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Government Control in Scientific Research.

THE nature and extent of government control in scientific research and its results, especially those which may involve monopoly in some form or other, has always been a matter of deep interest to all men of science. Indeed, its interest is not confined to them alone, for it is a question which vitally concerns the whole nation. It is scarcely too much to say that, to-day, when technical prowess and invention have reached a dominating position in connexion with national strength and well-being, this matter of government and science is among the most important of the present age.

Sir Ambrose Fleming discusses the question in the July issue of the *National Review* in an article entitled "Technical Inventions and Government Control". At the very outset he strikes the right note by exposing the absurdity and shallowness of the usual query—Of what use is it?—applied to any new advance in pure science. The classical example, often quoted but losing nothing by repetition, is afforded by Faraday's discovery in 1831 of induced currents, for which at that time no one would have paid him a shilling, though since worth untold millions. This example not only shows to what heights potential use may rise, but also indicates to what a remarkable degree new wants may be created by invention of means to satisfy them, a most interesting economic phenomenon.

A peculiar position arises, however, when the satisfaction of these wants leads, or may lead, to the establishment of a monopolistic industry. It was chiefly with the view of controlling and limiting monopoly that Government has intervened in highly technical industries, such as the electrical, often with very disastrous results. "The baby is put in handcuffs to prevent him becoming a burglar when he grows up." The nascent electric telegraph industry in Great Britain was bought up by the Government in 1868–69 at a cost of £10,000,000 from private interests and handed over to the Post Office to prevent monopolistic abuse; and so skilfully—accidental or otherwise—were the acts of transfer drawn that they covered all forms of electric communication, including wireless. It is open to question whether one form of monopoly has not been exchanged for another, possibly worse.

Sir Ambrose emphasises the need for generous and, so far as possible, intelligent treatment of

men of genius when they appear. It is preposterous that the work of such men, and its results in epoch-making discoveries—of which an infinite number are still possible and are hidden in the unknown—should be judged or in any way controlled by a single departmental head. Many such departmental heads lumped together might not make one good one. In the specific case of electric telegraphs and telephones, it is only fair to admit that State control has probably led to their greater extension into remote rural parts than might have been possible to private enterprise; but on the general question of government intervention it is of the utmost importance that there should be the closest and most effective co-ordination between State departments concerned and private enterprise and research.

An encouraging sign of the times and a step in the right direction is the organisation and work of the Department of Scientific and Industrial Research, to which Sir Ambrose Fleming pays a well-deserved tribute in the article to which we have referred. The part of the government is to encourage and stimulate research in the right direction (though who shall specify what is 'right direction' is perhaps difficult), and prevent exploitation of the public. Co-ordination is once more found to be the key to much blessedness.

H. J. Elwes, as Naturalist, Explorer, and Sportsman.

Memoirs of Travel, Sport and Natural History. By the late Henry John Elwes. Edited by Edward G. Hawke. With an Introduction by the Rt. Hon. Sir Herbert Maxwell, and a Chapter on Gardening by E. A. Bowles. Pp. 317+18 plates. (London: Ernest Benn, Ltd., 1930.) 21*s.* net.

IN describing his journeys in Sikkim, Elwes writes that Claude White's "Sikkim and Bhutan" forms a fitting supplement to Hooker's "Himalayan Journals". A perusal of parts of these memoirs, nearly a third of which are devoted to India and journeys in Sikkim and round Darjeeling, will readily show to the initiated that Elwes's reminiscences and experiences cover a very valuable period of years between the day of Hooker and that of White in this region. Before treating of this aspect a few general remarks will be necessary on this remarkable and fascinating book. It is difficult to recall any book of quite its type published during the last, perhaps, forty years. If the knowledgeable reader is left with one regret it will probably be that Elwes did not commence the publication of the memoirs during his lifetime, and give them to us in two or three volumes.

Sir Herbert Maxwell, a contemporary of Elwes at Eton, has written a most appreciative and informative introduction to the book; and Mr. E. A. Bowles, in a last chapter entitled "Gardening and Horticulture", embodies personal impressions and recollections of Elwes and his botanical and horticultural work, with some descriptions of the remarkable gardens brought into being by Elwes at his Gloucestershire home, Colesborne.

Anything approaching a detailed review of the memoirs is out of the question. The book well reflects the personality of Elwes himself; it is inexhaustible. In order, however, to render the following remarks intelligible it must be understood that apart from sport provided by rifle and gun, in the use of both of which he was expert, the author started early in life collecting birds. His first expeditions, undertaken as a young man, with the chief object of increasing his knowledge and his collections of birds, were made in the Hebrides (1865–68) and Turkey—Macedonia (1869). These were made during the period he served in the Scots Guards. Later his main interest centred in butterflies and moths, although he never gave up bird-collecting—and lastly, after some twenty years during which Lepidoptera were his chief interest, although he also collected both birds and plants, he definitely concentrated his attention chiefly on plants with the most valuable results. For, as his numerous friends were well aware and his book will disclose unerringly to future generations, this man was possessed of immense energy, powers of observation of no mean order, which he cultivated to a very high pitch, and a shrewd mind. These attributes enabled him, as his experience grew with his varied voyages and the management of his own estates, to deduce reasons, sum up arguments, and present solutions of value. He contributed many valuable papers dealing with his collections to scientific societies.

Sir Herbert Maxwell says it was enthusiasm, aroused by reading Hooker's "Himalayan Journals", which first took Elwes to India in 1870. He landed at Madras in January from the old P. and O. *Mooltan*. Two brother officers of the Scots Guards joined him, and their chief object was to kill elephants, a sport which after a brief experience Elwes did not think much of, much preferring "stalks after stags, elk, and chamois". From Madras they sailed to Calcutta. From here Elwes had wished to explore the wild Mishmi Hills on

the north-east frontier of Assam, the flora and fauna of which were unknown. Owing to the recent murder of missionaries the Viceroy, Lord Mayo, would not assent to the suggestion and Elwes went north to Siliguri, at the foot of the Himalaya, where he says there was even then a fair dâk bungalow. There was to be a big tiger-shooting party in the Jalpaiguri Duars and Cooch Behar jungles. To this fortunate fact we owe Elwes's eye picture of this country as it was sixty years ago, and about twenty-two years after Hooker's visit and description. What is now a great stretch of tea-gardens was then dense forest and grass jungle on both sides of the Tista River, with a few scattered tea-gardens only; the country contained numerous rhinoceroses, elephants, and tigers. Before the end of the century the rhinoceros had been exterminated in these parts and elephants did not come so far west from the Assam border. Elwes comments on the magnificent forest of sal he saw stretching out from the foot of the hills and climbing up some way, to be replaced by sub-tropical species up at Kurseong (about 4500 ft.). There was no railway then; and later Elwes was as much put out by the spoiling of the beauty when the railway was carried up to Darjeeling, as I was astonished when (in 1925) I went up there from Siliguri by motor-car!

Elwes lost his heart to Sikkim on his first visit in 1870. Finding Darjeeling too muggy and misty in the rains for his liking and purposes, he descended to a tea-garden named Ging, managed by Mr. Macdonald. This was in the early days of tea-planting in that region and many ignorant mistakes had been made and much money wasted. With the assistance of Macdonald, Elwes bought neighbouring land and commenced a garden of his own under Macdonald's supervision. Elwes said later that he had never made a better investment than in that garden. During the following sixteen years he made four visits to Darjeeling and the garden—but they were to some extent mere pretexts upon which to hang one of his journeys out into his loved Sikkim hills; though the last was connected with the proposed but abortive Tibet Embassy of 1886. But this time he got up to the Rishi-la and practically explored a new route to the Tibet boundary.

I spent the best part of the last three years of last century in Sikkim and on the Darjeeling side. The Tista valley, roadless in 1870, the Rangit valley, and the roads and paths up into the Sikkim hills, the wonderful views and the extraordinary tropical, semi-tropical, and sub-temperate flora and fauna were my companions on many solitary journeys for weeks at a time; and oft did I ride with a dripping jacket, as Elwes had done, through the magnificent uncanny forests, the trunks of the trees coated with long beards of grey moss and lichen.

It is with this later knowledge of the progress and development which have taken place in the region that it is possible to realise to the full the very great value of the chapters of Elwes's memoirs which are devoted to Darjeeling, to a visit to the Singalela Range dividing Sikkim from Nepal on the west, and above all to his four journeys into Sikkim, the first made with the late Dr. W. T. Blanford, director of the Geological Survey. They must have been a curious couple, for Elwes was but twenty-four years old, with his ideas quite unformed—but he recognises how much he learnt from and owed to his older and skilled scientific companion. The well-known names which cross his pages are in themselves a remarkable testimony to Elwes's wonderful life. For they are names well known to officers who served out east and to those connected with Kew and Edinburgh Botanic Gardens; but which were mostly quite unknown to men—squires of the social county position of Elwes. Hooker, Thiselton Dyer, and Prain, at Kew; Bayley Balfour at Edinburgh; Anderson at the gardens in Calcutta; C. B. Clarke at the Cinchona Garden at Mongphu, followed by Gammie; F. D. Godman, A. O. Hume, Godwin Austen, Hampson, Knyvett, de Niceville, Mandelli, Atkinson, Woolly-Dod, and a host of others.

In none of the journeys Elwes paid to other parts of the world did he find any country to outvie the Tista Valley and the Sikkim Hills for scenery and variety in flora and fauna. The great fascination which this region exerted over him, in spite of its drawbacks at the lower elevations of damp heat and innumerable leeches, is comprehensible to the naturalist. It was the first part of the Himalaya I visited, and subsequent journeys all over India and parts of Burma never showed me anything to compare with Sikkim.

During these visits Elwes collected and sent home or brought back valuable collections of birds, butterflies, and moths, many now in the national collections; and also introduced numbers of plants and bulbs and orchids into England. His own gardens and greenhouses at Colesborne (in spite of the thin poor soil of the region limiting his possibilities) gradually included a wonderful collection of plants, orchids and rhododendrons being perhaps his favourites. In addition to his

four visits to Sikkim he made a last journey to India to visit Nepal in 1913–14, being then aged sixty-seven, and his account of the trip shows that his keenness and his powers of observation were as great as ever.

Apart from India, Elwes made an adventurous trip with a companion to the Altai Mountains in 1898 and shot *Ovis ammon*, but, as he relates, he was keener on collecting. He twice went to North America (1888 and 1895) and on each tour did a certain amount of collecting. Another interesting journey was undertaken to Chile (1901–2) with three main objects in view—as he says: (1) To gain some idea of the peculiar conditions which make the fauna and flora of Chile so interesting; (2) to collect as many as possible of the Lepidoptera "which had never been studied by a competent entomologist"; (3) "I wished to learn something about the very beautiful plants of Chile which we grow in gardens and of whose habitat we know but little, and to introduce to cultivation the terrestial orchids which are such a marked feature in the flora of the country". There speaks the man—and this is his life's note. He always had quite clearly conceived ideas before he started on a trip—and he was amazingly successful as a result.

One of not the least interesting of Elwes's journeys was the one made in 1911–12 to the Malay Peninsula, Java, and Formosa. The similarity of parts of the latter to Sikkim appears to have struck Elwes forcibly, but it is impossible to follow him through these interesting countries. Two points may be made. His study and comparison of the cinchona-growing in Java with the Indian gardens—Java exports the largest amount of quinine, *C. Ledgeriana* being the best species for sulphate production. His remarks on the growth of rubber in Malaya, and, as an old tea planter, the advice he tendered—advice as true to-day as it has been any time during the last century in the British Empire—are worth recording: "I could not help thinking that if rubber planters were not so anxious to get a large area cleared at once, it would probably pay better in the end to leave all the poorer patches of land in forest as a shelter to the rubber (*Hevea*)". In the hills this would prevent the rapid erosion and loss of valuable humus, etc., which total clearance gives rise to; whereas in the plains great pure blocks of one species of tree would be broken up and therefore suffer less from insects and fungus pests.

The last four chapters are devoted to home—two discussing problems of rural life and farming, with the great knowledge and shrewdness of a fine intellect; the others devoted to a description of how his great book "The Trees of Great Britain" came to be written in collaboration with Prof. A. Henry; and a review of the Committee's Report on the Deer Forests of Scotland (1922), written in the year of his death.

For the sportsman not the least interesting and remarkable parts of these fine memoirs are the chapters devoted to sport. For twenty years (1891–1911) Elwes rented shoots in Norway, where he stalked the elk, bear, and reindeer; he also shot wild boar in the Ardennes and rented a shoot in the Austrian Alps where the quarry was red deer, chamois, and roe deer. These chapters, which cover a considerable period of shooting years, would render any book remarkable, not only for the interesting accounts of the various animals and the methods employed in hunting them, but also owing to the care with which Elwes describes the country and the natural history of the locality visited.

I feel confident that this book is destined to become a classic; higher praise no book can achieve.

E. P. STEBBING.

Foundations of Silviculture.

Foundations of Silviculture upon an Ecological Basis. By Prof. James W. Toumay. Vol. 1. Pp. xxv + 438. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 20*s.* net.

IN this manual, Prof. Toumey, of Yale University, deals with silviculture from the point of view of the forests of the United States, a country which, he correctly says, owing to its vast size and diverse character, imposes inevitable limitations. But this is not the only point in which Prof. Toumey's work differs from the usual type of silvicultural manual. He writes:

"In the evolution of the subject, the vast body of accumulated facts which gradually came into being, relating to trees and their environment, though useful in silvicultural practice, lacked for a long time the following basic concept: Forest vegetation is composed of plant communities or units of vegetation, developed and arranged in accordance with definite biological laws and is not an aggregation of trees and other plants brought together by chance." . . . "Foundations of silviculture as we conceive it to-day is not an outgrowth of plant ecology, but rather plant ecology is an outgrowth of it. When biologists took their investigations of the relation of plant to the environment from the laboratory to the field, they found

the silviculturist already there with the accumulated facts of a century of field work."

The latter allusion is to the work of men like Cotta, Hartig, Köenig, and Pfeil. But in the preceding century these latter had had forerunners in Duhamel du Monceau in France and Euderlin in Germany. This work had for its chief basis the relation of soil factors to forest vegetation, studies which were continued in the later works of Mayr, Duesberg, Wagner, Reuss, Dittmar, and others. In these works the authors apply fundamental sciences such as biology, physics, and chemistry to the theory of silvicultural practice.

Forest experiment stations were established in several countries from 1861, and though the results attained have not perhaps reached the somewhat sanguine hopes placed in them, certain useful data have been arrived at.

It is perhaps in its connexion with ecology that this manual differs from many of its predecessors. Haeckel, in 1866, defined ecology as the science treating of the reciprocal relations of organisms and the external world. Says Prof. Toumey:

"Until recent times, what is now conceived as ecology was included under biology. Biology is a general term including both botany and zoology, and ecology is a part of each. Although biologists have for many years been concerned with the relation of plants to their environment, the term plant ecology has come into use within comparatively recent times. As a science, it is a branch of botany, which is concerned with the relations of the individual plant, the species and the plant community to the site. It has its roots firmly anchored in the basic principles of physics, chemistry, physiography, geology, and meteorology."

This recognition is not only of interest but also of considerable importance to the future value of the large amount of silvicultural research work awaiting the forester in many parts of the world. But when dealing with a consideration of silviculture proper in a forestry manual, it becomes necessary to consider the limits to which a treatment of the subject should be set.

In the manual in question, the author divides his subject into three parts: (1) the site factors; (2) the forest vegetation; (3) the methods of investigating the site factors and the forest vegetation and their relation one to the other. Only parts 1 and 2 are treated of in the volume under review, part 3 appearing in a later volume. Out of 423 pages in this first volume, some 250 are devoted to the site factors which, after a chapter on definitions, are treated of under climatic factors, physiographic factors, biotic factors, and the reaction of forest vegetation on the site factors.

The author deals with these matters in the greatest detail and with admirable lucidity; for example, the sections on light effects, intensity, etc., are of absorbing interest: but the question thrusts itself forward—Is the detailed treatment of such matters in its proper place in a manual on silviculture? Should we not recognise the fact that this subject has now become so broad that it requires an introductory manual dealing with such matters as are considered in Part 1 above and including sections of Part 2 treating of the origin and development of forest communities, succession, and so forth. The word ecology is a new one. It should prove possible to find a satisfactory term for the considerable introductory matter which now leads up to silviculture proper —for silviculture, both in derivation of the word and its practice, belongs of right to the practical executive forester working out in the field.

This being said, Prof. Toumey is to be congratulated on a remarkable piece of work. His second volume will be awaited with considerable interest.

Coal Carbonisation.

Coal Carbonisation. By R. Wigginton. (Industrial Chemistry Series.) Pp. x + 287. (London: Baillière, Tindall and Cox, 1929.) 21*s.* net.

"BUT for its obvious importance, no one would interest himself in the action of heat upon coal." This is surely a strange doctrine, for scientific men do study many things out of mere human curiosity. Mr. Wigginton presumably means that the problem is so involved as to discourage inquiry. Even the action of heat, he points out, on so simple a compound as ammonia has provoked a mass of research, collated in Chapter v. How much more complex will be the action of heat upon coal, "a mixture of altered plant tissues, the original plants being composed of substances chiefly of unknown constitution".

The book is concerned with this question of the action of heat on coal, first historically (Chapters i. and ii.), then with the science of the subject (Chapter iii.), as it has developed from modern laboratory work. Chapter iv. treats of coal gas manufacture and purification, Chapters v. and vi. of the by-products ammonia and tar, while the last chapter is devoted to the formation and properties of coke.

The book is not intended to be a manual for industrial practice, which is treated only in broad

outline, illustrated by simple diagrammatic sketches. The value of the book is due rather to the fact that it gives a conspectus of the subject in the light of recent laboratory studies. Anyone desiring to get to grips with the science of carbonisation will scarcely find a better channel of access, for the author is evidently familiar with the British, European, and American investigations of the last decade. The collection of information on the decomposition of ammonia and hydrocarbons at high temperatures is valuable—especially the recent work on pyrolysis carried out at Sheffield. On p. 42 he says: "At the time of writing, the high (though declining) price obtainable for creosote oil is having a considerable bearing on the economics of the process". If he were writing that sentence to-day, he would have to substitute 'low' for 'high' and say that creosote is such a drug on the market as to make its disposal a real problem. Ammonia has also ceased to be a considerable asset, and indeed sometimes is a charge on the process, Nothing could indicate better the need for caution in placing any high value on the gain obtainable from by-products of carbonisation. The sale of gas according to heating value dates from 1920—not 1922 (p. 132). The description of the manner of removing naphthalene from gas (p. 138) does not suggest the continuous process now in use. On p. 173, 'undecomposed' steam should be added as an additional source of water in gas liquor from vertical gas retorts, which constitute more than half the plant in use to-day in British gasworks.

The publisher invites criticism at times. On p. 104 he has not done the author justice in reproducing curves on so small a scale as to make them difficult to read. Again, the price is the highest in the whole "Industrial Chemistry Series", while books of similar size are priced at 10*s*. 6*d*. upwards. The number of guineas which young students can afford is limited, and this is a book which one would like to recommend them to buy. H. J. H.

Geography and Regional Studies.

Studies in Regional Consciousness and Environment. Essays presented to Prof. H. J. Fleure. Edited by Iorwerth C. Peate. Pp. xii + 220 + 14 plates. (London: Oxford University Press, 1930.) 21*s*. net.

BY a curious coincidence, the publication of this volume of essays presented to Prof. Fleure by a group of former students on the completion of his twenty-five years at Aberystwyth coincides with the announcement of his departure for Manchester. Few tributes could be more eloquent, few more acceptable, than such an acknowledgment of the inspiration afforded by academic leadership. At first sight the essays seem extraordinarily diverse, ranging from geology to helminthology, economic history, and French politics, and in area from Wales to Natal and the Great Barrier Reef. But the whole collection is united in that it is concerned with the world as the environment of the central figure—man—and typifies the science for which Prof. Fleure has stood for more than a quarter of a century—the science of modern geography.

Amongst the more purely geographical researches included are Miss R. M. Fleming's "Outline of some Factors in the Development of Russia"—a valuable summary which incorporates a considerable amount of material formerly only available in Russian; Miss F. F. Laidler's study of the limits of certain cultivated plants in Spain—an important contribution to the solution of the vexed problem of how far Spain can be regarded as a 'Mediterranean' country; and Mr. E. E. Evans's geographical study of the Pyrenees as a barrier to mankind. The editor of the volume, Mr. Iorwerth C. Peate, contributes an account of the old Welsh wood-turning industry; Wales also figures in a geological contribution by Prof. W. J. Pugh and a study of miners' phthisis in Cardiganshire by Mr. E. G. Bowen.

Miss H. A. Wilcox has attempted to throw light on the former distribution of natural vegetation in southern England—a subject fraught with difficulty but of the utmost importance to the prehistorian. Mr. S. J. Jones deals with the distribution of perforated stone axes in Europe, Mr. R. A. Pelham with the trade of the Cinque Ports in 1307–8, Miss S. Harris with field systems in Guernsey. Mr. H. Hauck deals with the influence of geographical factors on the French elections of 1928. His maps emphasise the fact that the rich cattle-rearing and cultivated districts support the right wing party, the peasant owners of small farms maintain the radical faction, whilst the extreme left receives its main support from urban and industrial centres. It is interesting to notice how closely his conclusions would apply to Great Britain.

The last essay in the volume strikes a different note, giving a delightful sidelight on daily life and work with such an expedition as that to the Great Barrier Reef. L. D. S.

Our Bookshelf.

Australian Rain-Forest Trees : excluding the Species confined to the Tropics. By W. D. Francis. Pp. xii + 347. (Melbourne : Council for Scientific and Industrial Research, 1929.) 10*s*.

ALTHOUGH this book is primarily intended for the Australian forester and botanist, it provides a wealth of information about the trees of the rain-forest of eastern Australia which renders it a useful work of reference. The outstanding feature is that the descriptions are drawn up by a botanist who is equally familiar with his specimens as trees in the forest and as herbarium material.

The practical side of the work is further enhanced by an artificial key to the trees described, which has been worked out and drawn up by the author in the field. Keys of this nature are difficult to make as a rule, but undoubtedly they are appreciated more by the forester, who often finds difficulties in working in the field with keys prepared from herbarium material only and worked out on a phylogenetic basis. As the systematic enumeration of the species is according to Engler and Prantl, it would have been helpful had page references been inserted against the names of the species where they occur in this artificial key. The book itself is not a convenient size for field work (9 in. × 6 in.) and it would be advisable to issue the artificial key in pamphlet form so that its usefulness can be extended.

The book is profusely illustrated by plates which are given generally in pairs—one plate showing the lower part of the bole of each trunk, the nature of the bark, the base of the tree, and the character of the surroundings; the other, a more detailed view of leaves, flowers, and fruit.

This is a very good example of a work which cannot have more than a local—though a very wide local—interest and application. So much work of this nature is never able to be published because it cannot be considered to be an economic proposition. It is very gratifying, therefore, to note that Mr. Francis was able to secure official publication through the recommendation of Mr. Lane-Poole, Inspector-General of Forests. This is the second publication by the Commonwealth Government under the scheme for assisting the publication of work carried out by Australian scientific workers which is not likely to prove financially remunerative and therefore is unattractive to commercial publishing houses.

Marriage, Past, Present and Future : an Outline of the History and Development of Human Sexual Relationships. By Ralph de Pomerai. Pp. xvii + 370. (London : Constable and Co., Ltd., 1930.) 15*s*. net.

MR. DE POMERAI'S book is a welcome and opportune addition to the literature on marriage, even though Prof. Westermarck has published within the last few years a revised and enlarged edition as well as an abridgment of his classical work on the subject. The author of the present book holds that both Westermarck and Letourneau, having written exclusively from the viewpoint of the family and regarded procreation as the sole or highest function served by matrimony, have paid insufficient attention to the urge of the gregarious. In other words, he suggests that they have fallen out of date owing to the institution and spread of 'companionate' unions and the changed ideals and ideas which they imply. Further, there has to be taken into account the effect of current psychological theory in relation to sexual activity and repression.

