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The Royal Commission on the Civil Service.

THE announcement by the late Government of its intention, if returned to power, to set up a Royal Commission on the Civil Service was received by us with satisfaction, which was heightened when Mr. Churchill afterwards informed the House of Commons that "the object of the Royal Commission is, not to shelve, but to undertake a dispassionate and informed examination of the Civil Service from the point of view of its efficiency as a national instrument and of its own well-being". These spacious phrases seemed to be indicative of a change of attitude towards the administrative machinery of the State and to offer a possibility of an ordered approach to the problem of efficient public administration, the solution of which is as vital to the well-being of the community as that of the parallel problem which British industry under the stress of adversity has at long last begun to face.

With the change of Government some uncertainty existed until early in July, when the Prime Minister indicated the intention of the present Government to set up a Royal Commission with terms of reference "so framed as to bring all matters of general importance affecting the Civil Service within the scope of the inquiry". The actual terms of reference have now been announced as follows :

(1) The structure and organisation of the Civil Service, including methods of recruitment.

(2) Conditions of service in the Civil Service with reference to—

(*a*) The general standard of remuneration of civil servants and the existing differentiation between the rates and scales of remuneration payable respectively to men and women civil servants ;

(*b*) Machinery for the discussion and settlement of questions relating to conditions of service ; and

(*c*) The position of ex-Service civil servants in unestablished employment.

(3) Conditions of retirement from the Civil Service, including the retirement of women civil servants on marriage.

With these terms of reference we have no fault to find, for they permit of a thorough scrutiny of the present system, as well as an examination of the numerous grievances alleged by the civil servants' organisations, with which the existing Whitley machinery has apparently been unable to cope. The Commissioners are also to report upon

two questions of social policy affecting the employment of women by the State which have been the subject of prolonged controversy, and in favour of one of which, namely, equal pay for men and women engaged on similar duties, the House of Commons has already committed itself on two occasions.

When, however, we turn to the list of the members of the Commission, our emotion can mildly be described as one of bewildered amazement. Of sixteen members, including the chairman, who is an eminent lawyer, not one is a scientific man, not one is engaged in the application of science to the needs of the community, and not one is in the public mind as having devoted consideration to the problems of public administration. Instead, we find that no fewer than seven are or have been connected with the administration of education, and six are Members of Parliament, mainly not with wide administrative experience. Apologists have stated that the aim of the Government has been to select persons who have not revealed any prejudices on the matters referred to the Commission, but in an age when progress is so completely dependent on scientific knowledge and methods it is almost incredible that absence of opinion flowing from lack of either experience or study of a subject is to be deemed a primary qualification for service on a public inquiry of this importance.

If the problems facing the Commissioners were purely economic, if they were required to confine themselves merely to matters chiefly of domestic interest to civil servants, such a Commission would doubtless have proved adequate though uninspired. But something more is involved than the emancipation of women or the contentment of the Civil Service with their conditions of employment. Great Britain has been for a long period in the throes of an industrial crisis which, if prolonged indefinitely, must have a profound effect on the standard of living of every member of the community. Whatever may be the causes of the present industrial situation, it is certain that no remedy can be found other than by the fullest application of scientific methods and discoveries to the problems of industrial production. This process of industrial recovery can be assisted and stimulated by the State by the impetus it can give to pure research, by the policy it pursues in those spheres where public intervention is regarded as appropriate, and by the co-ordination of national effort and the development of national resources that it alone is in a position to undertake. With these duties confronting them, a peculiar responsibility must fall upon the permanent civil servants who act as the advisers of Ministers.

With this increasing dependence of industry upon Governmental action, and the growing intervention of the State in the social life of the people, it has become imperative that the Civil Service should be critically examined as regards both structure and personnel from the point of view of the demands that are now being made and will in future be made upon it. We hold that the public departments will never achieve their maximum efficiency or be in a position to make their proper contribution to the solution of present-day industrial difficulties unless a greater effective share in administration is accorded to the scientific and technical expert.

We have repeatedly referred to the inadequacy of the status and consequently of the salaries of the scientific and technical experts employed in Government departments. In the departments where professional knowledge and training are essential, the professional officer is in almost every instance definitely subordinated to administrators whose education, however rigorous as an intellectual discipline, has little regard to the place of science in the modern community. So strong is the monastic tradition of culture that in the competition for administrative posts in the Civil Service the dice have been deliberately loaded in favour of those who have specialised in the humanities rather than in pure science. Coupled with this limitation of the field from which the administrative element is drawn has been the practical debarment of professional and scientific Civil Servants from promotion to posts of administrative rank. It is officially stated that in fact no bar exists, but apart from the Department of Scientific and Industrial Research, we are unaware of any department where the permanent secretary is, for example, a trained scientific worker or engineer.

The classic example of the subordination of the technical expert is afforded by the Post Office, which administers under Treasury control great nationalised services. The Engineering Department which is responsible for the technical side of the telephone and telegraph services is presided over by the Engineer-in-Chief, who has under his charge a staff running into tens of thousands, from professional engineers downwards. His basic salary is £1500 a year, which with bonus is equivalent to about £1700. He is subject to the administrative

control of the secretariat, the head of which is the Permanent Secretary with an inclusive salary of £3000. No Engineer-in-Chief, however gifted administratively, can ever expect to be promoted to an administrative post even in control of such a distinctively technical service as that of the telephones. There are, indeed, only four professional men in the Service in receipt of salaries of more than £2000, the highest being £2500. In the scientific departments the position is worse, for no head of a scientific department of the Service is in receipt of a basic salary exceeding £1500.

The disparities between the careers open to administrators on one hand, and professional and scientific officers on the other, are but the reflection of the low status deemed appropriate to the latter, and this state of affairs will never be remedied by reform from within the Service, dominated as it is by 'establishment' traditions extending over several generations. This urgent problem of the status and functions of the scientific and technical experts in the public service is clearly suitable for consideration by an outside body, and it was our hope that a strong and representative Royal Commission composed of persons of acknowledged authority, even if handicapped by the possession of opinions based on knowledge and experience, would advise the nation on the whole question. Such a Commission should obviously contain an adequate representation of scientific and professional interests, for experience of committee working shows that the practical justification of this laborious system of arriving at a report on an administrative question is in the education of the less well-informed by the well-informed. The scientific and professional point of view will doubtless be effectively put to the Commission by evidence from such organisations as the Institution of Professional Civil Servants and the Association of Scientific Workers, but, particularly in a body which has been selected on the basis which has been indicated, the need for exposition and elucidation after the witnesses have withdrawn will be overwhelming.

Leading members of the Labour Party have on many occasions associated themselves with the aims of progressive science and referred to the important services rendered by scientific workers to the modern State. We have always advocated this community of spirit between Science and Labour, and we are greatly disappointed that, now the Labour Party is in power, it should disregard so completely the essential place of Science in the Commission which has just been appointed.

Sir Joseph Wilson Swan.

Sir Joseph Wilson Swan, F.R.S. A Memoir by M. E. S. and K. R. S. Pp. 183 + 6 plates. (London: Ernest Benn, Ltd., 1929.) 7*s.* 6*d.* net.

THE biography of Sir Joseph Wilson Swan, written by two of his children, gives an admirable record of the life of this great inventor. His inventions in connexion with photography and electric lighting place him in the front rank of the world's benefactors. Important industries employing tens of thousands of workmen are founded on the results of his labours. His most successful inventions are the carbon process (better known perhaps as the 'autotype' process); bromide printing paper familiar to all photographers; the incandescent carbon filament electric lamp; the cellular lead plate electrical storage battery, and the most important of all, artificial cellulose thread, the prototype of artificial silk.

Swan was born at Sunderland in the year 1828. His parents belonged to families of Scotch descent who had settled in the county of Durham about the middle of the eighteenth century. Swan's father had a bent towards a seafaring life, but circumstances prevented him and so he had to content himself with a comfortable business on shore making ship's anchors and chains. Later, ill-success in business deprived his children of an easy start in life, but they undoubtedly inherited from him many of the fine qualities which so endeared Joseph Swan to his friends.

When an old man, Swan wrote a few biographical details of his early life which illustrate some of the amazing changes which have taken place in comparatively recent times. "The days of my youth", he says, "extend backward to the dark ages, for I was born when the rush-light, the tallow-dip, or the solitary blaze of the hearth were common means of indoor lighting." In the houses of the rich wax candles were used. Outdoor illumination was derived from lamps raised on wooden posts about ten feet high. The lamps consisted of glass bowls containing about a cupful of evil-smelling train oil in which a cotton wick was immersed. The watchman with his lantern and rattle went his rounds calling out the time and describing the weather.

Joseph was sent first to a dame's school, where his imagination was stirred by the effects produced by light passing through a glass prism and the spark from a Leyden jar. He afterwards joined his brother at a large boys' school near Sunderland. Here he learnt how to manipulate laboratory apparatus and to make and store gases. The

pyrotechnic side of chemistry attracted him most. He left school when he was thirteen years of age, and for three years he was a druggist's apprentice at Sunderland. His duties were commonplace, but he was a member of the Sunderland Athenæum and had access to an excellent library. He remembered reading in 1845 with the greatest interest an account of an 'incandescent electric lamp' invented by a young American, J. W. Starr. During these three years Swan writes, "All my spare time was spent in chemical and electrical experiments carried out for the most part by means of home-made apparatus and appliances".

Swan was strongly attracted by electrotyping, afterwards developed into electroplating, and used various types of primary battery for the purpose. One day when passing a shop window in Sunderland he caught a glimpse of a daguerreotype portrait. He paid many visits to this window, with constantly increasing wonder at this scientific achievement. He had heard of the conjuror's hoax of your likeness seen in a mirror and fixed there by a process of baking. Here was fiction turned into fact, a miracle realised. Every new scientific discovery created in Swan a feeling of elation which was a great stimulus to further experimental effort.

At the age of eighteen Swan went to Newcastle, where, in conjunction with his friend and future brother-in-law, John Mawson, he started a chemist's business. This business ultimately became the well-known firm of Mawson and Swan. Some twenty years later, Mawson, when Sheriff of Newcastle, was accidentally killed when seeing to the disposal of a quantity of dynamite left by some miscreants in a stable. Swan at once made his widowed sister a partner in the business, thus securing to her the income she would have had if her husband had lived.

Swan patented his carbon process at the age of forty-six. This was the first patent he ever took out and was the forerunner of seventy others, the titles of which appear under his name in the Patent Office Register. The carbon process, important in itself, has had far-reaching effects upon cognate branches of photography. Employed for the purpose of producing a variable 'resist' to the action of the etching fluid in photogravure, it is the parent of that most highly refined form of photo-mechanical reproduction. Many of the carbon prints made by Swan in 1864 still exist in perfect condition, as strong in tone as when they were made.

The invention by Hermann Sprengel in 1865 of the mercury vacuum pump cleared the way for the invention of the incandescent lamp. Ten years later Crookes astonished the world by his radiometer, the construction of which demanded an almost perfect vacuum. It was Crookes's researches which spurred Swan on to invent an incandescent lamp. In December 1878, and in January and February 1879, Swan publicly exhibited his carbon incandescent lamp to large numbers of people in Newcastle, Gateshead, and Sunderland. The first incandescent lamps made by Swan were not suitable for the market, but in 1880 he devised the parchmentised cotton filaments. For several years, all the world over, incandescent lamps were made with this filament. In 1883 this filament was superseded by Swan's invention of the 'squirted' filament, made from cellulose, the efficiency of which was much higher. It was during his early experiments with the squirting process that Swan conceived the idea that the thread-like material, designed for filaments, was also capable of being used in a textile way for the manufacture of a fabric. Some of the finer cellulose threads produced in this way were crocheted by Mrs. Swan into lace and used to make the border of small mats and d'oyleys. A few of these articles were exhibited at the Inventions Exhibition of 1885, under the description 'artificial silk'. In this application lay the germ of one of the most important inventions of modern times, the artificial silk manufacture.

In 1882 the Edison Company applied for an injunction to restrain the Swan Company from making lamps. This injunction was refused, but the good sense of the directors led to the amalgamation of the two rival companies under the name of "The Edison and Swan, United Electric Light Company, Ltd."

In 1894, Swan was elected a fellow of the Royal Society. His election followed upon a communication to the Society recording the results of an elaborate research upon the electrolytic deposition of copper which he had carried out with the assistance of John Rhodin.

For eighteen years Swan experimented with filaments for incandescent lamps. In particular he experimented with refactory metals, including tungsten. He was, however, forestalled by German inventors. Baron von Welsbach, the inventor of the gas mantle, produced the osmium lamp; Messrs. Siemens and Halske, the tantalum lamp, and Just and Hanaman the tungsten filament lamp. The osram lamp was so called because it was made from an alloy of osmium and tungsten (German *Wolfram*). The tungsten filament has now practically universally superseded the carbon filament in lamp manufacture.

Swan was an intense lover of Nature. The beauty of natural forms, colours, and sounds at all times filled him with a pleasure akin to rapture. His letters abound with allusions to the sounds and sights of the country. For him all the wonders of science were of little account when matched with the grandeur of a thunderstorm or the ' heavenly alchemy ' of a sunset on a summer's day.

His children in this book give an excellent portrait of his modest and unassuming personality. His habitual temper was one of considerate gentleness marked by a chivalrous courtesy which with him was a second nature. He was the soul of generosity. Those who sought his advice never failed to receive the best that he could give. He died in 1914 at the age of eighty-six years, lamented by many friends, having been fortunate to accomplish much for the welfare of humanity. A. R.

Scientific Farming in Germany.

Handbuch der Landwirtschaft. Herausgegeben von Fr. Aereboe, J. Hansen und Th. Roemer. Fünf Bände. Lieferung 8, Band 1. Pp. 129-256. 5·80 gold marks. Lieferung 9, Band 2. Pp. 385-512. 5·80 gold marks. Lieferung 10, Band 4. Pp. 129-256. 5·80 gold marks. Lieferung 11, Band 2 (Schluss); Band 3. Pp. xvi + 513-564 + 129-160. 5·80 gold marks. (Berlin: Paul Parey, 1928.)

THERE is a story of how, invited to contribute to the literature of elephants, an Englishman described " Elephants I have shot; with an appendix on the ivory trade ". A Frenchman, on the other hand, wrote an intimate biography, " Samson: the Amours of an Elephant "; but a German authority, inviting the collaboration of twenty-seven of his friends, produced six volumes of a " Handbook on Elephants in Health and Disease: their History, Life, Death, and Metaphysical Implications; with some Account of the Giraffe and the Rhinoceros ". To ensure the sale of all six volumes—for it seemed possible that a specialist interested only in ivory, or in giraffes, might omit to buy the other volumes—the work was produced in some score of parts: parts contrived to include frequently the beginnings or endings of articles, rather than the complete essay, consecutiveness also being carefully avoided. Thus a student requiring the conclusion of an important article in part 3 might possibly find it in part 17.

Like all parables, this exaggerates; but in some respects, when dealing with the present instalments of the " Handbook to Farming ", the reviewer began to feel that agriculture was an elephant. We have here a compilation of undoubted value, by authorities of undoubted eminence: but the method of its production is open to serious questions from the point of view of the English student. The work is not an encyclopædia or a dictionary, in the sense of an alphabetical series of articles that would lose their value unless the complete edition were obtained. It is rather a series of monographs, or text-books, covering the whole field of farming theory and practice: there can be few farmers who would buy and use the complete book, and there might be many workers interested in individual sections who would be unable to purchase all the twenty instalments of the ' Handbuch '. Since it was to be published in separate parts, one asks why the individual parts might not have coincided with complete sections of the work, in the manner, say, of Abderhalden's well-known " Handbook of Biological Methods ".

Apart from this, however, the ' Handbuch ' continues to fulfil its promise of providing full information about ' scientific farming ', as distinguished from agricultural science. That is, many of the articles have the character of short text-books rather than monographs, and this is reflected in the fewness of the references to original work. From this point of view, illustrations, graphical or photographic, are scarce relative to the amount of print, except in one or two of the contributions.

In the instalments now to hand, Part 8 contains one complete article and parts of two others from Volume 1 of the complete edition. This volume is to deal with farm management and the economics of agriculture: almost half of Part 8 is given to the conclusion of Prof. F. Beckmann's account of various aspects of economic policy. After discussing the question of agricultural customs duties and the reactions between German and world agricultural policies, he reviews the condition of agricultural credits and mortgaging in Germany since the stabilisation of the currency; then come shorter discussions of such questions as the best working size of a farm, and the hereditary transmission of landed property. Dr. H. Zörner of Berlin makes a survey of the buildings, plant, and equipment required for different types of cultivation, and for all the varieties of live-stock farming down to rabbits, fish, and bees. Then Prof. Z. W. Ries of Bornim considers the nature and composition of farm-labourers, and the paying of their wages.

Part 9, after concluding Dr. M. v. Wrangell's article on plant nutrition (where we note a graphical

representation of Mitscherlich's views on the relationship between increasing fertilisation, yields, and profits), is devoted largely to the enemies of crops. Weeds, their classification and control, are discussed by Prof. C. Fruwirth of Vienna, who distinguishes between special methods and those that may form a part of ordinary soil treatment. Then, after a section by Prof. O. Heuser of Danzig, on catch-crops and green manures, Prof. G. Gassner of Braunschweig contributes a very comprehensive article on plant diseases of all kinds. (This contribution occupies the latter half of Part 9 and is continued in Part 11.) After a detailed analysis of the causes of disease, whether chemical, physical, or attributable to parasites from the plant or animal kingdoms, there is a discussion of the fundamentals of control. Then various methods of control are described under their appropriate groups: first those involving cultural measures—soil management, and the manuring, rotation, and after-treatment of crops; then biological control, briefly considered; specific susceptibility and the breeding of immune varieties; and the use of mechanical, physical, and chemical treatments. The dipping of seeds is fully described.

Passing from methods of control, Dr. Gassner then discusses the rusts of cereals: their classification, distribution, and development, and the influence of external factors such as climate and soil. The identification of rusts is aided by some very effective illustrations in full colour—but at present these illustrations are to be found in Part 11 of the 'Handbook'.

Volume 4 of the complete 'Handbuch' is intended to cover general questions of animal husbandry, and Part 10 contains a portion of this volume: namely, the conclusion of an account of the breeding and selection of farm animals, by Prof. C. Kronacher of Hanover, and a large but incomplete section by Prof. G. Fingerling on animal nutrition. Prof. Kronacher's article is well illustrated with photographs and charts—particularly the section on hybridisation and the application of the Mendelian law, which goes far into the theory of genetics. In Prof. Fingerling's contribution on animal nutrition, the constitution and digestion of feeding stuffs, their uptake by animals, and nutrient values are first considered. There is a brief review of vitamins, and then follows the establishment of feeding standards and maintenance rations for various classes of stock. Green fodder and hay are under detailed consideration when Part 10 ends.

The remainder of Prof. Gassner's article on plant diseases appears in Part 11; after rust control, and immunity or resistance to rusts, comes a useful review of the organisation of protective measures against plant disease in Germany. The next article in Part 11, by Dr. G. Blohm of Halle, gives a practical account of the harvesting and storage of crops; it includes an illustration of the English method of crop-drying, and other less usual methods, such as the 'souring' of beet leaves and potatoes. This concludes Volume 2 of the 'Handbuch' on arable farming, and an efficient but not exhaustive index is followed by four plates in full colours to aid in identifying weeds and rusts. The remainder of Part 11 is a section without beginning or ending, from Prof. Opitz's contribution on potato cultivation.

Malaria in the Roman Campagna.

Die Malaria in ihrer Bedeutung für die Geschichte Roms und der römischen Campagna: eine kulturhistorische Studie. Von Prof. Angelo Celli. Herausgegeben von Anna Celli-Fraentzel. Pp. vii + 118. (Leipzig: Georg Thieme, 1929.) 12 gold marks.

THIS is an abridgment of the monograph in Italian on the history of malaria in the Roman Campagna (1925) by the late Prof. Angelo Celli, and is edited by his widow. Prof. Celli gathered his evidence from an amazing variety of sources, as the references in the bibliography attest, and the result is a fully documented account of the author's assiduous and masterly investigation in this very difficult subject, which occupied the last years of his life.

A short introduction of ten pages refers to the problems in the history of the Campagna, the key to many of which is to be sought in malaria, a brief account of the organism of which and its mode of transference is given. The author directs special attention to the rhythms of malaria and states that statistical records in the second half of last century show that the high points of epidemics recurred with a ten-year frequency. He also points out that, with recent fuller knowledge of the history of malaria, a periodicity in which centuries are involved is recognisable. In the investigation of such a subject, which is of great interest not only from the biological but also from the historical point of view, Prof. Celli held that there was no place more suitable than the Roman Campagna, the varied ups and downs of which, from prehistoric times, have been studied again and again by archæologists, historians, naturalists, doctors, politicians, economists, and agriculturists.

A short section of half a dozen pages on the pre-Roman period commences with the statement that it is an open question whether in that period malaria was already prevalent in the Latin plain or whether it was introduced in historic time. In view of the high culture of the Latin and Etruscan towns, the author concludes that in the first century after the founding of Rome malaria was either absent or mild, but in the earlier period of the Republic came the decline and many of the communities of Latium disappeared, owing, as the author concludes, to malaria.

In the next section the history of the Campagna during the time of the Republic and the Empire is considered. The Romans learnt from the Etruscans to drain the swamps, and to this end the *cloaca maxima* was made to drain the swamp at the Forum, though later it became a sewer. But in spite of much labour expended on canals and drainage, malaria spread. Prof. Celli notes the record by Livy of epidemics—apparently of malignant malaria—in the Campagna in 411, 409, and 399 B.C. He does not agree with the statement of W. H. S. Jones that malaria was introduced into Rome from Carthage. He turns to the ancient writers on agriculture, the army, and public works for further evidence on the varying incidence of malaria. He argues that in the early part of the Imperial period (the first century A.D.) malaria was not important in the Campagna; had it been strongly prevalent, the Emperor and the patricians would not have exposed themselves to the air of that region in summer and autumn, nor would the catacombs, situated in the suburbs and in the Campagna, have been a suitable meeting place, for being dark and moist, cool in summer and warm in winter, they would have been an especially good haunt for *Anopheles*.

Prof. Celli points out that when Christianity became the State religion in A.D. 312, about thirteen bishoprics were founded around Rome—a sufficient index of human activity in the very region which later was depopulated by malaria. He cites some of the records, and concludes that by the middle of the fifth century the epidemic had spread in the neighbourhood of Rome, and he traces its further great development during the next century or more—for this was the second high portion of the malaria curve.

During the eighth century there was a spontaneous decline of malaria, but the disease flared up again in the tenth century and remained prevalent during the next two or three hundred years. Prof. Celli refers to the gardens of the Campagna which, about the end of the tenth century, were highly cultivated—the gardeners had their own guild. The gardens required water and the old drainage ditches were neglected, *Anopheles* bred and carried malaria, and the gardens of the Campagna went entirely to ruin. In the thirteenth century malaria extended over many parts of Italy, but was probably on the wane about the end of the fourteenth century.

From almost certain indications the gradual rise of the malaria curve in the second half of the sixteenth century can be followed, and in the first half of the seventeenth the disease became not only more frequent but also ever worse. The chief modern authorities on the Campagna are agreed that the middle and end of the seventeenth century was the period during which the decline of the Campagna was completed. The history of this epidemic—the fourth high curve—is traced up the nineteenth century.

Angelo Celli preached the crusade against malaria especially in the Campagna, and in 1898 was the principal founder of the malaria society which successfully advocated the distribution of quinine by the State, and also, of course, vigorously pressed other methods of attacking the problem, such as drainage, treatment of water, and the netting of doors and windows. He refers, however, to the possibility that the betterment may have been due to a spontaneous diminution of malaria.

This very interesting volume concludes with a bibliography of 434 references, an index of names of persons and places referred to, and a map of the Campagna.

Our Bookshelf.

(1) *Science and the Unseen World.* By Prof. Arthur Stanley Eddington. (Swarthmore Lecture, 1929.) Pp. 56. (London: George Allen and Unwin, Ltd., 1929.) 2*s.* 6*d.* net; paper, 1*s.* 6*d.* net.

(2) *The Meaning of Life: as shown in the Process of Evolution.* By C. E. M. Joad. (The Forum Series, No. 10.) Pp. iv + 60. (London: Watts and Co., 1928.) 1*s.* net.

(1) PROF. EDDINGTON'S Swarthmore lecture will be read with interest by all who watch the movements of scientific thought in relation to philosophy and religion. The attitude of the author has become generally familiar through his volume on "The Nature of the Physical World", but in the present lecture he attacks the religious problem at closer quarters. His treatment of it, as one would expect, is both original and suggestive. He puts aside the question, Does God really exist? "because it raises so many unprofitable side issues, and at the end it

scarcely reaches deep enough into religious experience. Among leading scientists to-day I think about half assert that the aether exists and the other half deny its existence; but as a matter of fact both parties mean exactly the same thing and are divided only by words." He points out that the crucial point for us is not a conviction of the *existence*, but a conviction of the *revelation*, of a supreme god. It is, if we may venture to say so, only very rarely that a man of science so well understands the true nature of the religious problem. Also, Prof. Eddington has no sympathy with any attempts "to base religion on scientific discovery" which the scientifically nebulous and the religiously fantastic have sometimes made. He knows how much to expect from science, namely, what it can tell us and what it cannot. The methods of physical science do not lead us to anything which can serve as a basis for religious experience, but only to "a shadow world of symbols". For that necessary basis we must return to our starting-point in human consciousness, the only point where we have direct and first-hand knowledge of reality.

