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Knowledge and Social Service.

It may appear otiose to compare the South African War with the Great War. But one curious difference *saute aux yeux.* At the conclusion of the South African War, there was fierce denunciation of our Army, of our aristocracy, of our neglect of science. The attempt was even made to reform the War Office ! Prof. H. E. Armstrong, now a Nestor both among men of science and among educationists, was outspoken on the neglect of science in our schools. To him was largely due the creation of the Educational Science Section of the British Association in 1901, at the first meeting of which he urged the scientific treatment of education in all its branches, and the introduction of scientific conceptions into every sphere. He is, however, still far from satisfied with the scope and method of scientific teaching in our schools, and our columns from time to time afford evidence that he has not reached the end of his long, long trail winding towards a perfectly organised nation.

Norman Lockyer, exemplar of that race of pioneers who " debouch upon a newer, mightier world ", founded the British Science Guild in 1905 with the object of promoting the application of scientific methods and results to social problems and public affairs. He urged with success upon the Government the need for more liberal support of university education and scientific research. Haldane, with prevision of the life-and-death struggle facing the nation, worked out a scheme for the development of technological study and research at South Kensington, significantly called the London Charlottenburg scheme. The University of London, under the brilliant guidance of Sir Arthur Rücker, endeavoured to set its house in order. The University of Birmingham, our first civic university, founded in 1900, was the prototype of a powerful group of modern universities. The Government, ceasing to dally with the question of educational reform in its broader aspects, accepted with a single gesture Robert Lowe's advice to " educate your masters " and Matthew Arnold's advice to " organise your secondary education ".

> " Bliss was it in that dawn to be alive,
> But to be young was very Heaven ! "

Contrast the vigour of those pregnant years, especially the earlier years after the South African War, with the temperament of the public since 1918. The Great War summoned the whole nation to arms. Silent and abashed we stand before the Cenotaph, asking whether any sins of commission or omission on our part have contributed to the loss of our friends, to the cataclysm which has overtaken the world. Armistice Day is celebrated with increasing solemnity year by year. We have the feeling that the childish question, " What did you do, daddy, in the Great War ? " is an indictment rather than an ingenuous request for information. We cannot school ourselves to learn the stupendous lessons of the War. Like that adorable dreamer, we cherish lost causes and forsaken beliefs, unpopular names and impossible loyalties. The ' schoolmen ' attempt again to spellbind us with their words. The War Office ' carries on '.

That mental attitude has continued ominously for thirteen years. But the shattering events of the last few months have awakened the nation to a more realistic frame of mind. Especially significant, we would suggest, is that university professors have been stimulated to express their opinions more freely, to give a lead to an inarticulate but well-disposed public, reviving a sound tradition established by men like Playfair, Huxley, Norman Lockyer, Roscoe, and other men of science who could be named. Two recent pronouncements of this *genre* deserve special mention.

Prof. Ruggles Gates, professor of botany and plant biology in the University of London, addressing the Educational Science Section of the British Association on " Eugenics in Education ", at the recent centenary meeting, said that the elements of our community most capable of producing men of achievement, intellectually, socially, or financially, are failing to reproduce themselves, and are being eliminated " unobtrusively but fatally ". Parliament, he declared, is almost wholly lacking in the type of intellect capable of restoring the nation to biological soundness by legislation. " One must conclude that almost every important legislative measure since the War, when our racial and economic resources were so greatly in need of conservation, has been effective rather in hastening racial degeneration by its disregard of the fundamental facts of biological inheritance." Prof. Gates pleaded not for more education but for better education, especially in those biological principles which underlie national progress. Following that would come leadership on questions of population, marriage selection, the production of children, racial crossing, and related matters.

The other pronouncement was even more outspoken and relevant to our immediate difficulties. Prof. John Hilton, the first Montague Burton professor of industrial relations at the University of Cambridge, referred in his inaugural lecture to the depressed condition of industry. The cost of living has fallen but wages and interest have held ; hence unemployment. Industry will have to live on its own fat, which is already very lean, and nobody will feed it with the capital which comes from savings. There is no formula to settle wages in this or that industry, to adjust the claims of worker, investor, and public—only a code of rules which each of the contestants ought to observe. For many years industry has been baffled and spellbound by forces not its own. Take the curse from industry and it will give the world good service.