The reader will here find the evidence to be collected from primitive peoples reviewed from a new point of view; the practices of the present day, both orthodox and those regarded by some as unorthodox, are analysed; and the probable course of future development is sketched in the light of tendencies here revealed. Much of the book is naturally of a highly controversial character. The validity of the argument, in fact, depends upon whether its viewpoint rests upon what is merely a passing phase or on a development which is to be a permanent directional factor in the future evolution of society. This is too large a subject for discussion here, much as Mr. de Pomerai invites it. It may be pointed out, however, that the modern attitude towards marriage and sex appears to give too great weight to factors which are secondary to the main biological purpose of society and of sexual relations.

Gnetales. By the late Prof. H. H. W. Pearson. (Cambridge Botanical Handbooks.) Pp. vii + 194 + 4 plates. (Cambridge : At the University Press, 1929.) 18*s*. net.

THE class Gnetales is unique among seed-bearing plants in the habit and habitat diversity of its members and in the use made of it by those interested in phylogenetic hypothesis. The appearance of a monograph by the late Prof. H. H. W. Pearson is, therefore, a matter of considerable importance. The manuscript was completed and prepared for printing by Mrs. Thoday, who has added valuable notes and is largely responsible for the final theoretical chapter.

The first chapter summarises the habit, distribution, ecology, and taxonomy of the three genera *Ephedra*, *Gnetum*, and *Welwitschia*; the second gives details of their vegetative morphology and anatomy; the third considers their inflorescence and flower structure; and the fourth deals very fully with their reproduction. A frontispiece of the author, three plates, and 89 figures illustrate the book.

The interrelationships of the three genera remain obscure, and proof that they are of near affinity is lacking. The somewhat diverse views held as to the natural position of the Gnetales most often agree in placing the group in the vicinity of the top of the Gymnosperms and the bottom of the Angiosperms. The Angiosperm characters have been emphasised by recent writers, and Pearson agreed "that there must be a Gnetalean-Angiosperm alliance" but probably not a direct one. A hypothesis is outlined which derives the

Angiosperm embryo-sac from a primitive form the essential characters of which are preserved in *Gnetum*, the evolutionary tendency being towards a shortening of that portion of the life-cycle which lies between the macrospore mother-cell and the functional gamete. W. B. T.

Œuvres d'Émile Godlewski, père. Publiées par Ladislas Vorbrodt. Vol. 1 (1870–90). Pp. viii+599. (Cracovie: Académie Polonaise des Sciences et des Lettres, 1930.)

THE Polish Academy of Science and Letters is publishing in three volumes, of which the first has already appeared, the collected work of Émile Godlewski, the veteran plant physiologist who celebrated his eightieth anniversary in 1927. This first volume contains an early paper on the dependence of the amount of oxygen disengaged from leaves upon the carbon dioxide content of the air, which was carried out by the author in Sach's laboratories with apparatus previously used by Pfeffer, then also working at Würzburg, as were also the English botanists Vines and Francis Darwin.

The volume contains papers written prior to 1890; they are published usually in the language in which they originally appeared, but a few of the Polish papers are translated for the first time (into French). These papers alone are sufficient to show what a valuable influence Prof. Godlewski must have had upon the development of the biological sciences in relation to agriculture during his tenure, first of the chair of botany at the School of Agriculture in Doblany (1878) and then of the chair of agricultural chemistry at Cracow, where he was also in charge of the subject of vegetable physiology (1891–1919). Still vigorous upon the expiry of his post under the regulations for superannuation, Prof. Godlewski then accepted the direction of the agricultural section of the Institute of Rural Economy just established at Pulawy.

50 Jahre Kältetechnik 1879–1929: Geschichte der Gesellschaft für Linde's Eismaschinen A.-G., Wiesbaden. Pp. iv+192+6 Tafeln. (Wiesbaden: Gesellschaft für Linde's Eismaschinen A.-G., 1929.)

THIS well-illustrated volume has been issued in commemoration of the jubilee of the foundation of the Linde company in 1879. It contains a short life of Prof. Carl von Linde, the founder, an account of his early work on refrigeration and on the use of the Joule-Thomson cooling as a means of liquefying gases on an industrial scale, and a history of the development of the company and its offshoots up to the present time.

Von Linde was born in southern Bavaria in 1842, a son of the manse. After education at the local Gymnasium, he spent three years at Zurich polytechnic and after two more years in locomotive works he was in 1866 appointed to the technical staff of the Krauss locomotive works at Munich. In 1868 he became additional professor and in 1872 ordinary professor of engineering in the newly founded technical school at Munich. Here he introduced such improvements in the theory of refrigerating machines that in 1879 the Linde company was formed with works at Wiesbaden to manufacture machines on his system. In 1892 he returned to Munich and lectured on refrigerating machines there until 1910. In 1895 he succeeded in liquefying air by the Joule-Thomson effect and this led to the liquefaction of other gases and the establishment of Section B of the company for the manufacture of machines for industrial liquefaction and fractionation of mixtures of gases.

Coleridge: the Sublime Somnambulist. By John Charpentier. Translated by M. V. Nugent. Pp. x+332. (London: Constable and Co., Ltd., 1929.) 15*s.* net.

THIS is certainly a beautiful and inspiring book, in spite of a certain heaviness of style due partly to excessive faithfulness in the translation. It is remarkable how many English worthies are finding their best interpreters in Frenchmen. M. Charpentier does not compete with the vivacity of M. Audré Maurois in his lives of Shelley, Disraeli, and Byron, but he is a much more profound and sympathetic student. He judges very fairly the philosophic attainment of Coleridge, not rating it high; he is enthusiastic about the best in his poetry and he gives a penetrating and convincing study of his personality. The fight with opium, the devastating effects of the drug and the noble and finally successful struggle to overcome it, with the help of Dr. Gillman, could scarcely be better described, and will be to many readers the most interesting part of the book. But they should not resist the fascination of M. Charpentier's picture of the 'old man eloquent' in his last stages at Highgate. He was essentially good and would not have seemed old, had it not been for the ravages of his vice. He was but sixty-two when he died, and those who care for his memory, a number likely to be increased by this book, would do well to see that his tomb in the crypt at Highgate School is more reverently treated than it was when we last visited it. F. S. M.

Experimental Optics. By Prof Albert F. Wagner. Pp. xii+203. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 16*s.* net.

THE course of optics outlined here is one which has been developed for an advanced class at the postgraduate school of the United States Naval Academy. Some ninety experiments are described, in general of an advanced type and requiring more elaborate apparatus than is found in most teaching laboratories in Great Britain. Its value for general purposes would have been increased considerably if more photographs and perspective diagrams of apparatus had been given, although those present are excellent. In spite of these minor defects, which are indeed only apparent when it is put to a use other than that for which it was originally intended, the book should be of much value as a work of reference for technical students and the more advanced degree classes. Prof. Wagner insists upon the importance of geometrical optics.

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.*]

Single Collisions of Electrons in Nitrogen.

IN some recent experiments, I have measured the energy losses suffered by electrons of initially homogeneous speed in passing through nitrogen, the pressure of which was so chosen that no appreciable amount of multiple collisions should occur. The method consists in accelerating electrons from the hot cathode C into the field-free space bounded by A and B, where the collisions take place (Fig. 1). Those electrons which have not been deflected appreciably from the original direction of travel proceed through the perforated centre of B and through the narrow slit S_1 enter the box D, where their speed is measured by means of a deflecting electric field between E and F and a box collector G, placed immediately behind the exit slit S_2.

Hughes, Rojansky, and McMillen [1] have shown that in such a cylindrical deflection condenser refocusing of the electron paths takes place for a mean deflection of 127° 17′, which is the distance along the arc from S_1 to S_2. Pure nitrogen is supplied through an artificial leak and, having passed the collision chamber, is pumped away to the right of S_1 by a large steel diffusion pump. Sensitive compensation devices enable bombarding and deflecting voltage to be checked and adjusted with a high degree of accuracy. A number of curves at constant bombarding voltage were taken by varying the deflecting voltage in small steps. In most experiments, however, the deflecting field was kept fixed, and the different parts of the electron distribution curve were measured in turn by applying an adjustable accelerating voltage between B and S_1. Bombarding voltages ranged from some 80 to about 600 volts; pressures of $1\text{–}4 \times 10^{-2}$ mm. were used.

The distribution curves obtained with both methods of measurement exhibit a strong and sharp peak due to electrons which have retained the whole of their

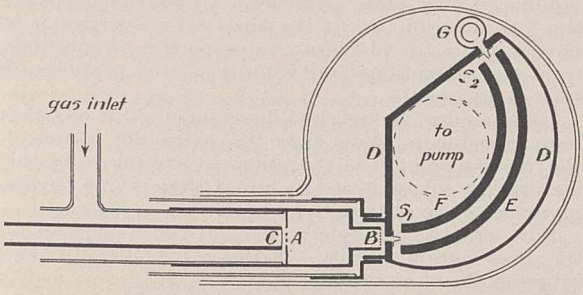

FIG. 1.

energy. Close to this peak, on the side of lower velocities, there are several small maxima in addition to a continuous distribution, which is rapidly approaching zero at greater distances from the primary peak. Fig. 2 shows the general appearance of the curve corresponding to energy losses of 0-30 volts. Part of the inelastic collisions responsible for this curve take place at the edges of S_1 and of the holes in B (possibly also to a small extent in A). From a comparison of curves with a high vacuum in the chamber and with different pressures of nitrogen it is usually possible to distinguish the effects of such collisions from those produced by impacts with molecules of the gas.

The volt equivalents of the energy losses indicated by the maxima in the distribution curves are tabulated below, together with the number of independent determinations and the average error in each single determination.

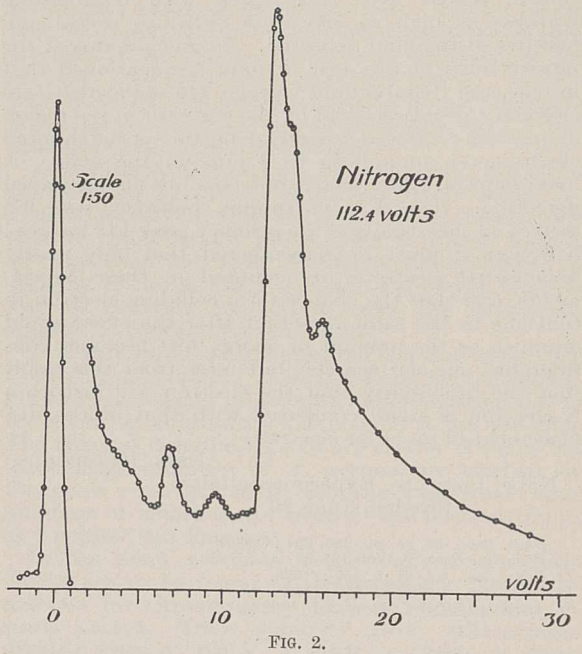

FIG. 2.

	V_1	V_2	V_3	V_4	V_5	V_6	V_7
No. of determ.	22	23	9	24	19	23	5
Average error	0·24	0·17	0·28	0·13	0·15	0·19	0·42
Maximum	6·64	9·25	10·86	12·78	13·93	15·82	18·03
Interpretation	Pt 6·5 Cu 6·9	*a* (2) 8·91 *a* (3) 9·11 *a* (4) 9·31		*b* 12·52 *b*′ 12·79 *c* 12·87-8			

V_1 must be attributed to impacts with the electrodes. In fact, I have previously been able to show [2] that there is frequently a loss of 6·5 volts with platinum —B is a platinum foil—and of 6·9 volts with copper (copper slits). Of the rest, at least V_2, V_4, V_5, and V_6 appear to belong to collisions in the gas.

By far the most conspicuous one of these is V_4. Energy losses of this magnitude have been observed by Langmuir and Jones,[3] and by Harnwell,[4] in connexion with other work. The value of 12·78 volts is in excellent agreement with a transition from the X level of zero vibration for the normal molecule to the group of electronic levels b, b', c, found by Birge and Hopfield.[5] The 0 level of the lower a state is only 8·51 volts above the normal level in the non-vibrating state. From the known emission intensities of this band, however, it appears that the most probable jump from the latter level to the a state would be to a level of vibrational number 3 or 4. If V_2 is attributed to such transitions, the observed value of 9·25 volts would, in fact, indicate a most probable end level of vibrational number 3 or 4. The considerable width of the 9·25 volts peak is consistent with this interpretation. The other maxima have not been correlated with any known spectroscopic levels at present.

One of the chief objects of this investigation was to look for evidence of excitation processes pertaining

to the K-level of nitrogen. Since $K = 388{\cdot}6$ volts for the nitrogen atom, these processes would be expected to give rise to a maximum in the region 370-410 volts below the primary peak. However, a careful search over this region with bombarding voltages as high as 590 volts failed to reveal any features of the kind expected. To give an idea of the sensitiveness of this test, it may be mentioned that in one case (bombarding voltage 540 volts) the total electron current received by the collector in the region in question produced a steady deflection of the shunted electrometer amounting to 3 mm. of the scale. A maximum of 2 mm. could not possibly have escaped detection. The $V_{4'5}$ maximum, however, was 9·5 metres on this scale and the primary peak 148 metres ! Although it must be remembered that only nearly undeflected electrons are counted in these experiments, and that the chance for a colliding electron to continue in the same direction after the event could diminish as the amount of energy lost becomes considerable, one can scarcely but infer from this result that the probability that the electron will disturb a K-electron is small compared with that of the displacement of an outer electron.

ERIK RUDBERG.

Nobel Institute, Experimentalfältet,
Sweden, June 20.

[1] *Phys. Rev.*, vol. 34, pp. 284, 291; 1929.
[2] *Roy. Soc. Proc.*, A, vol. 127, p. 111; 1930.
[3] *Phys. Rev.*, vol. 31, p. 357; 1928.
[4] *Phys. Rev.*, vol. 33, p. 559; 1928.
[5] *Astrophys. J.*, vol. 68, p. 257; 1928.

The Dissociation Theory of Solution.

IT is now forty-three years since the electrolytic dissociation theory was proposed by Arrhenius in 1887, to account for the changes in the physical properties of solutions caused by electrolytes, which had compelled Van 't Hoff to introduce the coefficient i into the gas equation

$$PV = RT.$$

Impressed with the view that the osmotic pressure, depression of the freezing point, diminution of vapour pressure, etc., of solutions are functions only of the number of dissolved particles, Arrhenuius concluded that 'electrolytes' must contain a greater number of particles, which could only be derived from the dissociation of the solute. By choosing the 'dissociation' of each substance to fit the observed values the theory could easily be made to account for such effects. It can now be shown that the assumption involved is incorrect.

In a series of papers on the molecular theory of solution, and on the vapour pressure of liquids, in the *Philosophical Magazine* (**38,** 696, 1919; **44,** 897, 1922; **48,** 936, 1924; **50,** 1147, 1925; and seventh Ser., **10,** 160, 1930), I have shown that the vapour pressure of a liquid is produced by the particles that approach the surface with sufficient heat energy to enable them to overcome the attraction of the liquid and escape into the vapour. The vapour pressure is therefore a function of molecular attraction, volume, and motion only. It is expressed by the formula

$$p = 81{\cdot}84\frac{T\lambda}{A\phi}e^{-\frac{9{\cdot}665SMA^{2/3}}{T\delta\lambda^2\rho}} \quad . \quad . \quad (1)$$

in which T is the absolute temperature, λ the ratio of the total average velocity of the molecules in the liquid in the given circumstances to that in a perfect gas, A is the actual state of aggregation of the molecules in the given liquid, ϕ its co-volume, S its surface tension, M its molecular weight, $\delta \times 10^{-8}$ the nearest distance of approach of the centres of the molecules, and ρ the density of the liquid. In this formula the factor λ should be specially mentioned because its introduction amounts to a denial of the principle of the equipartition of energy. As we are considering the motion of molecules in a liquid, which are subject to the action of the tremendous forces that produce the cohesion of the medium, we are compelled to admit that their velocities cannot be the same as those of the particles in a perfect gas at the same temperature. The factor λ represents the ratio of the most probable speed of the molecules in the liquid to that in a perfect gas, and is a function of the cohesion, K, of the medium.

If this expression is extended to cover solutions of non-volatile solutes, it becomes

$$p = 81{\cdot}84\frac{M_2 w_1 T\lambda}{(AM_1w_2 + M_2w_1)\phi} \times e^{-\frac{9{\cdot}665A^{2/3}M_1S_1^{1/2}\{S_1^{1/2}\rho_{12}w_1(\delta_2^{1/2}-A^{1/6}\delta_1^{1/2})+S_{12}^{1/2}\rho_1(w_1+w_2)A^{1/6}\delta_1^{1/2}\}}{T\delta_1\delta_2^{1/2}\lambda^2\rho_1(w_1+w_2)}},$$

in which w is the weight of solute or solvent, the subscripts relating to solvent and solute respectively, and gives values for salt solutions in accordance with observation.

It follows that the vapour pressure of salt solutions is determined by the attractions, volumes, and motions of the particles only. When a salt is dissolved in water, the cohesion of the liquid is increased on account of the greater cohesion of the salt particles. In the case of a salt solution, therefore, as distinct from that of an inert substance that does not increase the cohesion of the liquid medium, the vapour pressure is diminished by the greater attraction to be overcome by the escaping molecules, as well as by the diminution in the number of particles of solvent present in unit volume of the liquid. That is to say, in an aqueous solution of urea, for example, the vapour pressure is less than that of pure water, merely because there are less water particles present in unit volume, but in a solution of common salt the fewer water particles must also overcome a greater attraction on the part of the solution before they can escape into the vapour. Therefore, the fundamental assumption of the dissociation theory, that the diminution of vapour pressure is proportional only to the number of solute particles present, is incorrect. The vapour pressure is determined also by the cohesion and volume of the solute particles. Instead of choosing the 'dissociation' to fit the observed properties, it is now possible to calculate the properties of solutions from the attractions and volumes of the particles of solvent and solute.

By a similar, though less direct, method it has also been possible to show that the extra depression of the freezing point of salt solutions is determined by the increase in cohesion of the liquid that is due to the presence of the salt particles in it.

Further, it is possible to give a direct disproof of the dissociation theory. Edser's formula for the cohesion, K, of a pure liquid,

$$K = \frac{4S}{\delta}, \quad . \quad . \quad . \quad (3)$$

can be extended to give the cohesion, K_2, of the dissolved particles in a solution, in the form

$$K_2 = \frac{4(S_{12}^{1/2} - S_1^{1/2})^2}{\delta_2}. \quad . \quad . \quad (4)$$

As the values of K_2 given by this formula are involved in the vapour pressure formula (2), which has been found to be correct, there is no doubt that the formula (4) corresponds to the actual attractions between the salt particles in solution. From this formula the attraction between two particles of, for example,

potassium nitrate in solution, at a distance of, say, 10^{-7} cm., is found to be $6{\cdot}24 \times 10^{-11}$ dynes. If the particles were 'dissociated', the electrical attraction between the 'ions' at the same distance would be $2{\cdot}21 \times 10^{-5}$ dynes, which is of the order of a million times as great, and is impossible. Therefore, the potassium nitrate cannot be dissociated.

By taking into account the attractions between the particles, it is possible to account for the solubilities of different substances and to explain the mechanism of solution, which the dissociation theory was unable to do.

The results are evidence that the so-called failure of the classical dynamics is due, not to inherent defects in the method, but to the omission on the part of mathematicians to allow for the attractions of moving particles in close proximity to one another.

S. C. BRADFORD.

Science Museum,
South Kensington, S.W.7,
July 5.

The Nucleus of *Amoeba proteus* Pallas (Leidy) [= *Chaos diffluens* (Schaeffer)].

IN "Ergebnisse mit der Nuclealfärbung bei einigen Rhizopoden", Aug. 12, 1929,[1] Bogdanowicz describes the effect of Feulgen's nucleal reaction on the nucleus of *A. proteus*. In a letter to NATURE (June 22, 1929) I briefly summarised my results of a long series of experiments on the same subject. It will be seen from a perusal of the two publications that our findings agree with regard to the presence of a reticulum of chromatin in the karyosome (a conclusion I had already arrived at by a study of the development of the nucleus [2]), but differ with respect to the nature of the so-called 'chromatin blocks' in the periphery of the nucleus. Bogdanowicz fails to obtain a chromatin reaction for these blocks. Now these 'chromatin blocks' have a twofold theoretical significance: (1) they form the karyosomes of the Agametes, (2) they show a very primitive type of mitosis.[3] It is, therefore, important to arrive at a decision with regard to their exact character. There is, however, another reason for endeavouring to clear up any discrepancies in the various descriptions of the nucleus of *Amoeba proteus*. As I have already pointed out, two large free-living amoebae have been confused under the name of *Amoeba proteus*, namely, *Amoeba dubia* (Schaeffer) and *Amoeba proteus* [Pallas (Leidy) = *Chaos diffluens* Schaeffer]. Therefore in making any reference to papers published before 1916 care should be taken to ascertain to which of the two amoebae reference is being made. As I know from experience, it is not always easy to do this. But failure in this respect is a fruitful source of confusion. Hence the justification of this summary of the results of many years' study of the nucleus of *A. proteus*, in its development and in its adult condition, by the ordinary microscopical stains; these results being checked and confirmed by a later investigation by Feulgen's method.

The nucleus of *A. proteus* consists of (1) a more or less centrally placed karyosome, (2) a peripheral achromatic network in which are suspended 'chromatin blocks', the whole immersed in nuclear sap and surrounded by a nuclear membrane. The karyosome is in the form of a thick disc with rounded edge, so as to appear circular in plan, 'band' shaped in elevation. It presents a variety of appearances when being rolled about in the cytoplasm, and thus changing from its 'plan' to its 'elevation' position.

The karyosome is made up of an achromatic ground substance on which is to be seen a reticulum of chromatin. The consistency of the karyosome differs in different specimens and varies according to the age of the amoeba and other circumstances. The amount and the distribution of the chromatin in the karyosome varies at different times. In the young, that is, immature, amoebae the karyosome is well marked off and is a conspicuous structure in the nucleus. But the chromatin is very sparse. In fact, I failed to get any positive reaction for chromatin in uncut nuclei, except the merest trace, until I had examined hundreds of specimens.

In the older, that is, fully differentiated, and adult amoebae the karyosome sometimes stains deeply by Feulgen's method, showing well-marked blocks and patches of chromatin which differ in colour tone in no way from the fully developed chromosomes in dividing nuclei of other animals and plants used by way of controls. At other times the karyosome appears to contain less chromatin.

It is important to emphasise the fact that chromatin is a living substance. It is, therefore, ever-changing, growing, increasing in amount, differentiating out of the chemical substances which build it up, dividing. The changes described above are clearly brought out when large numbers of *A. proteus* are studied by Feulgen's reaction, as is also the case when large numbers of amoebae are treated with aceto-carmine, as I pointed out long ago.

In the adult amoebae clearly defined chromatin blocks are to be found in the periphery, giving the reaction for chromatin by Feulgen's method as already stated. These similarly grow, differentiate, divide; when a 'block' is ready to divide, it stains very brightly; when it is in the 'resting' condition, it is not so evident and it does not stand out so prominently from the underlying ground substance.

In conclusion, I may add that, through the kindness of Prof. Robert Chambers of New York, I have been able to examine the *Amoeba dubia* of the States (it differs in no wise from the material obtained locally), and so to assure myself that not only do the cytoplasmic characters of the two species differ, but also, there is no karyosome in the nucleus of *A. dubia*.

MONICA TAYLOR.

Notre Dame, Dowanhill,
Glasgow, June 23.

[1] *Zeitschrift für Zellforschung und mikroskopische Anatomie*, 10 Band, 3 Heft.
[2] *Quart. Jour. Mic. Sci.*, vol. 71, part ii., August 1927.
[3] "Amœba proteus: some new observations on its Nucleus, Life History, and Culture." *Quart. Jour. Mic. Sci.*, vol. 69, p. 126, part i., December 1924.