(2) It is interesting that Mr. C. E. M. Joad, who writes rather from the point of view of biology than of physics, says much the same thing. He, too, looks to our inner conscious life for the key to the nature of things; yet even this knowledge eludes us, or at least resists description. "Life as we experience it is indescribable: knowing what it is like to be alive, we cannot yet say; we can say what life does, but not what it is." Yet life is purposive, and has now reached a point when its control over matter is almost complete; so much so that our interest in matter will tend to decrease—"having emancipated itself from the need to know matter, life's attention comes to be centred directly and continuously upon the world of value". This book is full of most interesting ideas and suggestions. J. C. H.

Perfumes, Cosmetics, and Soaps: with special reference to Synthetics. By William A. Poucher. Vol. 2: Being a Treatise on Practical Perfumery. Third edition. Pp. xiv + 521 + 45 plates. (London: Chapman and Hall, Ltd., 1929.) 25*s.* net.

THE first chapter of the new and enlarged edition contains a short historical survey of the subject, accompanied by some excellent illustrations of kohl pots and other adjuncts of the perfumer in use among the ancient Egyptians, Greeks, and Romans. A general account of the occurrence and separation of plant perfumes is followed by chapters on flower absolutes, the classification of odours, and fixation. A main feature of the book is provided by a series of some two dozen short monographs on flower perfumes: each of these contains notes on history, varieties, odour, natural perfume, chemistry, compounding, and synthetic components. Formulæ and recipes are given for a large number of miscellaneous fancy perfumes and toilet waters, and there are also informative sections on soap perfumery, tobacco flavours, floral cachous, etc. In the second part of the work the subject of cosmetics is treated in similar detail.

Mr. Poucher's book has been well planned and executed, and it will be helpful to all who are concerned with the industrial, scientific, or historical aspects of the important subject with which he deals. The general production is excellent, and the sixty-six illustrations cover a wide range of cultivated plants and technical processes and apparatus. As an example of the simple faith of our forefathers, we cannot refrain in conclusion from quoting a quaint letter written by the third Earl of Pembroke, Lord Chamberlain, to the Sheriff of Staffordshire:

"Sir, His Majesty, taking notice that the burning of Ferne doth draw down rain, and being desirous that the country and himself may enjoy fair weather as long as he remains in these parts, His Majesty has commanded me to write to you to cause all burning of Ferne to be forborne until His Majesty be past the country." J. R.

Lichtelektrische Erscheinungen. Von Prof. Bernhard Gudden. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 8.) Pp. ix + 325. (Berlin: Julius Springer, 1928.) 24 gold marks.

THE subject of photoelectricity has of late become of primary importance in physical theory. The present book is a laudable attempt to survey the whole of the complex phenomena included in that title. The author divides the phenomena into external ones, where electrons are projected outside the substance, and internal ones, where the photo-effect is confined to the interior of the substance. The former class is most familiar to physicists, and has been greatly cleared up by the verification of Einstein's quantum theory of photoelectric action. The author refers to Elster and Geitel's success in discovering single quanta by photoelectric action, and adds, "this attains the sensitiveness of the human eye". He should have said "greatly exceeds", since the human eye requires at least 200 quanta per second to perceive light.

The internal photoelectric effect is dealt with mainly from the point of view of crystals, on which the author himself has done valuable work. The chapter on selenium is a short one of fifteen pages, and is somewhat disappointing. It is practically taken from Ries's "Das Selen", published in 1918, and omits much recent work which has cleared up several obscurities. The work concludes with a brief account of certain phenomena as yet imperfectly linked up with photoelectricity, such as the Becquerel and Weigert effects.

Études sur les mouches parasites. Tome 1: *Conopides, Œstrides et Calliphorines de l'Europe occidentale; recherches sur la morphologie et la distribution géographique des Diptères à larves parasites.* Par E. Séguy. (Encyclopédie entomologique, Tome 9.) Pp. 251. (Paris: Paul Lechevalier, 1928.) 65 francs.

THIS memoir is divided into two sections. The first section is devoted to a systematic account of the species of Conopidæ found in western Europe. The second section is of a more general character

and deals with morphology, biology, and taxonomy of the Œstridæ and Calliphorinæ, which are included by the author in the family Tachinidæ. The Conopidæ are parasitic, as larvæ, on bees and wasps, and in a few cases upon Orthoptera. Very little is known of the details of the parasitism and research is greatly needed. The Œstridæ are all parasites of vertebrates, while the Calliphorinæ are of more varied habits. Their larvæ are either saprophagous or carnivorous, and are more rarely occasional or regular parasites. The biology of the groups of flies dealt with, therefore, affords unusually interesting examples of various phases of development, while many of the species concerned are of definite economic significance. We can commend the memoir as a sound and trustworthy contribution by a recognised authority on the subject. It is adequately illustrated and is accompanied by a full bibliography.

Flora of West Tropical Africa: the British West African Colonies, British Cameroons, the French and Portuguese Colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. By J. Hutchinson and Dr. J. M. Dalziel. Prepared at the Herbarium, Royal Botanic Gardens, Kew, under the Supervision of the Director. Published under the Authority of the Secretary of State for the Colonies. Vol. 1, Part 2. Pp. iii + 247-523. (London: The Crown Agents for the Colonies, 1928.) 8*s*. 6*d*.

PART 2 of this work comprises 44 families from Sterculiaceæ to Umbelliferæ in the phylogenetic order devised by Mr. J. Hutchinson, one of its authors. Several families of great importance from the botanical as well as the economic point of view are included, such as the Malvaceæ, Euphorbiaceæ, Leguminosæ (here divided into three families), Meliaceæ, Anacardiaceæ, and Umbelliferæ. The one represented by the most abundant species is of course the Papilionaceæ, which occupies just one-fifth of the whole part (the 'Leguminosæ' take up three-eighths). Next in order come the Euphorbiaceæ with one-seventh. There are sixty-nine excellent full-page and text illustrations, drawn by W. E. Trevithick, which materially assist in the determination of the plants represented and in the understanding of the chief characteristics of the families to which they belong. C. FISCHER.

Evaporating, Condensing and Cooling Apparatus: Explanation, Formulæ and Tables for Use in Practice. By E. Hausbrand. Translated from the second revised German edition by A. C. Wright. Fourth English edition revised and enlarged by Basil Heastie. Pp. 468. (London: Ernest Benn, Ltd., 1929.) 25*s*. net.

HAUSBRAND'S work, the first English edition of which appeared in 1903, has long been recognised as an authority on the subject. It sets before the engineer, in a readily applicable form, the results of experiments in physics and of large-scale plant processes, and contains a number of valuable tables. In the present edition, the work carried out in the National Physical Laboratory in 1916, which confirmed the earlier investigations of Osborne Reynolds on fluid flow, is taken into account. It supersedes the empirical results which were previously the only ones available, and large changes have been made in the sections and tables dealing with this part of the subject. The experiments on heat losses by radiation and convection, also made in the National Physical Laboratory in 1923, have been dealt with by the reviser, and a chapter has been added on modern evaporating plants. These and other alterations have considerably improved the work, and the English translation is therefore much in advance of the German edition. When the great amount of valuable information in the book is considered, the price must be regarded as moderate.

From a Bird-Lover's Diary. By Arthur Astley. Pp. ix + 306 + 8 plates. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1928.) 7*s*. 6*d*. net.

THIS little volume gives us the results of the author's observations on birds in a northern district of England. He divides his chapters into those containing the birds of lakeland, those of woodland, and those of the mountains, after which he devotes a chapter dealing with bird life month by month as he finds it to be within these areas, selecting certain birds as emblematical of each individual month. The author calls his book a diary, and, perhaps, it has lost some of its charm by his keeping too carefully to the form which its title indicates. We confess we should have liked less diary—entailing a good deal of overlapping—and more information and anecdote about the birds and their habits. In spite of this, though we are told nothing that is new, there is much that is of interest, whilst the book is easy to read and holds one's attention throughout. The photographs with which the book is illustrated are very charming, and have been well selected with the view of giving as varied suggestions as possible of the haunts of the birds discussed.

Power Resources of the World (Potential and Developed). Compiled by Hugh Quigley for International Executive Council, World Power Conference. Pp. xii + 170. (London: World Power Conference, 1929.) 21*s*.

THE assessment of the power resources of the world presents formidable difficulties, if only on account of gaps in precise figures from many countries. The lack of a standard method of investigation and a common basis of evaluation are other drawbacks to reaching satisfactory conclusions. In this volume, however, an attempt has been made, and apparently with considerable success, to assess the world's power resources in coal, oil, and water. Inexhaustible sources of power, such as wind, tide, and solar energy, and also timber, do not come under review. Their use depends partly on inventions and, in the case of timber, on man's will to increase the supplies. The book concludes with a chapter on world power production on a common basis, and a lengthy bibliography covering works published since 1924 on power resources.

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.*]

Biology of Lakes in Kenya.

WESENBURG-LUND, Thienemann, and others have for years been emphasising the need for more detailed studies of tropical fresh waters. Having recently been enabled, through the help of the British Association and the Percy Sladen Memorial Trust, to make a short investigation of some lakes in the Rift Valley in Kenya, I may summarise here some of my observations.

FIG. 1.—Lake Nakuru, with flying flamingoes.

Lake Baringo, lying just to the north of the equator at an altitude of 3000 feet, was visited once, while Lakes Nakuru, Elmenteita, and Naivasha, and a small crater lake lying about 2° to the south, at an altitude of more than 6000 feet, were examined more fully.

The temperature conditions found at the higher altitude approached those of temperate regions, but diurnal changes were more marked, complete inversion occurring in the shallower waters, as shown below :

Depth.	7 A.M.	9.30 A.M.	Noon.
0·5 m.	18·2° C.	18·5° C.	21·5° C.
1·5 m.	18·6	18·5	20·0

Lake Naivasha was the least abnormal and perhaps approached most nearly the ' oligotrophic ' type. It contained planktonic Entomostraca and Rotifera, of which quantitative hauls taken at a number of depths showed concentration in the lower layers by day. The phytoplankton contained a species of *Microcystis* and various diatoms, while successive zones of aquatic plants, such as *Potamogeton* sp. and *Myriophyllum* sp., extended more than half a mile from the shore and sheltered an abundant fauna. Fish, recently introduced, were numerous, and bird-life was rich and varied.

The alkali reserve of Lake Naivasha, expressed in normality, was 0·004 (cf. Cambridge tap water 0·0042 *N.*), but instead of calcium, as in English hard waters, the base was sodium derived from the surrounding alkaline lavas. This may have had a specific effect, as in increasing concentrations the alkalinity appeared to effect a marked reduction in quantity of both fauna and flora. The other lakes illustrated this, since their alkalinity increased in the order : L. Baringo (0·01 *N.*), Crater Lake (0·11 *N.*), L. Elmenteita (0·22 *N.*), and L. Nakuru (0·27 *N.*). This increase raised the hydrogen ion concentration from *p*H 9·0 to about *p*H 11·2. Lake Baringo contained Crustacea, Rotifera, insect larvæ, and fish, and also *Microcystis* sp., but no higher plants were seen. The three others, ' soda ' lakes, contained chiefly Rotifera and insect larvæ, Lake Nakuru having apparently only one species of *Brachionus*. They were further characterised by the presence of a very abundant blue-green alga, *Spirulina* sp., in the plankton and an entire absence of shore vegetation, which was replaced by foul, barren mud, largely admixed with flamingo excreta.

On these ' soda ' lakes there are two classes of birds. The first are occasional visitors only, such as pelicans, gulls, and ducks ; the second and most important are the flamingoes (Fig. 1), of which vast flocks formed a striking pink border to the green water. Examination in May of some flamingoes' stomach-contents showed them to have been feeding almost entirely on the *Spirulina*. Whether or not this association persists throughout the year cannot be stated, but these microphagous birds must always be dependent upon some such ' water-bloom ' as that observed, and they must play an important part in the bionomics of these lakes. It may be tentatively suggested that diatoms, although comparatively scarce at the time of the investigation, may be sufficiently abundant at other times of the year to form their staple food.

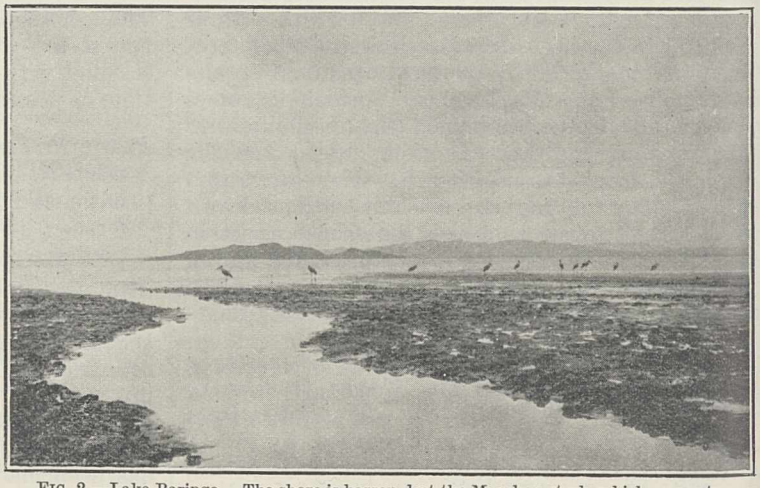

FIG. 2.—Lake Baringo. The shore is barren, but the Marabou stork, which comes to fish, can be seen.

PENELOPE M. JENKIN.

Department of Zoology,
University, Birmingham.

Fused Paramagnetic Salts.

ABOUT a year ago I reported measurements on a class of 'polynuclear' organic salts of iron and chromium which obeyed the law $\chi_a(T-\theta)=C$ with very large negative values of θ of the order -600 for the iron salts and -100 for those of chromium (*Phil. Mag.*, **6**, 481; 1928; and *Phys. Rev.*, **32**, 320; 1928). The suggestion was made that negative θ was a measure of a certain control by or coupling with neighbouring organic groups which opposed the orientation of the metallic ions considered as the elementary magnets. For these particular salts the control was imagined to be due to the electric dipole character of the organic groups.

Negative values of θ are, however, of general occurrence in salts in the solid state, and appear when we have no reason to believe that the anions are electric dipoles. In order to retain the hypothesis of control or coupling, it is desirable to ascribe it more generally to the forces which determine the crystalline state. It was with this in mind that I planned the present measurements of the susceptibilities of some paramagnetic salts throughout a range of temperatures including the melting point. It seemed possible that θ might change at the melting point and in the sense required by the interpretation under discussion: namely, diminished control in the liquid state should give $\Delta\theta > 0$.

The salts chosen were the hydrated salts which melt at low temperatures, avoiding danger of decomposition although not entirely excluding the possibility of more subtle chemical complications. They were used as powders packed in glass bulbs of about 0·6 cm.³ capacity through a capillary long enough so that the bulbs could be sealed off without melting any of the salt. The measurements were made with a torsion balance of the Terry type (*Phys. Rev.*, **9**, 394; 1917). The water-cooled magnet had pole faces of 10 cm. diameter, and the gaps were 6 cm. or more. With such large gaps, $\int H\frac{dH}{dx}dv$ was sensibly constant over the volume of the bulb, so that there was no error due to redistribution of the material when it melted. An electric furnace served as heater. The usual corrections for container, diamagnetism, and emergent thermometer stem were applied. The air corrections were negligible. $FeNH_4(SO_4)_2+12H_2O$ was used as a standard with $\chi=+30{\cdot}1\times10^{-6}$ at 20° C. All the salts were analysed for water of crystallisation.

The results are shown in Fig. 1, in which is included a table of the observed constants C_s, C_l, θ_s, and θ_l, where the subscript s and l refer to the solid and liquid states respectively. The melting points are indicated by short vertical bars across the curves. The results are reproducible. The curves shown represent the second run on each of the salts except $FeNH_4(SO_4)_2+12H_2O$. Only one curve was taken for the latter salt, as it is of the same form as that obtained by Honda and Ishiwara (*Sci. Rep. Tôhoku*, **4**, 215; 1915) for the same temperature limits.

We see that for all of the first eight salts θ changed in the sense anticipated, $\Delta\theta=\theta_l-\theta_s>0$, and that the change is sometimes surprisingly large. Fusion is generally accompanied by a change in the Curie constant as well. For these eight salts this constant always decreased.

$Er(NO_3)_3+11H_2O$ (?) is the only exception to the rule $\Delta\theta>0$ on fusion. Perhaps the rule $\Delta\theta=0$ applies to all rare earth salts since their paramagnetism originates in the deeper energy levels not directly involved in chemical valence and crystalline structure. It should be mentioned that while this salt was labelled erbium nitrate it was, apparently, not pure. The Curie constant for the erbium ion should be about 11·2. It is probable that the salt was a mixture of salts of the so-called yttrium group. However, it seems safe to assume that it was a mixture of nitrates of the rare earths only.

The exception in the case of $FeNH_4(SO_4)_2+12H_2O$ is only apparent. This salt did not really fuse at all. In a separate experiment, in which the changes with increased temperature could be directly observed, it was found that a precipitate formed on passing the nominal melting point 37° C. Beyond 62° C. (335° K.), where the curve is linear again, the precipitate had settled to the bottom of the clear solution.

It became evident early during the course of the work that melting-point data for hydrated salts must be used with caution. When fusion really occurs the melting point is not usually in agreement with the tabulated values. A more serious source of error

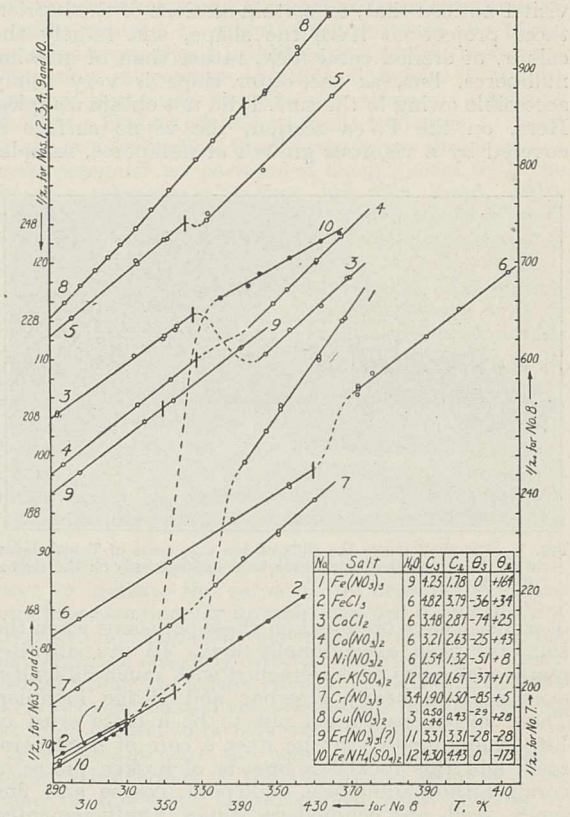

FIG. 1.

may arise from the fact that some salts do not actually fuse. For example, the salts $MnCl_2+4H_2O$ and $NiSO_4+7H_2O$, which are supposed to melt at 87° C. and 99° C. respectively, merely coalesced at those temperatures as if the particles had become wet. They did not flow in the sealed containers even at 150° C.

Fused hydrated salts may, of course, be regarded as solutions in their own water of crystallisation. This point of view is, no doubt, more consistent with the observation that $Fe(NO_3)_3+9H_2O$, $FeCl_3+6H_2O$, $CrK(SO_4)_2+12H_2O$, and $Cr(NO_3)_3+3{\cdot}4H_2O$, when once fused, do not solidify on cooling to room temperature. It is scarcely worth while to compare the present data with previous work on solutions because of the vast differences in concentration.

Finally, it should be stated that considerations similar to the foregoing have been applied by Honda (*Sci. Rep. Tôhoku*, **3**, 171; 1914) and by Kunz (*Phys.*

Rev., **6**, 113; 1915) to account for the term $\chi_a\theta$ in the law $\chi_a(T-\theta)=C$.

This work is due in part to Prof. E. P. Adams, who suggested that fused salts in general might profitably be studied.

LARS A. WELO.

Princeton, N.J.,
July 31.

Recession and Age of the Tahitian Coral Reefs.

I HAVE further facts to offer in support of the contention that the reefs of Tahiti, in spite of their abundant corals, are no longer growing, but receding, a subject to which I directed attention in NATURE of Oct. 29, 1927, p. 618.

It is characteristic of the ocean slopes of the barrier reef to be covered with rounded lumps of nullipores, as in the case of many other reefs. On my former visit I noticed that, on certain sections of the barrier, these projections have the shape, and largely the colour, of eroded coral rock, rather than of growing nullipores, but, as the outer slope is very rarely accessible owing to the surf, I did not obtain samples. Here, on the Pa'ea section, the whole surface is covered by a vigorous growth of nullipores, samples

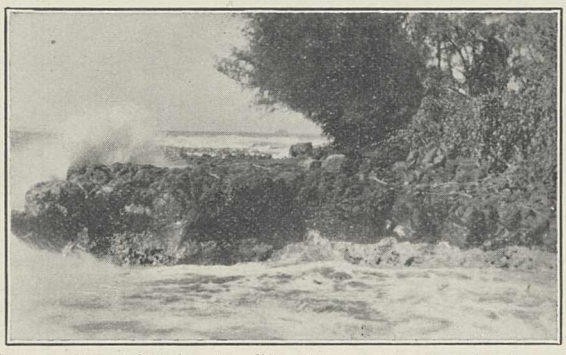

FIG. 1.—The shelf below the cliffs of the east coast of Tahiti, below which is a stratum of coral limestone, exposed only on the retreat of a wave.

of which I have obtained on those occasions when the surf has been exceptionally low. To my surprise, many specimens were detached with much difficulty, even with a heavy crowbar and sledge hammer. These specimens turned out to be a mere crust of Lithothamnioneæ growing over a core of hard coral rock, and this rock is a breccia of broken pieces of coral, Lithothamnioneæ, millepora, coarse and fine sands, shells and echinoderm spines, firmly cemented together by redeposition of calcium carbonate. Now it is evident that such small loose material could collect, and be solidified, only in hollows, and not even there unless very deep, or under several fathoms of water, and the fact that it now appears as projecting points affords direct and decisive proof that this apparently growing reef has undergone erosion; as usual, the finer filling material is more resistant and remains when the whole corals surrounding it have disappeared.

It is to be noted, too, that the destructive action of boring organisms goes on actively beneath the living crust; there is, in all cases, a band, a centimetre or so wide, surrounding each section of rock, which has been thoroughly riddled. The protective effect of an organic coating to rocks is clearly not so perfect as I have hitherto supposed.

That a coating of actively growing Lithothamnioneæ should add nothing to the reef need cause no surprise; many coasts are covered to the last inch with such a living crust, such as the Mediterranean, Cape Verde Islands, and the Marquesas (in the latter cases often with the co-operation of *Vermetus*, the tubular shells of which add not only bulk but also tenacity), but there is no reef formation.

Coral growth was abundant around Tahiti when lava was still pouring into the sea, and parasitic cones were in eruption on its shores, while the cutting of the cliffs was in progress, and, presumably, the outpouring of alluvium by streams at its maximum. This is shown by the fact that a stratum of coral breccia passes under the basaltic shore shelf at the base of the rejuvenated cliffs of the east coast. This breccia is a fine-grained rock, and is similar to that which forms the surface of the high level coral flats of this coast. Dr. Howell Williams, who has recently made the much-needed geological examination of the island, allows me to mention his discovery of several parasitic cones along the shore, besides those of Taharaa Head and Tataa Point mentioned by Davis. In two cases the tuff has carried up coral fragments, all of which are small, and may indicate eruption through a breach rather than through a reef. It will be interesting to know whether they are species still forming part of the Tahitian fauna; they are all recent, but it is possible that the fauna of Tahiti has been impoverished in recent times. In two cases the lagoon passes almost through the site of the vent of the original cone, a fact difficult to explain on any of the usual theories of lagoon formation. Moreover, the barrier reef sweeps uninterruptedly by the denuded cones; there is no bulge corresponding to their original outlines.

In the *Geographical Journal* of June 1928 I described the disappearance of several of the reef islets. *Bulletin* No. 48 of the Honolulu Museum, in an account of the districts of Tahiti given by native chiefs to the Rev. J. Orsmond between 1820 and 1840, names three islets off Point Venus, of which one alone remains, and two near Papeete, of which the eastern, named Broken Coral Island, has left no trace, while the remnant of the western, Motu Uta, is the ornament of Papeete Harbour. This account also confirms the statements given to me by natives of the former existence of islets where are now only small sandbanks.

CYRIL CROSSLAND.

