* L., 1758a, 768 (*pomatia*); *Limax* L., 1758a, 652 (*maximus*); *Littorina* Feruss., 1821, Tabl. Syst. XXXIV. (*littorea*); *Natica* Scop., 1777, 392 (*canrena*); *Physa* Drap., 1801, 31 (*fontinalis*); *Planorbis* Müller, 1774, 152 (*cornea*); *Succinea* Drap., 1801, 32 (*putris*); *Tethys* L., 1758a, 653 (*leporina*); *Vitrina* Drap., 1801, 33 (*pellucida*).

Lamellibranchiata: *Anodonta* Lam., 1799, 87 (*cygneus*); *Cyprina* Lam., 1818, 556 (*islandicus*); *Dreissena* Van Bened., 1835, 25 (*polymorpha*); *Mactra* L., 1767, 1125 (*stultorum*); *Margaritana* Schum., 1817, 137 (*margaritifera*); *Mya* L., 1758a, 670 (*truncata*); *Mytilus* L., 1758a, 704 (*edulus*); *Ostrea* L., 1758a, 696 (*edulis*); *Sphærium* Scop., 1777, 397 (*cornea*); *Tellina* L., 1758a, 674 (*virgata*); *Teredo* L., 1758a, 651 (*navalis*); *Venus* L., 1758a, 684 (*mercenaria*).

Polyplacophora: *Chiton* L., 1758a, 667 (*tuberculatus*).

Scaphopoda: *Dentalium* L., 1758a, 785 (*elephantinum*).

Tunicata: *Ascidia* L., 1767, 1087 (*mentula*); *Botryllus* Gaert., 1774, 35 (*schlosseri*); *Clavelina* Savig., 1816, 174 (*lepadiformis*); *Diazona* Savig., 1816, 35 (*violacea*); *Distaplia* de Valle, 1881, 14 (*magnilarva*); *Molgula* Forbes, 1848, 36 (*oculata*).

C. W. STILES,
Secretary to the International Commission on Zoological Nomenclature.
Hygienic Laboratory,
U.S. Public Health Service.

Frequency Curves of Genera and Species.

DR. J. C. WILLIS and Mr. G. Udny Yule attach great importance to the fact that the form of frequency distribution for sizes of genera follows the rule that the logarithm of the number of genera plotted against the logarithm of the number of species approximates to a straight line, except that there is a marked deficiency of the larger genera (NATURE, February 9, 1922, p. 178).

In a recent paper (Ann. Mag. Nat. Hist. (9) xiii. p. 478) I have given my reasons for concluding that the causes that determine the sizes of genera are so many and various that an approximation to a chance effect may be expected, but with a deficiency of the larger genera, because there is no room for them in small families and because it is the systematist's business to divide them up. The object of this letter is to point out that the series $x, x/2, x/3, x/4$, etc. . . . x/x, representing the number of genera with 1, 2, 3, 4, etc., species in a group where the sizes of genera are purely a matter of chance, has the property that the logarithm of the number of genera plotted to the logarithm of the number of species gives a straight line.

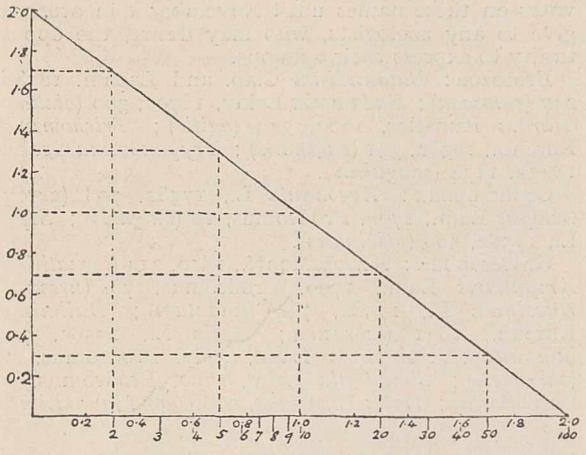

FIG. 1.

The accompanying diagram (Fig. 1) shows the result of plotting the logarithms for the number of genera against those for the number of species in such a hypothetical group, having 100 genera with 1 species, 50 with 2, 20 with 5, 10 with 10, etc.

C. TATE REGAN.

Mendelism and Evolution.

As Mr. Dover supposes (NATURE, May 17, p. 712), my letter criticising some of Dr. Annandale's theoretical views was beyond my control when his untimely death was announced. I sincerely trust that my words may have given no pain when nothing was intended but the frank criticism of one working zoologist by another.

In reply to Mr. Dover, I should like to point out that his letter repeats, without any further justification, the identical assumption which I criticised. He appears to be clear that he is shielding Dr. Annandale's views from the type of criticism I put forward by writing, "More than twenty years of first-hand experience of tropical biology led him to the conclusion that environment does affect certain forms of life, and that some inherited characters [*sc.*: 'produced by environmental modification'?] at least are persistent."

Now no biologist disputes that the environment affects the individual, or that the differences seen between species, genera, etc. (in other words, their evolutionary diversities) stand in some intimate relation with their environment. (And, by the way, if Mr. Dover will refer to the Linnean Society's Journal, vol. xxxv., 1923, p. 253, he will find that I am not so unfamiliar as he supposes with practical research on certain aspects of ecology along just the lines he mentions. I have for long been interested in the detailed field-study of bird behaviour, and in that paper attempted to show how closely the diversity of type of courtship is correlated with differences in environment and mode of life.)

While biologists, I should say, universally accept these principles, the one question which exercises our minds is the *method* by which the latter or evolutionary relation between environment and characters is brought about. It is precisely here that the methodological error creeps in. To assume from field observation, however prolonged and acute, anything whatever as to this method appears to one acquainted with the recent development of genetics as radically unsound. For without experiment it is *impossible* to discover not only whether modifications are inherited, but also what character-differences depend on differences in the environment, what on differences in genetic constitution. Some agreement on this point seems to me essential for progress in evolutionary biology. Correlation is not equivalent to causation.

J. S. HUXLEY.

New College, Oxford,
May 19.

Refractive Index of Indiarubber.

IN NATURE of May 3, p. 643, Mr. Mallock gives a list of refractive indices of various gums, including gutta percha, but not indiarubber.

The refractive index of indiarubber is of considerable importance in industry in connexion with the production of pigmented rubber goods. For example, many white powders of apparently good colour, such as magnesium carbonate, have very little opacity in rubber on account of the closeness of their refractive index to that of rubber itself. From this fact, indeed, it is possible to derive an approximate value of the refractive index of rubber.

It is surprising, however, that no actual determination of the refractive index in question appears to be on record in scientific literature. During the preparation of a paper on the value of rubber pigments recently (Year Book of the Institution of Rubber Industry, 1923, p. 295) I determined the refractive index of rubber, using a film of well-masticated pale crepe rubber (*Hevea brasiliensis*) in an Abbé refractometer, and obtained a value 1·525 for n_D at 15° C. This agrees closely with the index given for gutta percha (*loc. cit.*), and appears to deserve recording.

D. F. TWISS.

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Outposts of Vegetation.

IN a recent volume of the "Meddelelser om Grønland" (vol. lxiv., 1923), Prof. C. H. Ostenfeld, of Copenhagen, gave an account of a collection of flowering plants made by Dr. Thorild Wulff, naturalist to the second *Thule* Expedition (1916–18), under Knud Rasmussen, on the north coast of Greenland. This contribution to our knowledge of Arctic botany is exceptionally interesting, as it deals with the most northerly outposts of the world's vegetation on the shore of the Polar Ocean which have so far been discovered. The "Meddelelser om Grønland" is a series of which the Danish Government may be justly proud; but as its circulation is necessarily restricted, there is a danger of important communications which are of general interest being overlooked unless special attention is directed to them in some more widely-read scientific journal.

The Greenland collection was made in very difficult and tragic circumstances: Dr. Wulff succumbed to the effects of physical hardships and insufficient food, to which the members of the expedition were exposed during their journey across the inland ice from the north coast to the neighbourhood of Cape Agassiz, south of the great Humboldt glacier on the north-west coast. Prof. Ostenfeld quotes the last words written by Dr. Wulff in his diary on August 29, 1917: "I am half dead, but found Woodsia [one of the few genera of ferns in the Greenland flora]. Retired to rest at 7 P.M., as I will not be a hindrance to the movements of my companions on which their rescue depends." Dr. Wulff collected 70 species of vascular plants and made many meteorological and ecological observations which are reproduced in Prof. Ostenfeld's paper.

Before the second *Thule* Expedition visited the north coast, only 10 species of flowering plants were known from north of latitude 82° N., some collected by members of the *Fram* Expedition and others by Colonel Koch. Many of the plants are more or less circumpolar in distribution, but three species, *Melandrium triflorum*, *Taraxacum arctogenum*, and *Braya Thorild-Wulffi*, have not been found outside Greenland. These endemic plants are of special interest, as they, together with *Potamogeton groenlandicum*, are regarded as the only species—in a flora of about 400 vascular plants—peculiar to the island. A few species from the north coast are exclusively Arctic-American in range, *e.g. Lesquerella arctica*, a Crucifer with spherical fruits which is fairly common about half-way down the west coast and probably in other localities; *Ranunculus Sabinei*, *Dryas integrifolia*, a species very closely allied

FIG. 1.—Summer in Gunnar Andersson Valley. The ground is nearly clear of snow, both in the lowland and on the slopes. From "The Vegetation of the North-Coast of Greenland." (Meddelelser om Grønland, vol. lxiv.)

to *Dryas octopetala* (a British alpine plant which is characteristic of the east coast of Greenland); *Potentilla Pedersenii*, *Erigeron compositus*, and two species of Taraxacum. Some of the northernmost plants have wandered far to the east over Arctic Eurasia, probably starting from the west, while *Draba Adamsii* and *Taraxacum arcticum* are confined to the Arctic lands east of Greenland. The north-coast flora also includes the following:

Equisetum arvense and *Equisetum variegatum*, two of the commonest vascular cryptogams of Greenland, both

FIG. 2.—(1) *Hesperis Pallasii*, (Pursh) Torr. et Gray; (2) *Taraxacum phymatocarpum*, J. Vahl; (3) *Potentilla Pedersenii*, (Rydb.) Ostf. From "The Vegetation of the North-Coast of Greenland." (Meddelelser om Grønland, vol. lxiv.)

circumpolar and widely spread in more southern countries, reaching the Altai Mountains and the Rocky Mountains; three species of Carex; the circumpolar cotton grass *Eriophorum Scheuchzeri*, which flourishes on the Himalayas and on both sides of Bering Strait; several grasses, including *Alopecurus alpinus*, a circumpolar species which is especially luxuriant in the neighbourhood of Eskimo settlements on the west coast, where the ground is rich in nitrogenous material; a Juncus; two species of Luzula; *Cerastium alpinum*, one of the most abundant and wide-ranging Arctic species; *Melandrium apetalum* and *M. triflorum*; the familiar *Silene acaulis*; *Stellaria longipes*; *Cardamine bellidifolia*; five species of Draba; *Papaver radicatum*, *Oxyria digyna*, and *Polygonum viviparum*, common species in Greenland and other Arctic countries; three species of Ranunculus, the most abundant on the north coast being *Ranunculus sulphureus*; *Dryas integrifolia*; this species is the common representative of the genus in West Greenland, *Dryas octopetala* being characteristic of the east coast from Scoresby Sound northwards; both species occur in the Wolstenholme Sound area (*ca.* lat. 76° 30′ N.), and Ostenfeld points out that in districts where the two forms meet it is difficult to draw a clear distinction between them; four species of Potentilla; *Salix arctica*; six species of Saxifraga, the commonest being *Saxifraga cernua*, *S. nivalis*, and the most wide-ranging member of the genus, *S. oppositifolia*, which is circumpolar and occurs also on the Himalayas; two Erigerons; four Taraxacums; the attractive *Cassiope tetragona* recorded from both sides of Bering Strait, the Rocky Mountains, and other American localities, but not found in Europe south of Arctic Scandinavia and Arctic Russia; *Pedicularis hirsuta*, a circumpolar species.

In addition to the 70 species of vascular plants, 16 species of liverworts and 51 species of mosses have been identified from Dr. Wulff's material by Dr. Aug. Hesselbo; also 64 species of lichens by Dr. Lynge.

It is interesting to glance at the climatic environment of these North Greenland plants. The vegetation is poor, as one would expect; the plants are low, and show comparatively little variation in growth-forms (Fig. 2). The sun is above the horizon throughout the short summer season, but on the other hand its low position diminishes the intensity of the light. Fogs are rare. The intensity of the sunlight caused snow-blindness and other eye-troubles in members of the Expedition; it also means much evaporation from the plants. In May the daily mean temperature never rose above zero; in June the average for the month was slightly below zero, and it was not until July that positive values in the mean air temperature were recorded On the north coast there is rather less difference between the temperature of the air and that of the plants exposed to direct sunlight than in the more southern districts of Greenland, probably because of the low position of the sun. In lat. 83° 6′ N. on June 11 at 3 P.M. the air-temperature in the shade was 4°·6 C.; among the leaves of *Polygonum viviparum* it was 19°·1 C. On June 20 in lat. 82° 48′ on a bright, calm day the air-temperature in the shade was 5° C., while sun-exposed tufts of *Saxifraga oppositifolia* registered 21°·1 C. No insolation temperature higher than 24°·4 C. was recorded even on days when the air-temperature was relatively high. In spring the air is very dry and evaporation is considerable: some of the plants are densely pubescent; most of them have a thick cuticle, and all are low or appressed to the ground, the young shoots being protected by layers of old, withered leaves. The ground is frozen throughout the year a short distance from the surface, and the low temperature of the unfrozen upper layers tends seriously to impede absorption by the roots. There is not much wind, and precipitation is small. It is only in July that water falls as rain.

All the species collected by Dr. Wulff are perennials; the growing period is too short for the completion of

the life-cycle in a single season. The annual growth is small: in a stem of *Salix arctica* barely 2 cm. in diameter Ostenfeld estimates the number of annual rings at about fifty. For nine or ten months the plants hibernate, but the advanced stage of development of the resting buds enables them to expand with almost explosive suddenness when growth is resumed. Flowers of *Saxifraga oppositifolia*, the earliest flowering species, were first seen on June 12. Wulff observed flies visiting some plants in flower, also a reddish-brown butterfly, probably a species of Argynnis; but most of the plants appear to be either self-pollinated or pollinated by the wind. The two photographs of *Saxifraga flagellaris* (Fig. 3) afford a striking illustration of Wulff's observation that "the explosive development of Arctic plants is absolutely staccato, fast in the warm, sunny hours, but at a complete standstill during the many cold and windy days."

The dominant formation is that called by Warming Fjaeldmark ("Rocky flats" of Ostenfeld), ground that is not covered with vegetation but consists of patches of plants among bare rocks. There is no true heath, but some boggy ground with Eriophorum and other marsh plants. On a Nunatak area, slightly north of lat. 82° N., where solitary peaks protrude through the inland ice, a few flowering plants were found, a fact which shows that "one must be extremely careful in asserting that an ice-bound country, that is, a country under conditions answering to an ice-age, is completely destitute of flowering plants."

The Wulff collection from the farthest edge of the circumpolar land area furnishes an impressive demonstration of power to endure hardships and of the efficiency of the plant-machine. As Schimper said, there is probably no place on the earth's surface where the temperature is so low that no plant can withstand it. Arctic species exhibit no special morphological features which distinguish them from plants growing on the Alps or in other situations; their secret of success lies in the constitution of the living protoplasm.