Molecular Rotation in the Solid State.

THE determined crystal structures of a number of primary alkyl ammonium halides indicate that in such compounds the carbon atoms are arranged collinearly [1] in a particular group. Thus in the case of primary amyl ammonium chloride [2] the X-ray diffraction data from powders and single crystals can be completely explained by a tetragonal unit of structure containing $2NH_3C_5H_{11}Cl$ with $a = b = 5{\cdot}01$ A., $c = 16{\cdot}69$ A. The space group is D_4^2, V_d^3, S_4^1, C_{4v}^1, C_4^1, D_{4h}^7, and the Cl, N and C atoms are at $o\frac{1}{2}u$, $\frac{1}{2}o\bar{u}$, with $u_{Cl} = c.\ 0{\cdot}095$. The absence of reflections in odd orders from planes $(hk0)$ with $(h + k)$ odd and the intensities of reflections from other planes such as (200) require the carbon atoms of the C_5H_{11} groups to scatter X-radiation as if they are arranged collinearly in each group.

Prof. Linus Pauling, of the California Institute of Technology, has recently suggested to me that the indicated collinear arrangement of carbon atoms might be in error. If the carbon atoms of an alkyl group really have a 'zig-zag' arrangement and the group is

rotating [3] about its chain axis independent in phase of other rotating groups, then the result given above would be obtained. If the temperature should be sufficiently lowered, this complete rotation would be replaced by slight oscillation about some equilibrium positions.

Observations were made on primary amyl ammonium chloride at approximately liquid air temperatures. The density, determined by suspension in mixtures of liquid nitrogen and oxygen, is *c.* 1·0, probably a little greater than the value 0·953 at 25° C. Diffraction lines on powder photographs (Cu*K* radiation) at liquid air temperatures are similar in spacings to, but markedly different in intensities from, those at room temperatures; some few additional lines requiring a larger unit of structure are also present. It is difficult to determine accurately the structural characteristics of such a complex compound from powder photographs alone. The photographs at liquid air temperatures, however, indicate, from their similarity to photographs at 25°, that the crystals have approximately orthogonal axes and that the atomic arrangement in the unit of structure containing $4NH_3C_5H_{11}Cl$, with the dimensions $a = b = 7{\cdot}0$ A., $c = c.\ 16{\cdot}6$ A., is closely similar to that in the unit of structure previously described. The presence of planes such as (210) and (300), referred to the axes of the larger unit of structure, could be explained by alteration in the structure but probably is best accounted for by absence of the suspected molecular rotation that leads to the fortuitous determination of the unit of structure and atomic arrangement at room temperatures.

The best test for a possible collinear arrangement of the carbon atoms of a C_5H_{11} group is the absence of reflections in odd orders from planes ($hk0$) with ($h + k$) odd. (Indices referred to a unit of structure having $a = b = 5{\cdot}0$ A., $c = 16{\cdot}6$ A.). The large axial ratio makes it difficult to distinguish between reflections from ($hk0$) and (hkl) with l unity on powder photographs. Reflections from (200) and (201), however, are very weak at liquid air temperatures, while reflections from (200) are strong at room temperature. This change in the intensity of (200) could be explained by a great departure of the chain axes of the C_5H_{11} groups from parallelism with the tetragonal axis of the crystal at liquid air temperatures, or, as is most probable, by a departure of the carbon atoms from a collinear arrangement.

The most immediate conclusion is that the carbon atoms in a C_5H_{11} group are arranged in a 'zig-zag' manner and that the characteristics of the X-ray diffraction photographs made at room temperatures from crystals of primary amyl ammonium chloride arise partially from rotation of the C_5H_{11} groups about their chain axes. The configuration of a hydrocarbon chain as deduced from the crystal structure of the primary alkyl ammonium halides is thus probably the same as that first found by Müller and Shearer [4] for some long chain aliphatic compounds. The carbon to carbon separation along the chain axis is *c.* 1·20-1·30 A., and the carbon-carbon distance might well be *c.* 1·54 A.

It thus seems, as Pauling has indicated, that in a crystal containing molecules or molecular groups with small moments of inertia about some axes, these molecules may undergo rotational motion about these axes.

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[1] S. B. Hendricks, *Z. f. Krist.*, **67**, 106, 475; 1928; **68**, 189; 1928.
[2] S. B. Henricks, *Z. f. Krist.* (In press.)
[3] See Linus Pauling, *Phys. Rev.*, July 1930.
[4] *Jour. Chem. Soc.*, **123**, 3156; 1923. G. Shearer, *Proc. Roy Soc.*, A, **108**, 655; 1925.

Raman Effect, Fluorescence and Colour of Diamonds.

THE Raman spectra of various simple substances, including especially the non-metallic elements such as phosphorus, chlorine, and carbon, have been investigated by me. In the course of this work numerous samples of diamond were examined, and a brief report of the results may be of interest as supplementing the accounts which have already appeared in NATURE of May 10.

The extreme sharpness of the Raman lines observed with diamond invited attempts to measure their wave-length with all possible precision. Seven different diamonds gave results identical within the limits of error of measurement. The best representative value for the infra-red wave-number was found to be $1331{\cdot}5 \pm 0{\cdot}5$ cm.$^{-1}$, in agreement with Ramaswamy's measurements but differing rather seriously from the value 1342 given by Robertson and Fox. In the case of

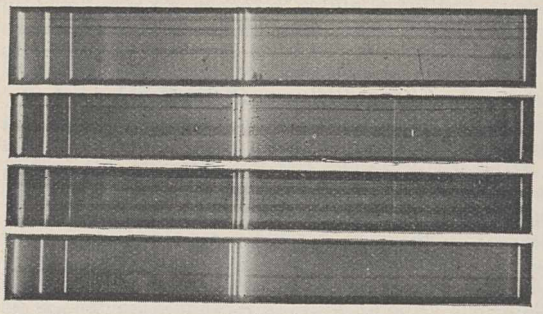

FIG. 1.

one very imperfect diamond, it was noticed that the line was diffuse and distorted and was accompanied by a faint companion line on the longer wave-length side.

A feature of importance not mentioned in NATURE of May 10 is the continuous spectrum accompanying the Raman lines. This appears with a fairly well defined edge on the violet side at about λ4240 A., and stretches out towards the visible region. Immediately preceding it are two bands of which the first at 4152 to 4162 A. is the more intense. The intensity of the bands and of the continuous spectrum varies in a remarkable way with the colour of the diamond. They are specially conspicuous with diamonds of a pale blue colour, and are extremely feeble with white diamonds. *Per contra*, the Raman lines are very difficult to observe with blue diamonds, and are most easily obtained with colourless diamonds.

In Fig. 1, *A* taken with a blue diamond and *B* with a white diamond exhibit these features. *C* was taken with a diamond having the palest yellow tinge and showed both the Raman lines and the bands accompanied by a continuous spectrum of considerable intensity. From the fact that the introduction of a filter cutting out the mercury line at 4046 A. eliminates the bands and practically the whole of the continuous spectrum, it may be inferred that these represent fluorescence of a special type. The aggregate intensity of the continuous spectrum appearing in *A* must have been very considerable, and it was thought that the blue colour of the diamond in ordinary daylight was really due to this fluorescent radiation. *D* was obtained with another diamond of a strikingly yellow colour. It gave feeble Raman lines, and a continuous spectrum (without bands) stretching practically over the whole region from 3800 A. to the red end.

S. BHAGAVANTAM.

210 Bowbazar Street,
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Raman Effect in Paramagnetic Crystals.

VARIOUS crystalline sulphates have been examined for their Raman spectra by the same method as that used for crystalline nitrates and described previously (NATURE, Mar. 22, p. 463). The results indicate what appears to be a very remarkable influence of the paramagnetism of the cation on the intensities of the Raman lines. This appears very clearly when we compare the spectra of ferrous sulphate crystals ($FeSO_4$, $7H_2O$) with those of other isomorphous sulphates, for example, magnesium or zinc. In the latter substances, a strong line appears with a frequency shift of about 980 cm.$^{-1}$. This frequency is characteristic of the SO_4^{--} ion, though its exact value shows considerable variations with the cation present in the crystal. In the spectrum of the ferrous sulphate crystals, however, the line fails to appear even when exposures are given of such duration that the feeble continuous spectrum accompanying the mercury lines comes out strongly on the plate. With aqueous solutions of ferrous sulphate, however, the SO_4^{--} line appears feebly.

That the disappearance of the SO_4^{--} line with ferrous sulphate crystals is connected with the paramagnetism of the substance is indicated by the fact that in other paramagnetic sulphates, as, for example, those of copper and manganese, the characteristic SO_4^{--} line appears only weakly. A similar weakening of the line due to NO_3^- inactive frequency is also noticeable on comparing the nitrates of copper and manganese with the nitrates of other metals. The observations indicate that when the substance is in solution, the influence of the paramagnetism of the cation weakens or disappears.

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Submarine Cable Interference.

THE description given by E. T. Burton [1] of his measurements of audio frequency interference is of great interest, and would be more so if quantitative values of the interference levels had been given. The similarity between the natural interference experienced on an untuned aerial and a cable is to be expected, but details of the depth and armouring of the cable would be valuable to estimate approximately the attenuation of the higher frequencies. Mr. Burton does not state whether a local earth was used, or a sea earth contiguous to the main cable; nor the length of the latter, if used.

An attempt at correlating the 'intermediate frequency' interference with the strength of the aurora borealis might meet with success; this suggestion is supported by (*a*) the partial correlation with magnetic disturbance, (*b*) the higher level at night, and (*c*) the interference level being on the increase when observations were apparently discontinued in September 1929. Extremely heavy and rapidly varying earth currents were observed at the Horta end of the Bay Roberts-Horta (1928) cable during the evening of Sept. 8, 1928, simultaneously with exceptional aurora at Bay Roberts.

The practical importance of interference measurements on submarine cables lies in the limit set by the interference level to the smallness of the received signals, and hence to the permissible amplification, both at low frequencies for telegraphy and at audio frequencies for telephony. The recent suggestions for a loaded trans-Atlantic telephone cable [2] will depend for their success on the degree to which natural and artificial interference can be eliminated, as for example by long, resistance-terminated sea earths, or by screening the cable by a high-permeability alloy. This will be realised when it is stated that an overall amplification of the order of 150 decibels will be required at about 2200 to 2500 c.p.s.[3]

The programme of tests on the La Panne-Lisbon cable, to be laid by the Telegraph Construction and Maintenance Co., Ltd., for the Italcable Co. later this year, includes the recording of telegraph frequency interference (from 0 to 200 c.p.s.) at La Panne. Should sufficient time be available, I hope to extend these observations to cover the audio frequency range. At this location, with a long length of cable in shallow water down the Channel, it is anticipated that the industrial interference will be very heavy; but the character and intensity of natural interference may be similar to that obtained at Trinity Bay.

A. L. MEYERS.

Telegraph Construction and Maintenance Co., Ltd.,
18 Wharf Road, London, N.1,
July 15.

[1] E. T. Burton: NATURE, **126**, p. 55; July 12, 1930.
[2] K. W. Wagner: *Elektrische Nachrichten-Technik*, **6**, p. 125; April 1929. H. C. Channon: *Jour. I.E.E.*, **67**, p. 500; April 1929. See also *Jour. Am. I.E.E.*, **48**, p. 635; August 1929.
[3] N. W. McLachlan: *Electrician*, **103**, p. 704; Dec. 6, 1929.

The Green Ray.

THE extract from a letter to NATURE by R. W. Wood (vol. 121, 1928, p. 501), in Sir Napier Shaw's recently published "Manual of Meteorology", vol. 3, suggested to me that an observation of the green ray I obtained last spring might be worth recording.

Wood remarks that the ray is more likely to appear when the horizon at which the sun sets is markedly colder than the air close above it.

While descending in clear weather as a passenger in a motor-car into a valley in Kincardineshire I watched the artificial sunset due to the obscuring of the sun by a hill some three miles away, the country being several inches deep in snow; the sunset occupied about five seconds; the last-disappearing edge of the sun turned from orange through yellow to a grass green. In spite of the rapid sunset which should have been unfavourable for seeing any green ray, the sharp increase of temperature with height usual above a snow surface appears to have produced a sufficiently high dispersion.

O. F. T. ROBERTS.

The University,
Aberdeen, July 3.

Plasmoidal Discharges in Gases.

IN the issue of the *Physical Review* of April 1, 1930, there appears a paper by Prof. R. W. Wood on high frequency discharges in gases at low pressure in which he describes a type of discharge, naming it a plasmoid. This appears to be a new name for a phenomenon which has been described before. In particular, it appears to be the same as a type of discharge described briefly by me in NATURE of Mar. 10, 1928. Such a discharge was also shown by Messrs. Gill and Donaldson at an exhibition during the British Association meeting at Oxford in the summer of 1926.

It does not appear that Prof. Wood has verified his references carefully. I find that a paper which was published by him in the *Philosophical Magazine* in August 1929 is referred to in his recent paper as having appeared in October 1929.

Also in his paper in the *Philosophical Magazine* of August 1929, he refers to another paper published by him in NATURE of Oct. 8, 1927, as having been published in NATURE 1926.

S. P. MCCALLUM.

Electrical Laboratory,
Oxford, June 6.

The Royal Society of Canada.

ANNUAL MEETING IN MONTREAL.

ON May 20–22 the Royal Society of Canada met at McGill University, Montreal. Prof. A. S. Eve gave his presidential address on the evening of May 20, his subject being "The Universe as a Whole". He dealt successively, and from the broadest point of view, with the macrocosm, space, the microcosm, atoms and electrons, the age of the universe, time, life and the origin of life, and domains of energy, and stressed the divergence of existing views on may important problems, and the number of such problems still to be solved. At the same session he presented the three gold medals of the Society. The Flavelle medal was awarded to Dr. A. B. Macallum, emeritus professor of biochemistry at McGill University, for his pioneer researches in micro-biochemistry, the Lorne Pierce medal for outstanding contributions to literature to Sir Andrew McPhail, professor of the history of medicine at McGill University, and the Tyrrell medal to Dr. Adam Shortt, of Ottawa. At the final session of the meeting the Hon. Vincent Massey, Canadian Minister to the United States, gave the popular lecture on "Art and Nationality in Canada".

Perhaps the most interesting and outstanding event of the whole meeting was the radio address delivered by Sir Ernest Rutherford, president of the parent of all Royal Societies, from his home in rural England to the fellows gathered in Moyse Hall at Montreal. The whole of the address, with the exception of a few opening sentences, was clearly heard by a large audience, as was the telephone conversation between Sir Ernest, at one end, and in turn Prof. Eve, Sir Arthur Currie, and Sir Robert Falconer, at the other. Only ten years previously it had been considered a remarkable event when, also under the direction of Prof. Eve, an artiste sang at Montreal to an audience of the Royal Society at Ottawa, 110 miles away (and the reception was much less perfect).

In Section I. (French Literature and History) eleven papers were read, and in Section II. (English Literature and History) twenty-five.

Section III. had to divide into sub-sections to hear the ninety-nine papers presented. The sectional presidential address was delivered by Dr. Daniel Buchanan, of the University of British Columbia, who spoke on the three-body problem and gave the historical development of this famous mathematical investigation. Prof. J. C. McLennan communicated a large number of papers by himself and his colleagues on spectroscopy and low temperature work. One paper with H. D. Smith and G. O. Wilhelm reported results indicating that there is no appreciable difference in the states of oxygen molecules in gas and in liquid form. Prof. McLennan himself described the construction of a new type of spectrograph which will photograph the auroral green line in less than twenty minutes, permitting comparison of its intensity in the light from the night sky for different periods of the night. With E. K. Moles he has found that there is appreciable absorption of the green auroral line in oxygen at high pressures. An interesting paper (with J. F. Allen and J. O. Wilhelm) on the non-superconductivity of bismuth alloys was also presented.

Dr. J. A. Gray gave several papers on X-rays and radioactivity. The most interesting of these (in conjunction with W. H. Zinn) showed that the scattering of X-rays at small angles to within five minutes of arc of the primary beam indicated an abnormal scattering with certain specimens of charcoal; the intensity increases so rapidly as the angle decreases that it is difficult to measure relative intensities accurately. Figures obtained show that with a certain specimen of charcoal the intensity of the scattered radiation at five minutes of arc is of the order of a million times that at ninety degrees. This abnormal scattering is also shown by the fact that the part of the mass scattering coefficient for radiation scattered between ten and ninety minutes is equal to 6·0, which may be compared with the total normal scattering coefficient which is of the order of 0·2. The scattering increased with rise of temperature. Different wave-lengths were used and it was not found possible to give an explanation of this new phenomenon in terms of the wave theory.

Dr. J. K. Robertson in a mathematical paper gave a rigorous treatment for measuring the half-width of spectral sources. Dr. A. N. Shaw and H. E. Reilley described a new method enabling the comparison of electrical voltages measured at different times and places to be made with the exceptional precision of two parts in a million. Dr. J. S. Foster and his students presented several papers relating to the Stark effect, including one (with H. W. Harkness) in which it was shown that in xenon the usual rule for hydrogen differences is not applicable. Papers on applied geophysics were presented by Prof. A. S. Eve, Dr. L. Gilchrist, and Dr. D. A. Keys, in which accounts of field work by different electrical and magnetic methods were described. An interesting demonstration of the piezoelectric pressure gauge combined with a cathode ray oscillograph was shown by H. G. I. Watson and Dr. D. A. Keys. Dr. W. L. G. Williams gave a paper on applications of the theory of formal molecular invariants to the theory of numbers, which leads to some rather general arithmetical results. Dr. S. Beatty spoke on the rôle of equivalent lines in a bilinear transformation in the plane, and Dr. C. T. Sullivan gave an interesting account of an investigation on an application of matrix rank to the classification of surfaces defined by a certain system of differential equations.

In the Chemical Sub-section Dr. Otto Maass and R. H. Wright described the physical properties of the system hydrogen sulphide–water, and F. R. Moorehouse and Dr. Maass described the preparation and properties of ethyl acetylene. Dr. R. H. Clark and E. G. Hallonquist reported a study of the

effect of a magnetic and also of an electrostatic field upon the ethylene linkage of the two electromers of 2-pentene. Dr. F. B. Allan gave a paper on the reaction of the solvent alcohol on dissolved esters in presence of calcium alcoholate, ammonia, or sulphuric acid. R. E. Whiting and Dr. W. H. Martin showed that extreme drying had no effect on either the light absorption or the photo-expansion of bromine. Dr. E. H. Archibald and F. Rendle made a communication on the solubility of beryllium hydroxide in solutions of sodium bicarbonate and the separation of beryllium from vanadium, chromium, and uranium.

In Section IV. (Geological and Mineralogical Sciences) thirteen papers were given, Mr. A. G. Burrows, provincial mineralogist for Ontario, presiding. Dr. F. S. Alcock presented a paper on the Silurian of Northern New Brunswick; his recent work in the Chaleur Bay region has indicated that Ordovician and Devonian as well as Silurian strata occur in the north-western part of the province, formerly mapped as occupied by Silurian; he included a discussion of the relations of the Silurian with older and younger strata. Dr. M. Y. Williams, in a paper on the Pierre Seas of Western Canada, advanced evidence to show that the great Colorado sea retreated to the north and south, leaving western Canada dry land. The rhythm of earth movements, however, continued, although with decreasing amplitude, and two or more invasions of the Pierre Sea closed the marine history of Cretaceous time. He discussed the areal extent, duration, and significance of the Pierre submergence.

W. A. Johnston and R. T. D. Wickenden gave a paper on the hitherto undescribed Glacial Lake Regina, Saskatchewan, which extended for 175 miles south-east from the elbow of the South Saskatchewan River, and had a maximum width of about 40 miles. The lake was formed as a result of damming of the drainage of the South Saskatchewan River by the retreating ice sheet of the last glacial epoch and outflowed towards the south-east by way of the Souris valley. In two other papers W. A. Johnston brought together scattered data regarding the occurrence of permanently frozen ground in northern Canada, discussed the question of the relationship of the frozen ground to present and past climatic conditions in the glaciated and unglaciated parts of Canada, and offered evidence in support of J. B. Tyrrell's view that fossiliferous clays on Roaring River, Duck Mountain, Manitoba, are interglacial in age. Dr. G. S. Hume dealt with features of foothill structures in Alberta, and pointed out that recent drilling for oil and gas in these foothills west of Calgary has revealed the presence of overthrust blocks lying on one another and separated by low-angle thrust planes dipping south-westerly. Turner Valley, New Black Diamond, and Jumping Pound structures are recumbent folds modified by faulting. Late Cretaceous rocks are believed to underlie and to be separated by a thrust fault from the Palæozoic rocks productive of oil and gas in Turner Valley, and it is suspected that the whole disturbed belt in this area is overthrust on to the relatively flat-lying sediments of the plains.

In Section V. (Biological and Medical Sciences) fifty-nine papers were presented, and in addition Dr. Szent-Gyorgyi, a guest at the meeting, gave a demonstration of the properties of hexuronic acid. Dr. A. T. Cameron, of the University of Manitoba, gave the presidential address of the section on temperature and life and death. Dr. Wm. Rowan communicated a description of a new species of *Hydra* found covering water-weeds in certain Albertan lakes; the body and tentacles when extended may measure four inches. Eggs are deposited in autumn and survive the winter. According to Dr. A. Willey, the young garpike, when less than a foot long, possesses a double tail, each part working separately; the tail-fin is a soft muscular process, which vibrates with great rapidity. Dr. C. M. Fraser reported the results of a study of the razor clam of the Queen Charlotte Islands. Dr. J. Playfair McMurrich presented a series of papers from the Anatomical Department of the University of Toronto. Amongst these was a report by Dr. J. C. Watt of a case of an adult man in whom there was a complete union of the membranes surrounding the heart and left lung, whence it was concluded that a special membrane of the heart is not necessary for its efficiency. Dr. H. A. Cates showed that the relative proportions of length and width of the skull do not alter to any considerable extent between infancy and adult life, but that the relative height, with measurement taken from the Frankfort plane, increases greatly. Dr. R. K. George showed, as determined by methods of precision, that in the majority of men the ring finger is longer than the index; in women the opposite holds. Dr. C. C. Macklin, of Western University, presented a study of stereoscopic X-ray films of lipiodolised lungs, which demonstrated that in inspiration the bronchial tubes become shorter and narrower, and in expiration the process is reversed, these changes facilitating air exchange, and being correlated with the minute anatomical structure. A network of smooth muscle with abundant elastic tissue envelops the tubes and controls the action. The results have a direct bearing on pathological conditions of the lungs such as pneumonia and tuberculosis.

Drs. J. G. Fitzgerald and D. T. Fraser, of the Connaught Laboratories, Toronto, presented an extended series of observations indicating that infants non-immune to diphtheria are the offspring of mothers who possess no natural protection, while the blood of adults shown to contain antitoxin continues to contain it for a period of years; non-immune adults remain non-immune. H. des B. Sims and D. A. Scott reported two absorption bands in the ultra-violet spectrum of solutions of crystalline insulin. Exposure to ultra-violet radiation lessens the potency of insulin. X-ray radiation produces no effect. A. F. Charles and D. A. Scott, from a study of enzymic digestion of crystalline insulin, find that loss of physiological activity apparently proceeds even faster than digestion, the result indicating that the activity is associated with the large molecule itself and not with some

constituent part of it. Dr. J. B. Collip, of McGill University, and his co-workers, outlined the preparation of the placental hormone emménin, and showed that immature female rats are brought to sex maturity by its injection, thereafter manifesting cyclic changes, while normal adult females are unaffected. R. L. Lutz outlined a method for determining potassium, sodium, calcium, and magnesium in biological material after initial fusion with fuming nitric acid, and described a crystalline organic substance isolated from fuming nitric acid hydrolysates of the protein fraction of beef muscle and of casein.