Pa'ea, Tahiti,
Aug. 18.

Universities' Library for Central Europe.

THE Universities' Library for Central Europe (established in 1921 in co-operation with the Universities' Relief Committee) works to co-ordinate and consolidate the securing by gifts, exchange and purchase, British books, journals, etc., for students, professors, and libraries in the universities of Central Europe. During the last few weeks a box of English books (all presented) was sent to the University of Debrecen, Hungary, where there is a marked lack of English literature. Recently, too, an attempt was made to complete the files of NATURE as preserved by the Fondation Universitaire of Brussels, and a number of back numbers were collected from various friends in Great Britain. Many foreign universities also still purchase their English books through the medium of the Universities' Library for Central Europe, and during the present year consignments have been sent to Austria, Belgium, France, Germany, and Hungary. A large collection of books received recently from various donors has been listed, and the lists sent to the appropriate centre of the countries mentioned in order that their wants may be ascertained.

It is obvious that the work of the Universities' Library for Central Europe is continuing steadily. The wells of charity, however, seem to have ceased functioning, so far as this society is concerned, except for the regular support received from the Student Christian Movement (formerly £50, this year and last year only £20) and from the Buxton Trust (this year and last year £10). This is all the more unfortunate in view of the fact that since 1924 this society has undertaken the distribution of exchange literature received from the international exchange offices in Belgium, Hungary, and Italy. This work is proving an increasing charge upon the society's limited funds. Although as many parcels as possible are sent carriage forward, this is often an unsatisfactory procedure, seeing that the recipient institution more often than not pays postage on exchange copies of its own literature sent abroad.

The ideal would be for all institutions in Great Britain which have exchange literature to send it to the Universities' Library for Central Europe for distribution abroad, in the same way as the international offices above mentioned collect and dispatch consignments of literature in their respective countries. At the present time the only institutions in Great Britain which make use of our outward services in this respect are the British Museum (Natural History), the Royal Society of Edinburgh, and the University of Leeds. This year we have already received and distributed 1138 parcels from abroad (consignments are now, in addition, being received from the International Exchange Office in the Netherlands), and have sent out 283 parcels for the British institutions above mentioned.

This work will certainly develop, and it should be possible for this society to carry out all the international exchange business of Great Britain. To do this more and more regular funds are requisite. All possible economy is practised and a large proportion of the work is carried out with voluntary assistance; thanks to the generosity of Sir William Beveridge, offices are supplied rent-free in the London School of Economics —but, despite all economy, transport charges on international exchange literature are fast eating up our meagre funds. Abroad, the international exchange offices are government departments: the same arrangement would perhaps not be welcome in Great Britain, but a regular government grant would enable this work to be carried out more comprehensively and satisfactorily than is at present possible. An annual grant of £500–£1000 (to mention an approximate minimum and maximum) would guarantee the execution of all the detail of this international exchange business. Such a grant would also strengthen the position of this society in carrying out its other aims, foremost among which stands the propagation of English culture. Here can be appropriately quoted the concluding words of the Executive Committee's report in 1925:

"There is a certain demand for English books in every country in Europe, and letters are often received indicative of a desire for knowledge of English culture and ideals, language, literature, and method of government. Given adequate financial means (an enormous sum would not be required), a great work might be accomplished along these lines, with possibly far-reaching beneficial, civilising, and stabilising effects. The gifts themselves, and the manner of giving, must awaken and stimulate only a spirit of toleration and common intellectual advancement."

C. FULLER
(Hon. Secretary).
Universities' Library for Central Europe,
London School of Economics, W.C.2.

Wild Birds and Butterflies.

PROF. MACBRIDE and I entirely disagree on the subject of natural selection and the validity of Darwin's metaphor, and I leave the subject at that all the more willingly because his letter has been, in my opinion, fully answered by Dr. G. D. H. Carpenter and Prof. W. Garstang.

The relation of birds to butterflies is so large a subject that I can only attempt to indicate certain essential points which are not touched upon by Dr. W. E. Collinge in his letter in NATURE of Aug. 31 (p. 334). I may also remark that I did not fail, as Prof. MacBride asserts (NATURE, Aug. 10, p. 225), to notice his words 'serious attack', and he might have seen that I even quoted them in my reply (NATURE, June 8, p. 874).

(1) *The Examination of Birds' Stomachs.*—Dr. Collinge does not mention the investigations of Lamborn and Swynnerton, which prove that Lepidoptera are so quickly reduced to minute fragments in the bird's digestive tract that a careful examination under the compound microscope is required before it can be asserted that such remains are absent. Lamborn wrote of a bird which he had shot: "though . . . seen to eat two butterflies barely two hours previously, I could recognise no portions of them except with the aid of a microscope" (*Proc. Ent. Soc. Lond.*, 1920, p. xxvi). In how many of the "100,000 post-mortem examinations" referred to by Dr. Collinge has such a careful examination been made?

(2) *Injured Wings as Evidence of Attack.*—The suggestion conveyed by the question-begging words used by Prof. MacBride (l.c.) when he speaks of "the jealously guarded treasure of butterfly wings which Prof. Poulton has collected after a search of many years", is entirely devoid of foundation. Such evidence is extremely common, as any observant naturalist will find if he looks for it. Furthermore, the shape and situation of many injuries are characteristic, and resemble those caused by observed attacks. Oftentimes the unmistakeable imprint of a bird's beak remains on the wing.

(3) *The Value of Negative Evidence.*—An example will serve to indicate the value of the negative evidence sometimes confidently brought forward by naturalists who have not made the relation of birds to butterflies the subject of specially directed observations. I may also add that the keener such a naturalist is the less likely is he to make them, because his faculties are all the more certain to be otherwise engaged.

The *Danainæ* are the commonest and most conspicuous butterflies of the Old World tropics. The males of the great majority bear scent-pockets or scent-patches on the hind wings, and from these the scent-brushes at the extremity of the body are charged and then used in courtship. (It may be remarked here, as bearing on Dr. Collinge's letter, that the epigamic scents of male butterflies which are presumably pleasant, or at any rate stimulative to their females, are also pleasant to man. Furthermore, many of the other presumably aposematic scents common to male and female butterflies of certain species are unpleasant to man. The subject is too large to deal with adequately on the present occasion, but it must be mentioned that there is remarkable unanimity in the treatment of conspicuous insects by insect-eaters of diverse groups.)

To return to the male Danaines, which certainly perform their toilet and emit the scent in courtship many times in their lives. We may safely infer this from the fact that males of all ages, as shown by their condition, may be found *in coitu*. Well, so far as I am aware, W. A. Lamborn is the only naturalist who has

seen the brushes charged with scent, but he has recorded it in two African and one Oriental species. The behaviour was observed when the butterflies were freely exposed at rest on leaves and in one instance, *Amauris niavius dominicanus*, he was able to approach sufficiently close to smell the scent, which he describes as resembling 'an aromatic snuff'. Furthermore, the subsequent use of the brushes in courtship has only been recorded by a single naturalist, Dr. G. D. H. Carpenter, who observed it in two African species, the males of which performed these epigamic functions on the wing in full sunlight, the expanded brushes being conspicuous even at a little distance. Why have not these observations been made again and again? For the twofold reason that attention has been concentrated elsewhere while this subject has been neglected. Negative evidence, here proved to be valueless, is, I believe, also valueless when it is offered in support of the conclusion that butterflies are not seriously attacked by birds.

EDWARD B. POULTON.
University Museum, Oxford,
Sept. 26.

An Iodine Liberator from Laminariæ.

THE letter of Prof. Thomas Dillon in NATURE of Feb. 2, p. 161, on this subject has suggested to us that the following preliminary report may be of general interest. Our observations being a part of the thesis for the doctorate of Karl Closs, will be published in detail later.

In carrying out experiments on the chemical nature of the iodine-containing compound in *Laminaria digitata*, we observed that iodine was liberated by acidifying the aqueous extract of the *Laminaria*. Sulphuric, hydrochloric, nitric, and acetic acids cause liberation of iodine in the same way. The *p*H of the extract must fall below a certain value before iodine liberation takes place. The *p*H of the fresh extract is about 4. After evaporating to dryness and redissolving, no iodine liberation takes place on acidifying. By adding potash to the extract when evaporating the 'iodine liberator' is preserved. Boiling with base is also without effect. The 'iodine liberator' is therefore not an iodide oxydase, as observed in the cellular liquid of Rhodophyceæ (O. Gertz, *Biochem. Ztschr.*, **169**, 435; 1926). When the iodine which is liberated by acidifying the *Laminaria* extract is extracted with chloroform, another smaller portion of iodine may be liberated by adding potassium nitrite. On the other hand, the acidified extract, after the extraction of liberated iodine and before nitrite is added, liberates iodine from potassium iodide, as also observed by Prof. Dillon.

We evaporated the original extract with potash on a water bath to dryness and extracted ten times with ethyl alcohol. The iodine-containing substance and the 'iodine liberator' are both soluble in alcohol. After adding potash the ethyl alcoholic extract was evaporated to dryness and the residue extracted 10-15 times with amyl alcohol. The iodine-containing substance is dissolved in the amyl alcohol and the 'iodine liberator' is left in the residue. The iodine liberator is not potassium iodate as is suggested by H. D. Kay in NATURE of Mar. 2, p. 317; 1929.

From our experiments we arrive at the following conclusions: The chief part of the iodine in the fresh aqueous extract of *Laminaria digitata* is present in such a form that the iodine is liberated by an 'iodine liberator', which is also present in the extract and only acts in acid solution. We do not agree with Prof. Dillon when he finds in this process an explanation for the concentration of iodine of the sea water by marine algæ, the iodine which can be liberated being present in a much higher concentration in the *Laminaria* extract than in the sea water.

Our experiments on this subject are being continued.

GULBRAND LUNDE.
KARL CLOSS.
Research Laboratory of the Norwegian
Canning Industry,
Stavanger, Sept. 12.

Dew: Does it Rise or Fall?

MESSRS. E. E. FREE and Travis Hoke say dew rises; Sir Herbert Maxwell (NATURE, Sept. 14, p. 412) says it falls; Dr. J. B. Cohen (NATURE, Sept. 28, p. 482) says it does both; may I add that it does neither?

The physics of dew formation is really very simple, although much has been written on the subject and there is still much misapprehension. On a clear night all bodies radiate more heat than they receive by radiation; and so does the air near the ground. There is therefore a general fall of temperature. If the temperature of the air falls below its dew point mist or fog appears. The fall of temperature of the air, however, is frequently not sufficient for the air itself to reach the dew point; but the temperature of grass and other bodies not in good thermal contact with the ground, falling more rapidly than that of the air, goes well below the dew point. Water then condenses out of the surrounding air directly on to the cold body and dew appears on its surface. The dew is nowhere until it appears on the surface; it therefore neither rises nor falls.

Both Sir Herbert Maxwell and Dr. Cohen speak of the water vapour first condensing in the air before appearing as dew. But if the water condenses in the air there is a mist or fog, and water deposited from mist or fog is not real dew. It is true that we have no word to describe the water deposited in this way and we make the word dew serve in this case also; but a physical process is involved different from that of true dew formation. When the temperature of the air is below the freezing point and the products of condensation appear as ice we do use two different words; for hoar frost is true frozen dew, while rime is the deposit from the water which has been first condensed in the air as mist or fog.

The essential of dew formation is that the temperature of solid bodies falls by radiation below the dew point and in consequence water is deposited by direct condensation from the air on to the surface of those bodies. Where the water deposited as dew comes from is an entirely different matter, and has nothing to do with the formation of dew.

G. C. SIMPSON.
Meteorological Office,
London, Sept. 28.

A Chromosome Ring in *Pisum*.

AMONG the descendants of crosses between an individual belonging to a race of *Pisum* cultivated in Tibet and some of our own edible varieties of peas, sterility affecting about 50 per cent of the ovules and pollen grains has been observed by Miss C. Pellew to occur frequently. From other crosses of the same description but with different individuals of the Tibetan variety, the progeny were all fertile. One of the sterile plants (F_2), self-fertilised, gave a family consisting of fertile and 'sterile' plants again showing 50 per cent gametic sterility. The recurrence of gametic sterility pointed to an abnormality in the reduction divisions, and accordingly Miss Pellew

asked me to make a cytological examination of the material.

Good preparations of flower buds were obtained by using Carnoy's fixative followed by the fixative of La Cour (NATURE, July 27, 1929, p. 127) and Newton's gentian violet method. In one of the sterile plants examined, a ring of four chromosomes was found to occur regularly at the heterotypic division of the pollen-mother-cells. The two pairs (*AA'* and *BB'*) can be distinguished with comparative ease. In Fig. 1 (*b*) and (*c*) indicates the alternative ways in

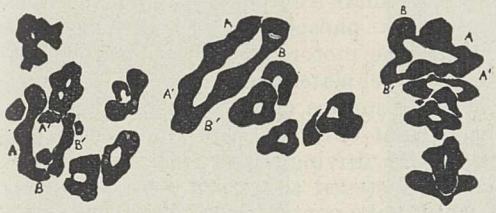

FIG. 1.—Camera lucida drawings of a chromosome ring in *Pisum sativum*. Magnification about 2500 diameters.

which chromosome separation may take place. It is suggested that the method illustrated in (*c*), in which two homologous chromosomes (of the ring) go to each pole, will give rise to non-viable gametes, whereas that shown in (*b*) will give rise to viable gametes. If the two methods of separation occur equally often, the ring formation may account for the 50 per cent sterility observed in many of the plants in this family.

I have examined several other strains of peas, and in all I have found the chromosomes arranged in seven pairs, as is characteristic of the species. Håkansson (*Hereditas*, **12**, 1929) has, however, observed the formation of a ring of four chromosomes in the experimental material of Dr. Hammerlund, in which two factors, usually independent, were found to be linked.

EVA RICHARDSON.

John Innes Horticultural Institution,
London, S.W.19, Aug. 27.

Planaria alpina in Lithuania.

Planaria alpina has been considered as very limited in its distribution and has played an important part in the theoretical discussions of the preglacial and the postglacial fauna of Europe. It has been reported from England, from various parts of southern Europe, from Scandinavia (cf. A. Thienemann, "*Planaria alpina* auf Rügen und die Eiszeit", *Jahresb. Geogr. Ges. Greifswald.*, **10**; 1906), and recently from Finland (A. Luther). It appears that this animal, with the notable exception of Finland, has not been found east of the Baltic Sea. It has never been reported from Prussia, from the Baltic States, or from the adjacent parts of Russia. Dr. A. Luther considers that specimens found in Finland show a relationship with Scandinavia, that is, with the countries west of the Baltic rather than those of the east. I have found *Planaria alpina*, however, on the eastern coast of the Baltic as well.

While investigating the planarian fauna in the springs of Eiguliai, some four or five kilometres north of Kaunas, early last June, I found a single specimen which on close examination proved to be *Planaria alpina*. After repeated visits to the same place I was able to confirm my findings, and up to this time I have collected seven specimens. The animal is rather rare, and the specimens are quite small, none of them being longer than 9 mm. when fully extended alive. Some of the specimens show recent fission, and none of them are sexually mature.

P. alpina in Lithuania is restricted to permanent springs where the annual changes of the water temperature are a minimum. Repeated attempts have been made to find them in a creek nearby, which is fed by the same springs, and so far not a single one has been found there.

My conclusion is that *P. alpina* is more widely distributed than it is generally supposed to be. I am sure that sooner or later it should be found in other Baltic States and in the western part of Russia, that is, in the region connecting Finland and Lithuania.

P. B. SIVICKIS.

Universitetas, Kaunas,
Lithuania.

Cosmic Rays and Cancer.

IN a letter appearing in NATURE of June 29, I suggested that change in the intensity of cosmic radiations might have influenced the incidence of malignant disease.

Millikan found that at high altitudes the effective intensity of these rays was many times as great as at sea-level. As a source of ionisation, these rays possess a power of penetration unequalled by any other known.

I suggest the desirability of direct experiments to ascertain whether at high altitudes appreciable effects would ensue in the progress of malignant disease or on its primary development. In such experiments—which must of course be differential in character—similarity in the factors of temperature and atmospheric pressure at greatly differing altitudes would be easily attained without notable influence on the penetrating rays.

Consequences of grave practical importance might arise out of such experiments. At any rate they must throw some light on a very obscure and important subject.

J. JOLY.

Trinity College, Dublin,
June 27.

Probable Origin of the Cold Wave in India, February 1929.

DURING the period Jan. 28–Feb. 3, 1929, an intense cold wave overran the whole of the north-west and centre of India, where surface temperature went down to about 12° C. below normal, several stations recording the lowest temperature in the last four or five decades. The results of a few soundings over Agra, which reached the stratosphere during and after the passage of the cold wave, appear to throw some light on the origin of the cold air. During winter the normal height of the tropopause over Agra (Lat. 27°) is about 14·5 gkm. and its temperature is 206° A. (see Dr. Ramanathan's Fig. 1, NATURE, June 1, p. 834), while with the invasion of the cold wave the base of the Agra stratosphere came down so low as 11·5 gkm. and its temperature rose to 213° A. The conditions in the troposphere and the stratosphere over Agra during the cold wave were similar to those normally found at about Lat. 40°. The trajectories of pilot-balloon flights up to 6 km. indicate that the cold air came from the north-west. It would thus appear that the cold wave had its origin somewhere to the east of the Caspian Sea.

S. C. ROY.
G. CHATTERJI.

Meteorological Department,
Poona.

The Movements of Flame in Carbonic Oxide–Oxygen Explosions.

RECENT WORK AT SOUTH KENSINGTON.

By Prof. HAROLD B. DIXON, F.R.S.

IF the highest reward a teacher can reach is to start a school which will carry on his lines of research, improving his technique, extending his data and enlarging his horizon, I may well claim that my lines have fallen on pleasant and fruitful places. This reflection is not a new one, for I have had many students who have extended and improved on my experiments, but it is brought vividly to mind by the appearance of a memoir by my old pupil and colleague, Prof. W. A. Bone, in conjunction with Dr. R. P. Fraser, on the photographic analysis of carbonic oxide explosion-flames (*Phil. Trans.*, A, **228**; 1929).

It is more than fifty years ago since the observation was made (at Oxford) that an electric spark, which would fire 'knall-gas' (a mixture of two volumes of carbonic oxide with one volume of oxygen—$2CO + O_2$) in a moist eudiometer, failed to cause an explosion when the gases and vessel were dried. The experiment was tried because in repeating Bunsen's work on the division of oxygen between an excess of carbonic oxide and hydrogen, I had found that the steam readily oxidised carbonic oxide at flame temperatures leaving free hydrogen. The moisture present in Bunsen's experiments must have taken part in the change, and the amount of carbon dioxide formed depended not only on the relative affinity between carbonic oxide and oxygen, but also on the quantity of steam present.

Since carbonic oxide was oxidised apparently by water, and not directly by oxygen, an attempt was made to measure the rate of the knall-gas flame along a tube when different amounts of steam were present. I can well remember how I first tried to do this by photographing the explosion flame with a camera swung on a long pendulum in front of a coiled lead pipe with glass end-pieces which were brought vertically one above the other.

The camera, as it swung, broke a circuit and fired the gases at one end of the coil: the object was to record the two flashes at either end of the coil on the plate as it was moving with a known velocity. The passage of the flame appeared to be instantaneous, but the explosion was so violent that the glass-piece at the farther end was shattered and the camera put out of action. This was in 1881: just afterwards came the discovery of *l'onde explosive* by Berthelot, and the photographs of the 'uniform' and 'vibratory' movements by Le Chatelier. Some years later (in 1895) my students at Manchester and I made the first spinning-wheel camera to study explosion-flames—especially those of cyanogen. I remember how we were warned that the wheel would probably fly to bits, and that the film attached to the wheel would certainly break off. Neither of these things happened; and from this crude rotating-film has descended a line of machines which has now culminated in the beautiful high-speed camera of Dr. Fraser's described in this memoir.

The most novel feature in this camera is the method of driving the rotating drum by contact between a small friction-wheel and the spherical surface of a phosphor-bronze driving-wheel attached to the motor. The friction-wheel is built up of two steel plates clasping a disc of compressed leather, the surface of which is machined at such an angle that only a narrow rim of it is actually touching the driving wheel. The latter (with its motor) is fastened to a turn-table which can be moved to make contact with the friction-wheel at any point in a line from the centre of the spherical surface to its outer edge. The gear ratio between the motor and the drum can thus be varied from one infinitely small up to a ratio of 4·5 to 1; and any constant speed between 30 r.p.m. and 16,000 r.p.m. can be maintained. With the larger of the two cameras now installed at South Kensington, a vertical film speed of 160 metres per second can be secured readily. Owing to the massiveness of the driving-wheel and the balance of the moving parts, very smooth running is attained, the vibration even at the highest speeds being remarkably small. The rate of the drum is measured by a Hasler high-speed counter which can be put in action at any moment, and works automatically. Having had the privilege of testing this driving gear recently, I was delighted with its steadiness over a wide range of speeds, and speaking from a long experience, could assure Messrs. Bone and Fraser (to borrow the words of Mr. Staple) that I "envied them the luxury of their own feelings on this occasion".

With this fine instrument the authors have followed in detail the spread of the flame in carbonic oxide knall-gas, both when moist and when submitted to various stages of drying up to the desiccation produced by contact with purified phosphorus pentoxide during eight months.

SPREAD OF FLAME IN CARBONIC OXIDE KNALL-GAS.

The first photographs in the memoir bring out very clearly the difference in the burning of the moist and dried gases. Fig. 1 (with a moist $2CO + O_2$ mixture) shows how the flame starts rapidly with an accelerating motion for the first 5 cm. from the powerful discharge spark; it then slackens and proceeds at a nearly uniform rate to the ends of the tube. At this moment there is a sudden increase of luminosity, which spreads backwards towards the centre of the tube. The region immediately round the sparking wires is at first more luminous than the flame fronts, forming a bright vertical streak on the film. It is probable, as the authors say, that the combustion is more rapid near the spark than elsewhere, and this is borne out by the fact that this narrow zone loses

its light and remains *dark* when the central region becomes luminous again—an indication that this layer of gas is completely burnt. Analysis of the residual gas showed that after the flame died out the combustion was complete throughout.

On the other hand, when the ignition occurs movement, a dark patch spreads from the centre of the tube and occupies a central zone 10 cm. long by the time the outward movement of the flame ceases. At this moment, some 120 milli-seconds after the spark, the dark patch contracts, and a bright flame nearly fills the central region of the

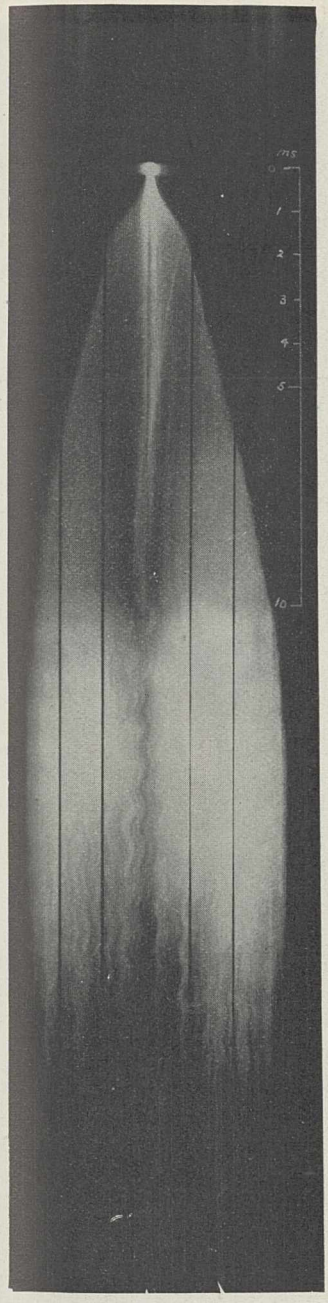

FIG. 1.[1]

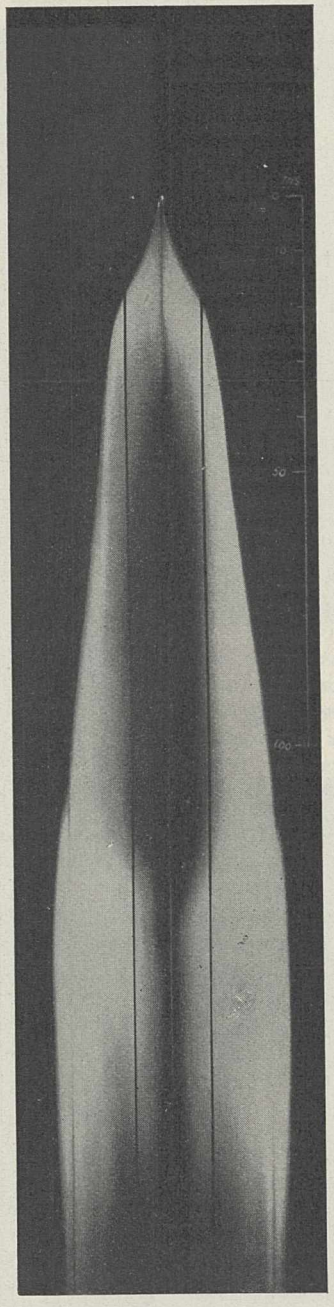

FIG. 2.