Prof. Ostenfeld has also contributed to the "Meddelelser om Grønland" (vol. xliv., 1923) lists of flowering plants and ferns from Wolstenholme Sound (*ca.* 76° 30′ N. lat.), Inglefield Gulf, and Inglefield Land (77° 28′; 79° 10′ N. lat.) in North-West Greenland. The flora of North-West Greenland includes about 115 species. It is pointed out that the strip of coast between *ca.* 76° N. and 82° N. is not a single plant-geographical area; the more northern flora investigated by Wulff is not only poorer in species but also includes some plants which have not been recorded from the more southern part of the district under consideration. Most of the species found on the north-west coast occur also in West Greenland south of Melville Bay, but a few, *e.g. Saxifraga hirculus* and *Dryas octopetala*, are members of the North-Eastern or East Greenland flora and thus form connecting links between the two geographical areas.

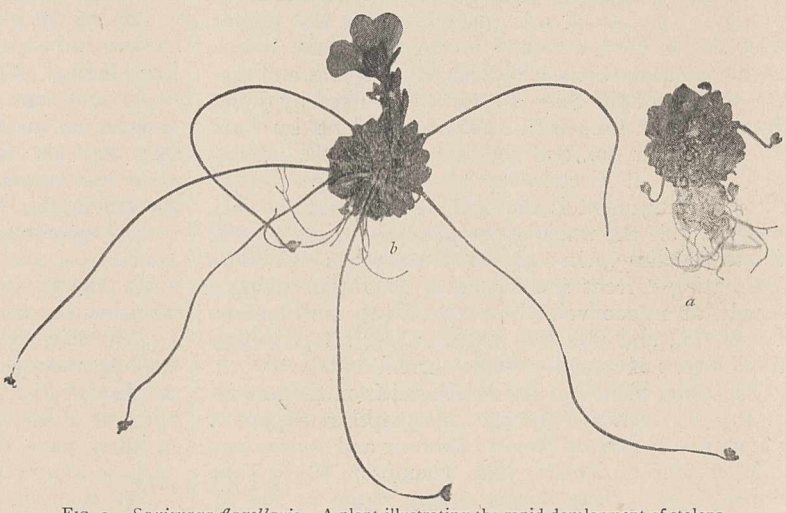

FIG. 3.—*Saxifraga flagellaris*. A plant illustrating the rapid development of stolons (the long, leafless branches) and a flower; stage *b* is 16 days older than stage *a*. From "The Vegetation of the North-Coast of Greenland." (Meddelelser om Grønland, vol. lxiv.)

The plants collected by Dr. Wulff at Cape Agassiz in Inglefield Land (*ca.* 79° 10′ N. lat.) include a species of Woodsia, mentioned in the last entry in the diary, and the brittle fern *Cystopteris fragilis*, a remarkable example of a plant ranging from high Arctic regions to South Georgia in lat. 55° S. Similarly it has been shown by Mrs. Ekman and by Prof. Ostenfeld that *Draba arctica* is merely a northern form of the sub-Antartic *Draba magellanica*.

In vol. lxiii. of the "Meddelelser om Grønland" (1923) Dr. Floderus of Stockholm deals at length with the Greenland willows; he recognises five species, *Salix herbacea*, *S. glauca*, *S. uva ursi*, *S. arctica*, a new species *S. chloroclados*, and several hybrids.

A. C. SEWARD.

Engineering at the British Empire Exhibition.

THE first impression made on the visitor to the Palace of Engineering at the British Empire Exhibition is the enormous size of the building in which the exhibits are housed. This building is not only the largest one in the Exhibition, but is also the largest concrete building in the world; it has a floor space of more than half a million square feet, equal to about six and a half times the area of Trafalgar Square. The building is divided into eleven bays, five of which are 75 ft. wide and have 25 ton overhead cranes. These cranes are carried on reinforced concrete continuous beams about 850 ft. long, with expansion joints at intervals. The roofs of the 75 ft. bays are carried on steel principals; those of the 50 ft. bays are supported on pre-cast reinforced concrete principals. The building itself is a noteworthy engineering feat, and deserves more than a casual glance.

The engineering exhibits which have been brought together inside this huge building will take many visits to examine thoroughly. No particular branch of

engineering has been overdone at the expense of another, and the organisers are to be congratulated on the comprehensive view of the industry which the collection affords.

The power station from which the Exhibition is lighted and power supplied for driving machinery forms part of the engineering building, and can be viewed easily from a conveniently arranged gallery. There are three sets of turbo-generators, each of 1500 kw., supplying current at 3300 volts and 50 cycles. One of these sets is by the British Thomson-Houston Co., with condensing plant by Cole, Marchant and Morley; the second was constructed by the English Electric Co., with auxiliary machinery by the Worthington Simpson Co. and by Hick, Hargreaves and Co.; the turbine of the third set was constructed by James Howden and Co., with condensing plant by John Musgrave and Co., and the alternator is the product of the General Electric Co. A commendable feature of the arrangement is the open character of the pits, which enable the whole of the auxiliaries to be viewed from the gallery. In addition to these sets there is an alternating current sub-station of 2000 kw., taking a supply at 11,000 volts from the North Metropolitan Power Co., and also four reciprocating sets, giving a total output of 1000 kw. direct current.

The boiler plant can also be viewed from the interior of the engineering building. It comprises a pair of water tube boilers by Messrs. Babcock and Wilcox and another pair by Messrs. John Thompson Water Tube Boilers, Ltd. These boilers supply steam at 220 lb. per sq. in., superheated to 600° F. All are fitted with Green economisers and with water-softening plant. The boilers are arranged with mechanical stokers, coal weighing and measuring apparatus, etc.; the ash-handling plant is extremely interesting. There is also an elaborate coal-handling plant by the Mitchell Conveyor and Transporter Co., Ltd. This plant brings the coal from the railway siding through a tunnel under the machinery hall, and delivers it to the boiler house.

Among the many objects of interest shown by Messrs. Armstrong, Whitworth and Co. is a very fine locomotive constructed for the Buenos Ayres Southern Railway. This machine is 8-coupled with a leading 4-wheeled bogie. The engine weighs 84½ tons in working order and the tender 50 tons, making a total of nearly 135 tons. The boiler supplies steam at 200 lb. per sq. in., and superheaters of the Marine Locomotive Superheater Co.'s design are fitted. The tender carries 4000 gallons of water and 8¾ tons of oil fuel; the single oil burner fitted is of the W. N. Best type. There are three simple expansion cylinders, 17½ in. diameter by 26 in. stroke; the outside cylinders have Walschaert valve gear and the inside gear is of the Stephenson type. Both steam and vacuum brakes are fitted. Another interesting exhibit by the same firm is the millionth inch measuring machine constructed by Sir Joseph Whitworth.

The exhibits shown by Messrs. Vickers and allied firms cover a very large floor area, and include oil engines, machine tools, steel forgings, guns, marine turbines, electrical machinery, and an experimental laboratory. In the latter may be seen Prof. Coker's polarised light apparatus for investigating complex states of stress, and another simpler form of apparatus for checking the annealing in the manufacture of glass articles. Messrs. Vickers also show an interesting gyratory crusher, 27 tons in weight, output 75 to 100 tons per hour, the product to pass a 3-in. ring, and requiring 65 to 95 horse-power to drive it.

In addition to the plant working in the power station, the British Thomson-Houston Co. shows a complete range of electric traction equipment, including motors, controllers, and air compressors. The firm also shows a complete turbine motor fitted with stainless steel blades.

Among the exhibits of the General Electric Co. is a 50-kw. turbo-generator, with the cover raised to show the blading. This machine is 3 phase, 50 cycles, 6600 volts, and runs at 300 revs. per min. A large lifting magnet 66 in. in diameter is shown working. This firm has also a special suite of rooms devoted to domestic applications of electricity, including an electric kitchen and an electric bathroom.

Reference may be made at this point to the unfailing courtesy of those in charge of the various exhibits and their readiness to answer inquiries. Further, there are so many examples of opened-out machinery that it is evident that the firms concerned have no intention of making trade secrets of their products. If any criticism in this direction may be offered, it must be confined to the part of the exhibition devoted to motor cars. Few of these have their bonnets raised, and one has to surmise what is within.

The Boulton water elevator at the stall of Messrs. Heatly-Gresham Engineering Co. attracts a good deal of attention. This elevator is of the endless chain type, with hollow links which pick up water from the lower tank and discharge it under the action of centrifugal force whilst passing over the top pulley. It is claimed that the chain or belt, when running at 6 ft. per second, delivers at the top 95 per cent. of the water picked up at the bottom.

At the stall of Messrs. Beardmore may be seen one of the Beardmore-Tosi internal combustion engines, made at the Dalmuir Works of the firm. This engine will be shown at work, and is of the four-stroke cycle, with cylinders 345 mm. in diameter by 480 mm. stroke. The piston speed is low—785 ft. per min. at 250 revs. per min. The compressed air required for fuel injection is supplied by a three-stage compressor. The low pressure of 350 lb. per sq. in. is sufficient for starting the engine, which indeed has started on air at 150 lb. per sq. in. On the test bed the engine has given a result of 0·41 lb. of oil per brake-horse-power per hour. A fine example of a locomotive constructed by Messrs. Beardmore is also shown.

Among the exhibits of Messrs. W. H. Allen, Sons, and Co., may be noted a fine example of a Diesel engine, and the stand of Messrs. G. and J. Weir is noteworthy for the complete range of auxiliary machinery shown.

The stall of Messrs. Hadfield's, Ltd., contains a miscellaneous collection, including steel castings of every description. Such castings are very difficult to produce and represent the steel casting art in its highest form. Many of the articles shown have special application to collieries and mines. Hadfield's patent "Era" manganese steel is well represented by numerous castings for the wearing parts of stone- and ore-

crushing machinery. A worn "Era" manganese steel compound tramway crossing may be inspected here; it was in service during a period of twelve years, and thirteen and a half million cars passed over it. There is also a good display of machined steel forgings, and two crushing machines for stone. Rustless steel is also represented, and there is a large and interesting collection of projectiles ranging from an 18-inch armour-piercing projectile to a small 12-pounder. There are also several examples of armour plates and gun shields. The non-magnetic character of "Era" manganese steel is illustrated by means of a powerful magnet in a glass case.

Messrs. Thos. Firth and Sons have also an interesting exhibit, and the uses of stainless steel may be observed at this and neighbouring stands. These include some fine examples of optical plane mirrors and a section of the test turbine wheel, to which reference has already been made in our columns, in which stainless steel blades were compared with 5 per cent. nickel steel. Visitors may compare for themselves the corrosion and erosion of the latter blades with the undamaged stainless blades.

The Wallsend Slipway and Engineering Co. was a pioneer in the burning of oil fuel in marine boiler furnaces, and examples of the different classes of burners made by this firm may be inspected at their stand. Both Messrs. John I. Thornycroft and Co. and Messrs. Yarrow show several models of ships constructed by them; the first-mentioned also show several marine oil motors and the latter have a Yarrow water tube boiler so arranged that its entire construction may be understood.

The Institute of Metals has a unique display in the scientific section illustrative of the corrosion of condenser tubes. The diagrams shown indicate that the rate of corrosion is mainly dependent upon the properties of the scales formed upon the tubes in sea-water. A novel method is shown for protecting aluminium from the action of sea-water, especially under conditions in which the aluminium is liable to be alternately wetted and dried.

The English Electric Company is represented in the power station, as has been mentioned above, and has a stand in which is shown a 30,000 horse-power twin turbine, built for the Behira station of the Tata Company. The enormous Pelton wheel of this turbine attracts a good deal of attention.

It is impossible to do justice to the contents of the Palace of Engineering within the limits of a short article, and those interested in engineering will find that several visits are required in order to become even moderately acquainted with the exhibits. The engineers of Great Britain have done extremely well for the British Empire Exhibition; the result is one to be proud of, and cannot fail to impress visitors from Great Britain and other countries.

Obituary.

DR. C. W. ANDREWS, F.R.S.

BY the death of Dr. Charles William Andrews on May 25, British palæontology loses one of its foremost exponents. Born at Hampstead in 1866, he graduated in both arts and science in the University of London, and began his career as a schoolmaster. He was, however, always deeply interested in biological and geological science, and in 1892 he became the successful candidate in a competitive examination for an assistantship in the Department of Geology in the British Museum (Natural History). Here he found ample scope for following his inclinations and exercising his abilities, and in 1900 he received the degree of D.Sc. in the University of London, as a recognition of the value of his original researches.

When he entered the British Museum, Dr. Andrews took part in curating the fossil vertebrata, and soon began to specialise in studying the extinct birds. In his first paper, published in the *Geological Magazine* in 1894, he described the remains of the largest known running bird from Madagascar, which he named *Aepyornis titan*. He next devoted attention to some of the extinct birds of New Zealand, and in 1896–97 examined a large collection of fossil bird-bones from the Chatham Islands, obtained by Lord Rothschild for the Tring Museum, contributing three papers on them to the *Novitates Zoologicæ* of that Museum. Later he wrote on the extinct birds of Patagonia, and to the end he retained an interest in all fossil remains of birds. His last important paper on the subject was a description of the sternum of the largest known flying bird from an Eocene formation in southern Nigeria.

Dr. Andrews, however, did not neglect the other groups of higher vertebrates, and he specially studied the marine reptiles of the Oxford Clay collected by Mr. Alfred N. Leeds in the neighbourhood of Peterborough. He began by describing the development of the shoulder-girdle in a Plesiosaur in 1895, and finished by preparing a great monograph of the whole collection, which was published by the Trustees of the British Museum in two well-illustrated volumes in 1910–13. He also made several other valuable contributions to our knowledge of the extinct marine reptiles, among which may be specially mentioned descriptions of Plesiosaurs from the Lias of Northampton and the Wealden of Sussex, published so recently as 1922. His last paper, read to the Zoological Society this year and now in the press, describes and discusses the skin of Ichthyosaurus.

In 1897 the late Sir John Murray was beginning to exploit the phosphate deposits on Christmas Island in the Indian Ocean, and he proposed to the Trustees of the British Museum that they should explore the island, at his own expense, before the fauna and flora were disturbed by man and his introductions. Dr. Andrews was selected for the work, and he spent ten months in 1897–98 in collecting natural history specimens and making a geological survey of the island. It proved to be a typical oceanic island composed of volcanic rocks and coral reefs, and the results of the exploration were published by the Trustees of the British Museum in a small volume in 1900. Eight years later, Dr. Andrews visited Christmas Island again, at the invitation and expense of Sir John Murray, to examine the changes in the fauna and flora which had taken place during man's occupation, but found little to report.

After his first visit to Christmas Island, Dr. Andrews began to show symptoms of an affliction which handicapped him for the rest of his life, and by the generosity of one of the Trustees of the British Museum he was

able to recuperate in Egypt during the winter of 1900–1901. He joined Mr. Beadnell, of the Geological Survey of Egypt, in the Fayum, where there are fresh-water deposits of early Tertiary age, and his keen eyes soon detected numerous remains of mammals which had not previously been noticed. Among these he recognised two successive ancestral elephants more primitive than Dinotherium and Mastodon, which he described under the now familiar names of Moeritherium and Palæomastodon. He thus showed that the African region was probably the original home of the Proboscidea, and in a paper published in the Philosophical Transactions of the Royal Society in 1904, he described various specimens illustrating the early stages in the evolution of these strange mammals. In 1902 Mr. Beadnell discovered the large horned mammal Arsinoitherium in the same district, and between 1902 and 1906 Dr. Andrews again paid visits to the Fayum, thanks to the generosity of the late Mr. W. E. de Winton, and obtained valuable specimens of the most important extinct mammalian fauna which has been discovered during the present century. The whole collection made both by himself for the British Museum and by Mr. Beadnell for the Geological Survey of Egypt, was eventually discussed by Dr. Andrews in "A Descriptive Catalogue of the Tertiary Vertebrata of the Fayum, Egypt," published by the Trustees of the British Museum in 1906. This deals especially with the beginnings of the Proboscidea, Hyracoidea, Sirenia, and Cetacea, and will always remain one of the classics of vertebrate palæontology.