Drs. V. J. Harding and L. J. Harris, of the University of Toronto, described the production of convulsions and subsequent death in dogs after forced ingestion of large quantities of water. Recovery from the convulsive stage is rapid following intravenous or intraperitoneal injection of ten per cent saline. Dr. John Tait and W. J. McNally, of McGill University, reported that the croaking of frogs is essentially an under-water signal, conveyed by vibration, this vibration occurring when air is shifted from the lungs to the mouth and air-sacs. The fact that croaking can be heard merely implies that the signalling animal has its head above water at the moment. Dr. B. P. Babkin gave an account of a number of studies of gastric and intestinal digestion by himself and his students. Prof. A. H. R. Buller reported on some further experiments on sex in fungi. Dr. Marie-Victorin gave an account of a study of the literature and of the plant *Elodea canadensis*, leading to greater precision of nomenclature, and Prof. G. W. Scarth presented a series of sinkage studies of floating logs of various trees, the relative amount and distribution of the three phases, wood, water, and gas being studied by gravimetric and microscopic methods. Prof. F. E. Lloyd presented a comparative study of the traps of *Utricularia gibba*, *vulgaris*, and *capensis*.

The Society, under the presidency of Dr. Charles Camsell, Deputy Minister of Mines of the Dominion, has accepted an invitation from the University of Toronto to meet there in 1931, whilst a similar invitation to meet in Vancouver in 1932 was referred to the Council for favourable consideration.

A Study of the Phenomenon of Spin in Airplanes.*

By H. E. WIMPERIS, C.B.E.

METHOD OF STUDY.

SO much for what the spin is and what causes it. We come now to the best way to study it. This can be done by employing models or by the use of full-sized airplanes. The latter method avoids uncertainties due to any possible 'scale effect', that is, failure of the model to represent truly the motions of the full-sized machine, but adds the greater difficulty of making accurate quantitative measurements when in free flight and adds the risk of crash. Experiments with models have been made in wind tunnels and in free flight. Small light models—to one-twelfth or one-twentieth scale—have been made at Farnborough out of balsa wood, and these have been dropped through a free fall of 90 feet in the large balloon shed. Kinematograph records have been made and the motion afterwards measured up from the films. (One of these films was shown on the screen.) In certain of these model dropping experiments a Bristol Fighter model was used, and success attended the effort to reproduce various types of spin. In this particular machine the rudder was found to be surprisingly effective as a controlling organ, and if the spin were started against this control it was stopped in six turns.

Of all the various controls the aileron is normally the least effective; that is, the ordinary type of aileron. If, however, the possible aileron angle is arranged to be *very* largely increased, the spinning motion is affected. The following account of a model dropping experiment at Farnborough will serve alike to indicate this aileron effect and to illustrate the nature of this mode of this form of experimentation. A 1/20th scale model of a Bristol Fighter was used. Ailerons were fitted to the upper and lower starboard wings and provision was made for moving any of the controls at a predetermined time during the spin. This was done by means of a spring loaded dash pot with a variable air leak. The model was released from a swinging pendulum just under the roof of the balloon shed in such a way that it was at release moving horizontally at its stalling speed with 10° of sideslip. It was launched with full left rudder and with the elevators fully up. With ailerons neutral the model completed 4½ turns of a left-hand spin in as many seconds. A further test was then made with control release set to move the outer aileron to an angle of 65° after an interval of 2½ seconds, with the result that the model ceased spinning within about half a turn.

The flat spin with this model was found to be one of very small radius, the mean angle of incidence appearing to be about 75° (the smallness of the radius in flat spins is of course well known, as is the consequent extraordinary difference sometimes found in the centrifugal forces acting on the pilot's and observer's bodies). Whereas in the ordinary spins of this model four and a half turns were made in four and a half seconds, in the flat spin, eleven turns were completed in five and a half seconds, and the axis of the spin instead of being well ahead of the nose came close to the centre of gravity.

Sometimes the little model was made automatically to centralise its controls during the fall, and the effect of this on the resulting motion was studied. Sometimes the models were set into a spin at the moment of release and the effect of variations in wing arrangement ascertained. In this way the effects of stagger, wing gap, decalage, and other features can be studied rapidly. This

* Continued from p. 136.

has proved a useful method of investigation; it is safe, speedy, and very picturesque.

The other way of using models is to mount them in a wing tunnel and measure the forces which arise during the spinning motion. This is an exceedingly difficult experiment to carry out for the motion is complex, and it is no very easy matter to lead out the connexions which will enable the couples about each of the axes to be measured. It is not so difficult to measure the moment about the autorotation axis, the axis of spin, and this investigation is now in hand. The amount of the autorotation moment will of course give a measure of one at any rate of the forces tending to keep the airplane in the spin. The fuller experiment will, however, be undertaken in one of the N.P.L. wind tunnels as soon as the apparatus is ready.

Yet another form of wind tunnel test is due to Prof. Betz. This consists in measuring the rate of autorotation of a hollow aerofoil in which air can be allowed to pass internally from one wing tip slit to the other. These slits are placed in the upper surfaces and are parallel to the wing spar. Measurements have been made in Germany with these slits in different symmetrical positions and with or without a free internal air passage. The result is found that with the best arrangement there is at some cost of maximum lift a distinct decrease of the tendency to autorotation, and that this gain is directly associated with the free lateral passage of the air inside the wing. The following explanation of the action is given by Schrenk.[1] It is known that the motion of a rotating wing produces different angles of incidence at corresponding sections of the two ends, such that at the rising end the flow adheres to the upper surface whilst at the other end it tends to break away. For this reason the lift on two such corresponding elements is not necessarily the same, and in no case will the pressure distributions on the elements coincide. The flow from slit to slit through the wing is caused by such differences of pressure, and acts in such a way that at the wing tip at which the flow breaks away from the surface the flow is improved by suction of the boundary layer towards the interior of the wing; at the other end the flow is rendered worse by the air streaming out of the slit. It follows that any autorotation there may be will tend to be much slower and therefore more controllable.

The first full scale experimental and mathematical investigation of spinning was that by Lindemann, Glauert, and Harris. This work was carried out at Farnborough, and in their report to the Aeronautical Research Committee, dated March 1918, full details of this very courageous investigation are given. It is noteworthy that they made use of streamers attached to outrigged spars, and by their use measured for the first time the angle of incidence.

At the present time full scale research on spinning is included in the research programme at Farnborough. Indeed, the phenomenon is one which requires continuous study since each new development of airplane design may bring in some new aspect of the spinning problem.

In addition to this work there are the normal 'performance tests' on spinning which are carried out at Martlesham on all new types of airplane, during which each machine is spun through not less than eight turns to right and to left with varying positions of the centre of gravity, and no machine is passed for service unless it can be readily bought out of such a spin by the normal use of the controls. Intrepid pilots are needed for such tests on new machines, and it does sometimes happen that the obstinacy of the airplane in its motion requires the pilot to resort to his parachute, though, curiously enough, the mere rising of the pilot in his seat with the view of leaving the airplane has on more than one occasion caused the machine to come out of its spin at once! Sometimes the engine throttle can be used as a control on the spin, since change of engine torque will of course tend to roll the machine to a new attitude. Spinning tests have also been undertaken by the Cambridge University Air Squadron with the help of Prof. Melvill Jones. In these tests the wool tuft method due to Flight Lieutenant Haslam has been found of use. This consists of mounting numerous little tufts of wool on the upper surface of the wing and watching (in some cases taking cinema records of) what happens when the machine gets into various attitudes. As I have already mentioned, a rather similar method of experiment has been used at Farnborough, in which long streamers have been attached to the wing tips or other airplane parts and their motion studied in the spin.

It is not pretended that the behaviour of these streamers is understood, but it is hoped that the continuation of the research will bring such knowledge as will enable these results to be usefully interpreted. As an example of the complexity the following extract may be given from a Farnborough report:

> It was decided to investigate the practicability of recording the direction of the air flow over various parts of the airplane while spinning by photographing streamers. Outriggers were fixed to the lower planes. These were attached to the front spars and projected two feet beyond the wing tips, fabric streamers four feet in length being attached to the ends. Streamers were also fixed to tubes projecting 9 inches in front of the leading edge of the tail plane three feet from the plane of symmetry. . . . The inclination of the wing tip streamers was found to vary in phase with the oscillation of the spin. In the left hand spin the mean inclination of the inner streamer to the wing cord was 73° and that of the outer streamer 24°. . . . The photographs of the tail plane streamers were less satisfactory, and it was only possible to determine the inclinations of the inner streamer; . . . the mean inclination of the streamer was about 15° from the *Z* axis towards the rudder, which implies a natural flow at the streamer which is opposite in direction to that caused by the rotation of the tail. An inward sideslip of the order of 20° would satisfy these conditions.

These experiments show that in nearly flat spins where the rate of rotation is high and the vertical velocity small, the tail unit has to operate in air previously disturbed by the passage of the wing tips. This disturbance of course does not add to the effectiveness of the tail control organs. The

sole merit to be found in the motion in a flat spin is that the vertical velocity is quite often so small that little more than a crashed under-carriage results from hitting the ground. In this type of spin the wings are acting rather like those of an autogiro, but very inefficiently, of course, since one wing is entering the air by its trailing edge.

Another method of full scale test making use of a kinematograph camera on the ground has been employed in Germany. The size of the image on the film gives a rough measure of the distance away of the airplane, whilst the angular distance and the time are readily noted. Cinema methods are also in use in U.S.A. (A cinema film furnished by the National Advisory Committee for Aeronautics of America, and showing a seaplane performing a flat spin, was shown at the end of the lecture.)

When new types of airplanes are tested at the R.A.F. Station at Martlesham in order to ascertain their performance under all conditions of flight, they need to be spun both to left and right and not merely in one direction only. This is because of the influence of the direction of engine rotation upon the slip stream, and because of the gyroscopic couple due to the rotating engine and airscrew which will try to depress the nose of the craft in one case and raise it in the other. Recovery is required to be simple and sure even when this gyrostatic couple assists the inertia couple in opposing the pilot's actions.

At first it was not realised that an airplane that could easily be brought out of a spin of a few turns would not necessarily be easily brought out if the spin were continued for a large number of turns. The reason for this is not certainly known, but it can scarcely fail to be associated with sheer lapse of time allowing the forces opposing recovery gradually to raise the nose of the machine, and so get it into a condition in which for one reason or another the pilot's controls are less effective. Nor has it long been realised that the effect of small differences in the actual mode of entry into the spin can persist even after many turns, and so sometimes render recovery unexpectedly difficult. This explains the previously puzzling question why pilot A's report on the controllability of a given machine in a spin differs entirely from pilot B's. The explanation no doubt is that the two pilots follow a slightly different technique in putting their airplanes into spins. For research investigations it is feasible always to employ the same technique, but during the performance testing of new aircraft consideration must be given also to what is likely to happen when this definite technique is not followed.

The Woof.

A recent discovery is the 'Woof'. This is a word coined by the Martlesham pilots to describe the unsteady form of spin sometimes met with in which there is an oscillation in pitch combined with an oscillation in spin, so leading to a very uncomfortable motion. This is so little understood at the moment that one of the Air Ministry Scientific Research Staff in a recent report had to admit that "the origin of the air forces necessary to maintain this fluctuation in attitude is at present a mystery, and this obscurity is typical of the present stage of the spinning problem". In one recent test the jerkiness of the motion could be distinctly seen from the ground. The unevenness of rotation was accompanied by an appreciable oscillation in pitch, the rate of rotation decreasing as the nose of the aircraft rose and increasing as it fell. Accelerometer records showed the mean period of the pitch oscillation to be rather more than 5 seconds, whereas the corresponding mean times per turn of these spins was only about $4\frac{1}{2}$ seconds. The complexity of the motion may be inferred from the different periodic times.

It may be of course that, long before these highly complex phenomena are fully understood, some novel constructional device will be produced which will at once render all spins controllable. A device which went so far as to prevent spinning altogether would probably not be desirable since it might also prevent the useful manœuvre of the 'roll'.

It is true, I fear, that in these matters we ask a great deal. We ask that the airplane shall do everything that the pilot wishes, but shall have no will of its own other than a moderate wish to remain the right way up, but even this not to be thrust too prominently before the pilot's notice. We want a docile machine. We want, in fact, an amount of docility which though often sought is but rarely found, even in humanity.

[1] *Z.T.M.*, Nov. 14, 1929.

Obituary.

Mr. W. J. Greenstreet.

BY the death of William John Greenstreet on June 28 the mathematical world loses, not an explorer or a geographer, but, if the metaphor may be pressed, a traveller familiar with a larger variety of landscape than almost any of his contemporaries. Born in 1861 and educated at St. John's College, Cambridge, he was an assistant master from 1882 until 1889, and headmaster of Marling School, Stroud, from 1891 until 1910, when he retired to Burghfield Common, near Reading, with the intention of devoting himself to literary work. For many years he had been a regular contributor to *Notes and Queries* and to the *Westminster Gazette*, and editor of the *Mathematical Gazette*, and he had every reason to anticipate a life congenial to his frugal tastes.

The War, however, put an end to Greenstreet's work for the *Westminster Gazette*, and at the same time raised the cost of living to an unforeseen level. The result was an extension of an activity which he had created, namely, the supervision of the

education of pupil-teachers in village schools; the value of this work, which he had begun voluntarily in the schools nearest to his home, came to be recognised by the county educational authorities, and soon from eighty to ninety students looked to him for guidance, and he was known throughout the countryside, reaping in labours which earned him a livelihood the reward of spontaneous help given to his neighbours in happier years.

Meanwhile his editorship of the *Mathematical Gazette* continued, and it was this which made Greenstreet's name familiar to every mathematician in England. While the *Gazette*, as befits the organ of the Mathematical Association, has been concerned primarily with problems of school teaching, from elementary arithmetic to scholarship analysis, the characteristic features of the journal have revealed the editor. Greenstreet always desired to attain, and believed that all teachers benefit if they can attain, to such appreciation of current advances in mathematics as is possible without intensive study of special branches; he therefore encouraged ample notices of treatises, Continental and American as well as English, far beyond the range of school mathematics, until the review pages of his *Gazette* were admitted to be among the best in the world. Also, he had an immense knowledge of the personalities of literary, scientific, and social history, the product of omnivorous and rapid reading and a retentive memory; one result was that his own reviews of historical works, now tracing cross-currents of influence, now bringing a dead name to life by an anecdote or an epigram, enriched alike the books with which they dealt and the journal in which they appeared; another result was that every spare corner of the *Gazette* was filled by a 'gleaning', some quaint incidental reference to mathematics or to a mathematician found perhaps in classical literature, perhaps in a daily newspaper. In short, Greenstreet gave a character and a standing to a periodical which might have become nothing but a pedagogical mouthpiece; and this was the achievement that was acknowledged when the completion, in 1929, of thirty years of his editorship was the occasion of a testimonial to which some two hundred mathematicians subscribed.

Of Greenstreet's literary and musical interests it is impossible to speak here, but mention must be made of his enthusiasm for De Morgan. Once he was addressed as the De Morgan of his time, and this compliment pleased him as no other ever did. In wealth of biographical and bibliographical knowledge each was indeed unrivalled in his day, and this was perhaps all that the comparison was intended to convey, but one may recognise also in the two men the same sense of honour and the same sense of humour. Of the multitude of correspondents and contributors who were grateful for Greenstreet's help and counsel, few could claim to know him personally. His friends hold the memory of a man who never spoke a wounding or complaining word, of one who was prodigal of his knowledge, forbearing in his judgments, and ready with his laughter.

E. H. N.

MR. G. H. CURTISS.

IT is with great regret that we record the death at Buffalo, U.S.A., on July 23, after an operation for appendicitis, of Mr. Glenn Hammond Curtiss, whose name, as a pioneer of flight, will always be associated with those of his countrymen, Langley and the Wright brothers. Curtiss, who was born at Hammondsport, New York, was only fifty-two years of age and was therefore somewhat younger than either of the Wrights. Like them, be began life as a bicycle repairer and then turned his attention to motor cycles, motor racing, and engine making.

It was the chance order of an engine for an airship which stimulated Curtiss's interest in aviation. The Wrights had first flown in 1903, Santos Dumont in 1906, and experiments were being made by many other inventors. It was, however, the performances of Orville Wright at Fort Myer, U.S.A., and of Wilbur Wright at Le Mans, France, in 1908 which definitely established the aeroplane as a practical means of transport. That same year, flights were made by other pioneers, among whom was Curtiss. In the summer of 1908 he flew his machine, *June Bug*, a distance of a mile, and this success he followed up by competing with distinction at the famous Rheims meeting of 1909, while in 1910 he won a prize of 10,000 dollars for a flight from Albany to New York, two places associated with the historic voyage of Fulton's steamboat *Clermont* a hundred and three years before.

Continuing his work, Curtiss in 1911 produced the first hydroplane, and by 1914 he had taken up the serious construction of aircraft and had built a multi-engined flying boat. The vast extension of flying during 1914–18 led to the execution of many orders for Great Britain, Russia, and the United States, and to-day the firm Curtiss founded is one of the largest organisations of its kind in the United States.

Curtiss also came into prominence through the Hammondsport trials of the Langley flying machine, which had been tried, but without success, in 1903. Langley died in 1906 but his machine was preserved at the Smithsonian Institution, of which he had been the secretary. Placed in the hands of Curtiss in the spring of 1914, the machine was modified to a certain extent, and on May 28, 1914, Curtiss flew it a short distance. Other trials followed with a Curtiss engine fitted to the machine. These events, together with the wording of the label of the machine as it stood in the museum, unfortunately led to a bitter controversy. Curtiss himself at the time was defendant in a lawsuit concerning the Wright patents, and it is generally agreed that the machine should never have left the museum. The action of the authorities of the Smithsonian Institution has often been criticised, but a short time ago the present secretary, Dr. C. G. Abbot, published a pamphlet in which an effort was made to do justice to all concerned.

News and Views.

THE economic difficulties which beset agriculture has focused public attention on the industry, and to judge by the many remedies which have been put forward, it would not be surprising if the general public and even the farmer himself concluded that science as applied to agriculture has failed in its efforts to improve the lot of the agricultural producer. It is fitting, therefore, that a considerable proportion of the programme of Section M (Agriculture) for the Bristol meeting of the British Association will be devoted to the discussion of two subjects, namely "Veterinary Science and Agriculture" and "Management of Grass Land", the economic importance of which it is not easy to exaggerate. The former is the subject of the presidential address, to be delivered by Dr. P. J. du Toit, who has given a new lead to veterinary thought, and by his work on the relationship of nutrition to the incidence of disease has opened up a field which may enable the sorely pressed farmer to minimise the enormous losses caused to his herds and flocks through the ravages of disease. A full morning session is to be devoted to the address and the subsequent discussion, and amongst those who will take part are Dr. W. H. Andrews, Major Walter Elliot, M.P., Sir Robert Greig, and Dr. J. B. Orr. To the discussion on grass land management, Mr. Jenkins of Aberystwyth will present the plant-breeders' viewpoint; Dr. Orr and Mr. Godden, of the Rowett Research Institute, the nutritional aspect; and Prof. Hanley of Newcastle will deal with the matter from the animal side. In accordance with the usual practice in the Section, an afternoon session will be devoted to a series of short communications outlining the scope and character of the agricultural work undertaken by the University of Bristol. In addition there will be several technical papers and Sir John Russell will open a discussion on the "Influence of Fertilisers on the Yield of Crops".

THE programme of the Ninth International Horticultural Congress, which is to be held in London at the invitation of the Royal Horticultural Society on Aug. 7–15, has now been issued to members. The main subject for discussion at the Congress will be "Propagation, Vegetative and Seminal", and papers on this subject will be given in the Greycoat Hall on Friday, Monday, and Wednesday, Aug. 8, 11, and 13; on intervening days the members of the Congress are offered the choice of a very interesting series of excursions, including visits to various private gardens, to the Royal Horticultural Society's Gardens at Wisley, to the various research stations of interest to horticulturists, and to many of the big commercial nurseries, plantations, etc. Papers for the Conference are so numerous that the executive committee has arranged for three meetings to proceed simultaneously on each of the days given to papers. The papers have therefore been grouped so far as possible under three heads: (1) Propagation, (2) pomology, and (3) tropical and sub-tropical horticulture. Under each section communications are offered by British, American, and European workers, and many topics of considerable scientific interest are represented on the programme.

IT is only possible here to indicate some of the main items for discussion at the Ninth International Horticultural Congress. Vegetative propagation from the point of view of plant anatomy will be discussed by Dr. van der Lek (Holland) and Prof. J. H. Priestley, whilst practical and experimental methods will be discussed by Dr. R. J. W. Graham and Mr. L. B. Stewart from Edinburgh and Miss Mary E. Reid and Dr. Zimmerman (U.S.A.). Mr. Niels Esbjerg (Denmark) will describe some of his experiments in inducing scion varieties to grow upon their own roots. The forcing of dormant buds will be discussed by Dr. Denny and Prof. Loomis (U.S.A.), whilst British workers will discuss polyploidy in connexion with graft hybrids, sterility and vegetative mutations in potatoes. The directors of the East Malling and Long Ashton Research Stations are to speak in the Pomological Section, where also Russian, Polish, Czecho-slovakian, and American contributions are promised. Italy, France, and Switzerland share an afternoon that will be given to the propagation of the vine and olive. British communications in the Tropical and Sub-Tropical Section will deal with horticultural work in the Dominions and Colonies, whilst America, Russia, and the Dutch East Indies will also contribute in this section. Dr. W. F. Bewley (Cheshunt) and Mr. G. Jacobsen (Norway), both interested in glasshouse propagation, will deal with the subject of the heating of soil in hot beds by electricity; this subject is, perhaps, appropriately placed under the 'tropical' section. Two papers on seeds will be taken in the last session of the Pomological Section, Prof. Work (U.S.A.) discussing scientific problems in connexion with vegetable seeds, and Prof. G. Tschermak-Seysenegg (Austria) discussing "Xenia in Leguminoseae".

THE serious floods that occurred in the neighbourhood of Whitby on July 22–23 last recall to some the disaster of ten years ago at Louth (Lincolnshire), when 22 persons lost their lives and damage estimated to exceed £100,000 was suffered by that town in a thunderstorm of exceptional severity on the afternoon of May 29, 1920. Meteorologically the two disasters were very unlike. In the Louth storm a belt of cold easterly winds over the North Sea opposed the advance of warm and moist southerly winds advancing across England. There was enough sunshine during the morning to raise the temperature of the southerly winds far enough to produce extreme instability, the easterly winds remaining cold owing to the low temperature of the waters of the North Sea, and the result was apparently an upward movement of the forward part of the warmer air stream and a thunderstorm which was estimated to have at one time a diameter of more than 60 miles. The storm lasted only a few hours, but during that time as much as 121 mm. of rain fell at one place near Louth, the final catastrophe

being apparently precipitated by the breaking down of a temporary dam formed of uprooted trees and other debris, which had held up a great volume of water on the outskirts of the town.

THE recent Whitby floods, on the other hand, were the result of prolonged rainfall of comparatively moderate intensity, due to an almost stationary depression off the east coast of England. Strong northerly winds prevailed throughout, and probably gave very much greater amounts of rain on the North Yorkshire moors than at coastal places of low elevation or inland stations referred to below lying to the west of the wettest region, which was probably the Cleveland Hills. The following totals refer to the period 17 h. or 18 h. G.M.T. on July 20 to 7 h. or 9 h. G.M.T. on July 23:

Scarborough	108 mm.	Ilkley	64 mm.
Bridlington	100 mm. (approx.)	Harrogate	57 mm.
Cleethorpes	65 mm.		

It is not clear from the accounts so far available of these floods to what extent floating wreckage may have assisted the river Esk to overflow its banks, but where rainfall representing the equivalent of about ten weeks of the normal precipitation is concentrated into such a short space of time, partial blockage of the normal drainage channels is to be expected. There is no evidence so far of there having been any particularly rapid rate of fall of rain at any one stage, and the amount measured in the night and early morning of July 22–23 just before the weather mended had been exceeded in a like period 48 hours earlier at all the stations mentioned above except Ilkley.