Whatever adjustments are required to ensure progressive social service should be based upon the best knowledge available. Without, therefore, expressing approval or disapproval of the professorial pronouncements referred to, we welcome their appearance as a sign of new life. " The War and the Russian Revolution ", says Bertrand Russell, " have made all timid men conservative, and professors are usually temperamentally timid ", and Hogben refers to " the intellectual discouragement which is the heritage of a World War ". Timidity and intellectual discouragement have only complicated our problems since the War! How long must a distracted world wait before its wise men shall be able to sound again a note of encouragement ?

" For, lo, the winter is past, the rain is over and gone ; the flowers appear on the earth ; the time of the singing of birds is come, and the voice of the turtle is heard in our land"—*The Song of Solomon.*

T. LL. H.

An Odyssey of Science.

Past Years : an Autobiography. By Sir Oliver Lodge. Pp. 364 + 13 plates. (London : Hodder and Stoughton, Ltd., 1931.) 20*s*. net.

IT can confidently be said that the life-story of no man in the scientific world to-day, is likely to be of greater interest to us than that of Sir Oliver Lodge. There is more than one reason for this, but the one above all others which we would have Sir Oliver realise, is that he has gained a quite peculiar place in the regard of his fellow-countrymen. His eminence in science is known to the multitude, and there is no one who has shown greater gifts in teaching them about the things in science on which they particularly want more light. It may be quite true that it is Sir Oliver's concern with matters 'psychic' which has aroused the widest interest of all, and will, perhaps, secure him most readers. But those in science whose memories go back to his early days, will say that they saw him then clearly predestined to fame as a scientific discoverer and as a leading expositor of scientific thought to his generation.

On Sir Oliver's position within the scientific world it is, of course, unnecessary to enlarge here, and, fortunately for the writer of this notice, there appeared recently in these columns (Dec. 12, p. 982) an appreciation of his chief work in the advancement of science, contributed by a more authentic hand—"R. T. G." Readers of NATURE will all feel that for longer or shorter years they have not only learned from him, but have also lived, as it were, in his genial company. Different readers will want to know different things in particular about his life, and so far as one can judge, none will fail to find them in this book.

The difficulty of writing the book must have been very great, even to such a practised hand. The wealth of material alone was calculated to create dismay, but most impressive of all is the evidence the book gives of the difficulties confronting an honest man, when he tries to make sure of recollections of his own life. In the narrative of ordinary events, this may not matter very much, but when a man is to record the course of his thought, the exact sequence of events, and his particular share in discovering, it is very different. The discoveries in which Sir Oliver shared have been of the kind round which the historians of science gather in subsequent generations, with unceasing curiosity and ever sharper scrutiny. At least three accomplished chemists are busy to-day still auditing the intellectual accounts of Priestley and Lavoisier. Happily, in the scientific world, the private 'exchange of ideas' is widely prevalent, both nationally and internationally. But here, though without evil intent, exchange may often be robbery. We continually witness men having their own ideas, like their own jests, presented to them as fresh-minted from another mind. Nowhere does Sir Oliver show his qualities more arrestingly than in dealing with this difficulty in relation to his greatest scientific discovery. He does not balk the reader of the pleasure of listening to first-hand personal memories; the incidence of ideas; the plans of campaign; the talks with friends; the obstacles to progress; the 'ifs' and 'might have dones'. No one knows better than he how to keep human. But when we come to the question, so often asked of his scientific friends, "What part exactly did Sir Oliver Lodge take in the discovery of electro-magnetic radiation?" he provides us with a reply by reprinting words used by the president of the Royal Society in 1899, beginning "The Rumford medal is given to Prof. Oliver J. Lodge in recognition of his researches on radiation and on the relations between matter and ether".

Space can suffice for little more than a general indication of the course which Sir Oliver has taken in his book. The tale extends from very early days, where it is relatively full; through middle life, where there is necessarily great compression; finally to the present day, where we should have to regret much left unsaid, if it were not already within our memories. Here, as in other ways, Sir Oliver shows a talent for omission; he has spared the reader minute reference to 'sources', lists of books and papers, and vexatious footnotes; he has scarcely drawn at all upon what must be a prodigious store of correspondence. Those who have lived longest beside Sir Oliver, and some of those on close terms of friendship, will find much new to them, and of exceeding interest, especially about his earliest days. The younger men will find here a graphic story of the state of physical science before the days of the 'Revolution'. They will see where thought was, who and what men were in the expectant world of science. Speaking in 1889 he said, "the long line of isolated ripples of past discovery seem blending into a mighty wave, on the crest of which one begins to discern some oncoming magnificent generalisation. The suspense is becoming feverish, at times almost painful." On the great questions of to-day, physical and philosophical, Sir Oliver gives in compact and clear terms his present opinions, and they are likely to carry comfort to some who are in sore perplexity.