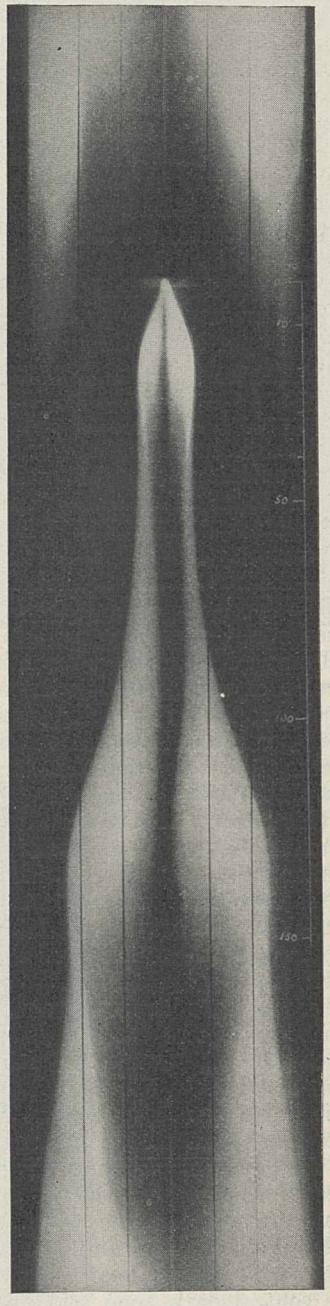

FIG. 3.

(Fig. 2) in a moderately dried gas (6 hours' contact with phosphorus pentoxide), the flames start slowly, but with an increasing speed, until, about 6 cm. along the tube, they are retarded and proceed at a slow uniform pace nearly, but not quite, to the ends of the tube. During this slow uniform tube, leaving (as in the moist gas) only a narrow dark streak. The luminous flame persists in this semi-dried gas six times as long as in the moist, and about 1 per cent of the gas was left unburnt.

With stronger drying the flames last longer (Fig. 3), and where the first retardations occur, after 3 cm. run, actually stop for a considerable time, and then proceed outwards until a second

[1] The illustrations are from *Phil. Trans.*, A, **228**, by courtesy of the Royal Society and Prof. W. A. Bone.

stationary period ensues. Each stoppage is accompanied by the development of a dark central zone; the flames finally reach the ends of the tube when the usual re-luminence spreads backwards. In this slow flame, although it had spread completely through the tube, more than 10 per cent of the gas remained unburnt. It is to be noticed that while the rapid flame in the moist knall-gas is traversed by marked bands, similar to the 'reflection' waves in my old photographs, there are no such bands visible in the flames of the dried gases.

In similar experiments made in a longer tube (60 cm. long) the same general phenomena were recorded; but in the moist mixture the initial period was marked by vibrations, and in the well-dried mixtures the 'halts' became temporary 'retreats', and the flames appeared to be drawn back and extinguished before they reached the ends.

In these experiments on long-dried mixtures, a large proportion of the gas remained unburnt. It was such a desiccated knall-gas that I saw tested in Prof. Bone's laboratory. It resisted ignition by many powerful sparks; but when at last the electric discharge sufficed for inflammation, the flame could be easily followed by the eye until it halted, remained stationary, and went out about half-way along the tube. The colour of the flame appeared to me different from that in the moist gas—the front of the flame being a pinkish orange. This colour was perhaps more marked when long-dried knall-gas was exploded in glass bulbs.

I may add that, more recently, I have witnessed similar experiments elsewhere—the conditions of dryness and purity being equally assured. The knall-gas showed the same resistance to powerful sparks, but when ignition took place the flame travelled with a slow motion to the ends of the tube.

This part of the South Kensington research is concluded with a very suggestive experiment. Two similar tubes were filled with the knall-gas from the same holder: one tube was plain and the other furnished with wires sealed in half-way between the central firing-point and the two ends. After prolonged drying each tube was fired centrally, the second tube having the supplementary wires attached to the two poles respectively of a Wimshurst machine. The flames in both tubes are seen to start slowly. In the plain tube the flame halted twice, then *receded* and went out: in the second, the flames travelled at unequal rates, which, on the flames approaching the charged wires, were greatly accelerated. On the arrival of the flames near the ends of the tube, their brightness is suddenly increased, and this luminosity extends backwards until it nearly fills the tube except for the central dark zone. It was evident that the resistance to combination offered by the dryness of the gases could be overcome by the electrostatic field, and apparently this 'relief' was more easily given by one pole than the other.

I have seen other effects of the electric field on the propagation of the carbonic oxide flame obtained in Prof. Bone's laboratory since this memoir was read: I can only say, without anticipating the explanation, that the problem presented by the burning of this gas has become one of the most interesting in physical chemistry.

THE EFFECT OF DIFFERENT SPARK DISCHARGES.

In part 2 of their memoir the authors study the effect on the flame of different modes of ignition of the moist knall-gas. There is little difference

FIG. 4.

between the spread of the flame when the ignition is made by heating a platinum wire to redness or by suddenly fusing a fine wire. In each case there *appeared* to be some little delay before ignition; the flame then started with its usual acceleration and slowed down to a nearly uniform speed after a run of 7 cm. When the same mixture was fired by

a high tension magneto-spark there was a measurable delay, but the spread of the flame followed much the same course.

The same kind of records was obtained when the moist gas was fired by the discharge from a condenser (charged up to 1000 volts) of increasing capacity, beginning with one of 0·001 mf. and passing on to 0·05, 0·5, and 3·75 mf., and then up to 8, 12, and 18 mf. With the lowest spark energy there appeared to be some delay in ignition; in the other cases the flame started immediately.

With the very powerful discharge sparks employed, oscillations were set up which had a visible effect on the flame from the start, and persisted so long as the flame was luminous—showing the well-known criss-cross patterns. There was also near the electrodes the very brilliant core of flame which burnt itself out rapidly and became a dark space. However fired, the spreading flame in the moist gases only became bright on reaching the ends of the tube.

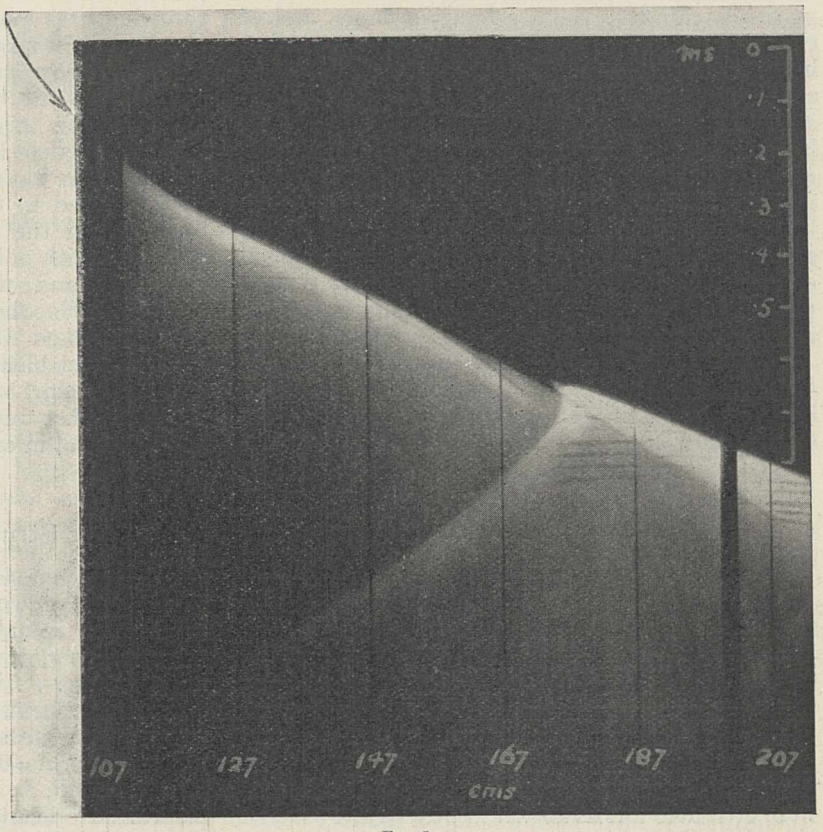

FIG. 5.

While some photographs given in the memoir appear to show that, when the ignition is started close to one end of the tube, the flames exhibit a mean speed and a set of oscillations nearly identical, although a heavy discharge is used in one tube and a light spark in the other; yet the beautiful photograph (Fig. 4) shows that, when the knall-gas is lighted simultaneously at one end by a heavy discharge and at the other by a light spark, the flames start unsymmetrically—that from the heavy discharge travelling the faster. This last photograph strikingly illustrates the oscillations of the two flames and of the column of unburnt gas between them: when the flames at last meet, the striæ, which until that moment were moving *away* from the flame fronts, immediately became motionless and appear as vertical streaks.

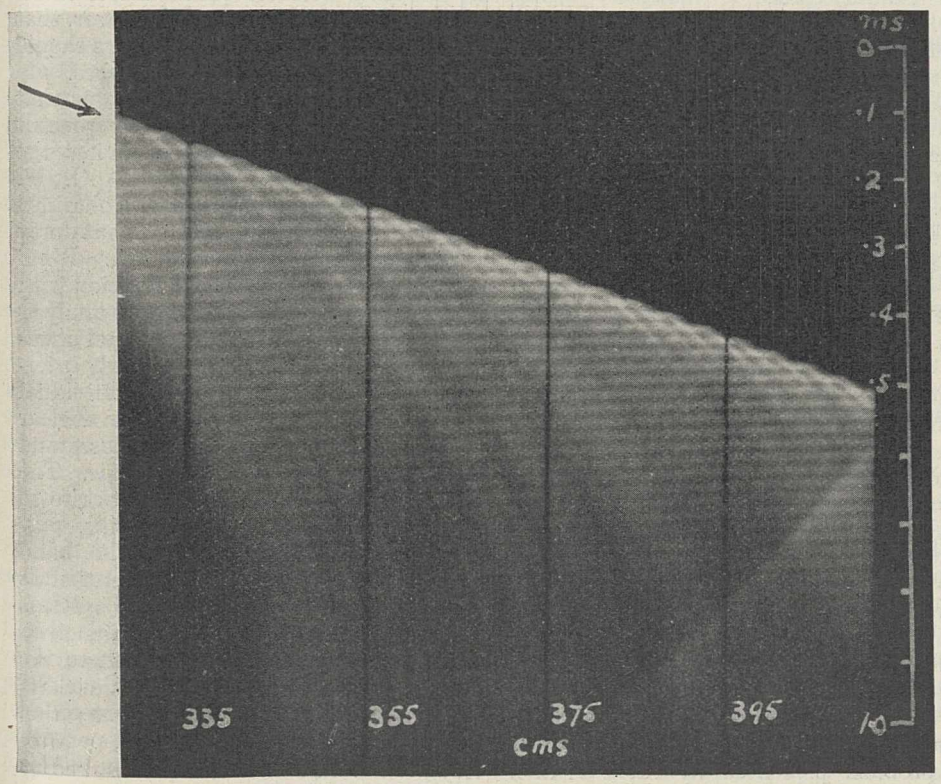

FIG. 6

Finally, by an ingenious device, the authors have studied the effect of shock-

waves catching up the accelerating flame, and of the accelerated flame overtaking shock-waves that have passed through it previously. They have shown how such shock-waves may impose a succession of 'uniform movements' on the flame, and how these accelerated flames may start a measurable distance ahead of the visible flame. When first confronted with such pre-ignitions, I attributed the appearance to halation on the photographic film; but the later work by Dr. Campbell at Manchester has long convinced me that the explosion wave may start under the influence of an invisible shock-wave ahead of the visible flame.

I agree, then, with the authors on their interpretation of the interesting photograph (Fig. 5). It is interesting not only because it shows the detonation starting at a point in front of the visible flame and throwing back a well-marked retonation wave, but also because it shows the peculiar banded structure (discovered by Dr. Campbell and his colleagues) not only in the explosion wave, but also in the region before the detonation is set up. Fig. 6 gives an excellent illustration of the banded flame of the explosion wave, which, the authors agree, must be attributed to the rotation of the head of the flame round the inner surface of the tube as it advances with a helical motion—the explanation suggested and then demonstrated by Messrs. Campbell, Woodhead, and Finch. How this rotation is checked when the flame comes in contact with an electrified surface is only hinted at in the present memoir, but already the Fraser camera has brought other mysteries to light. It is a fine weapon—and in capable hands.

Molecular Spectra and Molecular Structure.

THE Faraday Society met at Bristol on Sept. 24 and 25 for one of its valuable discussions on subjects of interest to physicists and chemists. The subject for this discussion was molecular spectra and molecular structure, and the importance of the subject could be gauged from the number of distinguished workers who were attracted from Germany, Holland, Switzerland, America, India, and Japan, and from the fact that thirty-eight papers were presented for discussion. These papers covered the whole field of inquiry in molecular spectra and focused attention on some of the problems still outstanding. The discussion was particularly valuable as it brought together workers in the infra-red, visible, and ultra-violet regions and provided them with an opportunity of correlating their results with those recently obtained from a study of the Raman effect.

One of the most important questions to be discussed was that of notation, for the present lack of agreement causes much unnecessary difficulty in the reading of the prolific literature which is at present being published. R. S. Mulliken, F. Hund, and others have recently agreed upon a tentative scheme, which was presented by O. W. Richardson. The main object of this scheme is to devise a notation in as close harmony as possible with that already agreed upon for atomic spectra. The quantum numbers n and l are retained with meanings analogous to those used for atoms, and in addition a quantum number λ is introduced for the projection of l on the molecular axis. Small letters are used for individual electrons, and capital letters for the electron system as a whole. Thus, the resultant of the l values of individual electrons is denoted by L, and the resultant orbital angular moment round the molecular axis by Λ. The individual electron spins are denoted by s, and the resultant by S, while the projection of S on the molecular axis is denoted by X. The quantum number of the sum total resultant angular momentum is denoted by J as in atoms. This consists of the electronic spin vector S and the resultant of orbital and rotation angular moments (together denoted by K). When individual electrons are known to have a definite angular momentum round the molecular axis, they are described as σ, π, δ, ϕ, . . . electrons according as $\lambda = 0, 1, 2, 3$ . . ., in analogy with the s, p, d, f, . . . notation of atoms. For the molecule as a whole, the molecular states are denoted by Σ, Π, Δ, Φ, . . . according as $\Lambda = 0, 1, 2, 3$, . . ., again in analogy with the S, P, D, F, . . . terms of atoms. Multiplicities are denoted as in atomic spectra, as, for example, $^2\Sigma$, $^4\Pi_{3/2}$.

There seemed to be general agreement among workers present at the discussion with regard to these main features, and criticism was directed mainly against other minor details. Those interested in polyatomic molecules urged, however, that the notation adopted for diatomic molecules should be capable of extension to more general cases.

One welcome feature of the discussion was that it led to a general stocktaking of the present position, and stimulated workers to review the advances made in the last few years. O. W. Richardson gave a summary of the results obtained for the hydrogen molecule, of which about forty different electronic levels are now known. W. E Curtis gave an account of the present position with regard to the band spectrum of helium, the analysis of which is nearly complete in the visible and ultra-violet regions. This spectrum is particularly interesting, as it shows that the l vectors of the individual atoms gradually become uncoupled from the nuclear axis as the rotation of the molecule increases and tend to become coupled to the rotation axis. The transition from one case to the other gives rise to striking anomalies of structure and intensity.

Apart from hydrogen and helium, the band spectrum which has received most attention is carbon monoxide, and at present 16 band systems are known. A detailed account of these was given by R. C. Johnson, who directed attention to the recent discovery by Asundi of a quintet level $^5\Pi$ in this spectrum (the first quintet to be recorded in band spectra) and attributed the third positive carbon band system to a $^5\Sigma \longrightarrow {}^5\Pi$ transition. This

conclusion is important, because, if correct, it necessitates a modification of the electronic levels of the CO molecule hitherto accepted. Johnson proposed a detailed scheme for the electronic configurations of carbon monoxide in its various levels. He also indicated the states of the carbon and oxygen atoms after dissociation from each state.

MOLECULAR FORMATION AND DISSOCIATION.

It is a matter of the greatest importance to the physicist and chemist to know what are the exact states of excitation of the component parts of a molecule on dissociation, for this knowledge can be used to control the reverse effect of combination. J. E. Lennard-Jones proposed an *Aufbau* principle for a number of diatomic molecules which provided this information. This investigation showed on theoretical grounds that some molecules would be expected to dissociate into normal components, others into one or more excited components. The molecular ion N_2^+, for example, would be expected to dissociate from its normal state into one *normal* N atom and one *excited* N ion, and it has been shown recently by Heitler and Herzberg that the experimental results point to the same conclusion. Other cases where a normal molecule separates into excited atoms were given in a paper by E. Bengtsson and E. Hulthén (Stockholm), who described some new results obtained for the spectra of some metal hydrides (CuH, AgH, AuH, etc.). A typical result is that CuH separates from its normal $^1\Sigma$ state into an excited Cu atom ($^2D'$ state) and an H atom in a $3d$ level.

F. Hund (Leipzig) contributed a paper on the general criteria for chemical binding. Theoretically, it is now possible by the new quantum mechanics to work out the interaction of two atoms in a molecule, but actually the calculations are so involved and so laborious that they have been carried out only in one or two simple cases, and it is desirable to have other simpler methods to indicate whether two atoms can combine to form a stable molecule or not. A method successfully used by Hund in many cases can be illustrated by considering the two pairs of atoms H + H and He + H in their fundamental states. One can form a molecule (H_2), the other probably not (HeH). The characteristic difference may be ascribed to the change in binding of the electrons in the two hypothetical processes: $H + H \rightarrow H_2 \rightarrow He$, and $He + H \rightarrow HeH \rightarrow Li$. In the first case, the binding of the electrons increases in the transition from the separated atoms to the united atom, while in the second case the binding of one of the three electrons is considerably diminished.

One of the interesting results of the work on band spectra is the determination of heats of dissociation. It has been observed that sets of vibrational levels often approach a point of confluence, that is, the separation of successive levels approaches zero, and it is now generally agreed that at the point of confluence one portion of the molecule (usually an atom) is separated from the remaining portion. If the vibrational energy levels can be followed up to, or almost up to, the point of confluence, the energy required for dissociation from the electronic level concerned becomes known. The ordinary heat of dissociation, as defined by the chemist, can then be deduced when the energy content (that is, the state of excitation) of the dissociated atoms is known. Unfortunately, it is not always possible to obtain a full set of vibration energy levels up to the limit of dissociation, and when only an incomplete set can be obtained, special methods have to be employed to infer the correct interpolation to dissociation. The most successful of these methods was given by Birge and Sponer three years ago and applied to nitrogen, oxygen, carbon monoxide, and other molecules. An improved method is now suggested by R. T. Birge which was described in a communication to the discussion. The essential point of the paper referred to a new method of plotting the frequency of vibration, which, it was claimed, leads to more trustworthy values of the heat of dissociation. The most probable values of the heats of dissociation of nitrogen and oxygen are now given as 9·1 volts and 6 volts respectively. Out of this investigation has emerged the fact that in many cases the plot of the frequency differences against quantum number possesses a point of inflection, which, it is suggested, is due to a discontinuity in the process of dissociation; it is considered that at the discontinuity, a molecular rearrangement occurs.

The band spectra of polyatomic molecules show a more gradual transition from band to continuous spectra. V. Henri and his colleagues find that with complex molecules the bands become *diffuse* before passing into a continuous spectrum. These diffuse bands are attributed to a loss of rotational quantisation. V. Henri employs the term 'predissociation' to indicate the state of the molecule after receiving energy corresponding to the wave-lengths in these diffuse bands, and brings forward evidence to show that in this state the molecule is photochemically active. He concludes that the vibrational bands become diffuse on account of a molecular rearrangement which takes place within a time interval which is less than the period of rotation but greater than the period of vibration of the molecule. This rearrangement may consist of dissociation into atoms or may be due to some change of molecular level. In a discussion of the above phenomena, V. Henri showed that the production of diffuse spectra is favoured by raising the temperature. A paper by S. Barratt reported the occurrence of similar diffuse bands in the spectra of the molecules formed by zinc, cadmium, and mercury with the alkali metals.

Ellis has applied the methods of Birge and Sponer to the calculation of the heats of dissociation of C – H and N – H groups in organic compounds. The results are in agreement with thermal data and indicate that the heats of dissociation of these groups are dependent on chemical constitution.

A paper by Goodeve and Stein on the absorption spectrum of chlorine dioxide provided an interesting example of a change of slope on the frequency difference–quantum number curve. This is of a different type from that discussed by Birge.

The rotational structure of the vibrational bands disappears at the point of change of slope; thus these experiments link up with those of V. Henri on predissociation. The theoretical basis of such phenomena is far from being understood.

BAND SPECTRA AND ATOMIC NUCLEI.

The study of band spectra promises to be a valuable source of information about the masses and structure of nuclei, and in particular seems likely to lead to the discovery of many new isotopes. The rapid advances which have been made in this field during the past year were summarised by R. T. Birge. Already it has been established that there are oxygen isotopes of mass 17 and 18, and that carbon has an isotope of mass 13. It may be that *all* elements have isotopes, although the agreement of Aston's mass determinations with the usual chemical atomic weights proves that any isotopes as yet unknown can only be present in very small amounts. For the detection of such faint isotopes, the analysis of band spectra seems superior to the mass spectrograph, though, as band spectra give only *relative* masses of two isotopes, the two methods must be used to supplement each other.

The evidence of band spectra as to the *spins* of nuclei was summarised in a paper by R. S. Mulliken. In the spectra of molecules which contain two nuclei, equal both in charge and mass, every other line in each series of band lines is relatively weak or else missing. Heisenberg and Hund have suggested that this phenomenon can be explained by assuming that a necessary condition of existence for any state of a molecule is that it be antisymmetrical in all protons as well as in all electrons. The correctness of this antisymmetry rule for the extra-nuclear electrons in atoms is well established by the facts of line spectra. Its applicability to protons is confirmed by the specific heat and band spectrum data for hydrogen,[1] but whether it applies to protons and electrons in complicated nuclei is still doubtful. There are difficulties in the case of N_2. In most cases the alternating intensities observed in the Raman effect are in complete agreement with those of band spectra and in accord with theoretical expectations; but for nitrogen, Rasetti finds that transitions between the even levels of the ground state are more intense than those between the odd levels. As nitrogen in the ground state is $^1\Sigma$ like H_2, and from the constitution of the nuclei would be expected to have a nuclear spin like that of hydrogen, the result seems to be in conflict with the rule given above.

It seems as if the eigenfunction of the nitrogen molecule is symmetrical in the nuclei. This means that the nitrogen nuclei follow the Bose statistics, whereas, as pointed out by Mulliken, they would be expected to follow the Fermi statistics, because they contain an odd number of particles which follow the Fermi statistics. In the course of the discussion, G. Herzberg gave the recently published views of Heitler and himself that in the nucleus the electron not only loses its spin (as shown by Kronig) but also its influence on the statistics. If true, this is a new and remarkable result.

[1] *Added in proof:* In a contribution to the discussion just received, J. C. M. McLennan finds similar confirmatory evidence from the Raman lines of liquid hydrogen.

THE RAMAN EFFECT.

The discussion on the Raman effect was opened by Sir C. V. Raman, and papers were contributed by R. W. Wood, J. Cabannes, P. Daure, H. S. Allen, A. M. Taylor, and A. C. Menzies. Raman gave a historical survey of his discovery and emphasised the necessity for linking up the effect with the diamagnetic susceptibility and optical anisotropy of crystalline substances. The new method has opened out many possibilities of development for the chemist, in particular in the direction of increasing our knowledge of the vibration frequencies and structure of organic molecules. The light scattered when a beam of monochromatic radiation passes through gaseous, liquid, or solid media is resolved into a series of bands of frequency, $N \pm n$, where n corresponds with the characteristic rotation and vibration frequencies of the medium. The agreement between the values of n and the frequencies of the infra-red bands affords a proof of the correctness of Raman's interpretation of the spectra discovered by him. It is, however, one of the important features of the Raman effect, that the frequencies of the scattered radiation indicate the existence of vibrations in molecules which are optically inactive in absorption. These had already been inferred, but could not be demonstrated from the infra-red spectra. For example, Schaefer showed in his paper that the infra-red vibration levels of the CO_3 ion can only be interpreted on the assumption that a number of the absorption bands are due to inactive vibrations occurring in combination with active vibrations. The frequency of the optically inactive fundamentals which is required for adequate explanation of infra-red spectra, is precisely that which is found in great strength in the Raman effect. A parallel case is that of the molecule of carbon dioxide, the optically inactive vibration of this molecule coming out strongly in the Raman spectrum (Rasetti).

The high degree of dispersion which is possible by the Raman method, has resulted in the separation of the C – H bands into several components. Raman showed spectra in which this band is resolved into four clearly distinguishable components, a resolution which has also been effected by Petrakaln and R. W. Wood. The latter contributed a paper in which the improvements in experimental technique necessary to obtain this result were described.