HAVING regard to the stringent financial conditions obtaining at present in Great Britain and their inevitable reflex upon employment, a welcome must be extended to any scheme which will, or even may, promote the utilisation of home products. It is opportune, therefore, to direct attention to the work of the National Benzole Association, the Research Committee of which has recently issued its seventh report. Despite the momentary restriction of work imposed by removal to convenient centralised premises, continued progress has been made in several directions: but the investigation of resin formation in benzoles and the thorough testing of the possibility of stabilising comparatively crude benzoles against resinification during storage and of afterwards utilising such benzoles satisfactorily as motor fuels, have been regarded as of primary importance. This problem of resinification, not being confined to benzole, has consequently interested workers in other fields. Thus, vapour phase cracked petrols contain appreciable amounts of unsaturated hydrocarbons and show a strong tendency to gum formation; moreover, on storage, they rapidly lose the appreciable anti-knock superiority which they possess over straight run petrols.

ALTHOUGH there are certain minor points of difference between the gumming of benzoles and of cracked petrols, in the main, similar conclusions are drawn in the two cases as to the mechanism of gum formation and the possibility of preventing deterioration of motor fuels containing unsaturated hydrocarbons, by the addition of small quantities of certain substances capable of inhibiting the oxidation and resinification of these bodies. More practically, extensive road trials have shown that comparatively crude benzoles, stabilised by the presence of 0·03 per cent of mixed cresols, are little if at all inferior to acid refined benzoles in their freedom from gumming in engines. The chapter is not yet completed, for the effects of the present inhibitor may be rendered void by the presence of small amounts of impurities, accidental or natural.

A SELECTION of the zoological and botanical specimens collected during Lord Howard de Walden's recent expedition to Uganda and the eastern Belgian Congo was exhibited at the meeting of the Trustees of the British Museum held at the Natural History Museum on July 26. The collection, which is the gift of Lord Howard de Walden to the National Collection, is one of the most important accessions received by the Museum of recent years. The expedition left Fort Portal for the Semliki Valley on Feb. 17 last. Collecting was carried out within twenty miles of Lake Albert, and afterwards in a south-westerly direction to the Semliki Valley, crossing over into the Congo on Mar. 7. The route then led up the western escarpment of the Semliki Valley to Mboga and then west into the Ituri Forest. On Mar. 29 the expedition divided, one party proceeding south to Beni, the other going west to the Ituri River. Both parties came out of the Congo via Irumu and crossed Lake Albert into Uganda on the homeward journey during May. Lord Howard de Walden, in addition to spending some time with the expedition in the forest area, made a special trip to the Birunga Mountains lying to the north-east of Lake Kivu, with the object of photographing the eastern gorilla (*Gorilla gorilla beringeri*) and its habitat. The personnel of the expedition to the Ituri and Semliki Valleys, in addition to Lord Howard de Walden and Dr. Avery, consisted of Mr. R. Akroyd, who as well as organising the expedition did valuable work as a collector of the larger mammals, Capt. F. A. B. Holloway, who concentrated chiefly on invertebrates, making a large collection of butterflies and other insects, and Mr. R. W. Hayman, a member of the Museum staff, who specialised on the medium-sized and small mammalia. Two white hunters accompanied the expedition as guides and supervisors of the 'safari'. The mammals collected number 427 specimens, including 67 monkeys, 110 bats, 71 carnivores, 23 ungulates, and 147 rodents. The reptiles and amphibians collected number 65 specimens representing 31 species in all. Many birds and a very considerable collection of invertebrates was also made.

THE complexity of the problem of the adaptation of varieties of farm crops and the value to the practical farmer of the results already obtained by the National Institute of Agricultural Botany were the theme of the address delivered by the chairman of the Institute, Sir Frederick Keeble, at the annual general meeting of the Institute held at Cambridge on

July 25. Choice of variety or strain, Sir Frederick said, is as potent a factor for improvement in the plant world as in the animal; and it has the merit of being the cheapest remedy for some at any rate of the ills of agriculture. The right sort of seed need cost the farmer no more money than the wrong, but there is generally a difference of ten per cent in the results and often very much more. The discovery of the best variety for each of the innumerable combinations of soil and climate which occur in the British Isles is the formidable task to which the Institute has set its hand, and a valuable nucleus of information has already been formed. The fact that in the famous wheat districts of Essex the best-paying varieties are grown on only forty per cent of the area is a measure of the need for extending the investigations and in particular the collection of records from farmers themselves. No more fruitful task, concluded Sir Frederick, could be undertaken by the Ministry of Agriculture than the provision of wide and effective publicity for the knowledge won by the National Institute of Agricultural Botany and kindred institutions. The Director of the Institute, Mr. Wilfred H. Parker, described the manifold ways in which the Institute has set about its work. Co-operation is the keynote of its success, and this is being given generously by universities, agricultural colleges, farm institutes, plant breeders, county agricultural organisers, research institutions, the National Farmers' Union, the National Association of British and Irish Millers, the Institute of Brewing, and numerous other bodies and individuals.

THREE interesting reports are included in the *Journal of the National Institute of Agricultural Botany*, vol. 2, No. 3, namely, those of the trials of spring-sown barleys, spring-sown oats, and maincrop potatoes. Each report marks the end of a series of trials continued over a number of years, and, as such, represents the considered conclusions of the Institute. The barley variety trials were carried out at six different centres, yield, quality of grain and malt, disease resistance, and differential response to intensive manuring being taken into account. Spratt-Archer and Plumage-Archer 1924 are definitely indicated as giving the highest average return per acre, the former variety being most suited to light and the latter to heavy soils. Of the different varieties of spring oats none showed any marked preference for light or heavy land, or, except as regards strength of straw, for land in high or low condition. In general, taking into consideration yield and both feeding and market value of the grain, farmers are advised to grow either Victory or Golden Rain, but if the soil is rich and lodging is likely to occur, Thousand Dollar is more suitable. Abundance is a further good variety, but this should not be grown on rich land. Oat trials were not carried out in the north of England, so that these recommendations should be applied with caution in that district. A large number of varieties of maincrop potatoes were tested at Ormskirk, Kirton, and Truro. Kerr's Pink, Arran Banner, and Majestic are decidedly the best croppers, although as regards earliness Ally has the advantage. All four varieties are, however, recommended. Golden Wonder and King Edward retain popularity on account of their quality, but their yield is inferior to that of the above-named varieties.

IN an authoritative article on "Unemployment" contributed to the July–September number of the *Political Quarterly*, Sir William Beveridge states that the continuance of unemployment does not invalidate the diagnosis of unemployment made by the Poor Law Commission of 1903–9 or the policies adopted in 1909, because these have not been carried through. Unemployment insurance, with all its devices for reducing claims to benefit, has been transformed into unemployment relief. The Labour Exchanges, after a hopeful start, were sunk in a flood of War tasks and post-War doles and they are only now reviving as employment agencies though their special and most needed services of de-casualisation have gone by the board. Sir William Beveridge points out that unemployment to-day contains two new features. A part of it is due to changes in industrial structure. Another part is almost certainly due to disequilibrium between wages and productivity, following the abnormal rise of real wages since the War. A further possibility is that of a permanent shift in the economic balance of the world, transferring industry from the coal of Great Britain to competitive sources of power elsewhere. Effective organisation of the labour market is even more needed to-day than it was twenty years ago. In so far as unemployment to-day is due to permanent changes of industrial structure involving changes of location, rather than to transient depression, it is more important than before to make labour mobile, locally and between industries.

IN a paper entitled "Economic Quality Control of Manufactured Product", presented before the American Association for the Advancement of Science last December, Mr. W. A. Shewhart advocates the use of modern statistical processes in practical manufacturing work, and particularly for judging whether variations in manufactured material are due to chance. The application of statistical methods in commerce and industry was discussed in a leading article in NATURE of Jan. 9, 1926, when it was pointed out that it would be unfortunate if those responsible in practical affairs failed to take advantage of the improved statistical machinery available. It is satisfactory to find that this statistical machinery has been used successfully in connexion with the work of the Bell Telephone System to show where the cost of inspection and of rejections can be reduced; there has also been a consequent improvement in the quality of the articles produced. The author does not describe in detail the statistical methods he used, possibly because he was afraid of lessening the appeal of his paper to practical men who might be confused by statistical technicalities. The paper has been reprinted in *The Bell System Technical Journal* for April 1930 and is well worth reading.

FEW people realise how flourishing the broadcasting industry is in the United States. Last year, more than a hundred million pounds was spent on

radio instruments. Eight years ago there were 60,000 receiving sets; to-day there are about ten million. In England, many who possess good radio sets scarcely ever use them and look forward with indifference to the coming of television. In the United States, however, there are many enthusiasts who are looking forward eagerly to improved methods of broadcasting the older arts and to the introduction of television. In *World-Radio* for July 25 there is an interesting account of the 'radio city' in New York, work on which will start this autumn. It will be built on Manhattan Island and will take all the space between 48th and 51st Streets and Fifth and Sixth Avenues. The estimated cost is fifty million pounds, and as it is intended to be as permanent as a cathedral, it will take three years to complete. Portions of 49th and 50th Streets will become tunnels. A sixty-story tower will rise above the main buildings to house the studios and office suites. This radio city will have four large theatres, the largest being capable of seating 7000 persons, a motion picture theatre with 5000 seats, an auditorium for comedy and another for drama, and probably a great concert hall. In addition, there will be a bank and shops with frontage on Fifth Avenue. A noteworthy feature is the faith which the supporters of the radio city have in the future of television. They believe that all the present experimental difficulties will be overcome in a few years and that sight and sound broadcasting will be transmitted to homes and hamlets all over the American continent and possibly all over the world.

ONE of the developments of British ornithology in recent years has been the identification of northern geographical races of birds, examples of which, captured in Britain, have shed fresh light upon migratory movements. Greater definiteness is likely to be added to knowledge of these movements by the institution of systematic marking of birds in Iceland, from which some useful records have already been obtained. In the July number of *Discovery*, P. Skovgaard, the Danish ornithologist, gives a first account of the recovery of 124 birds out of 4464 ringed. Of these, 86 were captured away from Iceland and 54 in Britain. One cannot help being struck by the great differences in the migratory habit of different birds revealed even by these limited results. Thirty-one widgeon were recovered and twenty-three golden plover, but whereas the former ranged over a wide area in its southern migration, from the eastern coast of North America to central Russia, the latter moved in a narrow path which probably brought every individual within the compass of the British Isles. The value of the results of the Icelandic work is the greater because some of them refer to birds the headquarters of which are confined to northern latitudes. Comments on Skovgaard's data are contributed by E. M. Nicholson.

INFORMATION has been received that the Quebec Public Service Commission has awarded to the Shawinigan Water and Power Company a "certificate of public necessity and convenience" authorising the commencement of operations in connexion with the development of hydro-electric power at Rapide Blanc on the Upper St. Maurice River, for the power rights of which and certain adjacent sites a seventy-five years' lease has just been entered into. The head of water to be developed at Rapide Blanc will be approximately 110 feet, and the primary installation will make provision for the generation of 160,000 horse power, at an estimated cost of about 18,000,000 dollars. The complete installation on this site will be approximately 240,000 horse power, at an estimated cost of 20,000,000 dollars. The Company is under obligation to commence constructional works forthwith and to develop at least 100,000 horse power by July 1933. As soon as 75 per cent of the primary power at Rapide Blanc becomes available, construction on the second site will be begun under similar conditions, as also will third and successive developments. In connexion with the above projects, including power transmission, as much as 94,000,000 dollars will probably be expended and the total power realised is expected to reach 1,208,000 horse power.

A SECOND bulletin on spectrum analysis has just been issued by Messrs. Adam Hilger, Ltd. It refers mainly to quantitative metallurgical analysis, and half of the pamphlet consists of a tabulated summary of recent work of this type, with references to original papers and a statement of the smallest amounts of the materials experimented on which were estimated in a given matrix. Limits of error are occasionally, but not often, given. The technique used in the several investigations is also outlined. Much of the work referred to has been carried out in Messrs. Hilger's laboratories and in other laboratories with which the firm is in touch, and details of some of this work have not yet been published. A bibliography of recent papers on spectrum analysis follows, including a brief summary of each paper mentioned. Special notes are given on the use of the spectrograph in the rapid assay of lead, copper, and zinc for compliance with certain British and American standard specifications with regard to purity. The pamphlet concludes with accounts of sundry metallurgical applications of spectrum analysis, and a note on physiological, pathological, toxicological, and pharmaceutical applications.

A CONSIDERABLE difference in price exists between the native pearl and the 'culture' pearl and yet so far as visual examination goes there is no distinction between them. The native pearl has originated from a haphazard intrusion of some irritant, while man has been responsible for its insertion in the other instance; in both the outer coat is produced by the mollusc in the same way. The disparity in value makes it desirable to have means of ascertaining the nature of the interior of the pearl. Recently Mr. Jacob Vos, the well-known Dutch jeweller, in conjunction with Philips Lamps, Limited, 145 Charing Cross Road, London, W.C.2, has devised an X-ray apparatus for testing pearls. It makes use of the fact discovered by Dr. von Laue that these short waves are interfered with by a crystalline structure, the

character of the resulting figure on a fluorescent screen or photographic plate being dependent upon the symmetry of the structure. In the present instance the genuine pearl shows a characteristic hexagonal figure entirely different from the figure yielded by a ' culture ' or imitation pearl.

THE fifth ordinary general meeting of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, was held on July 9. The Chairman, Sir Charles McLeod, reviewed the work of the year. Sir Ronald Ross, Sir William Simpson, Sir Aldo Castellani, and D. Shaw-Mackenzie have continued their researches, and a new department in charge of Sir Malcolm Watson has been created to deal with malaria and its problems. Short courses for planters on malaria control have been held and much propaganda work on this subject has been prosecuted. The Institute has no endowment fund except a few hundred pounds and is dependent for its income upon contributions from companies and donations and subscriptions, an increase in which is appealed for.

THE Frederick G. Donnan Fellowship in chemistry, tenable for three years at Johns Hopkins University, Baltimore, has been awarded to Mr. Alkin Lewis, of King's College, London.

DR. H. A. HARRIS, assistant professor of anatomy at University College, London, has been awarded the Alvarenga Prize for 1930 of the College of Physicians in Philadelphia for his researches on bone growth.

BY an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Sir Charles Sherrington, Waynflete professor of physiology in the University of Oxford, and Dr. J. A. Arkwright, honorary bacteriologist to the Lister Institute of Preventive Medicine, have been appointed members of the Medical Research Council in succession to Sir Frederick Hopkins and Sir Charles Martin, who retire in rotation on Sept. 30.

DR. H. R. LANG has been awarded the Institution of Petroleum Technologists fellowship for a further period of one year, to continue his researches on " The Determination of the Variation of the Specific Heat of Typical Crude Oil with Temperature etc ". This fellowship, of the annual value of £300, is granted for research work in technical and scientific problems which have a direct bearing on the petroleum industry, and applications for the 1931–32 award should be on a form which can be obtained from the Secretary of the Institution, and should be in his hands not later than June 1, 1931.

THE Trustees of the Beit Fellowships for Scientific Research founded and endowed in 1913 by Sir Otto Beit, Bart., have awarded fellowships, tenable at the Imperial College of Science and Technology, South Kensington, for the two years 1930–32 of the value of £250 a year, to the following: Mr. B. W. Bradford, Imperial College, for research upon the electrical condition of hot metallic surfaces when promoting the combustion of carbonic oxide; Dr. G. M. Richardson, for research into the further application of electrometric methods and theory to the study of problems of biological interest; Mr. G. H. Cheesman, for research on the electron distribution and structure of the halogen oxides.

ARRANGEMENTS are again being made this summer under the auspices of Prof. Patrick Geddes for a vacation tour of historical and archæological interest in the Dordogne. The tour will last from Sept. 12 until Sept. 25, of which period one week will be devoted to a stay at Domme for the study of the geography and objects of historical interest of the neighbourhood, and one week will be given to the prehistoric caves in the neighbourhood of Les Eyziès. A special study will be made of the everyday life of the Perigordian in relation to his geographic environment, under the guidance of M. Réclus, and at Les Eyziès M. Peyrony, by permission of the French Government, will act as guide. The cost of the tour will be £16 : 10s. Application for admission should be made to Miss Moya Jowitt, 33 Gordon Sq., W.C.1.

THE ' complete programme ' of the Anthropological Congress to be held in Portugal and summoned for September next by the Institut International d'Anthropologie of Paris, has now been circulated. The proceedings will be divided into four sections: morphological and functional anthropology with ethnology; palæontology with prehistoric archæology; eugenics and kindred subjects; ethnography, including linguistics, folklore, religion, and human geography. The contributions include 36 from Portugal, 11 from France, 8 from Poland, 6 from Spain, 4 from Holland, 3 from Switzerland, 2 from Russia, one each from Belgium, Finland, Canada, United States, and Brazil. Great Britain, Germany, Austria, Italy, and Scandinavian and south-east European countries are unrepresented.

A PRELIMINARY programme has been issued of the seventh annual conference of the Association of Special Libraries and Information Bureaux to be held at New College, Oxford, on Sept. 19–22, under the presidency of Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology. The programme includes general sessions to hear an account by Brig.-General Magnus Mowat of the year's work of the Association, and a paper by Herr A. Schlomann on the organisation of information in Germany. The sectional meetings will deal with the dissemination of information by exhibition and display (Sir Henry Lyons, Dr. F. A. Bather, and others), animal welfare and its dependence on accurate information (Capt. C. W. Hume), the inadequacy of the alphabetical subject index (Prof. A. F. C. Pollard, Dr. S. C. Bradford), surveys and planning (Mr. C. C. Fagg, Mr. G. L. Pepler, Mr. S. K. Ruck), training of students (Mr. G. F. O'Riordan, Mr. B. M. Headicar), technical English (Mr. C. C. Wharton).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A director of the Rural Industries Bureau—The Director, Rural Industries Bureau, 6 Bayley Street, W.C.1 (Aug. 8). A graduate master for electrical engineering at the

Sheerness Technical Institute and Junior Technical School—The Principal, Technical Institute, Sheerness (Aug. 11). A university lecturer in agricultural chemistry (soil science) at the School of Agriculture, Cambridge University—The Secretary, Appointments Committee, School of Agriculture, Cambridge (Aug. 11). A lecturer in mining electrical engineering in the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (Aug. 11). Two assistants in the art and industrial division of the National Museum, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Aug. 11). A lecturer and demonstrator in plant pathology at the Swanley Horticultural College—The Principal, Horticultural College, Swanley, Kent (Aug. 11). A professor of pure and applied mathematics at Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Aug. 15). A demonstrator in pathology and bacteriology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (Aug. 23). An assistant lecturer in pharmaceutical subjects at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Aug. 25). An assistant lecturer and demonstrator in physics at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 5). Investigators under the British Cotton Research Association for research work in, respectively, the study of air currents in machines and tubes used for transporting cotton and its separation from dust; the correlation between physical and mechanical properties of cotton cloth and its structure; the physical chemistry of cotton and rayon—Dr. E. H. Pickard, Shirley Institute, Manchester (Sept. 7). An engineer (ferrous metallurgist) under the Department of Mines, Ottawa, Canada — The Civil Service Commission, Ottawa, Canada (Sept. 15). A teacher of science and mechanical engineering at the Technical Institute, Ashford, Kent—The Principal, Technical Institute, Ashford, Kent. An assistant master for junior mathematics and science at the Stanley Junior Technical School, South Norwood Hill—The Headmaster, Stanley Junior Technical School, South Norwood Hill, S.E. A graduate assistant master for science and mathematics at the Tottenham Polytechnic Junior Technical School for Boys—The Principal, Tottenham Polytechnic, High Road, N.17. A Samson Gemmell professor of medical pædiatrics in the University of Glasgow—The Secretary of the University Court, The University, Glasgow. A junior male assistant under the Directorate of Ballistic Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A scientific assistant in the Coastguards and Fisheries Service of the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1.

Our Astronomical Column.

Periodic Changes of Colour on Jupiter.—Mr. A. Stanley Williams has observed Jupiter assiduously for a period of nearly forty years; in *Mon. Not. Roy. Ast. Soc.* for May, he discusses the question of periodic changes of colour in the case of the two equatorial belts, using observations from 1868 to the present time. He gives graphs which indicate clearly that there is a 12-year cycle in the colour changes. The maximum redness for the south belt occurred about 1873, 1884, 1897, 1912, 1926; that for the north belt about 1868, 1880, 1891, 1903, 1918, 1928. It appears, therefore, that the two hemispheres have maxima six years apart, indicating that the effect is of the nature of a seasonal one. He notes that the material is scanty in the years when Jupiter was far south of the equator; that is, about 1865, 1877, 1889, 1901, 1913, 1925.

Astronomy in South Africa.—The *Cape Times* of June 16 contains an article entitled "South Africa for Astronomers", by Dr. R. T. A. Innes, who recently retired from the directorship of the Union Observatory, Johannesburg. He traces the present astronomical development in that region to Sir David Gill's invitation to European astronomers to visit the Cape more than forty years ago. Prof. Kapteyn's visit there resulted in the formation of the Cape Photographic Durchmusterung; Prof. de Sitter began there the important work on Jupiter's satellites that he has lately brought to completion; he has also concluded an arrangement for Leyden astronomers to visit Johannesburg Observatory and vice versa. Three North American observatories have established branches in South Africa: Harvard has a branch at Bloemfontein; Yale has one at Johannesburg; and Dr. Abbot, of the Smithsonian Institution, has established a solar observatory at Bukkaros near Windhoek, being led to this by advice from Dr. Innes. Allusion is also made in the article to the proposed moving of the Radcliffe Observatory to South Africa. Dr. Steavenson has been testing the seeing at various sites during the present year, using a 6-inch equatorial that was originally constructed for the observation of the transits of Venus in 1874 and 1882. Dr. Innes notes that there are already more astronomers per thousand of the inhabitants in South Africa than in any other country; and the climate is so well suited for observation that "still further increase in their numbers is desirable".

Annual Report of the University Observatory, Cambridge. — The report indicates that work has continued on the same lines as in recent years. The Sheepshanks telescope is being used for determinations of stellar magnitude with a photo-electric cell. Mr. E. B. Moss has devised a new method of measuring the photo-electric current. Four more fields have been measured for the determination of the proper motions of faint stars. Dr. Knox-Shaw has taken colour-index plates at the Radcliffe Observatory, Oxford, to determine the colours of the stars of which proper motions have been found. These have been measured at Cambridge. Many theoretical investigations on variable stars, proper motions, etc., have been carried on by members of the staff and published in the *Monthly Notices* of the Royal Astronomical Society.

Research Items.

Metals and Cosmetics at Ur.—The authorities of the Museum of the University of Pennsylvania have called in the services of a scientific expert, Dr. A. Kenneth Graham, of the Towns Scientific School of the University, to examine and deal with the finds which have been received as their portion of the antiquities obtained by the expedition working at Ur. Notes on some of the technological and chemical results of Dr. Graham's work are published in the *Museums Journal* (Philadelphia) for Sept.–Dec. 1929. While the early bronzes are of a composition and quality that have never been surpassed, the silver and gold are not of a purity that modern methods permit. Their workmanship, especially of the silver objects, is such as to command admiration. Some of the objects, indeed, it would be an achievement for a modern silversmith to produce. One silver bowl, for example, was first cut from a sheet of silver alloy cast in convenient form. In hammering it into the finished shape, at least three to five annealings would be required. Microscopic examination of the silver objects shows that the structure is similar to that of a modern silver article—that of an annealed metal with numerous twinnings indicating previous working by casting and then alternately annealing and hammering. A chemical examination of the cosmetics used by Queen Shubad shows that both eyebrow and lip paint contained a large and dangerous quantity of lead. One sample of the light blue clay contains large quantities of aluminium, phosphate, copper, lead, and carbonate, with traces of iron, calcium, and silica. Probably it is powdered turquoise. A black powder similar to antimony or 'kohl' contains a large amount of manganese and lead with a small quantity of copper, aluminium, phosphate, carbonate, silica, and iron. The last six were evidently present as turquoise. The black colour was due to the manganese, the black oxide of which occurs naturally as pyrolusite. The lead and carbonate must have been added intentionally. The oxides of lead when mixed with the above minerals give shades of brown, red, and purple, and it is probable that in early times a greater variety of colours was preferred to the red and black of to-day.