At the outset of Sir Oliver's story, we learn some interesting facts of genealogy, such as that his paternal grandfather, who was in Anglican orders and also a schoolmaster, brought in an Irish strain; that his father, originally intended for medicine, went from the paternal home in Essex to settle amid the Five Towns, where at Penkull, near Stoke, this, the first of seven sons, was born. To a wonderful mother, the son ascribes, besides much else, the intellectual inheritance of himself and his distinguished brothers Richard and Alfred.

No part of the story of his life is likely more to touch the heart of readers than that dealing with Oliver Lodge's schooldays. It tells of a child, with exceptional appetite and aptitude for learning, in the hands mainly of bad teachers of mainly uncongenial subjects. That was, no doubt, the common case then, but the accompanying cruelty to body and spirit was such as to make Sir Oliver say now: "My schooldays were undoubtedly the most miserable part of my life". But here, as elsewhere, the victim says what he can for those who have despitefully used him, and he seeks out good in all the uses of adversity.

Schooldays were ended at fourteen by an exacting father, who for the next seven years set himself inflexibly to immerse and retain his eldest son in his business. This business was a prosperous agency for the supply of blue-clay and other requisites to the potters. It involved not only keeping the books but also continual travel within and beyond the Potteries. The story of these hard years of school and business is shot with many gleams of sunshine. We see the first lure of science, the earliest efforts, almost clandestine, at experiment. Then emancipation begins through the strong and benign influence of his mother's sister, Miss Heath ("Aunt Anne"), who lived in Fitzroy Square, London, and had been the first to feed her nephew's appetite for science. She comes into the story like a good fairy. During a winter with her, he attended classes and lectures; Tyndall became his hero, and from the Royal Institution he "walked home, as if on air". After his return from this to servitude we read of rapid developments, among other things, preparation for London matriculation (1871).

During two successive years, Lodge spent a period at the Royal College of Science, London, attending the special courses for science teachers. Then comes the final determination to break away, which, after his failure to attain the desired haven of Cambridge, brought him to University College, London. There, besides the great mathematical teachers, Clifford and Henrici, the young man found a friend indeed in Carey Foster. With £50 a year, assigned to him by Foster for assistance in teaching work, living as a "rebel from home" a life of real privation for three years in Camden Town lodgings, Oliver Lodge then set himself at last fairly on the highway along which he was to travel thenceforth. He became assistant professor of physics at University College. Then, too, began the splendid companionship that brings much radiance into this story of past years. Lodge left London in 1881 to become the first professor of physics at University College, Liverpool. In 1900, under the influence of Joseph Chamberlain, he was made the first Principal of the new University at Birmingham, remaining there until he resigned in 1919 and went to live near Salisbury. Such, in bald outline, was the course of events. They are not dealt with consecutively in the book, and the whole shaping and chaptering of it may not please literary formalists, but somehow it all seems just right for the purpose.

Sir Oliver has shown, to an extent that few could safely attempt, how he has played the great game of life. The frank record of his difficulties and doubts, his strivings and disappointments, his ambitions and defeats, will not only strike many responsive chords in the minds and hearts of the elders, but also will afford invaluable aid to younger men. They will see clearly depicted many difficulties that are among the hardest not only in the art of scientific discovery, but in life itself. They will see how at times crises arise, fate—and conscience, too—seeming to point with equal fixity both right and left. Those who study education will find here a rich mine. Sir Oliver does not descant much upon the teacher's art; but he exhibited it to a supreme degree in his "first and only text-book", that on "Mechanics", written in 1897, before his first appointment in the teaching world; in his "Easy Mathematics" (1906); and in every effort he has made through life to instruct his fellows. In these columns and elsewhere he has laid us under a heavy debt by his lucid exposition of the revolutionary modern discoveries in physical science. In particular he has been solicitous that the world should appreciate the great conquests that have been in progress at Cambridge during the last forty years.