It was emphasised that the frequencies of the lines due to C – H in aromatic and aliphatic compounds are different, and the degree of polarisation strikingly so. The lines from cyclohexane are intermediate between those of aromatic and aliphatic compounds. The theory of the intensities and degree of polarisation of the Raman lines received attention in papers by Cabannes, who

emphasised the value of the spectra in amplifying the information about crystal structure which is gained by the X-ray method. Daure directed attention to the differences between the spectra of liquids and gases, and pointed out the importance of the effect in the study of the association of liquids. A. M. Taylor's work on the Raman lines of AX_4 ions shows that the frequency of vibration is diminished on destruction of the crystal lattice and on hydration of the group, and Menzies described experiments in which measurements had been made of the Raman effect with powdered crystals (see also NATURE, Oct. 5, p. 511).

STRUCTURE OF UNEXCITED MOLECULES.

In the last few years there has been a rapid advance in our knowledge of the rotational and vibrational levels of molecules in the unexcited state. The study of infra-red absorption spectra has revealed not only the magnitude of internuclear distances and the nature of structural arrangements in space, but also has yielded precise information about the rotational and precessional movements of molecules. Detailed knowledge is at present limited to simple molecules in the gaseous state. For complex organic molecules, studied in the solid or liquid state, only the vibrational levels have been systematically examined, such as those of C – H, C = O, C – OH, N – H, C ≡ N groups, and the manner in which the frequency of these levels changes with modification in chemical constitution. In an introductory address on the infra-red spectra of gases, Sir Robert Robertson outlined the advances so far made, especially with reference to their bearing on chemical problems.

E. F. Barker and C. F. Meyer, in a survey of the experimental investigations on the vibration bands of simple molecules in the gaseous state, proposed a method of classification of molecules into groups according to the complexity of the rotational levels. Diatomic and linear molecules like carbon dioxide and acetylene only rotate in a plane and show no precession. Methane, on account of its symmetry, can rotate about any axis without precession, but, in general, polyatomic molecules rotate with a precession the complexity of which depends on the molecular symmetry. Ammonia, ethane, methyl fluoride, etc., which have symmetry about one axis of rotation, give a less complex rotational structure than water, sulphuretted hydrogen, and ethylene, which possess three unequal moments of inertia. It is a curious fact that carbon dioxide is linear, while water is a triangular molecule.

A noteworthy advance is made in the interpretation of molecular spectra by the application of the conception of nuclear spin. The acetylene bands exhibit a striking example of alternating intensities which are analogous to those observed in molecular hydrogen and can be explained in a similar way. The two hydrogen protons of acetylene, both spinning in directions parallel to the axis of rotation, may have either the same, or opposite, spins. Thus there seem to be two types of acetylene molecule, just as there are two types of the hydrogen molecule. The bands of molecules like methyl fluoride and ammonia, which have triple proton symmetry about a rotation axis, show every third rotation level intensified. The double Q branch of ammonia at 10·3 μ and 10·7 μ was discussed by Robertson and Barker. The view expressed by Barker is that the atoms of the ammonia molecule are nearly, but not quite, in a plane. The potential energy function for such a molecule would be symmetrical about the plane of the hydrogen nuclei and would have a minimum on each side. The possible vibration levels of the nitrogen in such a field would divide into sets, the eigenfunctions for one set being symmetrical and for the other antisymmetrical. Moreover, the energy levels of each set would be approximately coincident. The symmetrical set would be present for one type of nuclear spin, the other set for another type of nuclear spin. Combinations between consecutive levels of the symmetrical set give one of the Q branches of ammonia and the combination between the corresponding antisymmetrical levels the other Q branch. The double Q branch in ammonia may, therefore, be ascribed to the nuclear spins, as the symmetry properties of these determine the permissible symmetry properties of the vibrational eigenfunctions.

Mecke and Badger have succeeded in photographing the higher harmonics of the frequency bands of ammonia which occur in the near infra-red. The fine structure of these bands is analogous to that of bands in the further infra-red. This is a marked advance in the technique of the study of vibration bands.

The vibration levels of the C – H, N – H, C = O, etc., groups are now known, due to the labours of Bonino, Lecomte, Ellis, Sallant, and others, and by the Raman method it is found that the C – H levels are multiple. There appears to be a level for each C – H group in the molecule, the greatest difference in frequency occurring between the levels of C – H in aliphatic and aromatic compounds. G. B. Bonino discussed the effect of chemical constitution on the fundamental frequency of this group, and considered the effect of lengthening the carbon chain, of the presence of the double linking between carbon atoms, and the influence of hydroxyl and halogen substitution. The extinction coefficients of the absorption bands are found by Bonino not to be proportional to the number of groups in the molecule; investigation of the individual C – H levels from this point of view has yet to be undertaken.

THE SOLID STATE.

In an address on the infra-red spectra of solid bodies, C. Schaefer summarised the information so far obtained with regard to the frequency of vibration of crystal lattices and the vibration of atoms composing physically distinct groups in the crystal. The detailed investigations of Schaefer on the crystalline carbonates and nitrates have brought to light the optically inactive vibrations of the CO_3 and NO_3 ions, and also have indicated in what manner the vibrations of the atoms in these groups

depend on the crystal symmetry. The main features of the vibrations of these groups, their frequency, for example, are but little affected by the cation. This is in accord with the structure of these ions as deduced by X-ray analysis. In uniaxial crystals, however, the frequency bands are doubled, and this may mean that the equilateral of the CO_3 ion is distorted, though this has not hitherto been detected by Röntgen analysis. The infra-red spectroscope can, therefore, be used to supplement researches with X-rays.

Water of crystallisation gives nearly the same frequencies of vibration as liquid water, but the bands are doubled in uniaxial and tripled in biaxial crystals, showing that the symmetry of the water molecule partakes of that of the crystal as a whole.

This collection of papers when published in book form will doubtless be a welcome addition to the libraries of those interested in molecular structure.

W. E. GARNER.
J. E. LENNARD-JONES.

Obituary.

WALTER HEAPE, F.R.S.

WALTER HEAPE, whose death occurred on Sept. 10, was the son of Benjamin Heape of Manchester, and Mary Heape, daughter of Joshua Heap of Liverpool. Walter was born in London in 1855, and after completing his education at the age of eighteen, entered into business, and was thus occupied until 1879. He was a man of some fortune, and had business interests in different parts of the world, and to these he devoted himself intermittently throughout a great part of his life. But at quite an early age he realised that he had a natural aptitude for scientific pursuits, and coming under the influence of Francis Maitland Balfour, he proceeded to study embryology, a branch of zoology which at that time was undergoing rapid development.

Heape came to live in Cambridge in 1879 as soon as he gave up business. In 1882 Balfour died, and the organisation of zoological teaching and research in Cambridge fell to Adam Sedgwick, who carried on the tradition of his department as a centre for embryological investigation. In conjunction with Sedgwick, Heape undertook the part-authorship of the well-known "Elements of Embryology", published under the names of Foster and Balfour, and for many years in constant use by students of zoology. In 1882 he was appointed demonstrator in animal morphology, but he had no great interest in teaching, and after two years relinquished the post to take up the duties of superintendent of the laboratory of the Marine Biological Association. This appointment he held for two years.

In 1890, Heape was elected to the studentship founded in memory of Balfour for the promotion of zoological research. He was the second Balfour student (succeeding Caldwell) and he occupied the position for three years, after which he held no further academic appointment.

Heape's earliest original work was that on the development of the mole, issued in the *Quarterly Journal of Microscopical Science* in 1886. This work is generally admitted to be a model of its kind and it definitely broke new ground. It was not, however, until Heape's tenure of the Balfour studentship that he commenced those researches on the comparative morphology and physiology of the reproductive processes for which he made his name famous. The earliest of these were upon the menstrual cycle in monkeys, and were published in two elaborate papers in the *Philosophical Transactions* (1894–97). Not only did Heape describe fully for the first time the histology of the uterine cycle, but he also gave an account of the ovarian changes, showing that although the uterine cycle may continue throughout the whole year, ovulation and breeding are often restricted to certain special seasons, and that menstruation, therefore, may occur quite independently of ovulation, a fact which has recently been confirmed by Prof. Corner. In order to investigate the subject as fully as possible, Heape went to India, where he collected his material, which consisted of monkeys of two genera. Afterwards he supplemented his researches by a study of the menstrual processes in woman, and published a paper in the *Transactions of the Obstetrical Society*. He also, about the same time, published papers on the successful transplantation of fertilised ova from one rabbit to another (and so into a uterine foster mother), on artificial insemination, and on fertility, barrenness, and abortion in sheep.

Heape's best-known work is probably his memoir on the "Sexual Season of Mammals", which appeared in the *Quarterly Journal of Microscopical Science* in 1900. It contains a comparative account of the œstrous cycle for all the different groups for which any data existed. This memoir formed the basis of much future work, and although a certain number of Heape's conclusions have had to be revised in the light of later investigation, the paper will always stand as the first important contribution to the comparative physiology of breeding in the higher animals. It is doubtful whether Heape ever fully grasped the significance of the endocrine functions of the ovaries, and he appears at one time to have entertained the view that the œstrous cycle might continue after these organs had been removed. But it must be remembered that he never had any training in physiology, neither had he worked in a physiological laboratory; yet, in spite of that, his work gave a remarkable stimulus to research in the physiology of reproduction. In 1905, Heape published a paper on ovulation and the degeneration of ova in the rabbit, in which he postulated the seasonal appearance in the blood of a 'generative ferment' which was responsible for the reproductive and sexual activities. It is interesting to note that he was the first to discover that in the rabbit ovulation is dependent on coition, and that it takes place almost precisely 9½ to 10 hours after coition, an observation which, with some modifications, has since been extended to other animals.

Heape was also interested in the question of sex determination, and his latest papers were upon this subject. It was at one time rumoured that in certain instances he claimed to have controlled sex. His views, however, were shadowy, and he never clearly formulated them, but latterly, under the influence of the Mendelian discoveries, he adopted the theory that the gametes were themselves sexual, and that in certain circumstances the environment exercised a selective action on the life of the gametes, there sometimes being a preponderance of male gametes surviving, and sometimes an excess of female ones. In support of this view he published papers on the sex-ratio in dogs, in canaries, and in the human population of Cuba.

Mention must also be made of Heape's strong appreciation of the practical side of his subject. His papers on fertility have been referred to above, but he also wrote a book on "The Breeding Industry" (1906), in which he emphasised the economic importance of that industry in Great Britain, the desirability of animal breeders keeping records of their experiences so that these should be available for future use, and the necessity for improved organisation and for the application of scientific method to all branches of livestock breeding. Heape showed also a practical interest in questions of fertility in man and published a book entitled "Preparation for Marriage" (1914). Another book he wrote was called "Sex Antagonism" (1913), and consisted largely of a criticism of Sir James Frazer's "Totemism and Exogamy". Heape also planned the publication of a text-book of comparative embryology to be completed in three volumes. Of these, the first two only have appeared, and he relinquished the editorship after the publication of the first volume, on the invertebrates, by Prof. E. W. MacBride.

In 1891, Heape married Ethel, daughter of Joseph Ruston of Lincoln; she died in 1925. They had one son and one daughter. When in residence at Cambridge, Heape joined Trinity College, and the University conferred upon him the honorary degree of M.A. in recognition of his work and position. He was elected a fellow of the Royal Society in 1906. After leaving Cambridge in 1907, Heape lived successively in Southwold and London and finally in Tunbridge Wells. He was a partner in the 'Heape and Grylls' rapid cinema machine company.

Heape had a strong enthusiasm for his subject and was ever ready to help and encourage others. Had he been a teacher, there is little doubt that he would have had many pupils who would have devoted themselves to generative physiology. As it was, his influence lay chiefly in his writings.

F. H. A. MARSHALL.

LADY BRAGG.

IT is not easy to express in these columns the deep loss which science has sustained by the death of Lady Bragg on Sept. 29. She possessed the quality of radiating the sunshine of life wherever she was—at the University of Leeds, University College, London, and since 1920 at the Royal Institution—and her gracious influence cleared away all clouds as surely as the sun does in the solar system, enabling us thereby to see the stars. It was impossible not to be uplifted and stimulated by her smile, and scientific workers both young and old will cherish it as a glad memory throughout their lives. She did indeed reveal to all with whom she came in contact the "purity of grace. The mind, the music breathing from her face, the heart whose softness harmonised the whole."

Both birth and circumstance combined to produce the note of perfect harmony in Lady Bragg's life. She was the daughter of Sir Charles Todd, Government Astronomer and Superintendent of Telegraphs, South Australia, and in 1889 married Sir William Bragg, who was then professor of physics in the University of Adelaide. By understanding, as well as by social position, she was therefore richly endowed with the power to give light and leading to all around her, and she used her gifts always to promote noble life and high endeavour. We offer Sir William Bragg our deepest sympathy at the loss of his devoted partner, whose influence will be greatly missed over a wide circle. We are thankful for her life, and find consolation in the thought that her spirit remains with us for help and guidance, though she herself has passed into silence.

WE regret to announce the following deaths:

Prof. H. Beckurts, formerly professor of pharmaceutical and food-stuffs chemistry at the Technical Highschool at Brunswick and joint editor of the *Archiv der Pharmazie*, who issued the "Jahresbericht für Pharmazie" from 1881 until 1924, on Sept. 15, aged seventy-four years.

Frank Hurlbut Chittenden, entomologist in the bureau of entomology of the U.S. Department of Agriculture, known for his work on Coleoptera, on Sept. 15, aged seventy years.

Dr. Edward B. Craft, executive vice-president of the Bell Telephone Laboratories, vice-chairman of the engineering and industrial research division of the U.S. National Research Council, on Aug. 21, aged forty-seven years,

Prof. Andrew A. Kerr, head of the department of anthropology in the University of Utah, on Aug. 15, aged forty-nine years.

Dr. George P. Merrill, head curator of geology in the U.S. National Museum and a member of the National Academy of Sciences, known for work on petrography and the history of American geology, on Aug. 16, aged seventy-five years.

Mr. W. DeW. Miller, associate curator of ornithology of the American Museum of Natural History, on Aug. 4, aged fifty years.

Dean F. Franklin Moon, head of the New York State College of Forestry since 1920, and chairman in 1924–26 of the New York section of the Society of Foresters, on Sept. 3, aged forty-nine years.

Prof. R. P. Pictet, of Geneva, whose name will be remembered in connexion with his papers published in 1877–78 on the liquefaction of oxygen, aged eighty-four years.

Dr. Morton Prince, emeritus professor of neurology at Tufts College and associate professor of abnormal and dynamic psychology at Harvard University, who edited the *Journal of Abnormal and Social Psychology* and was president in 1909 of the American Neurological Association, on Aug. 31, aged seventy-four years.

News and Views.

THE views expressed in our leading article in this issue upon the composition of the Royal Commission on the Civil Service represent, we believe, the feelings of scientific workers generally. As at present constituted, the Commission cannot be regarded as competent to assess the importance of according to the scientific and professional staffs of the Civil Service their share in formulating policy. The Royal Commission will also have to consider whether an administrative structure designed to meet Victorian conditions has adapted itself to modern needs, and in this connexion the Commission would undoubtedly have been strengthened by the presence of one of those students of public administration whose names are familiar to those who have before them the ideal of efficient State machinery. In our issue of Aug. 31, we referred to the proposals submitted by the Institution of Professional Civil Servants to the Treasury Committee presided over by Sir Harold Carpenter for the creation of a unified State Scientific Service, of which a Ministry of Science would be the ultimate expression. We learn that the chairman has ruled that the latter project is outside the terms of reference of the Committee, although they include the examination of the functions and organisation of the scientific and research establishments. In view of the chairman's ruling, it is evident that the Institution's proposals for the unification of the scientific services will have to be carried to the Royal Commission.

IT is absolutely essential to an adequate consideration of far-reaching structural proposals of this type that scientific workers of standing should be added to the Royal Commission. Royal Commissions on the Civil Service come at necessarily lengthy if fairly regular intervals, and it will be disastrous if, through the absence of any representatives of those elements which have determined the course of modern social evolution, the traditional organisation of the Civil Service should be stereotyped for another twenty years. The Council of the Institution of Professional Civil Servants has signified "its concern that the Commission includes no representative of science, no representative of the professions (other than accounting), and no person of eminence who has devoted study to the problems of public administration", and feels strongly that "the presence of such representatives would have been of great assistance to the Commission in its deliberations, and would have increased the confidence of the public and of the Civil Service in its ultimate findings". Few scientific workers will dissent from this view; it is to be hoped that steps will be taken to repair these omissions.

THE absence of any attempt on the part of our Governments to create a national reserve in Britain has more than once been referred to in the columns of NATURE. The United States of America and our own dominions and colonies have led the way in setting apart great tracts of country for the preservation of wild Nature as it is represented by striking features of topography and by forest, flora, and fauna; all for the education and pleasure of the people now and in years to come. It may be urged in excuse of our lack of action that these younger countries are favoured with great open spaces and a sparseness of population which make it an easy matter to stay the march of civilisation in some remote district. Yet, remoteness is a relative term, with wide interpretations, as is shown by the controversy over the Zululand reserves to which we referred in a leading article on Nov. 24, 1928. If we turn to the older and more populous countries of the world, our excuse would appear to become thin indeed, for there is scarcely a State in Europe or abroad but has been able to afford, and has thought it worth while affording, space for one or more national parks of considerable area. Further, comparison of the condition of Great Britain, from the point of view of cultivation and settlement, with the conditions in European States does not support the idea that density of population or extensiveness of agricultural activities are less favourable to the creation of a national park here than on the Continent. Speaking roughly, about 18 per cent of the total land surface of Great Britain is unproductive, against some 20 per cent in each of Russia and Spain, 14 per cent in France, 13 per cent in Italy, and 9 per cent in Germany. Here, surely, even in Britain, is room for a national reserve.

ON these grounds, it is with interest and hope that we observe the announcement, published on Oct. 2, that the Prime Minister has appointed a Committee to canvass the possibilities of a national park in Great Britain. The terms of reference are wide: "To consider and report if it is desirable and feasible to establish one or more National Parks in Great Britain with a view to the preservation of natural characteristics including flora and fauna, and to the improvement of recreational facilities for the people; and to advise generally and, in particular, as to the areas, if any, that are most suitable for the purpose." The Committee selected is a strong one, composed of representatives of Government departments likely to be concerned in the project—Agriculture and Fisheries, Crown Lands, Health, Scottish Agriculture, Home Office, Office of Works, Forestry, and, last but certainly not least, the Treasury. We have only one criticism to make concerning the composition of the Committee, and we consider it to be a serious one. The preservation of the fauna and flora must be one of the prime ends of the creation of a national park; indeed, in other lands the existence of the wild inhabitants of the reserves is the subject of the most careful consideration and of detailed regulations bearing upon the public and the relations of the creatures themselves. That being so, it seems extraordinary that the Committee should include no scientific naturalist, familiar with the minute distribution of beasts and birds in the wilds of Britain, with the compatibilities of existing species, and with the possibilities of introducing species now extinct in particular areas.

THE reports on the annual meeting of the British Cotton Industry Research Association, held in Manchester on Oct. 1, are notable in that they mark a new phase in the activities of one of the largest of the

industrial research associations in Great Britain. The Association is now starting on the third of the five-year periods into which its existence has been divided for financial reasons. The Department of Scientific and Industrial Research has made large grants to the Association during the past ten years for development purposes, and it was thought that the cotton industry would take on the responsibility of maintenance of the Association at the end of this period. The cotton industry has doubled its contributions to the Association during the second half of this ten-year period, but, with the exception of the finishing section, the industry finds itself unable to increase its subscriptions to meet the demand for £75,000 per annum which the Council of the Association considers necessary for the development of its work during the next five years. In this opinion the Council is supported by the Department of Scientific and Industrial Research, which has offered, and the offer has been accepted, to contribute a pound for a pound on all income from approved trade sources exceeding £25,000 per annum. At the same time, the Department holds the view that the cost of maintaining the present operations of the Association should be borne by the industry. The Association is now assured of an annual income of £60,000, which is £15,000 less than the amount the governing body considers necessary for the successful development of its plans.

THE work of the Association during the past ten years has been directed mainly to the examination of the properties of cotton in all its forms. Thus many years have been spent by a large and capable staff of scientific workers in laying the foundations on which larger scale investigations could build. The Association is extending its premises to house machines representing those used in modern practice with which larger scale investigations will be made. The relationship between the Association and the cotton industry is now reaching an interesting and critical stage, and the next five years of the Association's work will be anxiously followed by all who believe that the salvation of the industry lies in extensive research work. It is very unfortunate that the industry and the Association are simultaneously passing through a depressing time. If the next five years do not bring the desired trade revival, it is difficult to foresee how the industry will be able to make use of the work of the Association. £75,000 per annum is a very large sum, but it is only a small fraction of the amount which would have to be expended in putting semi-practical scale results into successful practice. The simultaneous arrival of a trade boom, a successful period of research work by the Association, and a body of men sufficiently capable of making and successfully carrying through large scale changes in industrial method, appears to be the only hope for a happy issue from a difficult situation.

THE international exchange offices (for the collection and dispatch of consignments of literature) which have been set up as government departments on the Continent have no exact counterpart in Great Britain. Their functions have been to some extent undertaken by the Universities' Library for Central Europe, established in 1921, in co-operation with the Universities' Relief Committee, to co-ordinate and consolidate the securing by gifts, exchange and purchase, of British books, journals, etc., to meet requirements, otherwise likely to remain unprovided for, in continental universities. In our correspondence columns this week (p. 576) appears a letter from the honorary secretary appealing for support for what must be regarded, by all who believe in the world value of British thought and achievements in science and the humanities, as a work of vital importance. It will be noticed that the British Museum, the Royal Society of Edinburgh, and the University of Leeds make use of the Library's outward services. Offices are supplied rent-free in the London School of Economics, and a large proportion of the work is carried out with voluntary assistance. Opinions may differ as to the expediency of national governments undertaking work of this kind and the consequent risks of intrusion of political considerations and designs, but exception can scarcely be taken on principle to the suggestion of a modest but regular government grant for enabling the Universities' Library to give to its work the comprehensive character without which it labours under a heavy disadvantage. It is merely a question of evaluation of the work — and this from at least two points of view. It is clearly a national interest, deserving support from the national exchequer, that international commerce of ideas should flourish, and likewise that international amity should receive such stimulation as can be afforded by a knowledge abroad of English culture and ideals, language, literature, and methods of government. The service in question seems well designed for the promotion of both interests.

AT the end of September last, Prof. J. W. Gregory left the University of Glasgow on his retirement from the chair of geology, thus bringing to a close twenty-five years of honoured and fruitful service to the University. During that period the membership of his classes has risen from 15 to 400, and in his last session he lectured to the largest geological class in the British Isles, if not in the world. His skill as an organiser and his powers as a lecturer have been well displayed in dealing with the unique teaching problems brought about by these enormous numbers. Under his inspiration and guidance, the Glasgow geological school has produced a large amount of original work, which, in recent years, has been embodied in the annual volume of Collected Papers from the Geological Department of Glasgow University. Prof. Gregory has inspired numerous young men to take up geology as a career, many of whom are now in prominent positions in the geological world. He retires with the good wishes and affectionate regard of a host of present and former students, staff, and other friends.

IT is almost impossible in a paragraph to recount Prof. Gregory's scientific work, or to assess his influence on geology. His extraordinary versatility and powers of work are well known. Not only as geologist, but also as geographer, explorer, and social economist, has he won scientific fame. His twenty books and three hundred papers cover subjects ranging from palæontology to ore deposits, from the geology of

East African rift valleys to the origin of fiords, from structural and comparative geography to social problems such as the 'menace of colour' and human migration. His journeys in East Africa, Spitsbergen, Central Australia, Cyrenaica, Benguella, and Chinese Tibet are well known, and his racy travel books are models of their kind. There is scarcely a department of geology which he has not enriched by original observation and illumined by brilliant theory; and while he has been accused of a tendency to champion 'lost causes', his views have been frequently vindicated in the advance of the science, the latest example being found in Prof. A. Holmes's letter to NATURE (Sept. 28, 1929, pp. 477-8) on "Ore-lead and Rock-lead and the Origin of certain Ore Deposits".

Two notable personalities on the roll of English science celebrated birthdays during the past few days: they are Sir Philip Magnus, Bart., who, on Oct. 7 celebrated the eighty-seventh anniversary of his birth, and Prof. W. C. McIntosh, whose anniversary, on Oct. 10, marked the span of ninety-one years. Sir Philip Magnus was educated at University College School. One of the oldest living graduates of the University of London, he was its Parliamentary representative from 1906 until 1922, whilst for upwards of thirty years he acted as superintendent and secretary of the Department of Technology, City and Guilds of London Institute. Prof. McIntosh, born at St. Andrews, where he still manifests amazing vitality, is an *alumnus* of the ancient university of that city. His reputation as a zoologist is world-wide. He has added to our knowledge of sea fisheries in remarkable measure, and their industrial importance has been much enhanced through his labours. He was the first to found a marine biological station in Great Britain. Prof. McIntosh is a Royal medallist of the Royal Society.