Between 1911 and 1914 Dr. Andrews described and interpreted other important early Tertiary fossil mammals collected by Mr. C. W. Hobley and Dr. Felix Oswald in British East Africa, extending especially his observations on the Hyracoidea. At the time of his death he was looking forward to receiving another collection made last April by Mr. E. J. Wayland in a locality in Uganda whence a toe-bone of Chalicotherium was obtained a few months ago.

In the intervals of these more important researches, Dr. Andrews found time to deal with many smaller discoveries which were brought to his notice at the Museum. He was ever helpful and encouraging to visitors who submitted fossils for his consideration. His genial kindliness, which endeared him to both colleagues and friends, stood him in good stead as a curator, and he attracted many valuable gifts to the collection of the Museum. His keen insight into the meaning of the facts he observed illumined all his writings and made them fundamental contributions to science. The indomitable energy and enthusiasm with which he pursued his researches between the frequently recurring periods of illness during his later years, were altogether admirable. His scientific worth was recognised by his election to the fellowship of the Royal Society in 1906, and by the award of the Lyell Medal of the Geological Society of London in 1916. His personal worth was appreciated by a large circle of devoted friends, both in Great Britain and abroad, who sincerely mourn his premature end. A. S. W.

The many friends of Dr. Andrews will appreciate the following tribute from his surgeon:

"Like all surgeons I have had the privilege of meeting men who have faced the ordeal of a painful operation with courage. Andrews, however, will always remain in my mind as one of the bravest men I ever met. It is possible to hide the whole truth from some patients, so that their ignorance saves them distress. In the case of a scientific man this is impossible, and Andrews knew for many years that a time must come when nothing more could be done for him. None the less while he could work, he worked, and quite shortly before his death he was correcting the proof-sheets of a palæontological paper. He never complained, he never lost his courage, even when he was faced with not one but many operations. What this means only those who have to do with surgery can really understand. His personal charm and thoughtfulness for others were known to all his friends, but to no one were they more evident than to those whose lot it was to be with him in his time of pain.

His scientific work is well known and will ever remain his monument, but I would like to add to his epitaph not only that he was a very kindly and lovable man but that he was a very brave one." A. E.

Prof. E. F. Nichols.

According to a note by Prof. A. Trowbridge of Princeton University in the issue of *Science* for May 9, Prof. Ernest Fox Nichols, formerly professor of physics in Yale University, died suddenly on April 29 while addressing a meeting in the hall of the National Academy of Sciences at Washington.

Prof. Nichols was born in Kansas in 1870, and, after studying at Cornell University and spending two years on research at Berlin, he received the doctorate of science in 1897. He was professor of physics at Colgate and Dartmouth Colleges and Columbia University in succession, but in 1909 abandoned for a time scientific for administrative work and became president of Dartmouth. In 1916 he took up the professorship of physics at Yale, but on the entry of the United States into the War, he joined the Naval Ordnance Department. In 1920 he became director of the pure science research laboratory of the National Electric Lamp Works. For a short time in 1921 he was president of the Massachusetts Institute of Technology, but the state of his health led him to resign after a few months. He took a prominent part in the establishment in 1916 of the National Research Council and in its subsequent organisation.

Prof. Nichols's first paper was published in 1893 while he was still at Cornell, and its title, "Studies of Transmission Spectra of Substances in the Infra Red," suggests the field in which a large proportion of his research work was done. Three years later he was co-operating with Rubens in Berlin in the production and measurement of infra-red radiation, and his last paper, published in 1923, dealt with the same subject. In conjunction with Hull he succeeded in 1901 in measuring the pressure exerted by radiation on a body on which it falls, although the total force involved was only of the order of 10^{-5} dyne.

We regret to announce the following deaths:

Prof. H. O. Hofman, emeritus professor of mining and metallurgy at the Massachusetts Institute of Technology, and an original member of the Institute of Metals, on April 28, aged seventy-one.

Mr. F. Merrifield, formerly president of the Entomological Society, on May 28, aged ninety-three.

Current Topics and Events.

Two distinctions included in the list of honours announced on the occasion of H.M. the King's birthday on June 3 will give particular satisfaction to scientific workers everywhere. One is the Order of Merit conferred upon the president of the Royal Society, Sir Charles Sherrington, and the other is the knighthood of Dr. A. Smith Woodward, who has just retired from the post of keeper of the Department of Geology in the Natural History Museum, South Kensington. Among other names familiar in scientific circles included in the list are the following: *Baronet*, Sir Humphry Rolleston, president of the Royal College of Physicians; *Order of Merit*, Mr. F. H. Bradley, fellow of Merton College, Oxford; *G.B.E.*, Sir Josiah Stamp; *K.B.E.*, Mr. E. M. Dowson, financial adviser in Cairo since 1920; *C.B.E.*, Prof. E. P. Cathcart, professor of chemical physiology in the University of Glasgow; Mr. C. R. Peers, Chief Inspector of Ancient Monuments; Dr. W. C. D. Prendergast; *O.B.E.*, Mr. G. Jeffery, Curator of Ancient Monuments, Island of Cyprus; *Knights*, Mr. P. H. Clutterbuck, Inspector-General of Forests in India; Dr. W. Galloway; and Dr. G. T. Walker, lately Director-General of Observatories in India; *I.S.O.*, Mr. W. J. Bean, Curator, Royal Botanical Gardens, Kew.

MR. J. H. FIELD, who has been appointed Director-General of Observatories, India, in succession to Dr. G. T. Walker, was one of the staff of three European Imperial meteorologists at headquarters in Simla when Dr. Walker took up his post in 1908. Ever since Mr. Field went out to India, he has made the upper air his special study. He began with kites, but finding these particularly difficult to handle in India, he gave his attention to the adaptation of the *ballon-sonde* to Indian conditions. Mr. Field's enthusiasm for upper air research led to the establishment of the Aerological Observatory in Agra during 1912, of which he became the first Director. His work has been published almost entirely in the Indian Meteorological Memoirs, but the War and subsequent financial difficulties have prevented the complete publication of the results obtained at Agra, which, however, it is hoped will not be long delayed. Great changes took place in India during Dr. Walker's term of office. When he became Director-General of Observatories, he had under him a staff of nine Europeans—six whole-time and three part-time. Mr. Field will have only two Europeans under him. While we can sympathise with the desire to employ Indians in India, and appreciate the scientific ability of Indians, we are a little uneasy at the swiftness with which the change has taken place, especially when we remember the great responsibility of warning for hurricanes in two such dangerous areas as the Bay of Bengal and the Arabian Sea.

ON May 28, Prof. J. Joly, of Dublin, delivered the Halley Lecture of the University of Oxford on "The Influence of Radioactivity on the Surface History of the Earth." He said that the theory that the continents are floating on a viscid medium now takes rank as a fact rather than a theory. Recent observations in Holland have shown that the theory is satisfactory when large areas are considered. The evidence appears to be conclusive that basalt constitutes the substratum, which cannot *now* be fluid. The depth of the substratum is perhaps from 100 to 300 miles. Seismic, tidal, and precessional evidence is concordant, and seismologists give 20 to 24 miles for the thickness of the continental crust. In geological time there have been six or seven great cycles of continental submergence, as in North America in Cretaceous times. The earth is now approaching the beginning of a new submergence. These alternations are due to the respective radioactivity of the basaltic magma and the continental rocks. Boring observations have shown that heat is generated in the continental areas themselves; not conducted from below. Where the continental crust is thick, heat may pass downwards, eventually superheating the magma and causing it to liquefy. From these alternations in the condition of the magma, which are cyclical, not continuous, resulted the great geosynclines, such as that of North America. The lateral and upward pressure exerted in the margins of continents by the shrinking of the magma, gave rise to mountain chains skirting the main oceans. Finally, "the earth is not gradually cooling; nor is it decrepit. History begins afresh with every great revolution."

DR. ARTHUR HAAS, professor of physics in the University of Vienna, whose admirable short exposition of "The New Physics" was recently translated into English and published by Messrs. Methuen and Co., delivered a public lecture at University College, London, on May 30 on "Objective and Subjective Physics." The world-picture revealed to modern physics in its exploration of the atomic systems of movement proves to be of surprising simplicity. We find that it is not Nature itself but our path to the true knowledge of it which is complicated. The subjective human world-picture has undergone gradual transformation into an objective one. It ought then to be possible, if the objective world-picture is the true one, to construct inversely the subjective human world-picture from it. This in its turn should make it possible for us to understand how, under the powers and limitations of the human senses, Nature appears to us in a picture, formed and presented by those senses. Finally will arise the question how from this subjective world-picture, which alone we possess, a physical science appears, and how such a man-created science can be knowledge of the absolute qualities of Nature. Dr. Haas illustrates the problem by imagining a spirit whose perceptive faculty is unrestricted, who, comparing magnitudes and times, has no use for and finds no meaning in our terms "large," "small," "quick," "slow." Such a spirit, able to discern the faculties and restrictions of the human senses, would

at once perceive their importance in forming the essential features of the world-picture. The two facts of essential importance in the human world-picture would be evident; namely (1), that within the single octave of electric waves to which the human eye is sensitive most solid bodies absorb waves and the gases of the atmosphere do not; and (2), that the internal motion of matter on the earth is so slow in contrast to that in the fixed stars as to enable durable molecules to be formed. The fundamental conceptions of the objective world-picture—nuclei, atoms, molecules, internal velocities, electric forces, electric waves—would, to the apprehension of the human senses, be seen to give rise to the conceptions of the subjective world-picture—bodies, motions, gravity, light, colours, heat, temperature, substances, changes, firmament, planets.

THE third annual Report of the Board of the Institute of Physics was presented to the Institute at the annual general meeting on May 26. It shows that during the year the activities of the Institute have increased, and its corporate membership has risen from 362 to 401. An appointments register has been drawn up in order to meet the demand for highly trained physicists, which still exceeds the supply. Two lectures on the applications of physics in industry have been delivered to the members, and the Board is considering questions relating to the teaching of physics, the salaries of physicists, and their qualifications. The expenditure of the Institute still exceeds the income—this year the excess is 72*l*. The subscriptions for the year amount to 606*l*., and the office salaries and accommodation account for 550*l*. The administrative expenses of a young society are always heavy, but it is not to be expected that the members of the Institute will continue to feel confidence in the Board if it does not soon succeed in effecting an improvement in this respect. The finances of the *Journal of Scientific Instruments* are kept separate from those of the Institute, although the business management of the *Journal* is undertaken by the Finance Committee of the Institute. The *Journal* has been well received, but the circulation is not yet sufficient for it to pay its way. At the meeting held on May 26 the following officers were elected: *President*, Sir Charles A. Parsons; *Vice-Presidents*, Prof. W. H. Eccles, Mr. C. C. Paterson, Dr. E. H. Rayner, and Sir Napier Shaw; *Treasurer*, Sir Robert Hadfield; *Honorary Secretary*, Prof. A. W. Porter.

A SHORT time ago it was announced that the Advisory Committee on Research into Diseases of Animals had recommended that financial assistance should be provided for the construction of new laboratories at the Research Institute in Animal Pathology, at the Royal Veterinary College, London, and that the Development Commission, with the approval of the Ministry of Agriculture, had agreed to provide a substantial sum for the erection of a new Research Institute on the condition that the governors provided the site and contributed towards the cost. Fortunately, a suitable site could be arranged for within the College precincts, and on Friday, May 23, His Royal Highness the Duke of Connaught, president of the College, laid the foundation stone of the new buildings. In opening the proceedings, Lord Northbrook, chairman of the Board of Governors, pointed out how the College had hitherto been doing great work under enormous difficulties owing to lack of funds, and gratefully welcomed the assistance, pointing out that if knowledge regarding animal diseases is to be increased and properly applied, Research and Education must go hand in hand. The Duke of Connaught expressed the pleasure it afforded him to lay the foundation stone of such a building, and stated that he was well acquainted with the difficulties under which veterinary education had hitherto been carried on. The importance of it could not be overestimated, not only in so far as it affected the health of our most valuable studs, herds, and flocks, and that great friend of man, the dog, but also on account of the far-reaching effect on the health of man himself. There was the strongest incentive to make increasing efforts to extend our knowledge regarding the causes of serious animal ailments, which, as recent events had proved, might threaten the country with actual disaster. Mr. Noel Buxton, Minister of Agriculture and Fisheries, said that the Ministry regarded the chapter just opened by the College as one of the very highest importance. He agreed with Lord Northbrook that research and education must always go together, and the hope of the Ministry was that the Institute would effect as much instruction as research, and would yield a good harvest of recruits equipped with even better appliances than in the past. It is hoped that the Institute will be completed and opened by next autumn. It will be under the direction of Sir John M'Fadyean.

FOR many months, engineers have been busy in making arrangements for an international meeting to discuss the production and distribution of mechanical power. The first World Power Conference will be held at the British Empire Exhibition on June 30-July 12. The invitation to take part in the Conference has been very widely accepted and its success is assured. National Committees have been formed in twenty countries, official delegates have been appointed, and a very large number of papers will be communicated. Lord Derby is the president of the Conference and the leading engineers of Great Britain are vice-presidents. All necessary arrangements have been made to give the delegates a warm welcome, and an international executive committee has been formed so as to secure that each country is satisfactorily represented at the meetings. The papers will not be read but will be presented in groups, so that the time of the meeting can be devoted to discussion. The potential resources of each country in hydroelectric power, oil, and minerals will be considered. Engineers will give their experience in the development of scientific agriculture, irrigation, and transportation by land, air, and water. Conferences will be held between civil, electrical, mechanical, marine, and mining engineers. Particular attention will be paid to industrial and scientific research. Consumers of power will discuss with

manufacturers the best type of apparatus to employ. The educational methods used, especially those in connexion with technical education, in various countries will be described and the results obtained will be compared. Special importance is attached to the discussions that will be held on the financial and economic aspects of industry, which will be considered from both the national and the international point of view. It is hoped to establish a permanent World Bureau for the collection of data, the preparation of inventories of the world's resources, and the exchange of industrial and scientific information through appointed representatives in the various countries. The Offices of the Conference are at 36 Kingsway, London.

IN connexion with the World Power Conference, interesting official tours have been arranged in Great Britain and in France, Italy, Switzerland, Norway, and Sweden immediately after the Conference. These tours will give engineers the opportunity of seeing many of the great continental power stations and many places of great historical interest. A warm welcome will be given to the engineers in the various countries, and they have been invited to many official luncheons and dinners. Messrs. Thomas Cook and Son are making the necessary arrangements. Special arrangements have also been made by the various engineering institutions to entertain their guests. For example, the following provisional arrangements have been made. On July 12 the electrical engineers pay a visit to Cambridge, where they will be welcomed by Sir Ernest Rutherford at the Cavendish Laboratory, be entertained to lunch at Trinity College, and in the afternoon be received by the Vice-Chancellor. On July 14 they will be taken to Birmingham, where they will attend a civic luncheon and then go to Stratford-on-Avon. On July 15 they will visit the repair shops of the London General Omnibus Co., be entertained to lunch by Lord Ashfield, and then drive to Windsor Castle. In the evening they will be invited to a conversazione given by the engineering institutions. Every endeavour is being made to make the occasion of the Conference a memorable one which will long occupy a prominent place in the minds of engineers.

THE Scientific Exhibit of the Chemical Section at Wembley is, we are glad to note, attracting both from scientific workers and the general public the attention that it deserves. Each item is worthy of considered attention, but one of the most striking displays is that of a model by Prof. J. F. Thorpe showing in an ingenious manner how the change in the angle between two bonds of a carbon atom causes other changes between the remaining two bonds, and altogether the display relating to the atomic theory since the days of Dalton is particularly lucid and instructive. Another fact that impresses every one, whether he be a scientific man or not, is the very fine examples of glass-blowing carried out by British operators, which could not be surpassed by any other country in the world. Before the War, many people had the idea that nearly all the high-grade scientific glass-blowing was done in Germany, and that British workmen were not capable of producing it. The War showed how incorrect was this view, and a visit to the Chemical Section is a convincing proof of the high design and quality of British workmanship, not only in glass-blowing, but also in every branch of scientific instrument-making. After all, there is no reason why this should not be so, since Great Britain is the home of the chronometer, for example, and has always produced the finest grade of work also in chemical balances, optical instruments, telescopes, microscopes, pyrometers, and surgical, bacteriological, and meteorological apparatus.