Reptiles and Amphibians of the Malay Peninsula.—Since Dr. G. A. Boulenger published his account of this fauna in 1912, collections have been made, especially in the northern part of the Peninsula, which have added considerably to the old list. The additions include 1 species of turtle, 16 of lizards, 12 of snakes, and 18 of amphibians, and these, with a revision of the old names and identifications, Dr. Malcolm A. Smith publishes in a supplement to Boulenger's work (*Bull. Raffles Mus.*, Singapore, No. 3, 1930). The supplement is furnished with useful keys to the genera and species, and a new feature is a key to the characters of the tadpoles of the amphibia. Smith notes amongst the reptiles and amphibians a very marked discontinuous distribution, a number of species which are to be found in the northern part of the Peninsula and in the islands of the Malay Archipelago being absent from the southern portion of the Peninsula. A similar discontinuity has been observed in the distribution of certain mammals and birds, and the indication is that some very general but still undetermined influence must have been at work over the territory.

Luminosity in a Squid.—The small Japanese squid, *Watasenia scintillans*, is famous for the brilliance of its phosphorescence. This is due to three types of luminous organs, all of different construction, skin organs, eye organs, and tentacle organs, but all possessing certain granules which are situated in the luminous tissue. The rôle of the granules has given rise to differences of opinion. Shima considered them to be luminous symbiotic bacteria, Hayashi thinks they play an important part in luminescence, and now Teijiro Kishitani has re-examined the light organs of *Watasenia* particularly with the idea of deciding whether photo-bacteria are present or not (*Annot. Zool. Japon.*, vol. 11, p. 353, 1928; just received by NATURE). His attempts to isolate bacteria from the luminous organs on culture media failed, and smear preparations showed that the rod-like granules behaved differently from bacteria with various stains. Further, the rods were never seen in process of dividing and they broke into minute pieces under slight pressure applied to the cover-glass. The author concludes that the granules are not luminous symbiotic bacteria, of which he found no trace, but the question as to whether the spindle-shaped granules and rods function merely as reflectors, or may be crystals of luciferin (such as occur in the luminous organs of the fire-fly) and of importance in the production of light, remains unsettled.

Percoid and Related Fishes.—Under the title of "Notes on Percoid and Related Fishes", Mr. Henry W. Fowler (*Proc. Acad. Nat. Sci.*, Philadelphia, vol. 81, 1929) enumerates a large number of fishes contained in the general series of the Academy. Upwards of 2000 specimens belonging to nearly 300 species are recorded, and the new sub-genus Cheiroxenichtys is described to embrace *Xenichthys agassizii* Steindachner, being distinguished chiefly by its long pectoral fin, nearly as long as the head, and its uniform silvery coloration. These records, in several cases accompanied by descriptive notes, which are mostly from the American coasts and West Indies, are of value in extending our knowledge of the distribution of many rare fishes.

Wild Populations of *Plantago maritima*.—The analysis of the populations of a particular species occupying various natural habitats is a subject offering considerable scope for investigation. Dr. J. W. Gregor (*Jour. of Genetics*, vol. 22, No. 1) has made such a study of the plants of *Plantago maritima* from one small locality on the east coast of Scotland. This common coastal plant is found also in certain inland locations, especially on mountains. Mr. Gregor shows that, as regards one character, the individuals of the species range from decumbent to erect (5 types). The plants growing on an exposed rock just above high tide were more dwarfed and more decumbent than those growing on an adjacent grassy slope. Plants grown from seeds of the two populations under uniform culture conditions showed significant mean differences in such features as height and relative spread. The rock-population had a larger percentage of low-growing forms, but the grass-population contained no type which was not also present in the population from the rock habitat. The cultures indicated that the latter population had been more modified by its original environment than the former. They also showed a phenotypic parallelism between the modifying effect of the environment on wild populations and on the growth-forms present in the cultures. There was variation in succulence of the cultivated forms, and it was shown that, by watering plants with a 3·5 per cent solution of sodium chloride, the fleshy habit of the leaves could be induced.

Permian Flora of the Grand Canyon, Arizona.—Monograph 405 of the Carnegie Institution of Washington contains a complete and well-illustrated

account of an interesting Permian flora, found in the Hermit shale of the Grand Canyon, Arizona, and under investigation by the author, David White, since its first discovery in 1915 by Prof. Schuchert of Yale. This flora is interesting as the latest Palæozoic flora as yet known in America and particularly because, composed mainly of plant forms previously unknown, it presents a unique aggregate of western European elements with others which show definite points of contact with the Gondwana flora. In this flora the herbaceous plants, including the Pteridosperms on one hand and the shrubby or arborescent Gymnosperms on the other, are fairly well balanced; the author recognises no forms as ferns, as yet. The apparent absence of the Calamariales may be due to the arid conditions under which this flora developed. The most characteristic plants appear to be a group which the author regards as Pteridospermic, with affinities with the Gondwana plants, and to which he gives the name of *Supaia*; they are characterised by once bifurcated fronds, in which the strongly asymmetrical divisions, facing each other, *vis-à-vis*, are simply pinnate or pinnatifid. The Gymnosperms are strongly represented in this flora.

The Upper Atmosphere.—The *Journal* of the Royal Astronomical Society of Canada for April contains an article by Dr. W. E. Harper on the upper atmosphere. He recalls the evidence for rapid movements at a high level that was afforded by the eruption of Krakatoa in 1883: the dust of the explosion was projected to a great height, and carried rapidly round the whole earth, reaching higher latitudes in successive revolutions. He discusses the presence of ozone in the upper atmosphere, and its useful effect in absorbing the short ultra-violet rays from the sun; he notes that an excessive supply of these rays would be injurious both to animals and plants. The ozone layer is thickest in the spring, and then slowly and continuously diminishes to a minimum in winter.

Air as a Thermal Insulator.—The *Gesundheits-Ingenieur* has published at 5 marks a 26-page pamphlet by Drs. W. Mull and H. Reiter, "Der Warmeschutz von Luftschichten", which gives the results of their measurements of the thermal insulating properties of layers of air in buildings. For dwelling-houses they find that the best thickness of the air layer in a cavity wall is 5 cm. if it is limited to a single layer. Multiple layers give better insulation than a single layer of the same total thickness. The rate of transmission of heat through an air layer depends on the radiation constant of the surfaces bounding the layer, on the mean temperature of the air, on the difference of temperature of its surfaces, on its thickness, and in the case of a vertical layer on its height.

New Swedish Magnetic Observatory.—Capt. A. Reinius, Director of the Swedish Hydrographic Service, in 1927 obtained State sanction for the institution of a Swedish magnetic observatory, primarily as a base station for the magnetic survey, but also for purely scientific work. An account by G. Ljungdahl of its initiation, buildings, and equipment is included in the first publication of the observatory (*Ergebnisse der Beobachtungen des magnetischen Observatoriums zu Lovö, Stockholm*) together with the detailed data for the first year of working, 1928, edited by S. Aslund. On account of its high latitude (59°) the institution of this observatory is an important and valuable step, and its usefulness is the greater in that it publishes hourly values of the magnetic elements. It is situated 14 km. from Stockholm, on an island in the State forests; both the absolute and the variation instruments are above ground, the latter being in an unheated concrete chamber covered with a great thickness of earth, and shaded by trees; the change of temperature inside it, from day to day, does not exceed 0·2°. The instruments consist of a Carnegie Institution pattern of combined magnetometer and earth-inductor, for absolute measurements, and two sets of variometers, of normal and reduced sensitiveness; the *Z*-variometer is of the type invented by Dr. La Cour, and installed by him at Rude Skov and Godhavn (Greenland).

Light Scattering in Liquids.—A paper by R. M. Langer and W. F. Meggers in the May number of the U.S. Bureau of Standards *Journal of Research*, on the scattering of light by liquids, raises some important questions in connexion with the interpretation of Raman spectra. It is pointed out that the quantum theory of the change of wave-length in scattering does not necessarily require that the same characteristic frequencies of a substance should be effective both in scattering and in infra-red absorption, but that, on the contrary, data obtained by the two methods would rather tend to be complementary. In the earlier experimental work, much of the apparent agreement between the two sets of measurements was fairly obviously forced. These investigators, from their own measurements of the changes in frequency of light scattered by benzene, toluene, chloroform, and carbon tetrachloride, which appear to be as accurate as any yet made, conclude that the original idea of a direct correspondence between absorption spectra and shifts in scattered light is completely discredited, and that it is futile at present to attempt a complete interpretation of the modified lines scattered by liquids, or to draw any final conclusions as to molecular structure from them. Only the systematic accumulation of trustworthy data for scattering substances belonging to distinct chemical families, and especially the investigation of the simpler molecular structures, can be expected to give clues to the correct explanation of light scattering in transparent media.

Radio Beacons and Aircraft.—The U.S. Bureau of Standards and the Department of Commerce in the United States have developed a visual signal-indicating device to guide mail aeroplanes over the Appalachian Mountains. An aural beacon system is at present in use. Coded signals are picked up by the head telephones, but this is found to put a great strain on the pilot as he has to concentrate his thoughts when listening and must wear the telephones practically all the time. The new device consists of two vibrating white reeds. These will be placed on the instrument boards of the New York to Cleveland mail aeroplanes. The aviator can tell whether he is on the right path or not by watching the reeds. If the reed on the left vibrates most, he has turned off to the left of his course. Similarly, if the amplitude of the vibrations of the right hand reed is greater, he will know that he has veered off to the right. When both vibrate alike the aeroplane is on the right course. The searchlights which are installed at ten-mile intervals along the route will still be used. When the visibility is good the lights can be readily followed, but at present in fog, rain, or snow the ground and the searchlights are invisible and the pilot has to rely entirely on the aural signals. A recent test flight from Detroit to Washington was made almost entirely by beacon signals and not by maps. We understand from the *Daily Science News Bulletin* for May 9, issued by Science Service, Washington, D.C., that there is no prospect at present of attempting 'blind' landings. The path of the aeroplane with the help of the beacon

guide brings the pilot near enough to the landing field for him to see the ground lights and so make a descent by sight.

Valve-maintained Quartz Oscillators.—Radio engineers are looking forward to a much more extended use of quartz oscillators in the immediate future, not only for maintaining the frequency of the waves emitted from broadcasting stations constant, but also for making receiving sets very selective. In a paper read to the Institution of Electrical Engineers on Mar. 5, and recently published in the Institution's journal, J. E. P. Vigoureux, of the National Physical Laboratory, describes an investigation he has carried out for the Radio Research Board on valve-maintained quartz oscillators. The combination of a quartz resonator and a valve circuit is called a quartz oscillator. The frequency of the oscillator depends mainly upon the natural frequency of the quartz resonator, and when the temperature is constant they are both nearly constant. The former can be varied, however, by altering the air-gaps of the resonator, that is, the air-gaps between the quartz and the two electrodes of the resonator, or by varying the constants of the plate circuit or the interelectrode capacities and inductances. These variations have been studied both theoretically and experimentally. The theoretical treatment has been rendered possible by the experimental work of Dye, who has shown that the quartz oscillator can be replaced by an equivalent electrical circuit. The equivalent circuit consists of an inductance, a resistance and a capacity connected in series, the whole being shunted by a second capacity. Making this substitution, the problem reduces to one which can be solved by ordinary mathematical methods. Formulæ are deduced which give the conditions for the maintenance of oscillations. It is shown also how the amplitudes of the oscillations depend on the values of the component parts of the circuit.

Corrosion of Steel by Concrete.—Special Report No. 15 of the Building Research Department of the Department of Scientific and Industrial Research (H.M. Stationery Office, 6*d*. net) deals with the corrosion of steel by breeze and clinker in concrete. It is shown that coal residues are definitely undesirable ingredients in concrete which is to be placed in contact with steel, since they cause corrosion. In the interests of safety it would seem desirable to abandon altogether the use of breeze and clinker aggregates for concrete in contact with steel.

Abrasives.—Report No. 699 of the Department of Mines, Canada, deals with artificial abrasives and their manufacture, and abrasive products and their uses. Three parts previously published dealt with siliceous abrasives; corundum, emery, and diamond; and garnet, respectively. The manufacture of grinding wheels, sandpaper, steel wool, and other abrasives is described in detail, as well as their principal industrial applications. Although the report contains a very extensive bibliography, much of the information has not previously been published. Copies of any of the parts may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa, Canada.

Dipole Moments.—A monograph by J. W. Williams, entitled "Molekulare Dipolmomente und ihre Bedeutung für die chemische Forschung", being one of the parts of the "Fortschritte der Chemie, Physik und physikalischen Chemie" (Berlin: Gebrüder Borntraeger), gives a useful condensed account of a subject which is now attracting a good deal of attention, the fundamental theories and the experimental results being dealt with. Particular attention is directed to the determination of molecular structure from dipole moments. It may be noted that the structural formulæ which have been used by chemists for half a century appear in general to be confirmed by the new investigations. The relations of the results to those of other fields of investigation are briefly considered and, since the mathematical apparatus is reduced to a minimum, this clearly written monograph of sixty-five pages should prove of great interest and utility to chemists who have found the more ambitious treatises too abstruse for their requirements.

Thermal Expansion of Glass.—The March number of the *Journal of the Society of Glass Technology* contains two papers on the thermal expansion of glass, by Prof. Turner and F. Winks. It was found by Peters and Cragoe in 1920 that there is a range of temperature, called the critical or annealing range, over which the thermal expansion was several times as great as that in the range lying between the ordinary temperature and the lower critical temperature. The first paper summarises investigations made during the past five years. Reproducibility over the whole range of temperature up to the softening point was almost attained with a number of glasses. The influence of lack of homogeneity on reproducibility was found to be small. The effects of tension, composition, and heat treatment were investigated, and a general analysis of the thermal expansion curve is given. The critical point, when the rate of expansion alters abruptly, was not always found, and the normal expansion curve may undergo changes of direction at temperatures below the critical point. In a discussion on the nature of glass, it is suggested that a 'vitreous state' of matter, as well as liquid and solid, should be recognised. The second paper deals with the expansions of a series of sodium metasilicate-silica glasses. The results are discussed in detail.

Conductivity of Solid Salts.—In previous experiments on the effect of temperature on the electrical conductivity, k, of solid halides of sodium and potassium, T. E. Phipps and co-workers found that the curves of $\log k$ plotted against $1/T$ usually exhibited two distinct slopes, which were interpreted as follows. It is assumed that the conductivity of a solid is proportional to the numbers of ions in its lattice which have an energy greater than a certain threshold value, and the slope of the curve then measures the heat of liberation which the conducting ion or ions must acquire in order to participate in the conduction. In the April number of the *Journal of the American Chemical Society*, Ginnings and Phipps show that the curves for lithium halides are similar. The slopes found in the lower temperature range measure the heats of liberation of the metal ion in the lattice, and those at the higher temperatures the combined heats of liberation of metal and halogen ions. Transference experiments had shown that, in the case of sodium chloride, only the sodium ion takes part in the conduction process over the temperature range of the lower slope, while in the higher temperature range both ions contribute to the conduction. The melting-points of highly purified lithium halides were found to be: LiCl, 606°; LiBr, 551°; LiI, 467°. The heat of liberation of either alkali ion or halogen was smaller the lighter the alkali metal in a series with a common halogen. In a series with a common alkali metal, the heat of liberation of either ion is greater the lighter the halogen ion. A linear relation between the heat of liberation and the absolute melting-point is indicated.

Statistics of the Universities of Great Britain.*

WITH the current academic year has ended the five years for which the Parliamentary grant for universities and university colleges in Great Britain was fixed at its present figure, £1,550,000. Since 1919 the duty of advising the government of the day concerning the financial needs of these institutions has been discharged by the University Grants Committee, and this body has accordingly been engaged during the past twelve months in visiting them. In the light of the personal knowledge thus acquired and the various returns annually submitted to it, the Committee has prepared a review of the period 1923–24 to 1928–29 and a report on present needs and problems. These documents have now been published, together with the customary statistical tables for the year 1928–29.

The total number of full-time students of both sexes last year was 44,309. The total shown in the returns for 1923–24 is 43,025, but this includes 1742 students of a special type not represented in last year's total, namely, those aided to take university courses under the Government scheme for the higher education of ex-Service men. Deducting those, the increase in five years was 7 per cent. Taking men students alone the increase was 11 per cent, the number of women students showing a decrease from 12,962 to 12,899, or from 31·4 per cent of the total of both sexes to 29·1. Dissection of the total enrolment figures according to the various subject groups discloses a marked contrast between an upward trend of enrolment in the arts faculties, including theology, fine art, law, music, commerce, economics, and education, and a downward trend in medicine (including dentistry) and technology (including engineering, applied chemistry, mining, metallurgy, architecture, etc.), and comparative stagnation in pure science and agriculture (including forestry, horticulture and dairy work):

	1923–24.	1928–29.	
Arts . . .	18,981	23,625	+4644
Medicine . . .	10,997	8,387	−2610
,, women only .	2,020	1,108	− 912
Pure Science . .	7,402	7,377	− 25
Technology . .	4,709	4,082	− 627
Agriculture . .	856	838	− 18

The 'swing-over' from medicine and technology to arts was widespread but was most pronounced in Scotland, where the percentage of arts students rose from 44·2 to 59·3 (men 31·4 to 47·1; women 70·7 to 83·9), and there were corresponding declines in the proportions of students in other subject groups, and especially in medicine (men 38·1 to 29·3; women 17·9 to 7·4) and technology (men 17·8 to 10·5; women 0·5 to 0·4). It is accounted for thus: "The stationary position of the Pure Science group and the fall in the Technological group are no doubt due to the continued depression in many industries. The decreased number of students in the Medical group, which includes Dentistry as well as Medicine, seems to be the result of a reaction which followed the abnormally large entry of medical students just after the war." "The main reason for the growth in the Arts group is no doubt to be found in the attraction exercised, during a period of bad trade and restricted opportunities in other professions, by the securer and greatly improved prospects of the profession of teaching; in Scotland the general tendency has been intensified by the official requirement that only graduates can now normally be admitted to the Provincial Centres for training as men teachers."

Each of these factors is mentioned in an article in the April number of *The Universities Review* on overcrowding in the German universities. There, however, the students of the *technischenhochschulen*, corresponding more or less to the technological faculties of the universities of Great Britain, form nearly twice as large a proportion of the total number of university students as in Great Britain, and scientific education is very widespread. Whatever its causes, the falling off in the numbers of students in the scientific departments of British universities cannot but excite misgivings on the part of all who believe in the importance for our future welfare of "integrating into the intellectual structure of society", as J. B. S. Haldane puts it, "the scientific ideas which have furnished its material structure". In the part of the report relating to careers open to graduates (see below) the Committee indicates reasons for anticipating an increase in the enrolments in technology and pure science.

In the following tables universities are arranged in order of the numbers of their full-time students in 1928–29, first in all faculties and then (omitting many of the smaller enrolments) in the above-named subject groups severally. It will be seen that London heads the list in every case except arts and agriculture, in which, respectively, Oxford and Reading rank first, that Cambridge comes second in every case except medicine, and that Glasgow is third in every case except agriculture. The increase (+) or decrease (−), in comparison with the corresponding figure for 1923–24 is given in brackets:

All Faculties.

*London	9141	(+186)
Cambridge	5653	(+676)
†Glasgow	5329	(+562)
Oxford	4559	(+396)
Edinburgh	3616	(+ 47)
‡Wales	2664	(+ 1)
§Manchester	2314	(+ 52)
Liverpool	1560	(−239)
‖Durham	1431	(+ 70)
Leeds	1385	(− 90)
Birmingham	1362	(−143)
Aberdeen	1325	(−118)
¶Bristol	859	(− 88)
Sheffield	690	(− 7)
St. Andrews	677	(− 6)
Reading	615	(+ 37)

* 23 institutions: among them 2 medical schools, with enrolment 151, not represented in returns of 1923–24.

† Including Royal Technical College, Glasgow.

‡ University Colleges at Aberystwyth, Bangor, Cardiff, and Swansea.

§ Including Manchester College of Technology.

‖ Armstrong Coll., Newcastle-upon-Tyne, and Durham Colleges, including College of Medicine.

¶ Including Merchant Venturers' College.

Arts.

Oxford	3789	(+342)
Cambridge	3324	(+713)
Glasgow	3275	(+1340)
*London	3145	(+ 758)
Edinburgh	2017	(+ 412)
Wales	1730	(+ 190)
Manchester	918	(+ 214)
Aberdeen	820	(+ 13)
Durham	713	(+ 134)

* 8 institutions.

All other Faculties.

London	5996	(−572)
Cambridge	2329	(− 37)
Glasgow	2054	(−778)
Edinburgh	1599	(−365)
Manchester	1396	(−162)
Wales	934	(−189)
Liverpool	921	(−358)
Leeds	823	(−180)
Oxford	770	(+ 54)
Birmingham	729	(−233)
Durham	718	(− 64)

Medicine.

London	3373	(−611)
Edinburgh	1105	(−250)
Glasgow	886	(−419)
Manchester	412	(−165)
Cambridge	386	(− 13)
Liverpool	379	(−300)
Leeds	332	(− 52)

Pure Science.

London	1604	(+ 8)
Cambridge	1184	(+ 43)
Glasgow	588	(+125)
Wales	570	(−111)
Manchester	560	(+ 46)
Oxford	522	(+131)
Durham	297	(+ 67)
Leeds	277	(− 46)
Liverpool	275	(−111)
Birmingham	238	(− 72)
Edinburgh	220	(− 40)

Technology.

London	1019	(+ 31)
Cambridge	581	(+ 57)
Glasgow	554	(−469)
Manchester	424	(− 43)
Liverpool	267	(+ 53)
Birmingham	199	(− 48)
Leeds	173	(− 84)
Edinburgh	168	(− 46)
Sheffield	167	(− 1)

Agriculture.

Reading	181	(+ 46)
Cambridge	178	(− 44)
Edinburgh	106	(− 29)
Oxford	105	(− 22)
Wales	88	(+ 12)
Aberdeen	78	(+ 13)

* University Grants Committee. Report, including Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1928–29. Pp. 74. (London: H.M. Stationery Office, 1930.) 3s. 6d. net.

The number of full-time advanced students (as distinguished from those pursuing courses for first degrees or diplomas) shown in the returns for 1928–29 is 2082, including 374 women. The following table compares their distribution over the various subject groups with the distribution of the total number of full-time students :

	All Students.	Advanced.
Arts . . .	53·3 per cent.	39·1 per cent.
Medicine . .	18·9 ,,	4·8 ,,
Pure Science . .	16·7 ,,	42·6 ,,
Technology . .	9·2 ,,	11·4 ,,
Agriculture . .	1·9 ,,	2·1 ,,

Two-thirds of the total number of these advanced students were at work in London (696, including 246 at University College and 207 at Imperial College), Cambridge (378), Oxford (185), and Manchester (153). In the Scottish universities there were 182, and in the Welsh 97. Of the individual subjects by far the most popular among advanced students are chemistry (453) and physics (185).

The universities of Great Britain are drawing students from other countries in increasing numbers : so much so that more than half the total increase during the quinquennium in the number of full-time students is attributable to this source. Those from other parts of the British Empire numbered 2809 in 1928–29, being 14 per cent more than in 1923–24, whilst those from foreign countries numbered 1581, showing an increase of 26 per cent.