So much is at present under discussion respecting naval disarmament, sea power, and treaties of parity, over and above which looms a Five-Power Conference for next year, that it seems opportune to recall that the foundation, in 1900, of the Sir George Chesney gold memorial medal by the Royal United Service Institution was followed by its unanimous award, in the first instance, to that distinguished officer of the U.S. Navy, Capt. A. T. Mahan. When the initial award of the medal was considered, it was resolved that Capt. Mahan should be invited to accept the distinction in recognition of the three great works of which he was the author, namely, "The Influence of Sea Power upon History", "The Influence of Sea Power upon the French Revolution and Empire", and "The Life of Nelson". In acknowledging the gift Capt. Mahan recorded his satisfaction that "my works have contributed in some degree to the welfare of the British Empire, the strength of which is so essential to the cause of our English-speaking race, and of mankind in general".

ON Oct. 15 occurs the centenary of the eminent American astronomer Asaph Hall, the discoverer of Phobos and Deimos, the two satellites of Mars. Born at Goschen, Connecticut, he was left an orphan at thirteen years of age, and from the village school became an apprentice to a carpenter. He made unusual use of his opportunities, however, and was able to study mathematics at Norfolk, Connecticut, Mcgrawville, New York, and at the University of Michigan, and in 1857 became an assistant to Bond at Harvard Observatory with a salary of three dollars a week. In 1862 he joined the staff of the Naval Observatory at Washington, and the following year was appointed a professor of mathematics in the United States Navy. He remained connected with Washington Observatory until 1891, counting among his colleagues Gilliss, Newcomb, Harkness, Hubbard, and Eastman. He was placed in charge of the 26-in. refractor in 1875, and with this instrument on Aug. 11, 1877, he discovered Deimos and on Aug. 17, Phobos. The names, we believe, were due to Madan (1838–1901), the first science master of Eton. It has often been pointed out that Kepler had predicted the existence of two satellites to Mars, and that such bodies figure in the romances of Voltaire and Swift. Hall was among the first to appreciate the value of observations of Mars for determining the parallax of the sun; he took part in solar eclipse expeditions, was an industrious observer of double stars and contributed papers on the secular perturbations of the planets. He received the Royal Astronomical Society's Gold Medal and many other honours. Five years after retiring from the Navy, in 1896, he was appointed to a chair of astronomy at Harvard, which he held until 1901. Hall died on Nov. 22, 1907.

IN a letter in the *Times* of Sept. 30, the Earl of Scarbrough describes and illustrates the monument which has been erected on Jebba Island in the Middle Niger to the memory of the African pioneers, Mungo Park and Richard Lander. The movement for the erection of the memorial originated in 1911 with Lord Curzon, president of the Royal Geographical Society; Sir G. T. Goldie, president of the African Society; and Lord Scarbrough as chairman of the Niger Company. Park, who was born near Selkirk in 1771, made his first journey in 1795–97 from the Gambia to Silla and near the sources of the Niger, and his second in 1805, which terminated in his death in the Bussa rapids not far above the site of the present memorial. Lander was born in Truro in 1804 and made his first journey in Africa in 1825, and was with Commander Clapperton (1788–1827) when the latter died near Sokota. Afterwards he made two expeditions to explore the River Niger, and it was during these that the question of the course and outlet of the river was settled. Attacked in canoes by the people of one of the Brass River chiefs, he was mortally wounded at Ingiamma, and died at Fernando Po on Feb. 6, 1834. The memorial consists of an obelisk 40 feet high and 11 ft. square at the base, built of concrete faced with granite. The tablet bears the inscription, "To Mungo Park, 1795, and Richard Lander, 1830, who traced the Niger from near its source to the sea. Both died in Africa for Africa".

ON Oct. 5, the Duchess of York opened the Scottish National Memorial to David Livingstone at Blantyre. The memorial consists of the tenement house in which

Livingstone was born in 1813 and an adjacent building, and it is hoped to form a museum of personal relics of the explorer. The one-room 'house' in which Livingstone was born is much as it used to be, and original pieces of furniture have been lent by members of the family. The main object of the memorial will be to present the life of Livingstone in a series of pictures and tableaux. Of the £12,000 collected for the memorial, the main part has come from Scotland or from Scottish people overseas; £150 was contributed by the tribe of Chief Khama, whose father was a personal friend of Livingstone.

THE abnormal warmth of September 1929 was maintained in the south-east of England up to the last day. At Greenwich temperature failed to reach 70° on five days only and reached 80° or above on six days. The following table shows the mean figures for this month, together with those for four other notably warm Septembers that have occurred since the record began in 1841:

Year.	Mean Maximum.	Mean Minimum.	Mean of Max. and Min.
1865	76·4°	53·7°	65·1°
1895	75·4	51·3	63·3
1898	74·5	51·3	62·9
1911	72·1	47·9	60·0
1929	75·5	53·3	64·4

The September of 1865 keeps its place as the warmest, although it was less than 1° warmer than last September. In 1911 the month began with intense heat, and gave the absolute maximum of 94·1°, while 1895 provided an extraordinary series of hot days late in the month, 80° being exceeded on six successive days, Sept. 23–28.

IT is not surprising to find the temperature of the soil, even at a depth of 4 feet, abnormally high also. On the last day of the month it was well above 60° at a number of places; at Margate it was so high as 63·2°, at Brighton 62·6°, and at Falmouth 62°. To what extent this state of affairs may be expected to affect agricultural operations in the remainder of the autumn is a difficult matter to decide. Unusual dryness of the soil no doubt reduces its capacity for storing heat, and at Margate the rainfall for the year had amounted to only 6¾ in. up to the end of September, or 44 per cent of the normal. Heavy falls of cold rain quickly lower soil temperature, and a cold and wet October would no doubt dissipate nearly all the excess of accumulated warmth, especially in that considerable proportion of England where the recent rains have scarcely begun to restore the normal moisture content below the first few inches of depth. With average conditions, however, plant growth for the rest of this month will certainly be unusually rapid.

"THE Authentication of Materials used in Research" was the title of the inaugural sessional address at the opening of the Pharmaceutical Society's School on Oct. 2, delivered by Prof. Henry Hurd Rusby, professor of materia medica at Columbia University, New York, who was on that afternoon presented with the Hanbury Memorial Medal for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs. Prof. Rusby selected as the text of his address the example of Daniel Hanbury, the namesake of the medal, whose habit it was to resort to extraordinary measures in his efforts to authenticate his sources of information. Varied examples of errors resulting from the incomplete description of new species and the failure to preserve type-specimens, led Prof. Rusby to the proposition that "it would not be going too far to decree that no report of research work in pharmacognosy, chemistry, pharmacodynamics or therapeutics shall be regarded as valid or given serious recognition, unless such report shall state where authenticated samples of the material employed have been permanently deposited". For botany and pharmacy there are the Kew Herbarium and the Museum of the Pharmaceutical Society, for therapeutics a beginning at least has been made by the adoption of samples deposited in named laboratories as international standards for biological assay. What of chemistry? The mass of chemical research proceeding daily in every civilised country gives rise to an endless number of new organic compounds which form the basis of new methods and new theories. To collect and classify, without any attempt at authentication, would be a colossal task. Controversies based on differences of material would be eliminated, a few reputations would be saved and maybe a few others lost; but whether the results would counterbalance the labour "admits a wide solution".

PHOTO-TELEGRAPHY and television are new industrial applications of science which make use of the ether. Being late-comers, they find that the earlier users of radio-communication have in all countries combined together to dictate the kind of waves that must be used in the ether. International laws and regulations have been made. The ether waves have been divided up into frequency bands, practically all of which have been allocated for various services. The authorities have little, if any, interest in the development of radio-optics. The present frequency band has a maximum breadth of 9000 cycles, apparently because this is the breadth of the band used in radio-telephony. We are glad, therefore, that Dr. James Robinson has in *Television* for October strongly protested against this monopoly of the ether. He points out that the common interests of those who are working or interested in radio-optics are the same. They should combine to improve the methods used in this science, and increase the facilities afforded for its development. If we ignore the factor of time, there is no fundamental difference in the principles of photo-telegraphy and television. In the latter case it is necessary to transmit a complete picture in less than a tenth of a second; the pictures succeeding one another as in a cinematograph, and thus giving the appearance of continuous motion. At present, organisations all over the world are working at this problem. At the recent radio exhibition at Berlin, the Baird, Karolus, and Mihaly systems were demonstrated. The German Post Office gave an excellent

demonstration of television. The stand of the Fernseh A.G., which showed the Baird system, was very popular.

THE twentieth annual Exhibition of Electrical, Optical and other Physical Apparatus is to be held by the Physical Society and the Optical Society on Jan. 7–9, 1930, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a Trade Section and a Research and Experimental Section, and in addition, a new section for the work of apprentices and learners is to be introduced. The Research and Experimental Section will be arranged in three groups : (*a*) Exhibits illustrating the results of recent physical research ; (*b*) lecture experiments in physics ; (*c*) historical exhibits in physics. The Exhibition Committee invites offers, from research laboratories and institutions and from individual research workers, of exhibits suitable for inclusion in any of the above three groups. Accommodation will be provided in rooms separate from those devoted to the trade exhibits ; and a part of the Catalogue will be devoted to their description. No charge will be made for space or catalogue entries in the Research and Experimental Section. Offers of exhibits, giving particulars of space and other facilities required, should be communicated immediately, and in any case not later than Oct. 30 to the Secretary, Exhibition Committee, 1 Lowther Gardens, Exhibition Road, London, S.W.7. The Section for Apprentices and Learners has been instituted with the object of encouraging craftsmanship in the scientific instrument trade. Apprentices and learners may exhibit, in competition, specimens of their work, providing they are in the regular employ of a firm subscribing to the prize fund which is exhibiting at the next Annual Exhibition, or has exhibited once during the past three years.

A PRELIMINARY notice of a World Poultry Congress, to be held at the Crystal Palace in July 1930, has been issued by the Ministry of Agriculture and Fisheries. The response to the British Government's invitation to the various countries of the world to participate in the Congress has been highly satisfactory, no fewer than 34 governments having already decided to take part. The Ministry is preparing a national exhibit for Great Britain and Northern Ireland, the keynote of which will be the demonstration of the high standard of excellence reached by the home small live-stock industries. The Ministry promises help to leading poultry and live-stock societies to enable them to exhibit effectively. It appeals to the public to become Congress members and to the breeders to contribute to the success of the section by exhibiting specimens. Forms of application for membership may be obtained from the World Poultry Congress Secretary, 10 Whitehall Place, S.W.1.

THE National Mark Scheme, which has already been applied to the sale of eggs, apples, and tomatoes, has been extended to English wheat flour as from Oct. 1. The scheme, which is described in the *Journal of the Ministry of Agriculture*, **36**, 513, is voluntary and open to all millers and packers, but only registered persons may use the grade designation marks prescribed. Application for enrolment can be made to the Secretary, National Mark Committee, Ministry of Agriculture, 10 Whitehall Place, London, S.W.1. Three grades have been prescribed, namely : (1) All-English Plain, (2) All-English Self-Raising, (3) All-English 'Yoeman'. Flour sold under these standard grades will be guaranteed as to type, flavour, and keeping qualities, and will not have been subjected to any chemical treatment. Under the conditions of registration, the packing premises, equipment, and records of any person employing the National Mark will be liable to inspection by an authorised officer of the Ministry of Agriculture, and samples of the wheat and flour may be required, so that the maintenance of a high standard of purity is assured. Besides offering advantages to bakers and consumers, the scheme should also benefit the arable farmer, who is at present experiencing great difficulty in obtaining a profitable market for his wheat.

THE University of Birmingham has issued a report on the work of its Mining Research Laboratory for the year 1928. With the support of the British Colliery Owners' Research Association, for some years a study has been made of the hydrogenation of coal, which shows that considerable variation occurs in the ease of attack and that commercial exploitation will probably demand the acceleration of the reaction by catalysts or otherwise. Aided by grants from the Miners' Welfare Fund, investigations have been made on spontaneous combustion and on the atmospheric conditions in deep and hot mines. These are cognate subjects of growing practical importance, as with the exhaustion of shallow seams the collier faces the difficulties of the deeper seams. The combination of heat and humidity is most embarrassing for those engaged in hard manual labour. It is interesting to learn that experiments are being made to dry the air of the mine with the aid of silica gel. Lastly, under the ægis of the Fuel Research Board, the physical and chemical survey of the Warwickshire Thick Coal is being pursued. The report shows that a considerable range of work is in progress on behalf of the mining industry, which has at its command much more scientific talent than might be inferred from the daily Press. Moreover, the results of careful study, such as is tabulated in this report, are frequently of immediate service to those concerned with the utilisation as well as the winning of coal.

PROF. H. L. CALLENDAR, of the Imperial College of Science and Technology, will deliver the Thomas Hawksley Lecture of the Institution of Mechanical Engineers on Nov. 1 at 6 P.M. He will take as his subject "Critical Relations between Water and Steam".

MR. J. REID MOIR has been elected president of the Ipswich Museum in succession to the late Sir E. Ray Lankester, in recognition of his services to science and prehistory and to the Ipswich Museum.

THE Norman Lockyer lecture for 1929 of the British Science Guild will be given by Sir Walter Morley Fletcher, who will speak on certain aspects of medical

research and their applications, on Tuesday, Nov. 19, at the Goldsmiths' Hall, Foster Lane, E.C.2. The Guild has also established an Alexander Pedler lecture in memory of Sir Alexander Pedler, for many years honorary secretary of the Guild. The lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler lecture will be delivered on Nov. 26 by Dr. G. C. Simpson, on "Past Climates". It will be held under the auspices of the Manchester Literary and Philosophical Society, 36 George Street, Manchester.

THE following appointments have recently been made by the Secretary of State for the Colonies to the Colonial Agricultural Services: Mr. J. D. Gillespie, to be agricultural superintendent, British Guiana; Mr. C. W. Lynn, Mr. A. S. Thomas, and Mr. J. M. Ward, to be assistant superintendents of agriculture, Gold Coast; Mr. A. C. Maher, to be assistant agricultural officer, Kenya; Mr. P. W. T. Boughton-Leigh, Mr. A. E. Trotman, and Mr. R. Turner, to be superintendents of agriculture, Nigeria; Mr. R. Leach, to be mycologist, Nyasaland; Mr. W. M. Nutter, to be librarian, East African Agricultural Research Station, Amani, Tanganyika Territory; and Mr. R. W. Stuckey, to be agricultural officer, Uganda.

NOTABLE additions to our knowledge of the natural history of South America are contained in the thirty-fourth volume of the *Anales del Museo Nacional de Historia Natural*, of Buenos Ayres, a bulky issue of 600 pages comprising contributions received from 1926 to 1928. The range of subjects dealt with is very wide, but specially noteworthy are the descriptions of a new genus of Glyptodon and other prehistoric animals from the Argentine, and an account of three new meteorites.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Assistants at the Road Experimental Station of the Ministry of Transport at Harmondsworth—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Oct. 16). Two junior assistants for research work on blast furnace reactions at the Imperial College of Science and Technology—E. C. Evans, National Federation of Iron and Steel Manufacturers, Caxton House (East), Tothill Street, S.W.1 (Oct. 18). Junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Oct. 19). A "Wander" Scholar and Registrar to the Children's Department of Westminster Hospital—The Secretary, Westminster Hospital, Broad Sanctuary, S.W.1 (Oct. 21). An assistant lecturer and demonstrator in botany in University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff (Oct. 31). An Elder professor of anatomy and histology in the University of Adelaide—The Agent-General for South Australia, Australia House, Strand, W.C.2 (Jan. 1). A part-time lecturer in chemistry and experimental physics at Queen's College, London—The Secretary, Queen's College, 43/47 Harley Street, W.1. An assistant bacteriologist at the Rothamsted Experimental Station—The Secretary, Rothamsted Experimental Station, Harpenden. A draughtsman for the Survey Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1786). Two research assistants in the Department of Chemical Technology of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7.

Our Astronomical Column.

Suspected Variation in the Radial Velocity of Arcturus.—*Astr. Nachr.*, 5652, contains an article by Herr W. Schaub, of Bonn Observatory, in which he gives some measures that he has recently made of spectrograms of Arcturus taken by Prof. Kustner in the years 1904–1907 in the course of his investigation of the solar parallax from the radial velocities of stars. These spectrograms give some indications of an oscillation in the star's radial velocity, the range being about 0.2 km./sec. on each side of the mean, and the period 41 days. The range is too small for the result to be regarded as established, but Herr Schaub publishes the note in the hope that other spectrograms of the star may be examined.

Three Huyghens Lenses.—We owe to Huyghens the discovery of the true nature of Saturn's ring and of its brightest satellite Titan. A description by Profs. R. A. Sampson and A. E. Conrady of three long-focus lenses in the possession of the Royal Society (*Proc. Roy. Soc. Edinb.*, vol. 49, part 4, No. 23) is therefore of interest to astronomers. Their focal lengths are 122 ft., 170 ft., and 210 ft.; their apertures are $7\frac{7}{8}$ in., $8\frac{3}{8}$ in., and $9\frac{1}{8}$ in. The quality of the glass is very bad; besides numerous bubbles and black particles, there is a network of innumerable fine veins; but Huyghens's skill in figuring is stated to be very great. An eye-lens of $2\frac{1}{4}$ in. aperture and 6 in. focal length is also described and illustrated; the object glass was mounted on a high pole in such a manner that by pulling a string it could be brought into alinement with the eye-piece. It is noted in the paper that when the objective and ocular are both single lenses of the same kind of glass, and when the focus is adjusted for the orange-yellow rays, the chromatic faults of the combination are less noxious than is generally believed.

Rotation of Satellites.—*L'Astronomie* for September contains an illustrated article by M. E. M. Antoniadi on this subject. It includes a series of careful drawings of several of the satellites, showing their surface markings, their diameters, and their albedoes. It is pointed out that in many cases we know, either by surface markings or by periodic changes of light, that the satellite rotates in the same time as it revolves round its primary. This law is extended by inference and argument to all the satellites, with the possible exception of the very distant ones of Jupiter and Saturn. A drawing of Uranus, made with the great Meudon telescope in 1924, when the orbits of the satellites were seen almost edgewise, shows a system of belts on Uranus, very similar to those on Jupiter, and parallel to the direction of the satellite orbits. The article compares the case of the planet Mercury with that of the satellites, and shows that in this case also we should expect *a priori* that Mercury would rotate in 88 days, a fact which observation has now confirmed.

Research Items.

Antiquities from Lambay, Co. Dublin.—Some forty objects found during the building of a sea-wall on the island of Lambay in 1927, and presenting some remarkable features, are described by Prof. R. A. S. Macalister in Vol. 38, Sect. C, 8-9 of the *Proceedings of the Royal Irish Academy*. They belong to two different periods, the earlier being relics of a settlement, the later of an interment. The earlier series includes axe-, adze-, and hatchet-heads of grit, lance-heads of flint, flakes of flint, rings of limestone, sharpening hones, and fragments of pottery. In the later series are the umbo of a shield in bronze, fragments of a circular object with ornament of repoussé moulding, showing characteristic La Tène curves, an armlet with eight beads of bronze playing upon it, between each pair a flat disc of bronze, three ornaments from a sword scabbard, rings and fibulæ of Roman provincial type, and a fibula of Rhenish provincial military type; in iron, the fragments of a sword, and a circular mirror of classical type; a ring in lignite, and a few fragments of leather. In both series certain special points are noted. The earlier series belongs to a neolithic or bronze age settlement, but the types are remarkably exotic. The adze-heads predominate in a way not common in Ireland, and they are made of unusual material. The javelin heads are definitely of an Iberian type, differing from the flat lozenge-shaped javelins which have been compared to Iberian types. The large quantity of flint is surprising and points to a constant supply, which it is suggested is new and unexpected evidence of early trade. The interment series is also remarkable in indicating a community at the end of the La Tène period which had established relations with Romanised provinces in an unprecedented way. The mirror and fibulæ are new in Irish archæology. One fibula was evidently copied from another in the series by a workman who, though highly skilled, did not understand the mechanism of his model. The pin in the copy is fixed to the catch so that the fibula could not be used as a brooch. The two series "open doors that give us new vistas in Irish history".

Evolution of the Human Skull.—Prof. William K. Gregory continues his studies of the evolution of the human head from fish to man in *Quart. Rev. Biology* (June 1929, p. 233). The present article deals with the *norma basalis*, and leads to a series of findings of general interest. Thus the bony tracts of the skull appear to be moulded around and with reference to other structures which are frequently represented by fossæ in the dried skeleton. The form of a particular bone is partly determined by its position with reference to the midline of the skull, and to the axis and direction of locomotion, as well as by the stresses of gravitation and muscular contraction to which it is subjected. The increase or decrease of a bone affects neighbouring structures and tends to change the shape of the skull as a whole, but there appears to be some regulating mechanism, analogous to surface tension, which keeps the members of a functional series in line, particularly in the less differentiated stages. Occasionally it is found that over a long geological period a given element, such as the ectopterygoid, may be relieved of its functions and crowded out, illustrating change of function and the substitution of one part for another. But, although bones may be pushed apart or remoulded, they show a natural conservatism or inertia, so that many of them are retained throughout the whole series from fish to man, a conservatism more marked in the basal than in the lateral aspect.

California Sardine.—In *Contribution* No. 69 from the California State Fisheries Laboratory, Francis N. Clark describes a study of the weight-length relationship of this sardine (*Sardina cærulea*). He uses a mathematical 'factor' F, calculated from the formula $F = 1000W/Lx$, where W is the weight of a fish, and L its length; and x is the power to which L must be raised in order to express the relation between weight and length. From the data derived from material of four seasons, the value of x was found to be 3·15, but for the purpose in hand it was considered sufficiently accurate to assign the value 3·00 to x; that is to say, to assume that the weight increases exactly as the cube of the length. Clark concludes that the weight-length factor F is a reliable index of condition and reflects the fat content of the sardine. The value of F fluctuates from month to month, and differs from season to season. A useful bibliography is appended which brings together more than eighty references from the somewhat scattered literature on the subject treated.

Chinese Crab Naturalised in Europe.—In 1912, for the first time, a Chinese crab, *Eriocheir sinensis*, was found in the Aller, a tributary of the Weser, in Germany. There is no definite knowledge of its mode of arrival, but presumably it was transported by shipping. Its spread since 1912 has been rapid, as Dr. W. Wolterstorff has discovered (*The Aquarium Review*, September 1929). Shortly afterwards, it was discovered in the lower Elbe, and in 1923 had reached Hamburg. In 1927 it was observed on the coast of the North Sea from Ems to Büsum, in the Havel near Brandenburg, and in the Elbe north of Magdeburg. Since then it has continued its rapid multiplication and dispersal, so that the author now knows at least thirty-five places on the middle Elbe and its tributaries where it has been found. It seems not yet to have penetrated to southern Germany, but a look-out should be kept in rivers bordering the southern North Sea for this oriental, which threatens to colonise a wide area in Europe.

A Possible Relict Fauna in Sydney Harbour.—Occasional records of molluscs from Sydney Harbour have suggested that attempts are being made by tropical forms to establish themselves there. Hedley suggested that the occurrences were seasonal, that when the Notonectian flooded the port they gained a footing, but perished when the stream swung off the shore. These odd records were met with some distrust, but Tom Iredale now finds that a large unrecognised molluscan fauna exists in the Harbour, and of this he has described several new genera and species (*Australian Zoologist*, vol. 5, March 1929). The material was obtained from the dredger *Triton*, but since a load weighs 1250 tons, only a cursory survey of the material could be made, although it was sufficient to indicate that many new forms are still to be discovered. Recently two valves of *Hippopus hippopus* were found, and this, with the other records, leads the author to the suggestion that the fauna in question may be a relict fauna, a reminder (or remainder) of the times when Sydney Harbour enjoyed a tropical climate. This supposition has often been confidently put forward as a result of geological studies, but the time required from such data has always referred to an age much earlier than the apparent age of the collection of molluscs which has just been discovered.

Diptera of Patagonia and Southern Chile.—During the present year the British Museum (Natural History) has inaugurated a monograph which is intended to give a complete review of what is known of the Diptera of the forested region of South America and of the Patagonian plateau. It is intended to issue this work in six parts, and the subject matter is largely based upon collections made during a joint expedition arranged by the Museum in conjunction with the

Bacteriological Institute of the National Department of Hygiene, Argentina. The two collectors engaged upon the trip were Mr. F. W. Edwards, of the British Museum, and Mr. R. C. Shannon, who represented the Bacteriological Institute. The first part of the series to be completed deals with the craneflies and is by Dr. C. P. Alexander, who finds that a considerable proportion of the genera and certain groups of species exhibit a marked resemblance to Australasian forms—a fact already appreciated in other groups of animals. Of Part 2, only two fascicules have yet appeared. In Fasc. 1, Mr. A. L. Tonnoir discusses the Psychodidae, and remarks that they form an aggregate which exhibits great affinity with the Psychodid fauna of New Zealand. He brings to light a new genus which he names *Nemoneura*, while all but one of the species of the family enumerated by him are new to science. In Fasc. 2, Mr. F. W. Edwards deals with the Blepharoceridæ, and in the introductory part he discusses the affinities, morphology, and classification of that family. One interesting feature brought to notice is the presence or absence of mandibles in the females without the occurrence of species with these organs in an intermediate condition. The discovery of six new species of the most primitive known genus, *Edwardsina*, is also of interest, together with an illustrated account of the larva and pupa.