IN the past, the optical glasses used in the construction of large astronomical object-glasses have been made of ordinary crown and flint, chiefly because it has not been found possible to obtain sufficiently large discs composed of other glasses. In deciding the radii of the four surfaces, both mathematical and practical considerations have to be taken into account, and the usual practice has been to make the positive or crown glass element double convex, and the negative or flint glass element double concave, the hollow surface nearest to the eye-piece being generally of very long radius. This form of object-glass has the advantage, from the manufacturing point of view, of two concave surfaces, but the field of view is not very large owing to the presence of inward coma or side-flare in the oblique image. Recently Messrs. Chance Brothers of Birmingham have succeeded in producing a large disc of dense barium crown glass, and realised that this glass, used in conjunction with dense flint, would allow the manufacturer to retain the double concave form for the flint lens and at the same time reduce the coma or side-flare present in the oblique image to about one-third of the usual amount. This disc, together with a flint disc of the same diameter, was supplied to Messrs. Cooke, Troughton, and Simms, Ltd., of York, who have worked them up into an astronomical object-glass of 15-inch aperture, which is exhibited at Messrs. Chance Brothers' stand at the British Empire Exhibition. It is believed that this is the largest disc of first-quality dense barium crown that has ever been made, and it may be expected to attract the interest of those engaged in astronomical work. In due course it will probably be added to the equipment of one of the important observatories.

A DEMONSTRATION of the use of the kinematograph in schools was recently given by "New Era Films, Ltd.," at the Electric Pavilion, Clapham Junction, on May 26. Three films were shown, dealing with geography, machinery, and natural history respectively. The geographical film showed first the growth of the territory under the control of the Hohenzollern family, and then scenes illustrating Allenby's campaign in Palestine. With the exception of the mechanical device showing the expansion of territory, the film was of little value, and the captions afforded examples of styles to be avoided, *e.g.* "Manhood of Wales and Sons of the Emerald Isle." The working of a petrol engine was shown by a series of "animated diagrams," but it is probable that with the aid of a

sectional working model, a teacher would have been able to give pupils a clearer idea of the mechanism. This indicates one of the dangers that will have to be guarded against when the kinematograph is introduced into schools; that is, the inducement to neglect older and better methods of illustration. Two natural history films were a great advance on those previously shown, but they were subject to the criticism passed by a pupil on the whole exhibition, "too quick and hurried." The second of these films, called "Adaptations," was well calculated to arouse interest in the subject and to induce a desire for further knowledge. The exhibition certainly showed the kinematograph must be taken seriously as a factor in education and that, provided that the film is interpreted by the teacher, the knowledge acquired need not, as has been suggested in some quarters, be superficial. This interpretation by the teacher requires that the film should be shown in the school and not in public halls, and teachers interested in the subject will be glad to know that it is hoped to place on the market a projector suitable for the purpose at a cost of about 30*l*. This projector derives its light from an incandescent electric lamp and the film can be stopped at any time: the projector can also be used as an ordinary lantern. A picture up to eight feet in diameter can be obtained; that is, one large enough to show to about 300 persons.

IN his presidential address to the Royal Geographical Society at its anniversary meeting on May 26, the Earl of Ronaldshay gave a brief summary of the work of exploration that has been done during the last year or is at present in progress. Apart from the Mount Everest expedition, which is now on the eve of its assault on the summit, the most interesting task on hand is the scientific investigation of the Great Barrier Reef of Australia, which is being undertaken by the Geographical Society of Queensland with the help of the Government of Queensland. In polar regions little of importance has been done recently or is likely to be done in these days of financial stringency. But the forthcoming biological and oceanographical researches by the *Discovery* in the Southern Ocean, under the auspices of the Falkland Islands Government and the Colonial Office, should prove of great value. In conclusion, the president directed attention to the work of the Permanent Committee on Place Names and expressed the hope that further financial support would be forthcoming in order to allow the continuance and expansion of the work.

IT was to be expected that the opening of the aquarium at the Zoological Society's Gardens in Regent's Park would provide a much needed stimulus to the study of all that concerns the successful care of animals and plants living under aquarium conditions. The British Aquarium Society, the president of which for this year is the Director of the Zoological Society's aquarium, Mr. E. C. Boulenger, devotes itself to this work, and now there has appeared the first number of *The Amateur Aquarist*, a new monthly magazine dedicated to the same ends. The editor is Mr. A. E. Hodge, whose recent book "Vivarium and Aquarium Keeping for Amateurs" is evidence of his enthusiasm for this form of Nature study and of the knowledge and experience which he will bring to bear in the conduct of this new venture. The magazine will concern itself chiefly with the practical side of aquarium keeping, and with the publication of articles and notes on the habits and life-histories of fishes and other aquatic animals, suitable for small aquaria. Mr. Boulenger contributes an article on the history of aquaria, and other notes deal with the paradise fish, the bitterling, the trout, and the silver water beetle. There is undoubtedly room for a journal of this nature, and it should do much to foster the study of living animals and plants.

THE second conversazione of the Royal Society this year will be held on June 18, at 8.30 o'clock.

THE Gold Medal of the Linnean Society was presented to Prof. W. C. M'Intosh on the occasion of the anniversary meeting of the Society held on May 22.

THE Research Laboratories of the General Electric Co., Ltd., Wembley, have a vacancy for a research worker on high temperature problems, one having had full academic training with, if possible, metallurgy as his principal subject.

DR. C. E. RUBY, Massachusetts Institute of Technology, Cambridge, Mass., U.S.A., desires the co-operation of those who are interested, in the collection of verse relating to the sciences. He proposes eventually to publish an anthology of such verse.

APPLICATIONS are invited for an appointment as engineer in the Experimental department of H.M. Signal School, R.N. Barracks, Portsmouth. The duties of the person appointed will be connected with the development of low-frequency signalling devices, and preference will be given to candidates with an honours degree in physics. The latest date for the receipt of applications, which should be sent to the Secretary of the Admiralty (C.E.), Admiralty, S.W.1, is June 16.

ON May 24, the eighth joint meeting of the Challenger Society and representatives of Marine Biological Stations was held at the Millport Marine Biological Station, following a day spent in the new Department of Zoology of Glasgow University. Miss S. M. Marshall read a paper on plankton in 1923, dealing particularly with the food of Calanus. Mr A. P. Orr and Dr. J. H. Paul dealt respectively with carbohydrate metabolism in Crustacea and points in the physiology of moulting in Decapod Crustacea. A number of demonstrations were given by the staff of the Laboratory and others who have recently worked there.

THE Ministry of Agriculture and Fisheries is taking advantage of the presence in England this summer of a number of Dominion botanists and mycologists to hold a conference affording an opportunity for a free and open discussion between members of the British Empire of the scientific principles which should underlie legislation regulating the import of plants and plant products. The Conference will be held in

the hall of the Surveyors' Institution on Thursday July 17, commencing at 11 A.M. The presence of scientific workers, nurserymen, and other persons interested in the subject will be welcomed.

AT the anniversary meeting of the Linnean Society of London held on May 22 the following officers and members of council were elected: *President*, Dr. A. B. Rendle; *Treasurer*, Mr. H. W. Monckton; *Secretaries*, Dr. B. Daydon Jackson, Dr. W. T. Calman, and Capt. J. Ramsbottom. *Other Members of Council*: Dr. W. Bateson, Dr. G. P. Bidder, Mr. E. A. Bunyard, Mr. R. H. Burne, Dr. W. T. Calman, Prof. F. E. Fritch, Mr. R. W. T. Gunther, Miss Ann Cronin Halket, Dr. A. W. Hill, Dr. A. D. Imms, Mr. L. V. Lester-Garland, Mr. R. I. Pocock, Mr. T. A. Sprague, Mr. R. J. Tabor, Prof. F. E. Weiss, and Dr. A. Smith Woodward.

THE hundred and fifth annual meeting of the Swiss Society of Natural Sciences will be held on October 1-4 at Lucerne under the presidency of Prof. H. Bachmann. By that date Lucerne will be comparatively free from visitors, and the Kursaal and other halls will be available for the gathering. Prof. Bachmann's presidential address will be delivered on October 2, and the morning sessions of the two succeeding days will be given over to the scientific work of the seventeen sections into which the congress will be divided. On October 4, addresses will be given by Prof. L. Michaud, professor of clinical medicine in the University of Lausanne, on the rôle of colloids in medicine, by Dr. F. W. Aston, on atoms and isotopes, and by Prof. A. Einstein, on recent changes in the fundamentals of mechanics. Excursions have been arranged to places of anthropological, hydrobiological, zoological, and engineering interest in the neighbourhood. For most of the sections, papers must be received before June 25; for the remainder, July 1 is the latest date. All communications regarding the meeting should be made to Prof. H. Bachmann, Brambergstr. 5a, Lucerne.

THE Report of the Marlborough College Natural History Society for 1923 records the work of a really active and flourishing school society which is doing valuable work on the fauna and flora, geology and archæology, of the district in which the school is situated. As is usually the case, most attention is paid to the birds, butterflies and moths, and flowering plants, and the report includes full records of observations made on these groups during the year. We are glad to notice, however, that the activities of the Society embrace a wider field than this, and the records of other groups of insects and the paper on the fungi of the district are contributions of real value in fields so often neglected by similar societies. The hand-lists of the flowering plants and birds, and the records of the mammalia are brought up-to-date by summaries of the observations made and published since the lists were last issued. Local history and archæology have received their meed of attention in Mr. Brentnall's interesting articles on Barton Farm in the thirteenth century and on excavations on the line of Wansdyke, and in Mr. Clark's notes on the flint implements of Granham Hill. The report is a splendid record of a society with a wide range of activities carried on with an enthusiasm worthy of emulation by others.

Our Astronomical Column.

TRANSIT OF MERCURY.—Since the note on this subject appeared in NATURE of May 24, p. 760, several more observations have come to hand. Those at Bonn, Düsseldorf, and Höchst are given in *Astr. Nach.* 5289. It is now possible to give a fairly trustworthy estimate of the error of the predicted times, based on the formulæ in the Nautical Almanac, p. 469.

Denoting internal and external contacts by I, E, in the mean the formation of the black drop preceded predicted I by 38 sec.; apparent I preceded predicted I by 26 sec.; apparent E preceded predicted E by 36 sec. It is noteworthy that observed I is likely to be late, owing to the fact that irradiation appears to enlarge the sun and diminish the planet; also observed E is almost certain to be early, since it is scarcely possible to follow the very small encroachment on the sun's limb up to the time of its vanishing. Hence if we adopt 31 sec. as the amount by which observation preceded prediction, we are probably within some 4 sec. of the truth. The relative motion of sun and planet in 4 sec. is $\frac{1}{4}''$; this is not a large margin of uncertainty considering the low altitude of the sun in Europe. It will be interesting to compare it with the results obtained in India, Australia, etc., when these come to hand.

COLOUR PHOTOGRAPHY OF THE MOON.—Mr. F. J. Hargreaves showed at the April meeting of the British Astronomical Association some photographs of the moon in natural colours obtained on "Agfa Farben" plates with a compensating light-filter. The plates were taken with the 8-inch Cooke refractor at Headley Observatory (Rev. T. E. R. Phillips) and are described in No. 6 of the current volume of the Journal of the Association. The general tint of the lunar surface resembles weathered stone, concrete, or dried mud. Olive green appears in some of the Maria, notably Tranquillitatis; Serenitatis is brownish; Imbrium is mottled with brown and olive-green. Aristarchus is unfortunately slightly defective, so the suspicion of sulphur-deposits here is not at present confirmed. The study is a very hopeful one, and promises to increase our knowledge of the nature of the lunar surface. It is hoped to extend it to some of the planets.

THE VARIABLE AC HERCULIS.—Mr. G. Zacharov contributes to *Astr. Nach.* 5288 a series of observations of this star made at Taschkent Observatory with a comet-seeker of aperture $5\frac{1}{2}$ in., power 20. It is an eclipsing variable of the β Lyræ type with period 75 days. The two maxima are nearly equal at about 7·85 mag., but the minima are unequal, 8·25 and 8·55 mag. respectively. The time-intervals are m_1 to M_1, 18 days; m_1 to m_2, 35 to 36 days; m_1 to M_2, 52 to 54 days. The magnitudes are on the B.D. scale. The star will repay careful study, which would permit deductions to be drawn as to the shape, relative size, limb-darkening, etc., of the two stars the mutual occultations of which cause the minima. It is at all times bright enough for observation with moderate means.

Research Items.

THE TEMPLE OF THE MOON GOD AT UR.—The latest despatch of the British Museum and Pennsylvania University Expedition to Ur, which has appeared in the *Times*, indicates that as a result of this season's excavations, Mr. F. G. Newton, the architect of the expedition, has been able from the fragmentary indications of scanty walls and broken floors to establish the original character of the great *ziggurat*, or tower, of the Temple of the Moon God. Theoretical reconstructions of *ziggurats* have always assumed from the ground plan that these buildings were perfectly symmetrical. At Ur this was not the case. The original building of Ur Ungur consisted of two stages, of which the upper was removed in the restoration by Nabonidus. The lower stage, which was retained, was a rectangle 195 feet by 150 feet, with its corners orientated with the cardinal points. On this Nabonidus erected three stages, on the topmost of which was the shrine. Three flights of stairs, one in the centre and one at each end, led to the top of the first stage on the north-east side. The upper stages were not of the same proportions as the lowest, but left at each end a platform wider than that at the sides. From the courtyard on the north-east side, now cleared, the tower presented an imposing scheme of line and colour —whitewashed boundary wall, black parapet, and red brick upper terrace, leading up to the shrine of blue glazed brick.

TUNISIAN TATOOING.—In *L'Anthropologie*, t. xxxiv., 1-2, Dr. E. Gobert describes the tatoo designs of the natives of Tunisia and discusses their relation to the elements of other forms of decorative art. The designs in question are employed exclusively in the interior, those of the coast and towns being usually of foreign (Levantine) derivation. Tunisian tatooing is undoubtedly magical in origin, being connected with the protective letting of blood, of which it preserves the record and influence; but this is forgotten by the people themselves, and the great importance attached to it is now based solely upon its effect as a personal ornament. The designs are entirely rectilinear, as a result partly of the use of a kind of knife or lancet instead of a needle, but more particularly on account of the native bent towards the rectilinear in all forms of decorative art. The principal elements in the designs are the date palm, much stylised, the tortoise, generally on the external surface of the arm, and horns, which, being on the hand, serve as a protection against the evil eye. Other forms are associated with these, but their origin and meaning has been much disputed. Outside tatooing, symbolic designs have only a restricted distribution, while the purely geometric designs are common to all forms of North African decorative art. There would appear, therefore, to be two distinct elements, of which that represented by the symbolic design is possibly the earlier.

A PELAGIC NUDIBRANCH.—The morphology of that beautiful and remarkable mollusc, *Melibe leonina*, which seems to be not uncommon in certain localities off the American coast, forms the subject of a detailed memoir by Dr. H. P. K. Agersborg in the current number of the *Quarterly Journal of Microscopical Science* (vol. 67, part iv.). A peculiar interest is always attached to those aberrant representatives of normally shore-dwelling groups of marine animals that have taken to a pelagic life, arising from the fact that they illustrate in a very remarkable manner the almost unlimited extent to which modifications of bodily structure may be carried in adaptation to new conditions of life. The nudibranchs are, as every naturalist knows, an essentially shore-dwelling group of gasteropods. The genus Melibe, however, has adapted itself very successfully to a free-swimming or floating mode of life, with fin-like outgrowths of the body and that characteristic transparency and gelatinous consistency that we are accustomed to associate with pelagic organisms. It takes its place along with such forms as Pelagohydra, Pelagonemertes, Pelagothuria, and Tomopteris, all of which are to be regarded as adventurous members of groups which usually stay very much at home.