The financial resources of the universities of Great Britain are exhibited in the returns for 1928–29 in some detail. The incomes amounted in the aggregate to £5,174,510, and were derived from : (*a*) Parliamentary grants, 36 per cent ; (*b*) fees, 31 per cent ; (*c*) endowments, 14 per cent ; (*d*) grants from local authorities, 10 per cent ; and (*e*) other sources, 9 per cent. Capital benefactions received from other than Government sources in the course of the past five years amounted to more than £5,550,000, in which total are included gifts by corporations and individuals in the United States of America amounting to £1,700,000, nearly one-third of the total. Excluding these American contributions, the benefactions in five years amounted to less than one-sixth of the amount received as gifts and bequests in one year by universities and colleges in the United States, and about one-fourth of the amount received in one year by sixteen of the most favoured of them. The aggregate income is about half that of the universities and colleges of the State of New York. Sources of American university incomes are : (*a*) United States Government grants, 5 per cent ; (*b*) fees, 32 per cent ; (*c*) endowments, 16 per cent ; (*d*) grants from State or city governments, 26 per cent ; (*e*) other sources, 23 per cent.

Since figures for Oxford and Cambridge were not available at the beginning of the quinquennium on a sufficiently comparable basis to be included in the University Grants Committee's standard tables of financial statistics, the Committee's comparative statements of income and expenditure in 1923–24 and 1928–29 leave those two universities out of the reckoning. The comparison shows a growth of total income from £3,592,936 to £4,210,710, approximately 17 per cent. Rather more than half of the increase is under the head of Parliamentary grants. Income from endowment shows an increase of £72,822 (18 per cent), from donations and subscriptions £23,989 (26 per cent), from local education authorities' grants £92,926 (22 per cent), and from fees £44,267 (4 per cent). The proportion of Parliamentary grants to total income rose from 35·4 to 37·8 per cent, and that of fees to total income fell from 33·7 to 29·8 per cent. The only institutions deriving more than half of their income from Parliamentary grants are three of the London colleges, two Welsh colleges and Reading. Oxford and Cambridge get, respectively, 30 and 25·6 per cent of their incomes from this source. The Committee concludes an examination of the question of the increasing dependence of universities on State aid with the observation that the large increase in the grants given by the State five years ago has served to stimulate rather than to discourage the generosity of the other bodies and individuals to whom the universities have to look for support.

That dependence is about to be further increased by the raising of the amount of the annual Treasury subvention from £1,550,000 to £1,800,000. The report stresses, in this connexion, the fundamental importance of the teaching staff and the library and expresses the hope that one of the first uses to which the universities will put any increase they may obtain in their annual incomes will be to improve the lot of teachers of the senior lecturer class, many of whom find themselves in a serious plight. In discussing the position and prospects of the junior staff, the Committee directs attention to the barriers which stand in the way of their obtaining posts in secondary schools. These barriers have arisen through the operation of the new salary scales for teachers in schools and, in Scotland, the requirement that, whatever their previous experience, all applicants for such posts must have had a course of professional training for school work. This is, the Committee thinks, unfortunate, as the universities and schools both stand to gain by such exchanges.

In the part of the report relating to the careers open to graduates we find : "The need for a much more extensive application of scientific research to industrial practice is becoming more clearly realised every day, and the scientific departments of the universities are the obvious training grounds for men and women qualified either to undertake work on the fundamental problems, which are the field of the Industrial Research Associations established with State assistance, or to devote themselves, in the service of individual firms, to the improvement of particular industrial processes. . . . Some years ago it was common knowledge that the 'market' for chemists was seriously overstocked, and that many men with first-rate qualifications in Pure Chemistry were unable to obtain suitable employment, but we gather that the market has of late greatly improved, under the enlightened influence of the great combine over which Lord Melchett presides, and that though the output of students trained in Pure Chemistry continues to be, perhaps disproportionately, large, it is now being successfully absorbed. . . . There is evidence of an increasing range of demand for men who have had a good training in Physics, Geology, Biology, and such applications of Chemistry as Chemical Engineering or Fuel Technology."

The demand for university graduates is, moreover, we are told, extending rapidly to the administrative side of industry and of business generally. While it has hitherto been rare in Great Britain, though common in Germany, to give to men of high technical qualifications a place on the directorate of an industrial firm, many of the large industrial organisations are coming to look more and more to the universities for men of good general education and balanced character for the responsible administrative work which the vast range of their operations now involves, and even the smaller concerns seem more willing than they were to have recourse to the same recruiting ground.

The Italian Earthquake of July 23.

SINCE Jan. 13, 1915, when Avezzano and other towns in central Italy were ruined, there has been no earthquake in the peninsula so destructive as that which visited the provinces of the Basilicata and Campania shortly after 1 A.M. (0 A.M. Greenwich mean time) on July 23. The latest estimate of the number of persons killed is 1883, while the buildings of 34 communes are said to have been seriously damaged. The epicentre, which seems to be close to the town of Lacedonia, lies about 65 miles slightly north of east from Naples.

The area of slight damage, as at present known, is bounded by a curve that is roughly in the form of an ellipse directed west-north-west, 39 miles long, 16 miles wide, and containing about 490 square miles. The places that have suffered most are Villanova, Aquilonia, and Lacedonia, lying within a district about 19 miles long and 90 square miles in area, in the north-west half of the former curve, and Melfi and the surrounding towns near its south-east end. The principal centre apparently lies midway between Villanova and Lacedonia, but there may have been a secondary centre close to Melfi about 20 miles to the east-south-east. The shock was strong enough to damage a few houses in Naples and to have been felt in the province of the Marches, and even so far as Rome, so that the total area disturbed may contain about 95,000 square miles, or roughly that of the Hereford earthquake of 1896. The first movements were recorded at Kew at 0 h. 12 m. 11 s. and at Helwan (Egypt) at 0 h. 12 m. 42 s.

The province of the Basilicata is one of the most unstable regions in Italy. The great Neapolitan earthquake of Dec. 16, 1857, so admirably investigated by Robert Mallet, disturbed chiefly the southern part of the province. Mallet, from observations on the direction of the shock, placed the epicentre near the village of Caggiano, which lies about 34 miles to the south of that of the recent earthquake, but the principal centre was probably near Montemurro, 24 miles south-east of Caggiano. More closely connected with the recent earthquake are the Avellino earthquake of Sept. 8, 1694, and the Melfi earthquake of Aug. 14, 1851, described by Dr. Mario Baratta in his valuable work "I terremoti d' Italia" (pp. 173-181, 407-410; 1901). In 1694, the number of persons killed was 3571. The area of destruction was of unusual size, extending about 50 miles north-west from Potenza. In 1851, 628 persons lost their lives, and the meizoseismal area was small, not more than 11 miles in length, with its centre close to Melfi. The area strongly shaken by the recent earthquake thus includes that of the Melfi earthquake and lies along the northern boundary of that of the earthquake of 1694. C. DAVISON.

The Skull of Peking Man.

DR. DAVIDSON BLACK'S interim report on the skull of *Sinanthropus* found at Chou Kou Tien at the end of last year was presented at a session of the annual meeting of the Geological Society of China held on Mar. 29 last, and has now been published in the *Bulletin* of the Society. It is illustrated by six plates which reproduce the natural size of the photographs of the frontal, right and left laterals, occipital, vertical and basal views of the skull.

The whole external surface has now been freed from travertine, with which, however, the interior is still filled. During the preparation of the skull, the major parts of parietals and the whole of the frontal bone were separated from the stone filling; but these were replaced for the purpose of the photographs, which show the parts in approximately correct relation. A table of measurements is given which supplements and corrects those of the previous report, but they are themselves only approximate and subject to correction.

The skull, doubtfully identified as female, has a glabello-occipital length of 192 mm. and a breadth of 132 mm. (?), the maximum breadth which falls between the supra-mastoid regions of the temporal bones being *circa* 144 mm. The least frontal breadth is 83 mm. (?) and the greatest frontal breadth 102 mm. (?). The auricular height is 97 mm. (?) The parietal eminences are quite well developed; but the sides of the cranial vault below them are markedly inclined toward one another. The bones are much thicker in certain regions than was supposed (for example, below the lambda). They do not show the excessive thickness of the Piltdown skull, but they are much thicker than in modern man.

One of the most, if not the most interesting point brought out by Dr. Black in this interim report is the bearing of certain unique morphological features which were not apparent at the earlier stages of preparation. It is now clear that what was previously considered to be a markedly developed post-glenoid process is seen to be a very peculiarly developed tympanic portion of the temporal. In the massive parts of the tympanic elements, the posterior moiety is developed to form a prominent crest which extends inward to the base of the minute styloid process, while the anterior portion of the tympanic bone forms a massive rounded wall limiting the mandibular fossa and rising abruptly immediately behind the petro-tympanic fissure. The glenoid cavities are thus obliquely placed deep fossæ, the visible floors of which are formed wholly from the zygomatic elements of the temporal bones. The mandibular fossæ are thus wholly hominid in character.

It is, however, extremely interesting to note that for the first time among hominids is found a stage of development much more archaic than in Neanderthal man and at the same time in certain features recalling some of the relations characterising this region in anthropoids, such, for example, as the chimpanzee. Dr. Black recalls that both Boule and Martin in reference to the La Chapelle and La Quina skulls respectively have pointed to certain resemblances to the chimpanzee in that region, placing them somewhat intermediately in type between that form and *Homo*. The Peking skull in this respect may be termed pre-Neanderthaloid, and in the hominid scale may be not far removed from the type which evolved both the extinct Neanderthal and the modern *Homo sapiens*.

University and Educational Intelligence.

LEEDS.—The Council of the University of Leeds has elected Dr. F. Challenger to the chair of organic chemistry shortly to be vacated by Prof. C. K. Ingold. Dr. Challenger, who is at present senior lecturer in chemistry at the University of Manchester, is a graduate of London and Göttingen. Throughout his career he has been actively engaged on research work; amongst the subjects to which he has given attention are the organo-derivatives of bismuth, the organic chemistry of sulphur and the technology of mineral oils, the production of acids such as citric and oxalic by biological processes, and the chemistry of petroleum.

MANCHESTER.—Applications are invited for the Amy Henrietta Worswick fellowship for the investigation of the causes and treatment of rheumatoid

arthritis. The annual value of the fellowship is £150. The tenure will be for one year with the possible renewal for a second year. Applications must reach the registrar by, at latest, Oct. 15.

In schools in the United States of America are enrolled more than half of the total population of ages 15, 16, 17, and 18 years. Twenty-five years ago the proportion was only one-tenth. Some account of this remarkable growth is given, with voluminous statistics of public high schools in 1927–28, in *Bulletin*, 1929, No. 35, of the United States Office of Education. The rapid addition of large groups of pupils of types very different from those with which the traditional high school had been accustomed to deal necessitated radical changes, including an expansion of curricula from a strictly limited group of subjects (English, Latin, Greek, French, German, algebra, geometry, physics, chemistry, and general history) to very varied assortments of some two hundred and fifty subjects, of which many are definitely vocational and industrial in character. Other notable changes accompanied the 'junior high school' movement, started about the beginning of the present century. This has led to reorganisations, affecting nearly half of the total public high school enrolment, the main features of which are the differential treatment of the age group 16, 17, and 18 years (senior high school) and the absorption in junior high schools or departments of pupils of the higher grades (ages 13-14 years) of the primary schools. The place of sciences in the high schools seems to be a diminishing one, except as regards biology, hygiene, and sanitation. In 1910, eighty-two per cent of pupils were studying some science, in 1915 sixty-four per cent, in 1928 sixty-one per cent. The drop in numbers studying physics, from fifteen to seven per cent, is specially noticeable. Physical geography and physiology also show important decreases, and geology has almost disappeared from the high school programmes.

From the University of Leeds we have received two reports on its Clothworkers' Departments. They are of more than ordinary interest by reason of the highly important developments of research resulting from a special grant of £3000 by the Clothworkers' Company. A report on these developments describes in some detail researches conducted (i) under the direction of Mr. J. B. Speakman in the plasticity of wool, influence of plastic flow on the affinity of wool for water (already reported in NATURE of Sept. 14, 1929), rigidity of wool and its change with adsorption of water vapour, elastic properties of wool in water at high temperatures, examination of the fine structure of wool by X-ray analysis, thermal conductivity of and transmission of water vapour through textiles, and physico-chemical properties of wool fat; (ii) under Mr. W. T. Astbury's direction, some applying new X-ray methods of investigation inaugurated by Sir William Bragg to the problems of fibres in general and of wool and hair in particular, and others aiming at the solution of definite technological problems relating to the uniformity of yarns, the significance of fibre lengths, etc. In the Department of Colour-Chemistry and Dyeing, the progressive decline which has characterised enrolments of the past decade was followed last year by a considerable increase and the demand by industry for graduate students trained in the Department exceeded the supply available. Huddersfield Technical College also reports heavy enrolments in its dyeing department and an important growth of research work in all its departments, especially in colour chemistry and chemistry, and almost complete success by its appointment department in placing students in suitable positions.

Historic Natural Events.

Aug. 3, 1879. Hailstorm near London.—Over an area seven miles long and two miles broad, between Kingston and Ealing, violent hail fell. The stones were up to six inches in circumference, broke all glass exposed to them, pierced holes in zinc and slate roofs, and knocked out of shape the anemometer cups at Kew Observatory. The thunder and lightning were continuous from 9 P.M. to 3 A.M.; at Cambridge at 3 A.M. there were 120 flashes per minute.

Aug. 3, 1883. Cloudburst on Ochil Hills.—During the afternoon a violent storm burst on the Ochil Hills between Dollar and Alva. A flood of water poured down a deep narrow valley into Alva, the main street becoming deeply flooded in three minutes. Bags of flour and casks of butter were floated a distance of 100 yards from a baker's shop.

Aug. 4, 1577. Damage by Lightning in Suffolk.—On Sunday, Aug. 4, between 9 and 10 A.M., the parish church of Blythburgh, in Suffolk, was struck by lightning, which burst through the wall, struck almost a yard deep into the ground, and knocked down about twenty people who were on that side of the church. It then broke the door and badly damaged the steeple, breaking the timber and the bells. The people that were stricken down were found still grovelling more than half an hour afterwards, and two were dead. About the same time the parish church of Bungay, nine miles from Norwich, was also struck, the wire and wheels of the clock being broken and two men in the belfry killed, while in the church itself men were killed or burned.

Aug. 4, 1666. Hurricane at Guadeloupe.—A hurricane began at 6 P.M. and continued for twenty-four hours. Every vessel and boat on the coast of Guadeloupe was dashed to pieces, all the vessels in the Saints were driven on shore, and of Lord Willoughby's fleet of 17 sail with 2000 troops, only two were ever heard of afterwards. Houses and trees were blown down and a great number of cattle killed. The sea rose to an unusual height and flooded the land.

Aug. 4, 1829. Moray Floods.—Heavy rain began to fall on the evening of Aug. 2 in the upper parts of the valleys of the rivers Nairn, Findhorn and Spey, and continued almost without interruption until the morning of Aug. 4. It came mainly with a north-east wind, with such volume and force that it penetrated all the doors and windows facing in that direction. No rain-gauges were in operation in the area of heaviest fall, but it is not unlikely that the amount which fell on Aug. 3 exceeded any falls which have been actually recorded in the British Isles. The Findhorn at its greatest height filled the valley, 200 yards wide, to a depth of 17 feet above the normal surface of the river, this level being marked by a tablet.

Aug. 5, 1783. Great Eruption of the Asama-yama (Japan).—The Asama-yama, one of the principal Japanese volcanoes, lies 90 miles north-west of Tokyo and rises to a height of 8136 feet above the sea. The great eruption of 1783 began on May 9 and lasted 88 days, culminating on Aug. 5, when a huge mass of molten lava and hot mud descended from the crater and covered an area 2 miles from the crater and 4 miles wide at the base to a mean depth of 100 feet. This lava did not reach the villages and caused no loss of life or property. It was followed, however, by a great avalanche of volcanic materials that swept down, at first with a velocity of more than 50 miles an hour, and caused enormous damage in all the villages along the northern base of the mountain. The river Azuma-gawa was blocked for a time, but the gathering waters broke through the dam and

swept away houses along a course of more than 50 miles. The number of lives lost by the avalanche and flood was 1162. The district covered by the ashes was about 4250 square miles and the total volume about one-sixth of a cubic mile.

Aug. 7-14, 1899. West Indian Hurricane.—A hurricane of exceptional violence struck the West Indies near Guadeloupe, crossed the Leeward and Virgin Islands, Porto Rico, and the Bahamas, and continued along the east coast of the United States. There was great destruction of life and property, especially in the island of Porto Rico, where more than 3000 lives were lost, mainly by drowning, and many more died afterwards from starvation. The coffee crop, worth more than £1,400,000, was almost completely destroyed. The storm was traced from America across the Atlantic into the Mediterranean, where it finally dissipated.

Aug. 8, 1924. Transport of Insects.—The Oxford University Expedition to Spitsbergen recorded that after several days of south-westerly winds, on the morning of Aug. 8, living hover-flies and aphides were observed in considerable numbers, crawling on the ice of the glaciers. These were collected and were afterwards shown to have been carried from the forest belt of northern Europe, a distance of at least 800 miles.

Aug. 9, 1911. Heat in London.—The summer of 1911 was noted for its great heat in England. On Aug. 9 the thermometer in the Glaisher stand at Greenwich registered exactly 100° F., the highest authentic shade temperature in Great Britain. The maximum was not momentary, but was maintained almost continuously from 3 to 3.30 P.M.

Societies and Academies.

PARIS.

Academy of Sciences, June 2.—**Mesnager**: The optical determination of internal strains in solids of three dimensions. Remarks on a communication by Henry Favre on the same subject.—**H. Deslandres**: Properties of the series and abnormal lines in atomic spectra.—**L. Blaringhem**: The heredity of sex in *Aquilegia vulgaris*.—**Louis Lapicque** was elected a member of the Section of Rural Economy in the place of the late L. Lindet.—**Gaston Julia**: Some harmonic majorants.—**Georges Bouligand**; Poles, essential singularities.—**Victor Vâlcovici**: A mixed problem.—**T. Bonneson**: Inequalities between arithmetical means.—**Léonidas Kantorovitch**: Functions of the (U) type.—**Luigi Fantappié**: The singularities of a linear analytic functional of a function of several variables.—**J. Haag**: The theory of the spiral.—**Jean Chazy**: The velocity of propagation of attraction.—**N. Stoyko**: The orbit of the trans-Neptunian star discovered at the Lowell Observatory.—**J. Le Roux**: The interpretation of Michelson's experiment.—**Edgar Baticle**: The problem of the wall supporting a mass of powder.—**Mlle. Simone Boudin**: Coloured crystalline stratifications. Study of *p*-toluidine, *β*-naphthylamine and diphenylamine. A modification of the technique proposed by René Marcelin for the study of the development of the elementary leaflet of *p*-toluidine, with application to other substances.—**R. Forrer**: A method of discussion of the magnetic moments of alloys, and the common measure of atomic moments.—**A. Dauvillier**: The realisation of integral microradiography. The radiography of microscopic objects has offered great experimental difficulties. The author uses plates similar to those devised by Lippmann for interferential photography, prepared with colloidal silver according to the technique described by Watteville. A reproduction of a radiograph, with a magnification of 600, is given.—**Mme. Pierre Curie** and **Mme. S. Cotelle**: The average life of ionium. The method used, based on the rate of formation of radium in a mixture of ionium and thorium oxides, assumes only a knowledge of the atomic weights of ionium, thorium, and of the ionium-thorium mixture utilised in the experiments. The value obtained, 119,000 years, is intermediate between that of Soddy (110,000 years) and that of St. Meyer (130,000 years).—**F. Joliot** and **Mme. Irène Curie**: The radiations associated with the emission of the *α*-rays of polonium.—**G. Reboul** and **G. Déchène**: The activation of matter by the brush discharge. The brush discharge, produced by e.m.f. of 20,000-100,000 volts, activates metallic plates, communicating an activity measurable by an electrometer, and persisting for up to 72 hours. The curve corresponds to the superposition of three superposed exponentials of periods of 3 minutes, 27 minutes, and 20 minutes. The residual activity has a period of 10·6 hours. From these measurements the activity produced would appear to be due to the disintegration of the emanations of radium and thorium.—**Louis D'Or**: The manometric and spectrographic study of the thermal dissociation of pyrites, FeS_2. The thermochemical equation of the decomposition is $2FeS_2 = 2FeS + S_2 - 61{,}000$ cal. The energy of fixing the first atom of sulphur is 90,500 cal., whilst that of the second is 82,500 cal.—**M. Bourguel** and **P. Daure**: Chemical constitution and the Raman effect: the acetylene linkage.—**Ch. Jovignot**: Method and testing apparatus giving the extension coefficient and the breaking load of metallurgical products in thin sheets.—**G. Dupont, J. Lévy**, and **J. Allard**: The mechanism of the action of catalysts in the autoxidation of abietic acid.—**Georges Darzens**: The transformation by isomerisation of benzylvalerolactone into tetrahydromethylnaphthalene carboxylic acid. This transformation is effected by heating to 120°-125° C. with 64·5 per cent sulphuric acid with constant agitation for eight days. The reaction is very slow, but, allowing for recovered lactone, quantitative.—**Félix François**: The action of selenoxanthydrol on *β*-diketones and on ethyl acetoacetate.—**Mlle. Marie Thérese François**: The neutralisation of castor oil. A suggestion for the use of commercial triethanolamine for the removal of acid from castor oils used for lubricating purposes.—**Paul Combes** and **Roger Campredon**: The study of a new deposit of calcite exposed during the excavations for the new entrance to the port of Saint-Nazaire.—**Jacques de Lapparent**: The amount of titanium in bauxites.—**L. Dollé**: The *marcas* of the high plateau of Artois.—**A. Guilliermond**: Homo- and heterothallism in the yeasts.—**André Dauphin**: The histological characters of roots developed separately.—**Philippe Fabre**: An electrical hæmodromograph.—**Gordon H. Scott**: The arrangement of the mineral constituents of the nucleus during mitosis.—**I. I. Nitzescu** and **I. D. Georgescu**: The amount of citric acid in some animal fluids (cephalo-rachidian fluid, aqueous humour, follicular liquid, amniotic fluid).

BRUSSELS.

Royal Academy of Belgium, Nov. 9.—**G. Cesàro**: Cells with minimum surface. A mathematical discussion on the form of cell made by the bee.—**Th. de Donder**: Affinity. (Part 2.) Discussion of open systems with osmotic pressure, surface tension, and adsorption.—**G. Balasse** and **Mlle. G. Galet**: Iodine spectra with weak excitation. The tubes giving the spectra were without electrodes and the oscillating current, of 70 metres wave-length, was maintained by two triode emission valves. Details are given of

the method of purifying the iodine. All probable impurities were sought for spectroscopically and proved absent.—F. Corin: Contribution to the study of the chloritoides. An application of the methods of Fedorow to the study of these minerals.—Marcel V. L. Homès: Observations on the structure and cell division of living *Halopteris filicina*.—Lucien Godeaux: (1) The Lie quadrics of certain surfaces. —(2) The Guichard transformation and certain quadrics considered by M. Demoulin. —(3) The united points of the cyclic involutions belonging to an algebraic surface.—Yvonne Désirant: Ethyldifluoracetoacetate. Full details are given of the preparation, physical properties, and chemical reactions of the ester. The enol-ketone equilibrium was studied. —Raymond Defay: The thermodynamical study of surface tension. Affinity and adsorption velocity.

Dec. 7.—Paul Stroobant: Observations of the partial eclipse of the sun of Nov. 1, 1929. An account of results obtained at the Royal Observatory of Belgium (Uccle) and at the Astronomical Institute of the University of Brussels.—Jean P. Bosquet: Contribution to the invariantive theory of the calculus of variations.—J. Jaumotte: The movement of masses of air in the atmosphere.—L. and M. Lapicque and Henri Fredericq: Nerve and muscle chronaxies of the heart of *Limulus polyphemus*.—Radu Badesco: A functional equation.—Maurice Lecat: The application of azeotropism to functional chemical analysis. On the basis of extensive experimental work on the constant boiling mixtures formed by various classes of organic compounds, the author has devised a scheme for determining the class of an unknown organic compound from its azeotropic characters.—R. H. J. Germay: The application of a method of successive approximations to the solution of the Gauss equation $\sin(z-q)=m\sin^4 z$.