The Gulf Stream.—A useful paper by Mr. H. A. Marmer on the Gulf Stream and its problems appears in the *Geographical Review* for July. Mr. Marmer traces the history of our knowledge of the current and refers to many recent investigations in the problems of its origin, course, and effect. It has now been shown that the course of the Gulf Stream from the Straits of Florida to Cape Hatteras is nearer inshore than it was formerly thought to be. In places along this coast, it lies nearer to the 20-fathom than to the 100-fathom submarine contour. It has furthermore been found that the cool coastal waters along the eastern coasts of the United States, between the shore and the Gulf Stream, are not due to the Labrador current, which from Nova Scotia southward does not send south an inshore branch, at least as a regular flow throughout the year. Observations rather confirm the belief that the waters of the Labrador current, so far as they escape after contact with the Gulf Stream, turn eastward across the Atlantic. The cold inshore waters of the eastern coast of the United States are said to be due to land drainage, off-shore winds, and upwelling waters, and deflection by the earth's rotation of cold water from the Gulf of St. Lawrence.

Aerial Survey in Alaska.—Extensive experiments in aerial photographic surveys were made by the United States Geological Survey in south-eastern Alaska in the summer of 1926. The choice of area was decided both on account of the need of maps for forest, mining, and fishing interests, and by reason of the numerous waterways which provided easy access and landing-places for the aeroplanes. Three machines were employed, and in rather less than three months, during which there were many unfavourable days, an area of about 10,000 square miles was photographed. Prints were made from approximately seventeen thousand negatives. The aeroplanes flew to and fro, following lines as near as possible at right angles to the shore lines. A spacing of three and a half miles between adjoining lines was found to provide sufficient overlap in the pictures. The altitude of the aeroplanes was about 10,000 feet. An account of the work, with a specimen sheet of the map, is contained in *Bulletin* 797 E of the United States Geological Survey, by Messrs. R. H. Sargent and F. H. Moffit. The maps are preliminary sheets and of course without contours. They will serve as base maps for geological surveys that are planned for the region, but are subject to correction when more accurate horizontal control is obtained. But until this additional field work is undertaken, the aerial survey maps may be regarded as useful preliminary sheets.

The Rhineland Earthquake of 1929.—The results of an investigation of the records of the Rhineland earthquake of Dec. 13, 1928, have been published by B. Gutenberg (*Gerlands Beiträge f. Geophysik*, **23**, p. 22; 1929). The focus was situated near Rödingen and the focal depth is thought to have been about 30 km. The longitudinal waves were propagated in the upper, intermediate, and lower layers, with velocities respectively $Pg = 5{\cdot}6$, $P^* = 6{\cdot}7$, and $P = 8{\cdot}2$ km./sec. The values for Pg and P^* agree well with those found by Jeffreys from the Tauern and other Central European earthquakes, but the value for P is considerably higher than Jeffreys' value 7·7 or 7·8. Conrad has previously deduced $P = 8{\cdot}12$, though he, too, found $P = 7{\cdot}83$ for the Tauern earthquake. There appear, therefore, to be real differences between adjoining regions of the upper parts of the lower layer. The possibilities of further complications are suggested by R. Schwinner (*ibid.* p. 35), who infers from gravity measurements that there are sheets of heavy 'sima' rising up nearly to the surface through dislocations between the blocks of 'sial' corresponding to the Alps and the Bohemian massif.

Geology of Uganda.—The Annual Report of the Geological Survey of Uganda for 1928 (Entebbe, 1929) is a particularly interesting document. It contains a general description by A. D. Combe of the Bufumbiro volcanic area, notes on the leucite and other lavas of which were given by W. C. Simmons in the Annual Report for 1927. The discovery of large areas of moraines and fluvio-glacial deposits at the foot of Mt. Sabinyo is also recorded. Further information is given of the cassiterite deposits of Murisasando, and their association with quartz veins, pegmatites and muscovite-kaolin veins. There are already indications of several petrographic provinces in Uganda: leucite-lavas of Bufumbiro; augite-nepheline lavas of Elgon in the east; hypersthene-dolerite dykes; and granites of many types, including enstatite-granites in Karamoja and the better-known tin-bearing granites. At the Seismological Observatory records have now been made for a first complete year, and it has been possible to get time signals on a short-wave wireless set. Details of the shocks recorded are given. The Research Notes, which form a welcome feature of the report, deal with the geological history of the Great Lakes (E. J. Wayland); rock cisterns and prehistoric man (E. J. Wayland); augite crystals from the Belgian Congo portion of the Bufumbiro volcanic field (A. D. Combe and W. C. Simmons); and oscillations of lake level (W. C. Simmons). The officers of the Survey are to be congratulated on a successful and stimulating year's work.

The Hydrogen Molecule.—A recent paper by Prof. O. W. Richardson and Dr. P. M. Davidson, in the *Proceedings of the Royal Society* for August (vol. 125, p. 23) illustrates the very considerable extent to which the analysis of the complicated band spectrum of hydrogen has already proceeded. Many of the electronic energy levels for the molecule H_2 are now known, together with the associated vibrational and rotational changes in energy, and one of the important results obtained in the present paper is that the data for the energy functions of the more stable H_2 molecules obtained by two essentially different methods are sufficiently consistent to show that the analysis of the spectrum has progressed along sound lines. Other points considered are the potential energy of the molecules in the neighbourhood of

equilibrium positions of the two nuclei, the total energy of the molecules and the ways in which they dissociate, the kinetic energy of the electrons in the molecule, and the comparison of the states of the H_2 molecule and of the H_2^+ molecular ion. Attention is also directed to a mistake in the standard "Report on Molecular Spectra in Gases", and this is corrected in an appendix upon "The Mean Kinetic Energy of a System of Particles in Motion under their Mutual Forces, some of the Particles being held fixed and the others remaining in their neighbourhood".

Counting Ionising Particles.—Considerable attention is now being given to the improvement of electrical methods for detecting swift ionising particles. The old electrical methods, and one new one devised by Prof. Geiger, consisted essentially in the amplification of the ionisation due to a single particle by electrical fields within the ionising chamber. The majority of the new methods aim at making use of the initial ionisation without such magnification. One way in which this can be done is exemplified by the arrangement of Hoffmann and Pose (*Zeitschrift für Physik*, Band 56, p. 291), in which the ions are collected and registered in their original numbers by a very sensitive electrometer. This has several disadvantages, and a more promising line has been developed, largely in the Radium Institute at Vienna. The ions are again collected as a saturation current, but the potential changes brought about at the grid of a valve by their reception are amplified by other valve systems until they are large enough to be measured by less sensitive instruments. The circuits used differ somewhat from those which are most familiar in high frequency technique, since the input voltage is impulsive in this case, and numerous difficulties had to be overcome before the present arrangements were adopted. These do, however, appear now to be very satisfactory, and an investigation of natural H-particles has already been made with the new 'valve electrometer', by E. A. W. Schmidt and G. Stetter (*Zeitschrift für Physik*, Band 55, p. 467), which has revealed an interesting discrepancy between the numbers of particles recorded electrically and by the counting of scintillations, only about half the number found by the latter method being detectable by the former.

Standard Cells.—The August number of the *Journal of the American Chemical Society* contains two papers by Prof. G. A. Hulett and W. S. Niederhauser dealing with polarisation and hysteresis in standard cells. Although previous work had indicated that such cells were subject to considerable polarisation, even at relatively low currents, the analysis of the effect between the two electrodes had not been adequately studied. The first paper deals with the polarisation of the individual limbs of the saturated, unsaturated, and acid cadmium cells and of the zinc cell at very low currents. The effects of charging and discharging the cells were studied. The results show that most of the polarisation occurs in the mercury limbs; that the effect of charging is more severe at the mercury electrode; whilst that of discharging is more severe at the amalgam electrode; and that a recovery effect, present only in the mercury limb of the cell, appears when the polarisation occurs at the higher currents and tends to decrease the polarisation of the cell. No noticeable change in the resistance of the cell accompanies polarisation. A large number of important experimental results is accompanied by a discussion. In the second paper the adjustment of the individual limbs of standard cells to temperature changes is considered. New cells show high values of hysteresis, which decrease during the first month or so and are probably due to overheating in the course of construction. A method of avoiding this trouble and of setting up cells which give normal values within a few hours of construction is described.

The Night Sky.—The June issue of the *Journal de Physique* contains an account of an extensive series of observations upon the spectrum, colour and polarisation of the light from the night sky, by J. Dufay, of the Observatory of Lyons. The work has been done almost entirely with calibrated photographic plates, and is essentially quantitative. M. Dufay has studied both the green auroral line and the continuous spectrum, and finds that the former carries about one quarter of the total radiant energy between 5000 A. and 6000 A.; after allowing for the auroral line, the residual light has a distribution of energy which is more nearly like that of sunlight than that of the blue sky, although it is relatively stronger in the longest and the shortest visible wave-lengths. M. Dufay finds that the light from the night sky is definitely polarised, with the privileged plane passing through the sun, but that the extent of the polarisation—about three per cent—is decidedly less than that of the zodiacal light. He concludes that the light comes partly from feeble stars and the permanent aurora, and partly from atmospheric diffusion and zodiacal light, but that these factors do not account for more than about one-half of the total radiation, the origin of the remainder of which has still to be found.

Ignition of Firedamp.—Although a number of firedamp explosions have been attributed to frictional sparks or heating caused by picks or working machinery, experience and earlier research work have shown that it is very difficult indeed to cause ignition by such means. In a paper (No. 54, H.M. Stationery Office, price 6*d*.) issued by the Safety in Mines Research Board, Mr. M. J. Burgess and Prof. R. V. Wheeler have described further experiments carried out with sparks produced by the abrasion of steel by revolving wheels and also with an ordinary chain coal-cutting machine working against a built-up mass of rock in explosive atmospheres. The results show that, with certain kinds of rock, firedamp could readily be ignited, although it is not certain whether ignition was caused by the sparks emitted or by the heating of the rock surfaces caused by the impact of the coal-cutter picks. These results are obviously of importance in connexion with the use of such machines in mines where firedamp occurs and the paper is a valuable contribution to the literature of safety in mines.

Low-Expansion Nickel Steels.—For clock pendulums, standard tapes for geodetic surveys, standards of length, scientific instruments where variations in size due to changes of temperature are to be minimised, and for other purposes, a 36 per cent nickel-iron alloy is in general use and most of the credit for the development of the iron-nickel alloys is given to Guillaume and his co-workers. The alloys, however, have been the subject of extensive researches, and in *Engineering* for Sept. 27, Mr. T. F. Russell discusses two theories of this alloy and gives results from experiments carried out in the Research Laboratories of the English Steel Corporation, Limited, Sheffield. The theories are due to Benedicks and Honda, but having considered their respective views, Mr. Russell says he is convinced "that in order to explain the variations in expansibility, magnetic induction, hardness, etc., which may be brought about in this alloy by suitable treatment, much more profound theories, probably based on interatomic relations, will have to be propounded". Results are also given of an investigation of the alloy known as 'nilex', made with the view of correlating the coefficient of expansion, Brinell hardness and magnetic induction, the article being accompanied with curves and a description of the apparatus used in the research.

The Physiology of Vision.

AS in other branches of science, academic knowledge of the physiology of vision is finding its practical applications in many fields to-day. The importance of the eye as an optical instrument and of the correction of errors of refraction is obvious, but on the response of the organ to variations of illumination and on the degree of visual acuity attainable under different conditions of lighting depend the ease and correctness with which a variety of different tasks can be carried out. There need only be mentioned the lighting of mines and factories, or driving or flying by night. The adaptation of the eye to varying degrees of illumination, including its response to sudden changes in the amount of incident light, is therefore a subject of considerable practical importance; and two recently published monographs have been designed to collate and to increase our knowledge of this question.[1]

It is well known that the sensitiveness of the eye increases in the dark: the degree of this increase depends on the intensity of the light to which it was previously exposed and the time allowed for dark adaptation before the sensitiveness is measured; the increase may be several thousand times the initial sensitiveness and the maximum is reached in about 20-30 min., although it may still increase slowly over a period of several hours. In the dark-adapted eye the chromatic threshold is above the achromatic, so that a coloured light is first seen achromatically and appears coloured only when the intensity is raised. The colourless interval increases with progressive dark adaptation owing to the fall in the threshold for achromatic stimuli, or, in other words, owing to the increased sensitiveness. The interval is greatest for light of short wave-length: it is doubtful if it exists at all in the case of the extreme red end of the spectrum. Thus adaptation is greatest for blue light, least for red. When adaptation is followed in different regions of the retina, it is found that it is very slight at the fovea, the point of central vision, and the maximum increase in sensitivity is reached here in the first 5-15 min. in the dark: the greatest adaptation occurs in the peripheral regions of the retina, especially at 10°-15° from the fovea. It is not certain whether adaptation at the fovea is the same for all light or greatest for blue as at the periphery.

The course of dark adaptation is influenced by such factors as the age of the subject, the adaptation of the opposite eye, and the administration of drugs. There is a definite relationship between the size of an object and the illumination required to render it visible, which varies with the state of adaptation and the area of the retina stimulated: the minimal light stimulus has been found to be about $1 - 10 \times 10^{-10}$ ergs in different experiments. In dark adaptation, the subjective luminosity of the spectrum is greatest in the green instead of in the yellow as in the light-adapted eye. The course of dark adaptation is also altered in pathological conditions, such as colour-blindness, night-blindness, and other diseases of the organ.

Examination of the excised eye shows that certain structural changes occur in the retina in dark adaptation: the granules in the pigment epithelium between the rods retract in the eyes of cold-blooded animals, but a similar movement has not been observed in warm-blooded; the cones extend and the rods decrease in size, whilst minute changes can be observed in the nerve cell nuclei. It must also not be forgotten that the pupil alters in size with the intensity of the light shining upon the eye: this alteration in turn influences the visual acuity and the course of dark adaptation; it is therefore advisable to use an artificial pupil to obviate these effects, when studying dark adaptation. The reaction time of the iris is sufficiently slow to permit of a bright light entering the dark-adapted eye in excessive intensity, giving rise to glare: the pupil then constricts and limits the amount of light entering and the eye becomes light-adapted, or dark-adapted again, if the exposure to light was only momentary.

Certain chemical changes have been observed in the eye under different conditions of illumination: thus the retina becomes acid and the visual purple is bleached on exposure to light. This pigment is associated with the rods and probably not at all with the cones. It is easily bleached by organic solvents and acids and alkalis: it is soluble in bile salts, but insoluble in water. The curves of its energy absorption, and of its bleaching by spectral light, and the luminosity curve of the dark-adapted eye, are almost identical, indicating that it must be of great importance in twilight vision and that its regeneration is probably the basis of dark adaptation. It is possible that delay in its regeneration is the cause of night-blindness: and recent work suggests that a deficient intake of vitamin A is the ultimate cause of this delay.

It must also be mentioned that electrical responses can be obtained from the eye when stimulated by variations of the illumination: two groups can be distinguished, the responses in the optic nerve, similar to those in other sensory nerves, and the retinal currents. Examination of these responses has suggested that the retinal processes leading to excitation may consist of a primary change, coinciding with the flash of light and giving rise to a product proportional in amount to the quantity of light received, and also of a secondary change, leading ultimately to excitation of the nervous structures, the rate of which is a linear function of the amount of light product formed in the primary change.

It is now generally held that the cones of the retina are the end organs stimulated by light in the light-adapted eye, whilst the rods function similarly in twilight vision: dark adaptation, then, is the shifting from the cone to the rod mechanism. During the early stages the increase in sensitivity is slight, the cones are still functioning: then the rod mechanism comes into play and the sensitivity increases markedly. It has been suggested that the visual purple is only slowly regenerated and that this accounts for the slow onset of the rapid increase in sensitivity. F. Allen (*Jour. Opt. Soc. Am. and Rev. Sci. Instruments*, vol. 13, p. 383; 1926), however, has adduced evidence against this theory: he found that it was possible to enhance or depress the sensitiveness of the visual receptors, reflexly, by illumination of either the same or the opposite eye. The weaker intensities produce depression and stronger enhancement; but the strongest enhance or even depress only the response to their own colour, the remainder being depressed or enhanced respectively: with certain intensities and colours the two processes balance each other. Allen suggests that these reflex effects must be taken into consideration in any theory of dark adaptation.

In their work on the critical frequency of flicker, Lythgoe and Tansley kept both eyes of the subject in the same condition of light adaptation in order to avoid any reflex effects from one eye to the other. The left eye was used throughout and the flicker was

[1] Medical Research Council. Special Report Series, No. 127: Reports of the Committee upon the Physiology of Vision. 2: Dark Adaptation (a Review of the Literature). By Dorothy Adams. Roy. 8vo. Pp. 138. 5*s*. net. Special Report Series, No. 134: Reports of the Committee upon the Physiology of Vision. 5: The Adaptation of the Eye; its Relation to the Critical Frequency of Flicker. By R. J. Lythgoe and K. Tansley. Roy. 8vo. Pp. 72. 2*s*. 6*d*. net. (London: H.M. Stationery Office, 1929.)

observed at the fovea and at several points in the periphery at fixed degrees from it. It was found that during dark adaptation, with high degrees of illumination of the (flickering) test patch, the critical frequency of flicker fell in all regions of the retina but especially at about 10°-50° from the fovea : with low illuminations there was still a fall at the fovea, but a rise was observed in the periphery, in which region, with intermediate illuminations, there was first a fall and then a rise. When red light was used to illuminate the test patch, the critical frequency fell at the periphery with intensities of illumination which would have given a rise if white light had been used.

It is considered probable that the fall in critical frequency is a function of the cones, whilst the rise is associated with the rods. When the brightness of the surrounding field was varied, it was found that there was a fall in critical frequency at the fovea with an increase or decrease of the field brightness above or below that of the test patch. At high illuminations, lowering the field brightness lowered the critical frequency at the periphery more than at the fovea : at low illuminations the critical frequency, at the periphery, was brightest with dark or feebly illuminated surrounding fields. These changes in the critical frequency are considered to be due to the adaptation of the cones and the rods respectively : the authors consider that there is some evidence that the peripheral cones do not function in quite the same manner as those at the fovea.

Whales and Whaling.

WHEN, in 1919, Sigurd Risting became secretary of the Norwegian Whalers' Association, he began to collect all available statistics of catches and measurements of whales and whale fœtuses in order to throw as much light as possible upon the life, migrations, and conditions of growth of these animals. To this end, a schedule of relevant questions was sent with the various Norwegian whaling expeditions to the antarctic seas. In this way, measurements of 7750 blue whales, 6919 fin whales, and 1054 fœtuses (592 blue whale and 462 fin whale) have been obtained from the whaling fields of South Georgia, South Shetlands, and South Orkneys. In addition, from the year 1922 onwards, statistics have been sent to Risting from practically every Norwegian whaling company throughout the world, and a few foreign companies also have contributed. From this mass of statistical material much valuable information regarding both blue and fin whales has been deduced.[1]

It is shown beyond all doubt that both the above species of whale in the antarctic seas undertake more or less regular annual migrations, retreating northward to more temperate waters in the winter and returning southwards in the summer months of the year. By the beginning of September, the whales, both blue and fin, begin to appear in the southern whaling fields. At the commencement of the whaling season (October–April), the blue whale generally predominates, the main body of this species usually arriving somewhat earlier than that of the fin whale. In the month of May, the bulk of the whales leave the whaling fields, but a few of both species appear to remain throughout the winter. When they leave the southern fields, the whales begin to appear in large numbers off the west coast of Africa, where a number of whaling stations are now in operation. Further, it appears from the statistics that the blue whale migrates farther north than the fin whale.

Hitherto, information relating to the size of whales has been derived from isolated measurements of a small number of individuals. Risting's figures, therefore, systematically drawn from a large number of animals over a number of years, supply the first really accurate information on this point. The average length of a blue whale is found to be, in the southern hemisphere, 23·68 metres in the case of the male, and 24·72 metres in the case of the female : animals exceeding 31·38 metres (100 ft.) are seldom caught. In the case of the fin whale the corresponding sizes are 20·40 metres, 20·98 metres, and 27·3 metres (87 ft.) respectively. In the northern hemisphere, however, the average size of both species is considerably less.

[1] Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions. Vol. 50 : Whales and Whale Foetuses ; Statistics of Catch and Measurements collected from the Norwegian Whalers' Association, 1922–25. By Sigurd Risting. Pp. iii+122. (Copenhague : Andr. Fred. Høst et Fils, 1928.) n.p.

Proceeding to a consideration of the statistics relating to oil production, Risting has been able to make out the following table of the relative values of different whales in terms of the average yield of oil per animal : 1 blue whale = 2 fin whales = 2½ humpbacks = 6 seis in the same whaling region. The blue whale yields on an average 84-87 barrels of oil per animal in the southern hemisphere, and 60-64 barrels in northern seas. (Six barrels of oil = 1 ton.)

After a detailed analysis of the statistical material relating to whale fœtuses, Risting arrives at the following conclusions : (1) In the case of both blue and fin whales, pairing takes place practically throughout the year in both hemispheres. (2) The majority of pairings, however, take place in June, July, and August, in the southern hemisphere, that is, during the winter months when the animals are in more temperate waters. (3) In the northern hemisphere the majority of pairings take place between the middle of December and the middle of March. Thus the majority of pairings in northern and southern seas are found to take place in the corresponding winter months. (4) Both blue and fin whales reach puberty in the course of their second year, the period of gestation is roughly one year in both cases, and the female, therefore, does not as a rule produce young every year.

Sir Sidney Harmer[2] has brought together all available facts bearing upon the probable future of the whaling industry in the presidential address delivered by him last year to the Linnean Society. A historical survey of whaling operations in connexion with each species of whale which is, or has been hunted, is followed by an account of modern whaling and whaling methods. At present whaling operations are based mainly on rorquals, the species of practical importance being the blue, fin, sei, and Bryde's whales. Statistics relating to the various fields at present worked, including the antarctic area, Africa, Australia and New Zealand, South and North Pacific, and North Atlantic, are given. From these figures it is shown that by far the most important field is the first named, which, in the season 1925–26, yielded no less than 779,167 barrels of oil derived from 13,997 whales. The total oil production of all other localities in the same season was only 402,724 barrels, drawn from 12,965 whales. The total number of whales destroyed, however, was, without doubt, considerably in excess of this number, as many are killed which are not recovered, and it is probable that at least 30,000 individuals perished in this single season.

Sir Sidney is confident that the present rate of killing is too high. History has shown that whaling

[2] "The History of Whaling." By Sir Sidney F. Harmer. Presidential Address delivered at the Anniversary Meeting of the Linnean Society of London on the 24th of May 1928. Pp. 51-95. (London : Linnean Society, 1928.) 1*s*.

operations in the past have been responsible for a very serious reduction in the number of whales. As a concrete example, the case of the southern right whale is cited. This whale, once inconceivably numerous in southern seas, has been so reduced in numbers that a regular industry based upon it is now no longer carried on. But, high as it is, the present rate of killing will in all probability be far exceeded in succeeding years as more up-to-date methods of capture, 'flensing', and extraction of the oil are introduced and perfected. In the absence of preventive measures, therefore, Sir Sidney Harmer holds that the hunted species are in grave danger of becoming so reduced in numbers that they may with difficulty escape extinction. To the Discovery Expedition, at present investigating the habits of life and ecology of whales in antarctic seas, he looks for definite information as to whether or not this danger is a real one. Should such prove to be the case, it is hoped that whalers will unite with naturalists in seeking some method by which such an untoward result may be averted.

G. A. S.

New Observatory of the University of London.

THERE are already observatories at the Imperial College of Science and Technology, University College, and the Drapers' Company Transit House, but there was felt to be need for further opportunities in the University of London for research work. Prof. L. N. G. Filon and Mr. C. C. L. Gregory were fortunate in receiving an offer from Mr. J. G. Wilson of the 24-inch reflecting telescope with which his father, Mr. W. E. Wilson, carried out many useful researches at Darramona, Ireland; the only condition attached to the gift was that the University should erect a suitable building for it.

The Hendon Urban District Council offered a site opposite Mill Hill Park, which has been leased to the University for 999 years at a nominal rental. The Senate of the University voted £5000 for the building, and four London colleges with the London School of Economics voted annual subsidies towards its maintenance. The building being near a main road, vibration of the soil gave some trouble, but this was cured by filling the space round the pier with coke breeze. A new guiding telescope with a six-inch objective by Cooke (focal length, 11½ feet) was attached to the equatorial; the guiding eyepiece was mounted on a micrometer and position circle, to enable the telescope to follow moving objects. An 18-foot dome was constructed by Messrs. Cooke, Troughton and Simms, Ltd.; this has electrical driving, which can be controlled either from the floor or the eye-end. The Observatory has also a 10-foot Rowland grating spectrograph, fed by a cœlostat by Cooke, which can be adjusted either for solar or stellar work.