THE ISLANDS OF LANGERHANS.—The functions of the cells which form the Islands of Langerhans of the pancreas are of considerable interest to-day in view of the origin and significance of insulin. It is generally assumed that the islet tissue represents a tissue *sui generis*, and there is evidence that it is the site of formation of insulin. But there are not wanting indications difficult to reconcile with this view. Prof. Swale Vincent, in the *Lancet* of May 10, reviews some of this evidence, and still adheres to his opinion that, as suggested by Dale twenty years ago, the islet tissue is part and parcel of the general secreting tissue of the pancreas. The specific nature of the A and B granules of the islets has not yet been proved, and certain of the acinus cells of the pancreas also give the staining reactions considered to be characteristic of the B cells. During starvation also there is an increase in the bulk of the islet tissue, and in rats the same effect is produced by a pure carbohydrate diet. These views are strongly supported from the pathological point of view by Oertel. Finally, it is known that a substance closely resembling insulin can be extracted from other tissues besides pancreas, and E. C. Dodds and F. Dickens, at Prof. Vincent's suggestion, applied their method of insulin extraction to the submaxillary glands of the ox, and found as much as 710 rabbit units per kilo of gland. This gives strong support to the doubts concerning the specificity of the tissue of the islets of Langerhans.

COLOUR-BLINDNESS IN WAVE-LENGTHS.—A method for the investigation of colour-blindness has recently been described by Prof. H. E. Roaf, *Quarterly Journal of Experimental Physiology*, 1924, vol. 14, p. 151. It consists in finding the wave-length of light by which a colour match given by a colour-blind person appears also to match for one with normal vision. When this has been found, it is evident that the region of the spectrum in which the defect lies must have been removed. The problem therefore resolves itself into cutting off different regions of the spectrum, and finding the wave-length limits of the smallest decrease in the spectrum for which the original and the comparison colour match to a normal person. Examination of 28 cases shows that the defect is always in the red end of the spectrum. Common degrees of shortening of the red end of the spectrum are to λ5800 to λ4800.

NITROGEN FIXATION IN LEAF GLANDS.—Matthew Y. Orr has an interesting note in Vol. 14, No. 68 of the Notes from the Royal Botanic Garden, Edinburgh, upon the peculiar leaf glands which are found developed throughout the length of the striking acuminate leaf-apex of *Dioscorea macroura* Harms. The lumen of these glands is filled with a mucilaginous secretion, released from the multicellular hairs lining them, and in this is found present in great numbers a bacterium. Orr has isolated this bacterium in pure culture on artificial media and thus demonstrated that it has appreciable powers of nitrogen fixation.

COTTON SELECTION IN INDIA.—Maganlal L. Patel continues his studies of Gujarat cottons, Part II. dealing with the second of the great varieties of *Gossypium herbaceum* grown in Gujarat and known as the "broach deshi," being published as vol. xii. No. 5 of the Botanical Series of the Memoirs of the Department of Agriculture in India. A number of selected strains of this variety under cultivation by the author are very fully analysed in this report, and as a result an attempt is made to enumerate the characters which must be kept before the breeder's attention as of primary importance in the production of a type of cotton suitable for the special conditions of Lower Gujarat.

THE VIRUS OF THE MOSAIC DISEASES.—To this absorbing problem B. M. Duggar and Joanne K. Armstrong contribute a most interesting discussion which was read to the annual meeting of the American Philosophical Society in 1923 and is now published in the Annals of the Missouri Botanical Garden, vol. x. No. 3. Passing in review the main theories, enzyme, bacteria, filterable virus, protozoon, the authors then give some very interesting new data as the result of their own experiments. Using a graded series of ultra filters and comparing their resistance in passage with that of standard hydrophilic colloidal sols, they were able to conclude that the size of the particles in the tobacco mosaic virus was approximately that of the particles in a fresh 1 per cent. hæmoglobin solution. This means that the particles are approximately 30 $\mu\mu$ in diameter and that compared with a normal bacterial pathogen the volume relations would be about as 26 to 1,000,000. These particles, though very resistant to dehydrating agents like alcohol and acetone, are less so than the spores of *Bacillus subtilis*, but they are far more resistant to prolonged grinding. The authors by no means conclude that their findings necessarily mean that the virus of tobacco mosaic contains an ultra-microscopic *organism*. On the contrary, they emphasise that such an "organism" could scarcely have a true bordering membrane and a definite "endo-metabolism," and they suggest tentatively that the causal agency in such mosaic disease may be a product of the host cell, not a simple enzyme but a more complex structure endowed with the power of reproducing itself when in a suitable nutrient medium. Such a hypothesis certainly accounts for the otherwise curious fact that if the pathogen in the virus is an ultra-microscopic organism, similar saprophytic organisms, which should be easy to culture, have so far escaped detection.

DENDROGRAPHIC RECORDS OF TREE GROWTH.—The annual Report of the Director of the Laboratory for Plant Physiology, in the Year Book of the Carnegie Institution of Washington, No. 22, 1923, shows that the extensive experiments on the growth of trees made by the dendrograph, a very delicate instrument for measuring expansion in girth, are gradually accumulating some very suggestive data. The Director of the Laboratory, Dr. D. T. MacDougal, and Dr. Forrest Shreve are especially associated with this work. Dendrographic records of tree growth have shown that in the Monterey pine no obvious connexion exists between the season's growth of the adult tree and the precipitation; on the other hand, in the yellow pine the amount of wood formed in any year corresponds closely with the amount of precipitation. Clearly, then, without a careful experimental basis thus established, it will not be safe for ecologist or climatologist to use the annual rings of timber as an index of precipitation in previous seasons. A most suggestive paragraph records that the woody cylinder of a living tree shows a *daily* variation in diameter, amounting to 1 part in 1550 in March, falling to 1 in 3200 in April, and rising in midsummer again to 1 in 2500. The trunk of a dead tree shows no daily variation of a magnitude detectable with the instrument. This observation recalls the early observation (1801) of that pioneer plant physiologist, T. A. Knight, that a pin inserted easily between the medullary ray and the wood on an exposed surface on a sunny day was firmly gripped by the tree in the evening but dropped loosely out next morning. Defoliation of the Monterey pine early in the season caused a stoppage of growth, while defoliation in June had no such effect. Decapitation a metre above the dendrograph stopped increase in girth, a result that might perhaps be anticipated in view of Neeff's earlier observation (*Zeitschr. für Bot.*, vol. 6, 1914) on the effect produced upon the cambium below, by such removal of the leading shoot. Foresters will be interested in the 300 days of continued actual growth of a young Monterey pine, the longest seasonal growing period yet recorded by accurate instrumental methods.

GROUND WATER IN THE UNITED STATES.—Among the numerous water-supply papers that are published from time to time by the United States Geological Survey, one of more than usual interest and of wide application is Paper 489, in which Mr. O. E. Meinzer deals with the occurrence of ground water. The principles of the subject, including the water-bearing properties of various kinds of rocks and the influence of their structure on ground water, are fully treated, and the paper concludes with a systematic account of the water-bearing formations of the United States. Five other papers are promised, and the series when completed should form a valuable treatise on the subject. The present paper is admirably arranged and well illustrated, and includes a map of the United States, showing the division of physiographic provinces as determined by the Association of American Geographers.

MICROSEISMS.—The Rev. E. Gherzi has recently published an interesting and well-illustrated study on microseisms recorded at Zi-ka-wei (*Notes de Sismologie*, No. 5, Observatoire de Zi-ka-wei). He divides them into four classes, those due to cyclonic winds, those registered during an anticyclone, those caused by cold, and others of unknown origin. Microseisms of the first class consist of regular, almost sinusoidal oscillations, with a period of from 4 to 8 seconds. They are attributed to violent and rhythmical variations of pressure on the surface of the sea produced by the atmospheric eddy and transmitted through the water to the earth's crust. In the second class, the movements are like the teeth of a saw, preserving the same amplitude and period (from 2 to 6 seconds) whatever be the force of the wind. Microseisms caused by cold are irregular in form and long in period (1 to 4 or 5 minutes). They occur with cyclonic or anticyclonic winds, and microseisms of the first and second classes are superposed on them. The unexplained microseisms consist of waves that are sometimes regular in form with a period of several minutes. They are recorded somewhat rarely, but at times that are independent of the season and hour of the day.

GEOLOGICAL PHOTOGRAPHS.—Mr. F. E. Wright, of the Geophysical Laboratory of the Carnegie Institution of Washington, contributes an article on "Stereoscopic Photography in Geological Field Work" to the Journal of the Washington Academy of Sciences for February 4. He gives the details of a mathematical and experimental investigation of the recognition and representation of depth (the different distances of objects in the line of vision), and comes

to the following conclusions. In geological field work, stereoscopic photographs taken with an ordinary camera are of value to the geologist. Details which may have escaped notice are indicated more emphatically than in a single photograph. No special apparatus is required. It is advisable to take the two photographs, one after the other, the distance between the two camera stations to be from 1 to 5 per cent. of the distance of the object, the camera in each position to be pointed at the object and the line joining the camera stations to be approximately normal to the lines of sight to the object. The stereoscopic effect can be enhanced if enlarged prints are made and a lens stereoscope of the ordinary type is used in the examination of the prints.

RAINFALL OVER INDIA.—The Memoirs of the Indian Meteorological Department, vol. xxiii. part 7, give the monthly and annual normals of rainfall and of rainy days from records up to 1920, by Dr. Gilbert T. Walker, the Director-General of Observatories. The volume consists of 167 fcap. pages of figures and about 1 page of letterpress. The normals in most cases cover the period of 1878 to 1920. The number of years over which the rainfall data extend is given for each station, and the stations are grouped under provinces and districts. A special feature is that normals are given for each district as well as for the 15 chief divisions and 32 subdivisions of India. The normals of hill stations above 3500 feet are mostly excluded. In India a rainy day is a day on which 0·1 in. or more is recorded, thus differing from the practice adopted in the British Isles. Little can be attempted so far as comparison of the several stations is concerned, the mass of figures being too great. The normals for 15 chief divisions show that the heaviest rainfall occurs in Assam, where the fall for the year is 100·49 in. and the frequency 114·5 days; in both June and July the rainfall exceeds 18 in., while in December the fall is only 0·35 in.; the next largest annual fall is 80·76 in. in Burma. The division with the least rainfall is Sind, with 6·19 in. for the year, which falls on 8·6 days; the next driest division is North-West Frontier Province with 15·60 in. for the year. The mean rainfall for India as a whole for the year is 47·47 in., which falls on 57 days. The wettest month is July with 11·16 in., while both January and December have less than half-an-inch of rain. The height of each station would be of interest, although it would involve an additional column of figures, and a map or two showing rainfall distribution would have facilitated comparison. It is customary in similar discussions for the British Isles to give the name of the observers, which in a sense is a partial acknowledgment.

THE PASSAGE OF ELECTRICITY BETWEEN METALS IN LIGHT CONTACT.—A paper by Fraülein Angelika Székely in the *Zeitschrift für Physik*, March 6, describes experiments in which the characteristic curves for current and voltage were determined for loosely touching steel spheres. As found by previous experimenters the voltage increases at first slowly and regularly with the current, until a critical point is reached, when the voltage drops to a considerably smaller value than before; this value remains constant when the current is increased further, and is known as the equilibrium voltage. With pressures of from 1 to 20 grams, using spheres with radii from 0·5 cm. upwards, its value was 0·22 volts, and was the same with a sphere and a plate of steel. With alternating currents this value corresponds to the maximum instantaneous value of the observed effective equilibrium voltage. For currents smaller than the greatest which has passed through the undisturbed coherer since the establishment of equilibrium voltage, it behaves like an ordinary constant ohmic resistance, which diminishes as the maximum current through the coherer increases. The observations agree with the old theory of the formation of metallic bridges between the spheres at the critical voltage, the sectional area of the bridges increasing with the current, so that the product, current by resistance, remains constant. By drawing the spheres slightly apart while current was flowing, the existence of metallic bridges was demonstrated microscopically, and they were photographed. Nickel was found to behave something like iron and steel, while with copper, zinc, and brass no visible bridges were formed.

EXTRACTION OF OIL AND GREASE.—It is well known that the use of benzine, carbon bisulphide, alcohol, and ether for extracting oils, fats, and resin is attended with the risk of fire or explosion, and that owing to this fact the costs of transporting them, insurance charges, etc., are relatively high. To obviate these disadvantages and at the same time to produce equally efficient solvents, the Weston Chemical Co., of Liverpool and Runcorn, has for some time past been manufacturing and marketing a series of chlorine derivatives of the hydrocarbons ethane and ethylene. Of these compounds, trichloroethylene, C_2HCl_3, sold under the name of "Westrosol," has been found very useful for extracting edible oils, as it leaves no taint or smell on the extracted material; as a solvent for varnish and rubber-cement; and as a spot-remover in the textile industry. Tetrachloroethane, $C_2H_2Cl_4$, known as "Westron," is a similar colourless liquid which combines with other useful properties those of being a good solvent for cellulose acetate and sulphur, and a valuable insecticide. Recently it has been found possible to incorporate some of these compounds into soaps and thus to produce good scouring materials, which will remove from fabrics stains caused by mineral oil, grease, tar, and paints. "Westropol" is specially recommended for laundry work; "Westrol" for scouring cotton yarns and fabric, linen, jute, and silk goods; and "Westoran" for scouring cotton, wool, and silk. Both "Westropol" and "Westoran" have pronounced insecticidal and antiseptic properties.

BLEACHING.—Few of us can claim to be quite immune from susceptibility to the power of advertisements, but all of us should be able to discriminate between those which seek our patronage without a rational basis and those which appeal to the understanding as well as to our sense of form and colour. In the latter category we should certainly place some brochures on bleaching with chlorine, sodium peroxide, etc., issued by the Castner-Kellner Alkali Co., which should prove interesting and informing to all those who have no special knowledge of the subject. Thus we learn that great economy can be effected by using a bleach-liquor (made by adding ordinary bleaching powder to water) into which chlorine gas has been passed, the bleaching strength being thereby increased by 35 to 40 per cent. and the insoluble lime-sludge being reduced to about one-fourth of the usual amount. Precise instructions are given concerning the handling of cylinders containing liquid chlorine, and the applications of this substance in water purification and sanitation are described as well as urged. The advantages of sodium peroxide as a bleaching agent are emphasised and explained, this material being more economical and safer to store and transport than solutions of hydrogen peroxide. The precautions necessary to prevent the access of combustible organic substances, such as paper and straw, are outlined, and methods of handling, treatment with dilute acid, and testing are given in adequate detail.

Science and Labour.

THE Conference on Science and Labour organised by the British Science Guild in association with the National Joint Council of the Trades Union Congress and the Labour Party was held at the British Empire Exhibition on May 30 and 31. The Prime Minister (Mr. Ramsay MacDonald), who was to have opened the Conference, was unavoidably absent owing to public duties. In his letter of apology, which was read by Sir Richard Gregory, the chairman at the first session, the Prime Minister wrote :

" I have been looking forward to this meeting with great pleasure, as I wished to try and say something to impress upon the public the necessity of treating political questions in a scientific spirit, and not merely in a short-vision, partisan frame of mind. Until we regard administration and legislation in precisely the same manner as a scientific worker approaches his work in a laboratory, we shall never be able to get results of a permanent character, nor shall we secure respect for our public institutions. I was hoping that one of the results of the War would have been to have eliminated from the House of Commons the 'methods of the dog-fight.' Unfortunately, there are far too many signs that the hope is not to be fulfilled. The matter ultimately rests with the public, which ought to scan with scrupulous vigilance proceedings in Parliament, not merely in relation to this topic or that, but to the spirit of national concern which its debates show. If our social organisation is still so very rudimentary that the public are open to the exploitation of any interest that is placed for the moment in a position of economic advantage, it is mainly owing to the fact that scientific methods have hardly yet been applied to society itself. I hope that as a result of your Conference a beginning will be made in the scientific consideration of the problems which confront Parliament, and if that happens the promoters of this Conference will have great cause to congratulate themselves on what they have done."