Jan. 4.—Th. de Donder: The photonic field.—G. Cesàro: The ellipse circumscribed round a triangle and having for its centre the centre of the inscribed circle.—J. E. Verschaffelt: Determinations of surface tension by measuring the force required to remove a flat disc.—H. Buttgenbach: The optical appearances of the cleavage plates of rhodonite.—J. Melon: The orientation of the optical ellipsoid of rhodonite.—Raymond Defay: The chemical kinetics of Th. de Donder and stable and metastable equilibria.—Jacques van Mieghem: Study of retarded potentials. —G. van Lerberghe: The calculation of the fugacities of a solution.—Th. Lepage: A characteristic property of the equations of the extremals of multiple integrals.

Feb. 1.—F. Corin: Contribution to the petrographical study of the lodes of the Bastogne region.—M. Kraitchik: The statistical study of prime numbers. —Raymond Defay: (1) The thermodynamical study of surface tension. Affinity and adsorption velocity. —(2) The chemical kinetics of Th. de Donder and stable and metastable equilibria.—M. Cosijns and R. Moens: A precision wavemeter. Details of a wavemeter capable of rapidly measuring frequencies between 3×10^4 and 3×10^8 with an accuracy of 0·001 per cent in absolute value.—J. Jaumotte: A movement quasi-equivalent to the movement of the atmosphere.

CRACOW.

Polish Academy of Science and Letters, Jan. 13.—F. Leja: The linear transformations of double and multiple series.—Mlle. A. Dorabialska: The heat yield of some radioactive minerals. Results of measurements with an adiabatic microcalorimeter of the heat in calories per hour per gram of uraninite, johannite, thorianite, Arendal orangite, thorite and monazite. Three minerals, orangite, thorite, and monazite, give a calorific effect much greater than that calculated from their chemical composition: this requires theoretical and experimental explanation.—K. Dziewoński and J. Reiss: The oxidation of acetylacenaphthene.—F. Górski: Increase of accuracy in the method of counting the bubbles in photosynthetic researches.—E. Godlewski, jr., and Mlle. I. Latinik: The ontogenetic and regenerative growth of *Axolotl*.—A. J. Klisiecki: The movement and pressure of the blood in the arteries.

Feb. 10.—The Starunia rhinoceros. (1) J. Nowak and E. Panow: Geological characters. (2) J. Tokarski: The mineralogical characters of the diluvial mud. (3) W. Szafer: Character of the flora. (4) J. Stach: Description and reconstruction of the rhinoceros.—T. Mazewski: Some points of the theory of length.—E. S. Pearson and J. Neyman: The problem of two samples.—C. Zakrzewski and T. Nayder: The refraction of electric waves ($\lambda=12$ cm.) in some electrolytes. No difference could be found between the index of refraction of water and those of the solutions of electrolytes used. The value found, 8·8, was identical within the limits of experimental error with the index found with long waves.—M. Lancucki: Sorption and chemical reactions in the atomic radius. —Mlle. M. Moraczewska: New absorption bands of selenium vapour in the extreme ultra-violet.—M. Centnerszwer and W. Wittandt: The velocity of solution of aluminium in alkaline solutions.—K. Dziewoński: The syntheses of ketones, derivatives of 1-benzylnaphthalene.—M. Ksiażkiewicz: Geological researches in the Wadowice Carpathians. Stratigraphic and tectonic relations.—J. Talko-Hryncewicz: A contribution to the craniology of the present population and of past races of central Asia.—J. Lenartowicz: Researches on experimental syphilis.

VIENNA.

Academy of Sciences, May 2.—W. Knapp: The action of *o*-phthalylchloride on thio-phenol-methyl-ether.—R. Fischer: Testing with blood-gelatin for saponin in plants.—M. Beier: Zoological expedition to the Ionian Islands and the Peloponnesus (12). The ants of the Ionian Islands by B. Finzi.—M. Radakovic: Studies on the Raman effect (8). Calculation of simple molecular models. A system of particles bound together by elastic forces and an attempt to calculate the oscillations in a simple case.—H. Winter: The pole of inertia and its application in the graphic dynamics of plane gears.—E. A. W. Schmidt and G. Stetter: Ionisation of single α- and H-rays at the end of their range.—E. A. W. Schmidt and G. Stetter: Researches on α-reflection and disintegration effects with light elements.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (9). The Raman spectrum of organic substances. Molecules of different patterns were considered, $X-CH_3$ and $X-CH_2-X$, as systems of so many points and so many degrees of freedom, with an internal oscillation of the H atom and an external oscillation of the X with regard to the methyl group. As special examples $ClCH_3$, Cl_2CH_2, Cl_3CH gave useful results.—R. Springer and H. Roth: A sort of turbulence-friction in binary mixtures of liquids.—R. Kremann, B. Korth, and E. I. Schwarz: Electrolysis of molten silver-lead alloys. With high current density a limiting value to the concentration of silver round the cathode was observed.—R. Kremann and E. I. Schwarz: The electrolysis of bronzes with added silver. Silver and copper concentrate at the cathode. The percentage enrichment of silver is less with increasing concentrations of silver.—R. Kremann, F. Bauer, A. Vogrin, and H. Scheibel: The change in direction of migration of alkali and other metals during the electrolysis of their

amalgams in relation to the concentration. There is a transformation point above which Na, K, and Ba concentrate at the cathode; Bi even from the lowest percentages moves towards the anode. Apparently the polarity of the components of the alloy determines the direction of migration.—**R. Kremann** and **W. Piwetz**: Electrolysis of bronzes with added lead. Copper migrates to the cathode, lead to the anode. For high current density the enrichment of lead is greater in the alloys that are poorer in lead.—**F. Hölzl** and **K. Rokitansky**: The mobilities of some ions containing iron (2). The influence of radicle substitution on the mobility of complex iron-ions. Comparisons were made between $Fe(CN)_6$, $Fe(CN)_5CO$, $Fe(CN)_5NO_2$, and other groups. From conductivity measurements were calculated the radii corresponding to the apparent ionic volumes. The substitution of CO for one CN made little difference. By contrast $Fe_4(NO)_7S_3$ has a very small mobility.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 3, Mar. 15).—**Albert F. Blakeslee** and **Ralph E. Cleland**: Circle formation in *Datura* and *Œnothera*. The view is adopted that segmental interchange is a possible basis of circle formation of the chromosomes of these genera.—**Ralph E. Cleland** and **Albert F. Blakeslee**: Interaction between complexes as evidence for segmental interchange in *Œnothera*. The segmental interchange hypothesis leads to useful predictions of chromosome configuration in certain complex-combinations.—**J. T. Buchholz** and **A. F. Blakeslee**: Pollen-tube growth of the primary mutant of *Datura*, rolled, and its two secondaries.—**R. B. Lindsay** and **R. J. Seeger**: Operational calculus in quantum mechanics. Some critical comments and the solution of special problems.—**H. Bateman**: Physical problems with discontinuous initial conditions.—**F. Zwicky**: On the possible influence of the mosaic structure of crystals on the determination of Avogadro's number. There is a discrepancy between the wave-length of X-rays as determined by the method of reflection from a ruled grating and by reflection from a crystal of known structure, the latter of which involves use of the density and Avogadro's number. The conception of mosaic structure leads to a correction to this method, bringing the two results into better agreement.—**Everett S. Wallis**: The problem of preparing optically active free radicals.—**Raymond F. Blount**: The implantation of additional hypophyseal rudiments in urodele embryos. Where buccal endoderm only was transplanted, the results were negative. When grafts including ectoderm and underlying neural tube were used, pigmentation was increased and body length was decreased while certain parts showed disproportionate growth and there was early sexual maturity.—**Andrew Watson Sellards**: The cultivation of treponemata from the blood of normal monkeys (*Macacus rhesus*) and from the blood of monkeys infected with yellow fever. Repeated innoculations with culture from yellow fever animals caused death, but the liver lesions were not always those occurring in yellow fever. Thorough immunisation with culture of treponemata from yellow fever sources produced partial to complete protection against yellow fever virus.—**Marston Morse**: The problems of Lagrange and Mayer under general end conditions.—**R. L. Wilder**: Concerning perfect continuous curves.—**M. H. A. Newman**: Combinatory topology of convex regions.—**Tibor Radó**: Some remarks on the problem of Plateau.—**Eldred Currier**: The problem of the calculus of variations in m-space with end-points variable on two manifolds.—**Willem J. Luyten**: (1) On some statistical properties of double stars in space. (1) A formula for the estimation of the period in a relatively fixed system. The formula allows of the calculation of the period of a binary system from the angular separation, the parallax and the luminosity, the chance being 2 out of 3 that the actual period is between 0·4 and 2·5 times the computed value.—(2) On the mean period of double stars in space. Computed values agree well with those known and the equation is applied to all double stars nearer than 10 parsecs. The general conclusion is that the median-mean period is about 300 years and half of the binaries in space probably have periods between 20 and 4000 years.

Official Publications Received.

BRITISH.

Interim Report (March 1930) of the Furunculosis Committee appointed July 1929 by the Rt. Hon. William Adamson and the Rt. Hon. Noel Buxton. Pp. 65+10 plates. (Edinburgh and London: H.M. Stationery Office.) 3*s.* 6*d.* net.

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 2, Part 2. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. 61-128. (London: G. Bell and Sons, Ltd.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1307 (Ae. 447): On the Effect of Altitude upon the Distance required for an Aircraft to take off and climb 20 Metres, giving Generalised Curves of Weight Reduction necessary if a given Aircraft is to comply with the Requirements of A.P. 1208 under adverse Atmospheric Conditions. By K. T. Spencer. (T. 2894.) Pp. 7+5 plates. 6*d.* net. No. 1309 (Ae. 449): Stresses in Wing Structures—Accelerometer and Incidence Measurements in various Manœuvres. By S. Scott-Hall. (T. 2723.) Pp. 6+6 plates. 9*d.* net. No. 1287 (M. 67): Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition (Continued). By S. L. Archbutt and Dr. J. W. Jenkin. (A. 61.) Pp. 16+3 plates. 1*s.* net. No. 1288 (Ae. 437): The Accelerations of a Fairey "Flycatcher" Seaplane during Aerobatic Manœuvres. By L. P. Coombes and A. S. Crouch. (S. 72, revd.) Pp. 4+6 plates. 6*d.* net. No. 1296 (Ae. 430): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 1: Supermarine S.5 Models. By W. L. Cowley and Dr. R. Warden. (T. 2550.) Pp. 62+45 plates. 4*s.* net. No. 1297 (Ae. 431): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 2: Tests on the Gloster IV. Models. By W. L. Cowley and Dr. R. Warden. (T. 2550a.) Pp. 48+49 plates. 3*s.* 6*d.* net. No. 1298 (Ae. 432): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 3: Tests on the Crusader Models. By W. L. Cowley and Dr. R. Warden. (T. 2550b.) Pp. 35+26 plates. 2*s.* 6*d.* net. No. 1299 (Ae. 433): Tests on Quarter Scale Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 4: Comparison with Full Scale and Conclusions. By W. L. Cowley and Dr. R. Warden. (T. 2550c.) Pp. 32+13 plates. 1*s.* 9*d.* net. (London: H.M. Stationery Office.)

The Organization of Mosquito Control Work. By John F. Marshall. Pp. 10+8 plates. (Hayling Island: British Mosquito Control Institute.) 9*d.*

FOREIGN.

Ministry of Agriculture. A Brief Account of the Research Work of the Sections of the Ministry at Giza: Drawn up on the Occasion of the visit of H.M. King Fouad I. to these Sections (April 27, 1929). Pp. 15. (Cairo: Government Publications Office.)

Bulletin of the Imperial Earthquake Investigation Committee. Vol. 11, No. 4: Re-Survey of the Kwantô District after the Great Earthquake of 1923. By Rikuti Sokuryobu. Pp. 6+80+7 plates. (Tokyo.)

Proceedings of the Imperial Academy. Vol. 6, No. 5, May. Pp. xv-xviii+187-215. (Tokyo.)

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 3, No. 4: Announcements of Courses, 1930-31. Pp. 123. (Houghton, Mich.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 21. (New York City.)

Bulletin of the Geological Institution of the University of Upsala. Vol. 22. Pp. iii+308+4 plates. (Upsala: Almquist and Wiksells Boktryckeri A.-B.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 3, May. Pp. 175-280. (Tokyo and Kyoto: Maruzen Co. Ltd.) 1.50 yen.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 246-253: On the Physiological Rôle of Carotin and Allied Substances, by Kozo Kawakami and Ryang-ha Kimm; The Determination of the Helium Content of some Japanese Minerals, 2, by Jirô Sasaki; The Chemical Nature of Cypridina Luciferin, by Sakyo Kanda; The Band Spectra of OsO_4 in Gaseous State and in Solution, by Sechi Kato; An Attempt to prepare Higher Unsaturated Alcohols from certain Drying Oils, by Sin'iti Kawai; 4'-Iodo-biphenyl-4-isocyanate as a Reagent for Alcohols, 1: Corresponding Urethanes derived from Fatty Unsaturated Alcohols, by Sin'iti Kawai; 4'-Iodo-biphenyl-4-isocyanate as a Reagent for Alcohols, 2: Corresponding Urethanes derived from C_1-C_{18} Normal, Saturated, Primary Alcohols, by Sin'iti Kawai and Kunisaburo Tamura; Study on the Corona Discharge at Large Gap Lengths in Air (Abridgment), by Takeshi Nishi and Yoshitane Ishiguro. Pp. 231-282. (Tôkyô: Iwanami Shoten.) 80 sen.

Bulletin météorologique de l'Observatoire météorologique de Beograd. 1: Observations diurnes en Serbie, juillet-décembre 1905, et résumés annuels 1905. Publié sous la direction de P. Vujević. Pp. 43. (Beograd.)

CATALOGUES.

B.D.H. Medical Products. Pp. 68. (London: The British Drug Houses, Ltd.)

Wild-Barfield Air Tempering Ovens with Forced Air Circulation. (Section B.) Pp. 8. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue of Important Works on Mammals, Birds, Insects, Shells, etc., Geology, Fossil Plants, Botany and Horticulture. (No. 13.) Pp. 20. (London: John H. Knowles.)

The Nickel Bulletin. Vol. 3, No. 7, July. Pp. 209-240. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

SATURDAY, AUGUST 2, TO *TUESDAY*, AUGUST 12.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section).—Summer Meeting in the Ruhr area and Switzerland.

CONGRESSES.

AUGUST 3 TO 9.

INTERNATIONAL CONGRESS FOR SEX RESEARCH (at House of British Medical Association).

Monday, Aug. 4.—Prof. F. A. E. Crew: Puberty and Maturity (Address). Papers relating to Puberty and Maturity.

Tuesday, Aug. 5.—Papers on the Biology of Testicular and Ovarian Function.

Wednesday, Aug. 6.—Papers on Hormone Therapy.

Thursday, Aug. 7.—Discussion on Psychology and Biology.

Friday, Aug. 8.—Papers on the Biological and Therapeutical Aspects of the Control of Human Fertility.

Among the papers to be communicated to the Sectional Meetings are The Aschheim-Zondek Test for Pregnancy (Prof. Aschheim); The Corpus Luteum Hormone (Dr. Clauberg); Biological Tests of the Female Hormone (Menformone) (Assistants from Prof. Laqueur's Institute); The Channels and Significance of Excretion of the Female Sex Hormone (Prof. R. T. Frank); The Male Sex Hormone (Prof. S. Loewe); Evidence for the Metabolic Basis of Sexuality (Dr. O. Riddle); Human Hybrids (Prof. C. G. Seligman).

AUGUST 4 TO 9.

INTERNATIONAL CONGRESS OF EXPERIMENTAL CYTOLOGY (in conjunction with the Anatomical Congress) (at Amsterdam).

AUGUST 4 TO 9.

INTERNATIONAL VETERINARY CONGRESS (in Central Hall, Westminster).—Discussions on Foot-and-Mouth Disease, Tuberculosis, Infectious Abortion, The Relationship of the Veterinary Surgeon to Animal Husbandry, Veterinary Science in Relation to Public Health, and The Law Governing the Practice of Veterinary Medicine and Surgery. Sectional Meetings on Variola in Domestic Animals, The Use of Drugs in the Treatment of Diseases caused by Worms, Theileriases, Fowl Typhoid and Bacillary White Diarrhœa, Anthrax, Swine Fever, Milk Fever, Fowl-pox, Genetics, Rabies, Standardisation of Biological Products, Acute Infectious Mastitis, Control of Trypanosomiases, Deficiency Diseases, Black-leg, Scientific Feeding of Animals, Distemper, Bovine Sterility, Rinderpest, Treatment of Parasitic Diseases, Diseases of the New-born, and Fowl Plague.

AUGUST 5 TO 7.

IMPERIAL HORTICULTURAL CONFERENCE (to discuss the best methods of approach to horticultural problems and the technique involved) (at Royal Society of Arts).

Tuesday, Aug. 5, at 10 A.M.—Sir Robert Greig: Bureaux and their Work. The Director and Chief Officer of the Bureau: Discussion of the Work of the Imperial Bureau of Fruit Production and Future Lines of Development. This will be prefaced by a précis of the work already done.

At 11.30 A.M.—F. L. McDougall: Possible Development of Fruit Growing in the Empire from an Economic Point of View.

At 12.15.—J. L. Brown: The Evolution of the New Zealand Fruit Board.

Experiences of Horticultural Research—

At 2.30.—Dr. W. T. Macoun: In Canada:—(*a*) Centralised.

E. F. Palmer: (*b*) At an Unattached Station.

At 3.10.—Prof. A. C. D. Rivett: In Australia.

At 3.30.—Dr. B. Hahne: Horticultural Research in the Union of South Africa.

At 3.40.—W. G. Freeman: Tropical and Sub-tropical Fruit Industry. Difficulties Encountered and Lines of Attack.

At 4.15.—Sir Frederick Keeble: An Industrial Research Station.

Wednesday, Aug. 6, at 10 A.M.—Sir Daniel Hall: The Directions in which Experimentation is likely to be Valuable in Horticulture.

Field Experiments:—

At 10.45 A.M.—T. N. Hoblyn: The Adaptation of Modern Statistical Methods to Horticultural Conditions.

At 11.30 A.M.—Prof. E. E. Cheesman: Practicability of the Application of Statistical Method in the Case of Tropical and Sub-tropical and other Crops.

At 12.15.—F. J. Martin: Field Experiments in certain Tropical and Sub-tropical Crops in West Africa.

Application of Pure Sciences to Horticultural Problems under—Temperate Conditions:—

At 2.30.—Prof. B. T. P. Barker: Fruit Products and Associated Problems.

At 3.—Prof. V. H. Blackman: Some Physiological Considerations in Horticulture.

Tropical and Sub-tropical Conditions:—

At 3.30.—Dr. E. J. Maskell and Dr. T. G. Mason: Physiological Work in the Tropics. Some of the Problems with special reference to Cocoa, and some Possible Lines of Attack.

Soil and Climate Survey as a Basis for Fruit Research:—

At 4.—T. Wallace: Soil and Climate Survey as a Basis for Fruit Research.

T. Rigg: Soil Type and Manuring in Relation to Yield and Quality of Nelson Apples.

A. J. Prescott: Soil and Survey Work as a Basis for Fruit Production in Irrigated Areas.

At 4.30.—H. V. Taylor: Meteorology and Fruit Production: The British Scheme of Research.

Thursday, Aug. 7.—Progress of Fruit Storage Methods:—

At 9.30 A.M.—Dr. F. Kidd: A Survey of the Principal Fruit Storage and Transport Problems of the Empire to-day.

At 9.50 A.M.—T. Wallace: Factors influencing Storage Qualities of Fruits.

At 10.10 A.M.—Dr. A. J. Smith: Problems of Biological Engineering in the Cold Storage of Fruit.

At 10.30 A.M.—Dr. A. Horne: The Infection and Invasion of the Apple Fruit by Fungi in Relation to the Problem of Storage.

At 10.50 A.M.—Dr. D. Haynes: Chemical Change in Stored Apples: The Relation of the Time of Picking to the Chemical Composition and Storage-life of the Apple.

At 11.10 A.M.—Dr. L. P. McGuire and Dr. C. W. Wardlaw: Investigations of the Storage Behaviour of Bananas at the Low Temperature Station of the Imperial College of Tropical Agriculture, Trinidad.

At 11.30 A.M.—W. T. Hunter: Recent Progress in the Study of Johnathan Breakdown in U.S.A. and Canada.

At 11.50 A.M.—R. G. Tomkins: Biological Effects of Atmospheric Humidity.

At 12.10.—Meirion Thomas: Biochemical Study of Functional Diseases in Fruits.

Dr. B. T. Dickson and W. M. Carne: The Present Position of the Bitter Pit Problem in Australia.

R. Wheeler: Fruit Transport Problems in Canada.

E. A. Griffiths: Problems of Storage and Transport.

Prof. J. Young: Citrus Storage Investigations in Australia.

At 12.30.—F. A. Stockdale: Sources and Training of Future Horticultural Research Workers.

AUGUST 7 TO 15.

INTERNATIONAL HORTICULTURAL CONGRESS (in London).—*Papers to be read on Aug.* 8, 11, *and* 13:—

Prof. Priestley: Vegetative Reproduction from the Standpoint of Plant Anatomy.

Dr. Van der Lek: Anatomical Structure of Woody Plants in Relation to Vegetative Propagation.

Dr. R. Salaman: Vegetative Mutations.

Prof. E. Baur: Production of Mutations by External Stimulus.

Dr. F. E. Denny: The Excitation of Dormant Buds under External Influence.

John Innes Horticultural Institution: Graft Hybrids.

John Innes Horticultural Institution: Vegetative Production of Polyploids.

John Innes Horticultural Institution: Sterility.

G. E. Yerkes: Raising Root Stocks from Seed.

Dr. C. G. Dahl: Root Stocks from Seeds of known Parents.

Dr. R. J. D. Graham and L. B. Stewart: Special Methods of Practical Utility in the Vegetative Propagation of Plants.

Miss Mary E. Reid: The Influence of the Nutrient Conditions of Seeds and Cuttings upon the Development of Roots.

Prof. P. W. Zimmerman: Factors influencing Root Growth of Cuttings.

Dr. A. B. Stout: The Inter-relations between Vegetative Propagation and Seed Reproduction.

N. Esbjerg: Varieties grown on own Roots.

Prof. N. I. Vavilov: The Wild Progenitors of Fruit Trees in Turkestan and in the Caucasus.

R. G. Hatton: The Development of a Research Programme around the 'Build Up' of a Fruit Plant.

Dr. H. Faes: Vine Propagation.

L. Ravaz: The Influence of American Stock on French Vines.

W. G. Freeman: Vegetative Propagation of Cacao and the West Indies Citrus.

Prof. T. Tanaka and Y. Tanaka: Propagation of Citrus Fruits in Japan.

Prof. H. J. Webber: Studies on Rootstock Reactions in Citrus.

Dr. F. F. Halma: The Propagation of Citrus by Cuttings.

Dr. H. P. Traub: The Ripening Process in Fruits, with special reference to the Fig and the Grapefruit.

Prof. B. T. P. Barker: The Fruit Tree Complex in Relation to Environment: Some current Investigations at Long Ashton.

Prof. N. E. Hansen: Fruit Stocks where Mercury Freezes.

Prof. E. C. Auchter: American Experiments in Propagating Deciduous Fruit Trees by Stem and Root Cuttings.

W. T. Macoun: National Tastes in Apples.

Dr. L. Filewicz: The Frost Injuries of Fruit Trees in Poland in 1928-29, with special reference to the Influence of the Stock and Scion upon the Resistance of the Apple-trees against the Frost.

Dr. P. J. S. Cramer: Rubber Budding.

W. A. Orton: Propagation in Tropical Countries.

Prof. P. Work: Some Scientific Problems in connexion with Vegetable Seeds.

Eng. G. Jacobsen: Electric Heating of Soil in Hotbeds and Hothouses.

Prof. B. Fedtschenko: The Horticultural Work of Russian Botanical Gardens.

Prof. C. Regel: The Botanical Garden of the Present Day.

H. J. Rumsey: Horticultural Progress in Australia.