It is hopeless to enumerate the scientific and human topics on which the book touches; for Sir Oliver looks back on so many "crowded hours of glorious life". The versatility of his interests has been so great that he is not free from the misgiving that he might have done better had it been less. The first occasion on which the present writer met Sir Oliver was when he was expounding an ingenious graphical symbolism for organic chemistry, and certainly the chemists have always felt him to be a very near relation. He had the companionship of philosophers, including an intimate friendship with Arthur Balfour. He has, indeed, moved among all sorts and conditions of men, and browsed in many pastures.

There is one matter of which mention must not be omitted. On all grounds, public and personal, Sir Oliver had warrant for allotting a relatively large share of pages to the history of his experiences, and a recapitulation of his faith, in matters 'psychic'. From the days at University College in London, when he made the acquaintance of Edmund Gurney, through his experiences at Liverpool, Birmingham, Cambridge, in the island home of Richet, up to the present day the tale is told. It is told, as all else in the book is told, with exactly the same candour and the same control. We can confidently say that it provides just the authentic summary that so many men of science have wanted. More than that there can be no need to say in this notice.

On his way through life, Sir Oliver Lodge has enriched the world with many books. Greatly as these books have been, and are, prized, no one will be more ready than their author to say they will not all endure. Of one, "Modern Views of Electricity" (1889), it has already to be said that after a long and most useful day it has, in one sense, ceased to be. "The discovery of the discontinuous nature of electricity", Sir Oliver says, "caused the book to go out of print." But of this autobiography we shall surely say that no end can be foreseen to its acceptability and service in future generations. It is written by one who is veritably a giant in these days, a man of wonderful endowments and influence. He has participated in revolutionary discoveries in science, and has been a leader in perhaps the most fateful movement of his time—that which is at last making our race conscious of the mighty part that science must henceforth play in human thought and action. He has written of his past years in the spirit of one who wishes to bequeath what he can of the wealth of his experience and his stores of wisdom, and so has produced a human document of rare and abiding interest.

We see in his book some reflection of the nearest intimacies and greatest influences that have affected Sir Oliver's life; above all, those from within his own home. From that we come to understand a little of what has conferred upon this man, who has lived so strenuous a life, the serenity with which he walks among us in these later days, and the sway he exercises upon his fellow-men.

When a man has stepped, however lightly, into his ninth decade, it seems unfair to exact a great deal from him. But many readers of Nature must have been present during the British Association meeting last September, at the great debate on the recent trend of science, and have heard Sir Oliver sum up, with such sure touch, the performance of each of the protagonists who had been engaged. All who were present will look forward not only with hope, but also with confidence, to further gifts from the man who has already given so much.

Arthur Smithells.

Medical Bacteriology.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 8. By W. Bulloch, L. Colebrook, J. Cruickshank, R. Cruickshank, A. Dawson, J. T. Edwards, F. Griffith, L. W. Harrison, E. Hindle, Ivy Mackenzie, A. Robertson, R. St. John-Brooks. Pp. 390. (London: H.M. Stationery Office, 1931.) 21*s*. net.

Chap. I. of this volume deals with the Fungi pathogenic to man and is a valuable addition to the ordinary bacteriological literature. We agree with the authors that the space allotted to mycology is so restricted that it is impossible to cover the field even in summary, and we feel that the volume would have been improved if considerably more space had been given to this subject, which is so inadequately dealt with in all medical works. The gain to the book would have been great, and the loss would have been slight if some of the other chapters—for example, those on syphilis and the normal bacterial flora of man—had been even severely cut by the editors in order to give more space to mycology. The authors, however, have made the most of the pages allotted to them, and we congratulate them on a really valuable contribution.

We are glad to see emphasis laid on the fact that growth of these organisms takes place on the common laboratory media, and that, though Sabouraud's medium has advantages, it is not essential in the study of the fungi of ringworm and other conditions.

The chapter on actinomycosis, though short, contains all the essential points, but leaves us still in doubt as to the origin of most of the cases. Bostroem's original view is regarded with grave suspicion, but the alternative hypothesis of alimentary tract infection which the authors favour does not seem to have any more clear proof. The example given of infection round a fragment of a carious tooth found in an actinomycotic lung seems to us to give quite as much support to Bostroem's view as to the other one.

In view of all the work done on the actinobacillus as a causal agent in many of the cases of so-called 'actinomycosis' in cattle, the organism, we think, deserves more attention than has been given to it in the short note by Dr. Griffith, and does demand a revision of the work on actinomycosis.