Sir Richard Gregory explained that the term " science " as used in the title of the Conference was intended to have the widest possible meaning. In the view of the promoters of the Conference, scientific methods must be applied to all the conditions which influenced the progress of civilisation. Wealth in the form of new industries was created by scientific discoveries. In the political field, consideration was given not so much to the creation of wealth by these means as to its distribution among those who used the knowledge obtained by science.

Mr. Sidney Webb, president of the Board of Trade, in introducing the discussion on the Place of Science in Government, expressed doubt as to the doctrine sometimes put forward that if scientific men had been brought into close contact and co-operation with the Government before the War, we should have escaped some of the difficulties we had experienced. Men of science, he said, tended to keep themselves in a state of academic detachment and to develop a narrowness of outlook which seriously diminished their value in deciding problems of national action. But it could not be maintained that the State had abstained from utilising scientific ability when combined with appreciation of the conditions in which it was to be applied practically to the life of the community. He instanced the work of Sir John Simon in public health administration. Referring to public administration, he said that lay control should be tempered by expert advice. He had known a few distinguished men of science who in the past, by some happy chance, had obtained seats in the House of Commons, but doubted whether the impartial observer would say that they were as distinguished in the House of Commons as in their scientific work. The function of the elected representative was essentially that of the expert exponent and translator. After speaking in high terms of the ability shown by members of the Civil Service, he said that the fundamental problem was the creation in the community of the recognition of the importance of expert knowledge and of an atmosphere which would encourage research in all departments of knowledge without regard to immediate practical results. This might be described as a platitude—a platitude being one of those truths which everybody accepts and nobody acts upon. It was the Labour Party especially which placed the advancement of science in the forefront of its programme.

Mr. Webb's address promoted a spirited discussion on lay control of the man of science. Sir Richard Glazebrook urged that men of science in the service of the Government should be left free and untrammelled so far as was compatible with ministerial responsibility to Parliament, and should hold positions in councils which would secure for them the power to translate their discoveries into practice. Prof. Bairstow considered that lay sympathy in Government departments, which he gratefully acknowledged, was not sufficient to give the State the full benefit of the knowledge which it secured. Directors of scientific research in Government departments occupied inferior positions to administrators in other branches of Government work. It seemed to him essential that the scientific members of the staff should be grouped under a responsible head with direct access of the Minister. He instanced the slow progress of aeronautical research as due in part to defective organisation on the executive side.

The Conference addressed itself more specifically to scientific research at the second session, the chief speakers being Mr. Hugo Hirst, Sir Oliver Lodge, Sir Daniel Hall, and Mr. A. P. M. Fleming, all of whom contributed interesting addresses on the application of research to industry. Mr. Hirst, as director of the General Electric Company, was able to speak with direct knowledge of the creation of a great research department in connexion with the electrical industry. The Research Laboratories of the General Electric Company at Wembley had been established, he said, at a capital cost of 200,000*l.* and involved a yearly expenditure of about 50,000*l.* Scientific research in an industrial concern must not be undertaken on narrow or selfish or mercenary lines if it was to succeed. The papers published by members of the staff of the laboratories were looked for with interest by scientific and technical bodies. No well-conducted big industrial concern worked merely for profit. Profits were a measure of success, but it would be found that industrial concerns (as distinguished from trading concerns) constantly struggle not to part with more profit than is necessary to attract capital in the future any surplus being retained by the management for development. The Government was not competent to develop industrial research even if generous means were available. Who in the Government service, he asked, could be entrusted with the task of having to admit failure ?

Sir Oliver Lodge gave illustrations of the importance of pure scientific research leading to industrial applications. Referring to recent research in atomic physics, he said that it was an undoubted fact that there were immense stores of energy locked up in the atoms of matter and in the ether of space, and it seemed to him quite unlikely that fifty years would

elapse before some of this energy was tapped and applied to practical purposes. We were really using that energy already without knowing it, every day of our lives, but it was not yet under control, and we used it indirectly, as sunshine, and in combustion and chemical action. There might be physical methods of getting at this energy, and the amount was so vast that if we could get at only one per cent. we should have a source of power which would put all others into the shade. If he might allow himself a Wells-like speculation, he could conceive the aeroplane, the steamship, and the locomotive of the future as propelled rather like a rocket by the reaction of a small quantity of material ejected from the tail at a speed far beyond that at which gases are expelled even by the most powerful explosive. If this were ever achieved it would be through some of the most remarkable experiments ever conceived by the most fertile imagination. The discussion which followed the opening speeches turned on the action taken by the Government during the War to promote industrial scientific research. Major A. G. Church, M.P., expressed doubt whether the capital sum of 1,000,000*l.* dedicated by the Government to the work had produced comparable results, particularly as regards converting our manufacturers to a belief in the value of scientific research to industry. Several speakers connected with the recently established Research Associations justified the policy of the Government and pleaded for more patience in estimating concrete results and for an extension of the experimental period of five years.

At the remaining sessions, economic rather than scientific questions were to the fore. Co-operation of Science and Labour in Production was the subject of a stimulating address by Lord Ashfield. In the discussions of Science and the Human Factor, remarkable evidence was produced by Sir Arthur Newsholme, Dr. C. S. Myers, Dr. Cyril Burt, and Miss May Smith of the economic importance of preventive medicine and applied psychology. At the final session, Mr. R. H. Tawney, dealing with Science in Educational Organisation, laid stress on the economic waste resulting from the defects of our educational system. He was followed by Sir Thomas Holland, who argued for the humanisation of scientific teaching, pure and applied, and by Dr. R. P. Scott, who outlined suggestions for reforms in the administration of education, including the appointment of an Educational Council to advise the Minister of Education.

It was generally agreed that the Conference had served a useful purpose in focussing and examining a series of questions of grave importance at the present time. We understand that a full report of the proceedings is to be published in due course, in order that the discussions may reach a wider public than could be assembled in the Conference Hall at the British Empire Exhibition, which offers so many alternative attractions to those able to make the journey to Wembley.

Optical Effects of Motion.[1]

By Prof. P. ZEEMAN, For. Mem. R.S.

THREE optical effects of motion are known at the present time, namely, (1) astronomical aberration, discovered by Bradley in 1728; (2) the Doppler effect expressing the dependence of the wave-length of light on the relative motion of a source and an observer; (3) the effect of the carrying along of light by motion in a straight line of transparent matter, or the Fizeau effect, and a cognate effect of a rotation. Sir Oliver Lodge showed that the ether between two rapidly revolving steel discs is not put in motion.

The present lecture is concerned mainly with the Fizeau effect and experiments made in recent years as to its magnitude. The Fizeau effect was for half a century regarded as a direct proof of the existence of a stagnant and all-pervading ether, as assumed by Fresnel, Lorentz, and Larmor. The theory of relativity has radically changed our point of view concerning this effect, but it remains very important and was to be verified as accurately as possible. The velocity we are able to obtain in the laboratory with a column of water transmitting light is rather small—something like 10 metres per second. We can therefore change the velocity of light only by one part in twenty-five millions. Only an interference method can help us in such a case. In a most ingenious way Fizeau demonstrated the existence of the effect sought for. The displacement of the interference fringes proved to be less than should be produced by the full velocity of the moving water —how much exactly could be decided only by new experiments. Michelson and Morley, thirty-five years after Fizeau's first communication to the Paris Academy of Sciences, repeated the experiment. Michelson made use of his interferometer, and this enabled him to produce interference fringes of considerable width without reducing the intensity of the fringes. The principle of the arrangement is, however, the same as that used by Fizeau.

The agreement between the theoretical value calculated according to a formula of Fresnel, and observation, is extremely satisfactory. In 1895 Lorentz showed that a correction had to be applied to Fresnel's formula, and this made the agreement between theory and observation somewhat less perfect. It was therefore of some importance to repeat the experiment of Fizeau with water and using light of different colours in view of the fundamental importance of the experiment for the optics of moving bodies.

The axial velocity of the water was determined in a separate experiment, and various circumstances were considered which might influence the result. The agreement between the corrected Fresnel formula and observation leaves nothing to be desired.

An investigation was afterwards carried out with *moving, transparent, solid* substances. This case is interesting in itself and also because Fresnel was induced to formulate his hypothesis of the stagnant ether by an experiment of Arago with a glass prism. The apparatus used by the lecturer permitted a column of quartz or glass of 140 cm. in length to be moved in a straight line with a maximum velocity of 10 metres per second. The optical arrangement is the same as in the first experiment. The formula calculated for the effect to be expected differs considerably from that for Fizeau's experiment in its usual form with water. In the latter case, the velocity in a definite point of space is always the same, whereas in the experiment with the glass rod the light must overtake the moving bar.

The calculated and observed shifts of the interference fringes are in excellent agreement. The result of the application of the theory of relativity to the present problems must be the same as that of Lorentz's famous deduction, but the point of view

[1] Synopsis of a lecture delivered on Wednesday, May 21, in the Physics Theatre of the Imperial College of Science, South Kensington.

is quite different. The convection of light is given by the theory of relativity as a correction to the formulæ of classical dynamics. The observed shift of the interference bands is in perfect agreement with the new mechanics.

The Doppler effect is of interest in connexion with the experiments described. An application of the theory of relativity to the theory of the Doppler effect was made by Einstein. It is characteristic of the theory of relativity that this effect does not become zero when the motion of the source is at right angles to the direction of observation. According to theory, there remains a Doppler displacement of the spectral lines of extremely small amount. Einstein pointed out seventeen years ago that there was a possibility of observing this transverse effect by means of observations on canal rays. Experiments have been made on this subject, but different sources of error must be eliminated before the existence of this effect, which would be in harmony with the so-called dilatation of time, can be considered as proved.

The Interrelation between Physics and Industrial Research.

THE series of lectures which are being given under the auspices of the Institute of Physics have been concerned with the value of the physicist in modern industry. In his presidential address delivered at the annual general meeting on May 26, Sir Charles Parsons dealt with the converse influence which industry and industrial progress have exerted upon science, a beneficial influence which has not, perhaps, received sufficient recognition.

It is noteworthy, although not altogether surprising, that some of the greatest of the creators of the sciences of energy and thermodynamics were impelled by their engineering interests to take up their scientific work. In the case of James Watt, it was his interest in engineering which led him to his great work on the physical properties of steam. Joule began his work which led to the discovery of the mechanical equivalent of heat from attempts to solve an impossible engineering problem, namely, the supersession of the steam engine as a prime mover by an electromagnetic engine worked by the electrolytic consumption of zinc. The case of Carnot is a classic example of a similar procedure, and the birth of the modern science of thermodynamics was the result of a reconciliation, effected chiefly by Thomson, Clausius, and Rankine, of the discoveries of Joule and Carnot. A more recent example quoted was that of Lord Armstrong, who, though known chiefly as the introducer of hydraulic machinery and modern guns, was essentially a physicist in his methods of thought and investigation in engineering problems. His invention of the hydroelectric machine for generating high-tension electricity arose from a chance observation of the emission of electric sparks from a tie bar in the roof of a boiler house.

In the field of invention proper, Sir Charles Parsons considered that the testing of a discovery or invention was probably the most important and difficult part of the work, and here a knowledge of physics was of inestimable value. Some interesting sidelights were thrown on the invention of the steam turbine. Some preliminary experiments were made with high-speed shafts and bearings, but in order to complete the data a small turbine coupled to a high-speed dynamo of primitive design was made; the calculated stresses due to centrifugal force, the laws governing the flow of steam, and data from dynamos as approximately known at that time were taken into account. The constants for the flow of steam, the loss by friction in bearings at high surface speeds, the hysteresis and eddy current losses in armature core, conductors, and binding wire at abnormally high speeds were approximately investigated. Higher mathematics were not employed in this work, but were used much later to co-ordinate the accumulated data and forecast the effect of small improvements and refinements which have, in recent years, considerably increased the thermal efficiency of the turbine. The invention of the steam turbine reacted upon science by stimulating research in the dynamics of rotating shafts, the law of flow of saturated and superheated steam through jets, and the frictional resistances to flow through passages and over surfaces.

The address concluded with a consideration of the position in Great Britain of the scientific instrument industry. The industry, never a lucrative one, now finds itself, as a result of post-War conditions, in a position of extreme difficulty. Being small in magnitude out of all proportion to its importance, it is at a great disadvantage as compared with richer industries in facing times of depression. In the opinion of Sir Charles Parsons, perhaps a too-exclusive individualism, involving unnecessary overlapping and lack of interchange of knowledge among the various companies, may have been more pronounced than in some other lines of manufacture. At the same time there has grown up among physicists and others the practice of equipping their laboratories with instruments and materials largely imported from abroad. This has had a twofold injurious effect. It has reduced the home market and it has to some extent put the industry out of touch with the requirements of research workers and manufacturers. Sir Charles urged the users of scientific instruments to give more encouragement and sympathy to the home manufacturer, so as to enable him to provide himself with better equipment and a more skilled staff. Only thus will he be able to manufacture as cheaply and as well as the foreign manufacturer.

University and Educational Intelligence.

ABERYSTWYTH.—Applications are invited for the professorship of agriculture in the University College of Wales, vacant by the death of Prof. A. E. Jones. A knowledge of Welsh is desirable. Further particulars are obtainable from the General Secretary. The latest date for the receipt of applications is June 21.

CAMBRIDGE.—Prof. A. S. Eddington and Dr. P. A. MacMahon are to be appointed representatives of the University at the International mathematical congress at Toronto in August. Mr. A. Wood, Emmanuel College, has been re-appointed University lecturer in experimental physics. Mr. H. W. Florey has been elected to the John Lucas Walker Studentship.

The Council of the Senate has, on the suggestion of the Statutory Commission, proposed to the Senate a Statute to carry out the recommendation of the Royal Commission, to the effect that "no person shall be matriculated who has not passed or been exempted from an Examination to be recognised for the purpose by the University, except duly admitted Research Students and other persons or classes of persons whom the council of the Senate shall have approved for that purpose."

A proposal has been brought forward for an important change in Part II. of the Natural Sciences Tripos, namely, the introduction of the two subjects of biochemistry and pathology.

A Denman Baynes Studentship for research in

mathematics, physics, or chemistry will be awarded at Clare College in July, preference being given to graduates of the University and, *ceteris paribus*, to members of Clare College.

LEEDS.—An improvement of some importance to science students has been made in the library arrangements at the University by adapting a room near the main entrance. The Science Library has been fitted with steel bookshelves and contains some 12,000 volumes. The room is believed to contain the best collection of materials to be found in Yorkshire for research in most branches of science. This is but one of a number of additions and adjustments to the accommodation of the University Library that have been made in recent years. The time is rapidly approaching, however, when the whole question of the accommodation of the University Library will have to be treated in a more comprehensive manner than has yet been possible.

Dr. N. Comber has been elected to the chair of agricultural chemistry in succession to Prof. C. Crowther, who is now principal of the Harper Adams Agricultural College. Dr. Comber has for some time past been lecturer in agricultural chemistry, and recently he has also acted as advisory chemist under the Ministry of Agriculture's scheme for providing technical advice to farmers. He has published various papers on the constitution of the soil.

Mr. Henry Lamb, of Poole, Dorset, has accepted an invitation of the committee to paint the portrait which is to form part of the memorial to Sir Michael Sadler's work in Yorkshire. It is expected that the formal presentation of the portrait to the University, and a replica of it to Sir Michael himself, will take place in October, shortly after the beginning of the new session.