Prof. Filon is the Director of the new Observatory, and Mr. C. C. L. Gregory has the title of Wilson Observer. Students in the Faculty of Science in all the colleges of the University will be able to study at the Observatory, and facilities will be given for the investigation of new observational methods.

The general public will be permitted to view the Observatory on two afternoons in each month, except from July to September; ratepayers of Hendon will occasionally be admitted at night (two evenings per month from October to March) on making written application to the Director.

The Observatory was opened and the Wilson telescope unveiled by Sir Frank Dyson, the Astronomer Royal, on the afternoon of Tuesday, Oct. 8.

University and Educational Intelligence.

THE study of biology in the universities was one of the two subjects discussed at the annual conference of the universities of Great Britain and Ireland, held this year at the London School of Economics on May 11. One of the questions dealt with was whether the universities are sufficiently active in promoting the study of biology, and this part of the discussion was focused mainly on an appeal from the Colonial Office for university trained biologists competent to deal with the biological problems continually arising in the economic exploitation of the resources of various parts of the Empire. Commenting on this, Prof. G. N. Watson, of University College, London, emphasised the fact that for such work the narrow specialist is quite unsuitable, the problems in question being incapable of solution without wide knowledge and lively imagination. He outlined an appropriate four years' honours course. Prof J. Arthur Thomson and others directed attention to the necessity of providing in universities at least three separate courses in biology appropriate, respectively, to the requirements of the medical student, the arts student, and the student intending to specialise later as biologist. The report of the proceedings of the Conference, including the discussion of the other subject dealt with, namely, university entrance requirements and, in relation thereto, the curricula of the last two years of school, has recently been published by the Universities Bureau of the British Empire, 50 Russell Square, W.C.1 (1*s*.).

THAT the barriers between commerce and public service are breaking down was illustrated on Oct. 7 by the visit of the Lord Mayor of London to perform the opening ceremony of the new extension of Messrs. W. and G. Foyle, Ltd., in Manette Street, almost adjoining the older bookshop in Charing Cross Road. The new building is on the site of the old Goldbeaters' House mentioned by Dickens in "The Tale of Two Cities", and consists of six floors, providing accommodation for nearly two million books. A great bookshop such as Messrs. Foyle have built up during the past twenty-five years is something more than a commercial undertaking or, like Dr. Johnson's brewery, the potentiality of growing rich beyond the dreams of avarice; and this the firm have proved by their public literary lectures, the department of education films, and the demonstrations of new and classical music. Their public responsibility also extends to the destruction of worthless books, the number of which, we are told, amounts to ten thousand per week. Further, the machinery which Messrs. Foyle have established gives an assurance that accumulations of books of which executors and others have to dispose shall reach the hands of students and become again *fabrilia fabris*. That this is recognised throughout the world is demonstrated by the firm's morning mail, which in the busy season amounts to more than four thousand, and the number of books purchased is two and a half million a year. At the opening ceremony, literature was represented by Mr. W. B. Maxwell, who assumed the white sheet as representing the profession which filled these vast bookshelves; but Sir Godfrey Collins, representing the publishers, stated that his firm only publish three books out of a hundred manuscripts submitted. Messrs. Foyle's education department is especially strong with two hundred thousand volumes and accommodation for five hundred persons; and the same may be said of the periodical department, which claims to supply the back numbers of almost any periodical. The history of the firm is recounted in a book, "The Romance of a Bookshop, 1904–1929", by Gilbert H. Fabes, specially published for the opening ceremony of the new extension.

Calendar of Patent Records.

October 12, 1849.—The ordinary wire safety-pin was patented by Charles Rowley, button manufacturer, of Birmingham, on Oct. 12, 1849. Though pins of this kind were apparently not known at that time in the pin-making industry, there was little novelty in the invention, for similar pins were in common use in Roman and earlier times. The earliest known is one in the British Museum belonging to the Mycenean period, c. 1000 B.C., which is of almost identical construction.

October 14, 1568.—What appears to be the first Irish industrial monopoly patent was granted for twenty-one years to Peter Backe, a native of Flanders, on Oct. 14, 1568. The grant was to enable the patentee to collect madder in all parts of Ireland and to dye skins of animals.

October 14, 1801.—The specification of the patent granted to William Symington on Oct. 14, 1801, describes the engine and machinery of the *Charlotte Dundas*, which was one of the first practicable steamboats. The boat was constructed for Thomas, Lord Dundas, who was interested in the introduction of steam for canal navigation, and in March 1803 towed two loaded barges on the Forth and Clyde Canal for a distance of 19½ miles. On another occasion the vessel carried Robert Fulton, who a few years later, in America, initiated the first commercial steamboat service.

October 14, 1831.—The first complete bread-making machine was patented by John Cowderoy, of Hoxton, on Oct. 14, 1831. The apparatus, which was manually operated, consisted of the combination of a dough-mixing machine, a moulding machine, and mechanism by which the moulded loaves were run into the oven, without being touched by hand.

October 15, 1907.—Bakelite, an insoluble and infusible condensation-product of aldehyde and phenol, was invented by L. H. Baekeland and was the subject of a United States patent applied for by him on Oct. 15, 1907. Bakelite is not so flexible as celluloid, but it is more durable, stands heat, does not smell, does not catch fire, and is a bad conductor of heat and electricity.

October 17, 1691.—On Oct. 17, 1691, Edmund Halley, the astronomer, was granted a patent with other persons "to exercise and practice their new invention or engine whereby by conveying aire into a diveing vessell they can maintaine severall persons at the same time to live and worke safely under water at any depth for many houres for the retreiveing and regaining of gold, silver, bullion, money, and all manner of goods wreckt and lost at sea." The diving-bell was constructed of wood covered with lead, and the air was to be renewed through flexible connexions from weighted barrels lowered by the side of the bell.

October 17, 1850.—The Scottish shale-oil industry was started under the patent granted on Oct. 17, 1850, to James Young for his invention for "treating bituminous coals in such a manner as to obtain therefrom an oil containing paraffine (which I call paraffine oil) and from which oil I obtain paraffine." Samples of the oil were shown at the Great Exhibition of 1851 and aroused great interest, and in the same year works were opened at Bathgate by Young in conjunction with Edward Meldrum and E. W. Binney. The process was completely successful, paraffin oil being produced at 5s. a gallon, a great boon in the days when oil lamps were still the main source of illumination. The patent was many times attacked, but remained secure and ran its full course.

October 17, 1855.—Oct. 17, 1855, is the date of the first of the many patents granted to Sir Henry Bessemer in connexion with his famous process for the manufacture of steel from cast iron. (Cf. Calendar of Patent Records, Sept. 22.)

Societies and Academies.

LONDON.

Society of Public Analysts, Oct. 2.—H. E. Cox: Chemical tests in relation to fur dermatitis. Para-phenylenediamine is the most frequently used of the intermediates employed for dyeing furs and is also the most toxic. The so-called Bandrowski's base is not a fast final product; it is easily reduced, and then re-forms *p*-phenylenediamine, and so may be an indirect cause of irritation. It also appears to be associated with some partly oxidised *p*-phenylene-diamine, which can be detected chemically.—J. H. Coste: A nomogram for use in gas analysis. By the use of this nomogram the necessary corrections of temperature can be made over a reasonable range of temperature, with sufficient accuracy for many purposes.—P. S. Arup: The composition of Irish winter butter. Analyses are given of 580 undoubtedly genuine samples of butter obtained from creameries and agricultural schools in the Irish Free State during the winters of 1927–28 and 1928–29. In the former period 50 samples showed Reichert-Meissl values below 24; in the latter period 88 samples. In places where calving was not confined to one season of the year (as is generally the case in Ireland), and also where the conditions of feeding and shelter were superior, Reichert-Meissl figures below 26 were not obtained.—W. R. Schoeller and H. W. Webb: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. (16) Observations on tartaric hydrolysis. (17) The quantitative precipitation of the earth acids and certain other oxides from tartrate solutions. Precipitation of tantalic, niobic, and tungstic acids from tartrate solution by hydrochloric or nitric acid, though specific, is never quite quantitative. Only titanium and zirconium interfere to a certain extent with the normal course of the reaction. The earth acids and their mineral associates are classed into analytical groups according to their precipitability from tartrate solution.

GENEVA.

Society of Physics and Natural History, July 4.—A. Naville: (1) The action of the mitogenetic rays through a quartz screen (preliminary note). The author shows that onion roots, placed behind a quartz filter, are capable of producing kineses in the cornea of a frog. An exposed cornea showed from 36·4 per cent to 44·9 per cent more kineses than a cornea not exposed (exposure from one to two hours). (2) Sexualisation of the gametes and gonomery in the Myxosporidæ (preliminary note). Three different sex types exist in the Myxosporidæ, which can be attributed to the more or less great precocity of sexualisation of the germinative strain. The delay in sexualisation admits of isogamy as an extreme case, which, in fact, is met with in the Microsporidæ. The acceleration of the sexualisation leads to dicœcia. In the Actinomyxidæ a very precocious sexualisation is found. The author confirms by another method his earlier results on the gonomery of the zygote.—R. Wavre: New researches on the planetary figures to the second approximation. The gravitation on the polar axis is expressed by the following formula (ω = angular velocity):

$$g_0 = iMt^{-2} + \omega^2 g_{0,1} + \omega^4 g_{0,2}.$$

The difference between the moment of inertia with respect to the polar axis and the moment of inertia with respect to an equatorial axis is

$$i(C - A) = \omega^2 K_1 + 2\omega^4 \lambda K_2.$$

The terms in ω^4 represent the difference between the second and the first approximation.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 15, No. 7, July 15).—**J. H. Van Vleck** and **Amelia Frank**: The mean square angular momentum and diamagnetism of the normal hydrogen molecule. A mathematical discussion.—**Alvin B. Cardwell**: Effects of a crystallographic transformation on the photoelectric and thermionic emission from cobalt. The specimen was slowly and thoroughly 'outgassed'. Marked changes in both photoelectric and thermionic emission occur at about 850° C., when there is a change from hexagonal close packing to the face-centred cubic form. There seems to be an intermediate structure which is much more sensitive than the stable forms; the effect is more marked with descending than ascending temperatures.—**Paul R. Gleason**: The reflecting power of some substances in the extreme ultra-violet. The region 585 A.-1850 A. was investigated. Of the substances tested, platinum is the best reflector (18·6 per cent), and nickel, crystalline quartz, and gold were the only others giving more than 10 per cent at the shortest wave-length. Chromium and silicon are both superior for the longer wave-lengths.—**C. Y. Chao**: The problem of the ionised hydrogen molecule. A theoretical investigation using the polynomial method of wave mechanics.—**Harlow Shapley**: Note on the velocities and magnitudes of external galaxies.—**Curt P. Richter** and **Miriam E. Brailey**: Water-intake and its relation to the surface area of the body. Water-intake for rats increases with age and is greater for males than females. It is closely related to body surface and hence apparently to heat regulation.—**W. W. Alpatov**: The influence of thyroid gland feeding on the acceleration of the growth of larvæ of *Drosophila melanogaster*. Larvæ given hog thyroid were definitely larger than controls. It is suggested that invertebrates with short development period can be used as test animals for thyroid.—**G. Pincus** and **W. J. Crozier**: On the geotropic response in young rats. A mathematical relationship can be shown between the upward orientation on an inclined surface and the slope for genetically stabilised lines of young rats, and it can be traced in crosses. Thus the constant involved in describing homologous behaviour has a 'real' significance.—**William T. Richards** and **Alfred L. Loomis**: Dielectric loss in electrolyte solutions in high frequency fields. An expression connecting power loss, conductivity, dielectric constant and frequency is tested for wave-lengths from 14 m. to 1000 m. The effect of high frequency currents on organisms is correlated with the physico-chemical constitution of their body fluids.—**Oscar Knefler Rice**: The temperature co-efficient of radioactive disintegration. A consideration, based on the new quantum mechanics, of the sizes of atomic nuclei, indicates that the temperature co-efficient is very small; hence the impossibility of influencing the half-life period in the temperature range available.—**Nicholas A. Milas**: Some studies on homogeneous catalysis. An expression connecting maximum oxygen absorption rate, concentration of catalyst and time to reach maximum absorption rate has been derived and tested, using anthraquinone and benzoquinone as catalysts for the oxidation of anethol. Maximum oxygen absorption rate appears to be one of the most characteristic properties of auto-oxidation phenomena.—**Louis S. Kassel**: Unimolecular reactions. A discussion based mainly on the new quantum mechanics and criticising particularly Bourgin's suggestions.—**Henry S. Washington**: The rock suites of the Pacific and the Atlantic basins. On the whole, the rocks of the Atlantic basin are more alkaline and especially more sodic than those of the Pacific. There are other petrographic provinces, and it is considered possible that such areal differentiation could exist when the earth was in a fluid or semi-fluid condition.—**Simon Flexner** and **Cornelius P. Rhoads**: A method for the determination of the activity of antipoliomyelitic serum. The blood of human beings and monkeys recovering from poliomyelitis contains neutralising substances effective against the incitant of the disease. By injecting both virus and serum into monkeys by way of the cisterna magna (between the skull and vertebral column) no injury to nervous structures is caused, and the course of the experimental poliomyelitis parallels the disease in man. The results will be applied to treatment and prevention of human poliomyelitis.—**Ruth H. Lindsay**: The chromosomes of some dicœcious angiosperms. No morphological difference is recognisable between the two chromosomes of any pair in the pollen mother cells examined.—**R. L. Wilder**: Characterisations of continuous curves that are perfectly continuous.

Official Publications Received.

BRITISH.

Proceedings of the Royal Irish Academy. Vol. 38, Section B, No. 15: Semperviva of the Canary Islands Area. By Dr. R. Lloyd Praeger. Pp. 454-499 + plates 9-16. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.*

Lawes Agricultural Trust: Rothamsted Experimental Station, Harpenden. Report 1927-28 with the Supplement to the "Guide to the Experimental Plots" containing the Yield per Acre, etc. Pp. 176. (Harpenden.) 2*s.* 6*d.*

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 12: Grading and Marking of English Wheat Flour. Pp. 8. Marketing Leaflet No. 13: The Grading and Marking of Home-killed Beef. Pp. 8. (London: Ministry of Agriculture and Fisheries.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1238 (Ae. 393): The Effect of Body Interference on the Efficiency of an Airscrew. By C. N. H. Lock. (T. 2702.) Pp. 8+2 plates. 6*d.* net. No. 1239 (Ae. 394): The Application of the Theoretical Velocity Field round a Spheroid to calculate the Performance of an Airscrew near the Nose of a Streamline Body. By C. N. H. Lock. (T. 2703.) Pp. 4+2 plates. 4*d.* net. No. 1241 (Ae. 396): Experiments on a Series of Symmetrical Joukowski Sections. By A. Fage, V. M. Faulkner and W. S. Walker. (T. 2765.) Pp. 19+10 plates. 1*s.* net. No. 1242 (Ae. 397): The Force and Moment on an Oscillating Aerofoil. By H. Glauert. (T. 2763.) Pp. 17+4 plates. 9*d.* net. No. 1243 (Ae. 398): Wind Tunnel Tests on a Symmetrical Aerofoil (Göttingen 429 Section). By W. G. A. Perring. (T. 2762.) Pp. 4+4 plates. 4*d.* net. (London: H.M. Stationery Office.)

FOREIGN.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 1, July. Pp. ii+190+14 plates. Vol. 3, No. 2, August. Pp. ii+191-341+23 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 71: Heat and Time of Exposure necessary to kill Larvæ of the European Corn Borer in Ear Corn. By George W. Barber. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1928. Pp. 115. (Copenhague: Andr. Fred. Høst et fils.) 6.00 kr.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 9, Septembre. Pp. 467-520. (Prague: Regia Societas Scientiarum Bohemica.)

Diary of Societies.

FRIDAY, OCTOBER 11.

ROYAL SANITARY INSTITUTE (at the Castle, Shrewsbury), at 4.30.—A. W. Ward and W. H. Butler: Some Notes on Recent Bridges over the River Severn.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—E. F. Law: The Chemical Laboratory in Inspection.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.—Dr. F. A. Schilder: The Eocene *Amphiperasidæ* and *Cyprœidæ* of England.—G. C. Spence: The Epiphragm in *Streptaxis*.—G. C. Robson: Notes on the Dispersal of *Crepidula fornicata* (L.) in English Waters.—H. H. Bloomer: The Sex of *Anodonta cygnea*.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Cutter: Polymerisation of Drying Oils.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—J. A. Robertson: Developments in Power Production (Presidential Address).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Allen: Coal and Coal Cleaning.

LEICESTER TEXTILE SOCIETY (at Leicester), at 7.30.—J. W. Allinson: Colour and Design in Textile Printing.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. C. Robinson: Some Notes on the Selection of Suitable Metals to Resist Corrosion (Chairman's Address).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—J. D. Pratt: Rationalisation—its Meaning and Application; with Special Reference to the Chemical Industry.
EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. O. E. Lewis, Dr. Newth, and others: Mental Deficiency.
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—E. E. Maddox: Demonstration of the Cheiroscope.—Rosa Ford: Some Ocular Complications of Nasal Sepsis.

SATURDAY, OCTOBER 12.

ROYAL SANITARY INSTITUTE (at the Castle, Shrewsbury), at 10 A.M.—W. H. Purslow: Reconditioning of Houses under the Housing (Rural Workers) Act, 1926.—Miss B. Thrupp: The Scope of a House Property Management Department.
MINING INSTITUTE OF SCOTLAND (at 79 Grassmarket, Edinburgh), at 3.—J. E. Lambert: Some Notes on Colliery Blasting Practice.—Discussion on paper by S. Mavor on Recent Progress in Underground Conveying.
BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 3.—Mary Barnett Gilson: Some Inner Conflicts in Industry.

MONDAY, OCTOBER 14.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Sir Josiah C. Stamp: Presidential Address.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (London and District Branch) (at Borough Polytechnic), at 7.—F. F. Powell: Vacuum Cleaning.
INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—Prof. W. Morgan: The Member and the Institution.
INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, Glasgow), at 7.30.—H. H. A. Greer: Chairman's Address.
MEDICAL SOCIETY OF LONDON (Annual General Meeting), at 8.—At 8.30.—D. Armour: Some of Lettsom's Contemporaries (Presidential Address).
ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—Dr. F. Albee: Original Surgical Applications of the Bone Graft.
INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—E. B. Collier, F. E. B. Moritz, and others: Discussion on Season's Malts (made from 1928 Barleys).

WEDNESDAY, OCTOBER 16.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2.—
OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—Annual General Meeting.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7.30.—B. A. Robinson: Temperature Measurement and Automatic Control.
ROYAL MICROSCOPICAL SOCIETY, 7.30 to 10.—Annual Pond Life and General Microscopical Exhibition.—At 8.—A Meeting of the Society.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.—Dr. G. Giglioli: Paratyphocus Infections in British Guiana.—Dr. W. Broughton-Alcock: Section showing Fractures Morphologically Resembling Spirochætes of a Species Common to the Mouth, lying deep within its Mucous Membrane.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—H. Sutton: Recent Development in Protective Coatings for Metals.

THURSDAY, OCTOBER 17.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Colour Group), at 7.
CHEMICAL SOCIETY, at 8.—H. Burton and Prof. C. K. Ingold: The Modes of Addition to Conjugated Unsaturated Systems. Part II. The Reduction of Conjugated Unsaturated Acids by Metals Dissolving in Aqueous Media.—Prof. G. T. Morgan and E. A. Coulson: Synthesis of Anthracene Homologues. Part I. 2:6- and 2:7-dimethylanthracenes.—A. W. Chapman: Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part I. The Triarylbenzenylamidines.—Prof. T. M. Lowry and F. L. Gilbert: Studies of Valency. Part XIV. An Optically-active Telluronium Salt: p-tolylphenylmethyltelluronium iodide. Part XV. Optically-active p-tolylphenyl-telluroxide.—Prof. G. T. Morgan and E. A. Coulson: Synthesis of Anthracene Homologues. Part II. 2:3:6-Trimethylanthracene.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Dr. G. Carmichael Low: A Retrospect of Tropical Medicine from 1894–1914 (Presidential Address).
C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Grotrial Hall, Wigmore Street), at 8.30.—Dr. Marie Stopes: Birth Control To-day Some New Methods and Experiences.
BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (in Reid-Knox Memorial Hall of the Institute), at 8.30.—Prof. H. C. Jacobaeus: Studies of Acute Massive Atelectatic Collapse of the Lung.

FRIDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Wilmot Herringham: Harveian Oration.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Trephining—Ancient and Modern.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. D. Adamson: Presidential Address.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange, Swansea), at 7.30.—Dr. A. C. Edwards: The Chemistry of Tinplate Manufacture.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Willox: Some Recent French Railway Construction.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Newcastle-upon-Tyne).—L. E. Smith: Presidential Address.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. Tagliani: The Application of the Locust Beans in the Textile Industry and especially in the Calico Printing Trade.

SATURDAY, OCTOBER 19.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

PUBLIC LECTURES.

FRIDAY, OCTOBER 11.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. R. Thurnwald: The Problem of Evolution in the Social Processes. (Succeeding Lectures on Oct. 15 and 17.)
KING'S COLLEGE, at 5.30.—Sir St. Clair Thomson: Lord Lister: Reminiscences of a House Surgeon.

SATURDAY, OCTOBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: Mammoth and Man.

MONDAY, OCTOBER 14.

UNIVERSITY COLLEGE, at 5.—Dr. R. J. Brocklehurst: Secretion of the Digestive Juices. (Succeeding Lectures on Oct. 21, 28, and Nov. 4.)—At 5.30.—Prof. K. Fajans: Chemical Forces and Atomic Structure. (Succeeding Lectures on Oct. 16 and 18.)
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6.—Prof. T. J. M. Madsen: Seasonal Variations of Epidemic Diseases.

TUESDAY, OCTOBER 15.

BEDFORD COLLEGE FOR WOMEN, at 2.—Prof. Spencer: History of Chemistry.
GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on Oct. 16, 17, and 18.)

WEDNESDAY, OCTOBER 16.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: The Health and Conditions of Work of Medical Students.
KING'S COLLEGE, at 5.30.—Prof. F. J. C. Hearnshaw: The Contribution of King's College to the Advancement of Learning during the Century 1829–1929: History.—Dr. F. A. P. Aveling: Personalism: A Psychological Approach to Reality: The Experienced Self.
UNIVERSITY COLLEGE, at 5.30.—J. H. Helweg: Copenhagen, Past and Present.
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6.—Prof. T. J. M. Madsen: Milk Epidemics.

THURSDAY, OCTOBER 17.

KING'S COLLEGE, at 5.—Dr. J. A. Hewitt: Metabolism of the Carbohydrates and Fats. (Succeeding Lectures on Oct. 24, 31, and Nov. 7.)

FRIDAY, OCTOBER 18.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.—Prof. V. H. Mottram: Human Nutrition. (Succeeding Lectures on Oct. 25, Nov. 1, 8, 15, and 22.)
ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Cell Surfaces (Harben Lectures) (I.).
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Glory of Greece.
LONDON SCHOOL OF HYGIENE AND TROPICAL DISEASES, at 6.—Prof. T. J. M. Madsen: Diphtheria Toxin and Antitoxin.

SATURDAY, OCTOBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. M. Roberts: London in the Middle Ages.

CONFERENCES.

OCTOBER 10 TO 12.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS (at Connaught Hall, Newcastle-upon-Tyne).
Friday, Oct. 11.—Dr. W. Brand: A Scheme of National Propaganda regarding Tuberculosis.
Dr. A. H. Macpherson: Combined Treatment and Technical Education of Tuberculous Youths.
Dr. T. Beattie and Dr. F. Hewat: The Teaching of Tuberculosis to Undergraduates.
Dr. W. H. Dickinson: The Training of Tuberculosis Medical Officers.
Dr. H. Williams: Methods of Medical Propaganda regarding Tuberculosis.
Dr. W. Guy: Dentistry in Relation to Tuberculosis.

OCTOBER 12 AND 13.

NATIONAL CONFERENCE FOR THE PRESERVATION OF THE COUNTRYSIDE (at Queen's Hotel Pavilion, Ambleside).
Saturday, Oct. 12, at 10 A.M.—G. L. Pepler, Prof. P. Abercrombie, and E. James: A Policy for the Preservation of Lakeland.
At 8.—Sir Charles Trevelyan, Prof. P. Abercrombie, C. Williams-Ellis, and Sir Fabian Ware: Safeguarding the Beauty of the Lake District as a National Heritage.
Sunday, Oct. 13, at 2.—Hugh Walpole, H. J. Massingham, and H. H Peach: Special Aspects of Local Preservation.
At 8.30.—Dr. H. J. Moon: Bird Life of the District.
Dr. Vaughan Cornish: English Scenery.