LONDON.—Applications are invited for the Wheatstone chair of physics tenable at King's College. They should be sent to reach the Academic Registrar, University of London, South Kensington, S.W.7, by, at latest, July 7.

MANCHESTER.—The entries for the proposed summer courses for post-graduate studies in mathematics, to be held at Bangor, referred to in our issue of May 3, p. 660, have been such as to justify the holding of the courses. The dates of opening and closing are August 25 and September 6. Inquiries should be addressed to Miss D. Withington, The University, Manchester.

THE New York correspondent of the *Times* states that Harvard University has received from Mr. George F. Baker 5,000,000 dollars (1,000,000*l.*) as a permanent endowment for its graduate School of Business Administration.

THE Battersea Polytechnic invites inquiries from persons prepared to give short evening courses in either bacteriology, chemistry of proteins, physics and chemistry of colloids, enzymes, the technical microscopy of textiles, leather, paper, etc. The lectures and demonstrations will be primarily for industrial chemists of post-graduate standing in organic chemistry.

THE Council of the Institution of Mechanical Engineers has agreed to the principle of the endorsement by the Institution of Automobile Engineers of Diplomas in Mechanical Engineering in respect of automobile engineering subjects. This will mean that it will be possible for members of the Institution of Automobile Engineers, in addition to passing the Institution Examination, to obtain a special Diploma endorsed by the Board of Education, the Institution of Mechanical Engineers, and the Institution of Automobile Engineers in regard to their technical qualifications. The details are to be announced later.

THE League of Nations Union has arranged summer schools at Keble College, Oxford, on August 1-8, and at Geneva, August 9-16. Among the lecturers for the Oxford school are Prof. Gilbert Murray, Prof. H. J. Fleure, who will speak on "Geography and the League of Nations," and Dr. Harold Kerr, who will discuss health aspects of the League's work. The Geneva school will hear lectures from, among others, Dr. L. Rajchman, Director of the Health Section of the League of Nations, and Sir Arthur Salter, Director of the Economic and Financial Sections of the League. Applications to attend the schools should be made as soon as possible to the Secretary, League of Nations Union, 15 Grosvenor Crescent, London, S.W.1.

WE learn from *Science* that two well-known British scientific men will be lecturing in the United States during the coming months. Prof. W. L. Bragg, Langworthy professor of physics in the University of Manchester, England, is to give the two courses in the summer session of the University of Michigan on (*a*) X-ray crystal analysis and (*b*) recent contributions in the field of X-rays and their interpretations. Prof. Bragg will be in residence at Ann Arbor for four weeks beginning on July 14. Prof. A. S. Eddington, Plumian professor of astronomy in the University of Cambridge, after attending the meeting of the British Association at Toronto, will proceed to the University of California, where he will lecture in the department of physics during the first semester of 1924–25. He will offer a lecture course on general relativity and a seminar on problems of sidereal astronomy. He will also give a short course of popular lectures.

A LIST of Vacation Courses in England and Wales is published annually by the Board of Education. In the list for 1924 the courses are arranged in groups as follows: (1) Eighteen courses, each of about a fortnight's duration, arranged by the Board of Education for teachers in schools and training colleges, to be held at Oxford, Cambridge, London, Birmingham, Leeds, Liverpool, Rugby, Aberystwyth, and Swansea. (2) Courses of from two to four weeks' duration arranged by local education authorities of Brighton, Carmarthen, Glamorgan, Kent, and the West Riding of Yorkshire, chiefly for teachers. (3) Courses of from two to four weeks' duration organised by University bodies—Bristol (Fruit and Vegetable Preservation Committee), Cambridge (Local Lectures Syndicate), Leeds (School of Geography), Liverpool (Department of Spanish), London (University Extension Board's course for foreign teachers and advanced students; University College courses in English phonetics, French phonetics, spoken English for foreigners, and librarianship), and Oxford (Extension Delegacy's history course for teachers and advanced students and course for foreigners; School of Geography course; teacher-training course). (4) Courses in connexion with University Tutorial Classes and the Workers' Educational Association, of from two to seven weeks' duration, at Oxford, Cambridge, Bangor, Bristol, Canterbury, Chester, Malvern, Reading, Saltburn-by-the-Sea, and Sutton-Bonington. (5) Twenty-six courses organised by other institutions and associations concerned with speech training, science teaching, regional surveys, auto-suggestion, and other pedagogical subjects, Biblical study, Catholic studies, mining, oceanography, social service, and the League of Nations. No less than five of these are to be held at Oxford.

Early Science at the Royal Society.

May 31, 1677. Read Mons. Leewenhoeck and Dr. Wallis's account of the duplication of cubes, and of the instant motion of light.

1682. Sir Christopher Wren in the chair.—Some further experiments were made to try the strength of timber of several sorts.

June 1, 1664. Dr. Croune made the experiment of choaking and reviving a chicken with good success; for having choaked with his finger the chicken in such a manner, that there appeared no signs of any more life, he put a slender glass-pipe into the throat of the fowl, and through it blew air into its lungs; whereupon within a little time it came to itself, and lived again. It was ordered, that at the next meeting two chickens should be choaked, and one of them blown into, the other not, to see whether both would recover. [Dr. Croune was the founder of the Croonian Lecture of the Royal Society delivered annually.]

June 3, 1667. Mr. Hoskyns suggested, that it were desirable that the secretary by his correspondence in the East-Indies would learn the way used there of extracting spirit out of rice.

June 4, 1673. Mr. Hooke made an experiment with air produced out of bottled ale, putting it into a glass vessel, in order to see, whether, and how long, a candle would burn in it; and it was found that it would no more burn in this air, than it did in air generated out of aquafortis and pounded oister-shells.

June 5, 1661. The Duke of Buckingham who was admitted this day was requested to order charcoal to be distilled by his chemist.—Col. Tuke gave in a relation of the Academy at Paris, wherein he says that conceiving there is nothing which does more increase the force of the commonwealth of letters than a correspondency with the learned men of other nations, he presumed it would be an agreeable service to the assembly to inform himself when lately in Paris of friends in that city. There was, especially, a new institution of learned men whose business is to advance the knowledge of nature by conferences and experiments, into which society many that were formerly of the French academy are now entered. I went along (he says) with M. le Comte d'Albonne to Monsieur de Montmor's house, the patron and president of this society. And he . . . brought me into the hall where those of the Society do assemble. They fell upon the course of an experiment, which being ended, desired that I would report to them the subject of your conferences and the forms of your institutions. . . . The president replied that he was overjoyed to hear of the growth of so noble a design, of whose birth they had been advertised by letters from Monsieur Oldenburg. They did not doubt but that the success would answer the expectations of all lovers of learning; being convinced by many modern pieces that had been written by our countrymen, that the genius of our nation was very well fitted for the advancement of all sorts of learning.

1679. Mr. Hooke read a further discourse of Padre Lana concerning flying; and added to it a discourse of the impossibility of that attempt by that means; and also shewed wherein the author had been greatly mistaken in the grounds and suppositions of his demonstration, viz. in supposing the same thickness of metal to be sufficient to resist the pressure of the air inward in a ball of twenty-four feet diameter as in a ball of one foot diameter: whereas on the contrary it is necessary to increase the weight of the shell more than according to the proportion of the solidity or capacity of the ball.

June 6, 1666. The society did not meet, it being the day appointed for fasting and humiliation on account of the late pestilence.

Societies and Academies.

LONDON.

Royal Society, May 29.—D. M. S. **Watson**: The origin of the Amphibia (Croonian Lecture). The Carboniferous Labyrinthodonts have hitherto been practically unknown, but it is now possible to restore the body form in three genera. They belong to the grade Embolomeri, and possess all those features which might be expected to occur in ancestors of the terrestrial Rachitomi. As the group of Embolomeri contains primitively aquatic, terrestrial and secondarily aquatic forms, of essentially identical morphology, it is clear that those evolutionary changes which pursue a definite trend are not induced by changes in habit, although they are made use of in adaptation to different modes of life. As the Labyrinthodonts are always the most primitive Amphibia at any period, the Carboniferous Embolomeri are those most favourable for comparisons with fish. This has made necessary a complete account of the structure of the head in Osteolepids. The pattern of the dermal skull-roof in these fish is one from which that of the Embolomeri can be simply derived. The small, nearly spherical and widely separated olfactory chambers, which communicate with the exterior by anterior, and with the palate by posterior, nostrils are identical in all respects with those of Tetrapods. The Cœlacanths possess a median air-bladder, no doubt inherited from their ancestors the Osteolepids. The structure of the olfactory organ in Osteolepids supports the view that they were air-breathing, the air-bladder having been introduced as a lung, to act as an accessory respiratory mechanism in fish living in arid country with a seasonal rainfall. This view was first suggested by J. Barrell. The branchial arches of the larvæ of Archegosaurus and Branchiosaurus are so similar to those of fish as to suggest that the early Amphibia possessed functional internal gills. A larva of a Triassic Brachyopid, however, has branchial arches of a Urodele type, and no doubt depended on external gills. The respiratory movements of Amphibia are essentially similar to those of such fish as Ceratodus, and were taken over directly without fundamental modification of the muscular or nervous mechanism. The Embolomeri in their most primitive condition possess a fish-like shoulder-girdle, from which that of later Labyrinthodonts can be derived, as an adaptation to terrestrial and afterwards to a secondarily aquatic life. The movements used by the Embolomeri for locomotion are identical with those used in swimming by the modern Dipnoi. The process of adaptation to terrestrial life, which is the essence of the origin of the Amphibia, was an extremely slow one, part of it being carried out by animals which were clearly fish, the rest by creatures as indubitably Tetrapods. Throughout, it took place in such a manner as to avoid the necessity of any profound modifications in movements and in the mechanism of their control.

Zoological Society, May 20.—Dr. A. Smith Woodward, vice-president, in the chair.—Miss E. M. **Knobel**: The pelvic bones of the blue-fronted Amazon and other parrots.—Sir Sidney F. **Harmer**: On Mesoplodon and other beaked whales.—R. I. **Pocock**: Some external characters of *Orycteropus afer*.

Royal Meteorological Society, May 21.—Mr. C. J. P. Cave, president, in the chair.—J. E. **Clark**, I. D. **Margary**, and Richard **Marshall**: Report on the phenological observations in the British Isles from

December 1922 to November 1923. The controlling phenological factors were those of 1922 intensified; December to mid-March were continuously mild, with brief mid-month frosts. The last of these was followed by an equally brief heat outburst, repeated at mid-April and again in the first days of May, which were abnormally hot. Hence everything was very forward, the more so that after mid-April cold had supervened, ruining plum and pear bloom. This lasted for two months, apples as well as field crops all suffering. The prejudicial conditions were accentuated by sunlessness and severe June drought. The consequent June epidemic of blight specially affected plum trees and rambler roses. Mid-July heat and thunderstorms partly made conditions more favourable, and finally crops in the more advanced parts surpassed expectation, though much under average. The farther north and higher the land the worse were the results, until places like Alston and the Scottish Highlands reported hay rotting and crops uncut in December, whilst the almost unprecedented November frosts destroyed hundreds of acres of undug potatoes, even in Lincolnshire, Yorkshire, and Lancashire. It is once more demonstrated that winter warmth and a heavy autumn fruit harvest are rarely compatible.—C. E. P. **Brooks**: The distribution of rainfall over Uganda, with a note on Kenya Colony. Rainfall varies from 31 to 76 inches a year, the mean being about 50 inches. There are two rainy seasons, falling near the equinoxes on the equator but tending to approach the June solstice a few degrees north and the December solstice a few degrees south, so that in each hemisphere most of the rain falls in the summer half-year, and the rainy season each year "follows the sun" from south to north of the country and back again. More than 5 inches in a day is rare, and the heaviest monthly fall recorded is 17·85 inches.

PARIS.

Academy of Sciences, May 12.—M. Guillaume Bigourdan in the chair.—The president announced the death of M. Claude Guichard, correspondant of the Section of Geometry.—H. **Deslandres**: Observations of the transit of Mercury across the sun on May 8, at the Observatory of Meudon. Photographs were taken with the photoheliograph and with the large spectroheliograph; at the same time eye observations with the Eichens equatorial were made. The atmospheric conditions were poor, and the images were distorted by refraction.—Mme. **Ramart** and A. **Haller**: Syntheses with sodium amide. Mode of preparation of the benzyl α-alkylphenylacetates and of the corresponding acids.—Georges **Charpy** and Gaston **Decorps**: The determination of the oxidisability of coals. Nitric acid (specific gravity 1·30) is used as the oxidising agent at a temperature of 20° C. The results have proved to be of value in connexion with the prediction of the coking properties of coals.—Paul **Vuillemin**: Adherence between two leaves or two leaflets.—Sir William Pope was elected correspondant for the Section of Chemistry.—André **Bloch**: The direct demonstration of the theorems of Picard.—Paul **Flamant**: The form of the solutions of a functional differential equation.—Charles **Rabut**: The conditions of security of massive barrages. The effects produced on the wall of a dam by infiltration cannot be calculated: reinforcing with steel is suggested as the only practicable solution.—Charles **Platrier**: Concerning the works of MM. Blondel and Lecornu on the torsion of transmission axles.—Henri **Mémery**: The transit of Mercury across the sun on May 8, 1924. Observations were made at the Observatory of Talence under favourable atmospheric conditions.—Jules **Baillaud**: Study of the distribution of energy in some star spectra. Only in the case of Procyon (type F_5) did the curve of distribution of energy correspond to that of a black body. The energy distribution in the spectrum of stars of types A and B corresponds to radiation by masses of gas at high temperature. In stars of the Procyon type the continuous spectrum arises from a photosphere of solid incandescent particles.—L. J. **Simon**: The viscosity of aqueous mixtures of chromic anhydride and alkalies. The viscosity of chromates and sulphates from the point of view of their isomorphism. From a study of the viscosities of chromates and sulphates, it is concluded that the molecules of isomorphous substances modify the viscosity of the water in which they are dissolved to an equal extent, provided that the temperatures are the same and the observations are confined between certain limits of concentration.—R. **Cazaud**: The influence of annealing on the magnetic properties of silicon iron plates employed in electric construction. The temperature of annealing, velocities of heating and cooling, nature of atmosphere, and duration of annealing have been taken as variables in this study.—J. **Villey**, P. **Vernotte**, H. **Lacaze**: The methods of study of the evolution of india-rubbers. Dielectric polarisation and ohmic resistivity.—E. **Pitois**: Observations concerning a note by M. Mesnager on the differentiation of steels by the examination of sparks obtained by grinding. A reply to criticism, claiming originality for production of the sparks in oxygen.—Camille **Matignon**: The existence of carborundum in certain crystals of aluminium nitride. The carborundum is present either in the form of a solid solution in the aluminium nitride, or possibly as a compound, 6AlN . SiC.—E. E. **Blaise** and A. **Corrillot**: A new synthesis of α-*n*-butylpyrrolidine. Skita's method of reduction with hydrogen and colloidal platinum reduces α-*n*-butylpyrroline to the corresponding butylpyrrolidine. The product is not identical with the base obtained by Kurt Hess; hydriodic acid is regarded as an unsafe reagent for these reductions.—A. **Orékhoff** and M. **Tiffeneau**: The semi-pinacolic transposition of the arylhydrobenzoins. The comparative migratory aptitudes of the naphthyl and phenyl groups.—I. **Thoulet**: A particular layer in the midst of the mass of oceanic waters.—R. **Bureau**: The influence of meteorological discontinuities on certain atmospheric disturbances in wireless telegraphy.—P. **Freundler**: The iodine variation in *L. flexicaulis* at the period of annual growth; rôle of the stipo-frondal zone.—Jules **Amar**: The coagulation of the blood.—Pierre **Mathieu** and H. **Hermann**: The respective parts of the two lungs in the pulmonary ventilation in the dog.—M. M. **Le Noir** and A. Mathieu **de Fossey**: The study of the urinary ionic acidity in normal man. Urinary ionic acidity fasting. The variations of the urinary ionic acidity are very slight, except in the case of prolonged muscular effort.—E. and L. **Hédon**: The action of insulin on the basal metabolism of the dog after complete removal of the pancreas.—Marc **Bridel**: Application of the biochemical method of characterising glucose to the search for maltase in malt.—MM. **Cluzet**, **Rochain**, and **Kofman**: The best and limiting concentrations, in hydrogen ions, of cultures of micro-organisms. Variations produced by the organisms towards the most favourable concentrations.—Jacques **Benoit**: A new case of experimental sexual inversion in the domestic fowl.—Edouard **Chatton** and André **Lwoff**: A marine Infusoria *Spirophrya subparasitica* with two hosts, a Copepod and Hydra.

ROME.

Royal Academy of the Lincei, March 16.—V. Scialoja in the chair.—S. **Pincherle**: Simple transcendental functions.—B. **Grassi**: *Anopheles elutus*. It appears doubtful if this is a distinct species.—G. **Albanese**: Invariance of the genus P_α of an algebraic variety of four dimensions.—L. **Fantappiè**: Two simple expressions for the number of prime numbers comprised between assigned limits.—B. **Segre**: Algebraic complexes of straight lines of S_n.—A. **Pontremoli**: Electrical conductivity of flames containing salts of the alkali metals. On the hypothesis that in a flame containing an alkali metal salt thermal equilibrium of ionisation exists between the salt and a product of combustion, it is possible to determine theoretically the effective value of the electrical conductivity, in the region in which Ohm's law is valid, as a function of the flame temperature and of universal and atomic constants.—G. **Carobbi**: Supposed isomorphism of uranyl compounds with those of isomorphogenic metals of the magnesium metals. Under the experimental conditions employed, not even partial isomorphous substitution of the divalent group, UO_2, by divalent metals of the magnesium group is found possible.—C. **Porlezza** and A. **Donati**: Application of spectrographic analysis to the detection of rare metals in Italian materials. Various rare metals are among a number of elements not previously observed but detectable spectrographically in tufa from Fiuggi, granite from Castel d'Oria, Stromboli lava, and soil from Capri, of which all except the last contain scandium.—G. **Ponte**: Magmatic gas of the lava of Mount Etna. By forcing first dry nitrogen, and secondly moist nitrogen, into the lava which has been flowing from Mount Etna since 1911, and then withdrawing the gas and analysing it, results are obtained which confirm the view now held that the basic magma is anhydrous and show that the magma exerts energetic reducing properties.—M. **Pierantoni**: Luminescence and symbiosis. II. Phosphorescence of the ctenophores. The observations described render highly improbable the existence, with these organisms, of photogenic bacterial symbiosis.—M. **d'Ancona**: Differentiation of sex in the eel. Experiments made to ascertain the period at which sexual differentiation begins yield results which appear to confirm the views expressed by Grassi. With a certain proportion of the total number of eels, the sex is determined even before a length of 20 cm. is attained, whilst with the rest, although there is possibly a greater tendency towards one sex than towards the other, such tendency may at a still more advanced stage be modified by external factors.

SYDNEY.

Linnean Society of New South Wales, March 26.—Mr. A. F. Basset Hull, president, in the chair.—A. F. Basset **Hull**: The relation of the Loricates to the country rock (Presidential address). Observations made in the course of collecting Loricates (Chitons) on the Australian coast over a period of eighteen years have made it evident that there is some relation between the occurrence of the shells and the nature of the rock forming the littoral. The Loricates exhibit a marked preference for sandstone, limestone, and other sedimentary rocks, the number of species exceeding twenty-five and there being a wealth of individuals. Volcanic rocks are marked by a sparse Loricate fauna, but where these rocks are in association with, or overlie sandstone or limestone, the Loricate fauna at once assumes considerable proportions.

March 26.—Mr. R. H. Cambage, president, in the chair.—H. J. **Carter**: Australian Coleoptera. Notes and new species, No. 3. Two new genera and nineteen new species of Buprestidæ, and two new genera and sixteen new species of Tenebrionidæ are described.—Marjorie I. **Collins**: Studies in the vegetation of arid and semiarid New South Wales. Part ii. The botanical features of the Grey Range and its neighbourhood. An account is given of the vegetation of the various habitats, such as rocky hills and slopes, "gibber" and quartz rubble sheets, sandy plains, sand ridges, claypans, creeks and flooded flats; special attention is paid to early colonisation of bare areas and evidence of succession. The nature of the ground flora is discussed in relation to summer and winter rain controls, as also is the developmental aspect of the vegetation, reference being made to the apparent failure of natural regeneration of certain woody perennials.—J. **Mitchell**: New trilobites from Bowning, with notes on Encrinurus and Cordania. Eight species are described as new; two of them are placed in the genus Bronteus, the remainder in Encrinurus and Cryptonymus. Encrinurus (including Cryptonymus) appears to be confined to Upper Silurian and older rocks in Australia.—J. **McLuckie**: Studies in parasitism. (i.) A contribution to the physiology of the genus Cassytha. The general features of habit, habitat and hosts of the species of Cassytha are described. Detailed attention is given to the development of the haustorium.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 10, No. 4, April).—R. E. **Clausen** and Margaret C. **Mann**: Inheritance in *Nicotiana Tabacum* (V.). The occurrence of haploid plants in interspecific progenies. Constant species of Nicotiana when crossed give a definite hybrid type, but occasionally an exceptional plant appears.—G. Y. **Rainich**: Electrodynamics in the general relativity theory. Classical electrodynamics cannot be transferred without alterations into the general relativity theory and only an approximation is in some cases admissible at considerable distances from regions of intense magnetic field. A rigorous solution of the equations developed might lead to a theory of atomic processes on the basis of the general relativity theory.—J. L. **Synge**: Principal directions in an affine-connected manifold of two dimensions.—E. B. **Wilson** and W. J. **Luyten**: A statistical discussion of sets of precise astronomical measurements: parallaxes. The probable error calculated from the discordance of actual observations may differ considerably from the actual probable error. Using parallax data from Allegheny and McCormick Observatories, actual probable errors of individual observations are on the average 25 per cent. greater than those calculated from the observations.—P. S. **Epstein** and P. **Ehrenfest**: The quantum theory of the Fraunhofer diffraction. Duane and Compton have obtained formulæ based on quantum ideas for the reflection of X-rays by crystals. Their formulæ are developed further by means of the principle of correspondence, and it is claimed that there is complete identity in the Fraunhofer diffraction produced by an infinite sinusoidal grating, and hence for all Fraunhofer reflection phenomena, from the point of view of the classical theory and of the theory of light quanta. The principles are also applied to the linear point lattice, the infinite and the finite point lattice and the space lattice.—L. L. **Nettleton**: Effective radii of gas molecules. The number of ions produced in a gas by electrons is proportional to the pressure, and the number and length of path of the electrons. Increased velocity of the electrons

decreases the number of ions produced; *i.e.* there is a decrease in the effective molecular radii. Electrons are given off by a heated tungsten filament surrounded concentrically by two grids (shield and grid) and a cylinder of nickel (plate). Shield and plate are kept at a high positive potential and the grid at a negative potential. Ionising current and positive ions are measured by the changes of potential of the plate and the grid respectively, and the molecular radii can be calculated from Van der Bijl's formula. The results for air, hydrogen, and mercury vapour are in accord with Rutherford's formula, $I = K'/E^{-\frac{1}{2}}$, where I is the ionisation current, K' a constant, and E is the energy of the electrons.—Y. H. **Woo**: Note on absorption measurements of the X-rays reflected from a calcite crystal. The absorber, an aluminium sheet 0·05 cm. thick, was placed, first midway between the target and the crystal, and secondly, midway between crystal and ionisation chamber. Using the fourth order reflection, the mass absorption coefficients found are the same; apparently the wave-length of the X-rays undergoes no change by reflection. Using the first order reflection, similar results were obtained; hence no absorption due to "transformation" was detected.—G. L. **Clark**, W. **Duane**, and W. W. **Stifler**: The secondary and tertiary rays from chemical substances of small atomic number due to primary X-rays from a molybdenum target. Lithium, graphite, rock-salt, aluminium, and sulphur were used as secondary radiators in experiments similar to those described in previous papers (NATURE, March 8, p. 374, March 22, p. 448, May 3, p. 663) with similar results. The general conclusions reached are: (1) the position of the modified peak on the ionisation curve is a function of the atomic number; (2) the intensities of the shifted peaks decrease with increase in atomic number; (3) the position of the short wave-length limit of the modified peak agrees approximately with that calculated for tertiary radiation produced by the impacts of photoelectrons.—C. **Barus**: Density and diffusion of gases measured by displacement interferometry. One end of a quill tube filled with gas is connected suddenly to one shank of an interferometer U-gauge, and the pressure changes are measured by the fringe displacements. The method is rapid and an accuracy of 1 per cent. should be possible.—G. **Glockler**: The behaviour of low velocity electrons in methane gas. Current-potential curves obtained for argon, helium, hydrogen, methane, and nitrogen in a three-electrode tube are compared. Argon and methane both show marked maxima. That for argon is due to abnormal transparency to low velocity electrons; presumably methane shows the same phenomenon. An alternative explanation is the existence of a low radiation-potential.

Official Publications Received.

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series. Bulletin No. 48: The Availability of Potash in Hawaiian Soils; Soil Analysis and Potash Deficiencies. By W. T. McGeorge. Pp. iii+24. (Honolulu, Hawaii.)

The Journal of the Municipal College of Technology, Manchester. A Record, in abstract form, of Investigations undertaken by Members of the Manchester College of Technology. Vol. 11, 1923. Pp. vii+119. (Manchester.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1923. Pp. 125. (Bristol.)

Bulletin of the American Museum of Natural History. Vol. 49, Art. 2: Contributions to the Herpetology of the Belgian Congo, based on the Collection of the American Museum Congo Expedition, 1909–1915. Part 3: Amphibia. By G. K. Noble; with Abstracts from the Field Notes of Herbert Lang and James P. Chapin. Pp. 147-347+plates 23-42. (New York City.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1921. Pp. v+188. (London: H.M. Stationery Office.) 6*s.* 6*d.* net.

The Journal of the Royal Agricultural Society of England. Vol. 84, 1923. Pp. 8+380+clx. (London: John Murray.) 15*s.*

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indië (The Climate of the Netherlands Indies). Door Dr. C. Braak. Deel 1 (Vol. 1), Algemeene Hoofdstukken (General Chapters), Aflevering 5 (Part 5). (With English Summaries.) Pp. iv+279-341+123-158. (Batavia: Javasche Boekhandel en Drukkerij.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1923. (Chemical Section, Publication No. 30.) Pp. 37. (Khartoum.)

Medical Research Council. Fourth Annual Report of the Industrial Fatigue Research Board to 31st December 1923 (including Personal Contributions from Investigators). Pp. 65. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Botanical Series. Vol. 3, Part 2: Histological and Cytological Studies on the Fiji Disease of Sugar Cane; Further Studies on the Intra-cellular Bodies associated with certain Mosaic Diseases; Studies on the Mosaic of Sugar Cane. By L. O. Kunkel. Pp. 99-167+plates 24-29. (Honolulu, Hawaii.)

Transactions of the Cambridge Philosophical Society. Vol. 23, No. 2: A Mathematical Theory of Natural and Artificial Selection. By J. B. S. Haldane. Pp. 19-41. (Cambridge: At the University Press.) 4*s.* net.

Report of the Sixteenth Meeting of the Australasian Association for the Advancement of Science, Wellington Meeting, January 1923. Edited by W. R. B. Oliver. Pp. lv+872+12 plates. (Sydney, N.S.W.)

Diary of Societies.

SATURDAY, JUNE 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—C. Nabokoff: The Historical Trilogy of Count Alexis Tolstoi.

TUESDAY, JUNE 10.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—J. H. Pledge: Stem-Structure in Mistletoe.—Other Papers.

WEDNESDAY, JUNE 11.

FARADAY SOCIETY (in conjunction with the Textile Institute) (at British Empire Exhibition), at 2.30.—General Discussion on Physical and Physico-Chemical Problems relating to Textile Fibres:—Part I.—Dr. W. Lawrence Balls: Introductory Address.—Dr. S. A. Shorter: The Physical Properties of Textile Fibres in relation to Technical Processes and to General Colloid Theory.—Dr. T. Barratt: (*a*) The Lustre produced in Cotton by Mercerisation; (*b*) Measurement of the Transparency of a Fabric.—C. R. Nodder: Some Structural Characters of the Flax Fibres.—Dr. W. S. Denham and T. Lonsdale: Properties of the Silk Fibre.—Part II.—J. E. Ramsbottom: Aircraft Fabrics.—F. D. Farrow: Recent Advances in the Experimental Study of Warp Sizing.—A. R. Urquhart and Dr. A. M. Williams: A Review of Work on the Absorption and Desorption of Moisture by Textile Materials.—Dr. W. H. Gibson: The Function of Water in the Wet Spinning of Flax.—Dr. G. Barr: The Action of Light on Textiles.—Dr. T. Barratt: The Fibre Balance.

SOCIETY OF DYERS AND COLOURISTS (Conference at British Empire Exhibition), at 3.—J. R. Hannay: An Historical Survey of Dyeing and Calico Printing.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.30.—A. H. Ninnis: General Observations on the Radio Situation and the Development of Broadcasting in New Zealand.

THURSDAY, JUNE 12.

SOCIETY OF DYERS AND COLOURISTS (Conference at British Empire Exhibition), at 11.—Prof. A. G. Green: Modern Methods of Dyeing.

CHEMICAL SOCIETY (at Royal Institution), at 5.30.—Prof. R. A. Millikan: Atomism in Modern Physics (Faraday Lecture).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Col. L. E. W. van Albada: Wide Angle Orthostereoscopy, its Optical, Practical, and Psychological Advantages.—R. J. Trump: Binocular Vision and the Stereoscopic Sense.—E. T. Hanson: Some Problems in the Theory of Optical Diffraction.—T. Smith: (*a*) A General Solution of the First Order Aberrational Conditions; (*b*) The Fundamental Aberrational Constants of a Single Lens.

FRIDAY, JUNE 13.

RESEARCH DEFENCE SOCIETY (at 1 Wimpole Street), at 3.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Presidential Address on the Presentation of the Gold Medal to Prof. A. S. Eddington.—A. D. Ross: A Photometric Determination of the Brightness of the Solar Corona at the Eclipse of 1922, September 21, at Wallal.—A. D. Ross and R. D. Thompson: On the Conditions for the Observation of the Total Solar Eclipse of 1926, January 14.—Dr. W. J. S. Lockyer: Spectroscopic and Magnitude Observations of o (Mira) Ceti, 1924.—T. C. Hudson: Concerning Ephemerides and Small Planets.—J. Jackson: Note on the Numerical Integration of $d^2r/dt^2 = f(x, t)$.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. G. E. Bairsto: A Method for Synchronous and Instantaneous Illumination of Objects rotating or vibrating at Very High Speeds.—Dr. E. A. Owen, N. Fleming, and Miss W. R. Fage: The Absorption and Scattering of γ-rays.—W. N. Bond: The Flow of Compressible Fluids, treated Dimensionally.—D. B. Deodhar: Note on Israj, a remarkable Indian Stringed Instrument.

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

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 8.30.—Dr. G. Riddoch and C. Goulden: The Relationship between Sub-Arachnoid and Intraocular Hæmorrhage.

PUBLIC LECTURES.

THURSDAY, JUNE 12.

INSTITUTE OF PATHOLOGY AND RESEARCH (ST. MARY'S HOSPITAL), at 5.—Dr. W. Bateson: The Determination of Sex.

UNIVERSITY COLLEGE, at 5.30.—M. F. Cumont: L'archéologie de la Syrie (in French). (Succeeding Lectures on June 13 and 16.)