The short chapter on pathogenic Leptothriceæ by Dr. Ivy Mackenzie, giving, with much other information, his well-known observations on the two phases of the meningococcus, is of interest, and though we may not agree with some of his views, yet the inclusion of this article is thoroughly justified and we think it deserves very careful study.

Chaps. iv., v., and vi., on the spirochætes, are excellent. Though the information given in some cases is very limited, yet for a " System " of this kind it is probably ample, and we congratulate the writer on a very valuable article.

Chap. vii., on syphilis, is by Col. Harrison. This is a very full article and is not confined to the bacteriological aspects. Pathology and serum therapy are also dealt with fairly fully. The various serum tests are fully described. The article is very comprehensive and well written, as one would expect from a man who must be regarded as a leading authority on the subject. Our only criticism is that a good many of the details which are common in all ordinary textbooks might have been omitted with advantage to the readers, but the inclusion does not in any way minimise the value of the contribution as a whole.

The chapters on rat-bite fever, leptospiroses and yaws do not call for any special comment. They give all the important information on these diseases and give it in a very satisfactory way.

Chap. xi., on the normal bacterial flora of man, is admittedly a difficult one to write, as there must be a considerable variation in different individuals not dependent on any single factor. Climate, food, etc., must all play their part. To get any standard of real value would mean a very extensive and prolonged investigation. The writers of this chapter have given us a great deal of information, and have given it well, but we cannot say that much which is either new or of real value has been added to our already rather confused store. It is perhaps well that this chapter is included to make the " System " more complete, but we cannot be enthusiastic over what is, and possibly must be, a mere compilation of observations by many authors. The authors have attempted to bring some order into the confusion which exists, and with a certain amount of success. We still are, however, very uncertain as to what are really ' normal ' and ' abnormal ' bacteria in the various situations in an apparently healthy man and which are to be regarded as pathogenic. The portion of the chapter on the aciduric group of intestinal organisms with which the chapter closes, is, in our view, the best part of the article, and we feel that if more had been done along these lines a more valuable contribution would have been made.

Chap. xii., by J. T. Edwards, is on swine erysipelas, and gives a fairly full account of the disease and the organism concerned. J. M. BEATTIE.

Mineral Treasures in South Africa.

Mineralische Bodenschätze im südlichen Afrika. Von Prof. Dr. Hans Schneiderhöhn. Mit Beiträgen über die Diamantlagerstätten Südafrikas von Prof. Dr. Erich Kaiser und die Kohlenvorkommen Südafrikas von Prof. Dr. Paul Kukuk. Pp. viii + 111. (Berlin: N. E. M. Verlag G.m.b.H., 1931.) 18 gold marks.

PROF. SCHNEIDERHÖHN was one of those who had the good fortune to attend the fifteenth meeting of the International Geological Congress held in South Africa in 1929, the conferences and excursions in connexion with which ranged over an area extending from Cape Colony to Northern Rhodesia and from South-West Africa to Natal. Because of his special knowledge of the geology and ores of South-West Africa he acted as a director of one of the excursions to that region, conducting a large party over the mining field of Otavi, of which he had made a study in previous years. He also took part in several excursions conducted by others. During his travels he kept records of the areas visited, and on returning to Europe wrote these up into a series of articles, which were published by *Metallwirtschaft* between December 1929 and June 1930.

At the suggestion of the editor of that journal, Dr. Schneiderhöhn has now elaborated these articles and assembled them in a single volume, entitled " Mineralische Bodenschätze im südlichen Afrika ". The volume, making no claim to be encyclopædic, confines itself to fields visited by the author or by some of his German colleagues. It is divided into six sections, dealing severally with the Congress programme, excursions in South-West Africa, in the Union of South Africa, in Southern Rhodesia, Northern Rhodesia, and the Belgian Congo.

The section on South-West Africa includes a general account of the geology, and special descriptions of the mineral-bearing pegmatites of Namib, the copper-lead-zinc deposits of Otavi, the associated vanadium ores, etc. That on the Union comprises accounts of the Witwatersrand gold-field, and of the diamond, coal, and iron deposits of South Africa as a whole, the diamond occurrences being described in collaboration with Prof. E. Kaiser of Munich, and the coal by Prof. P. Kukuk of Borchum. There is also a good description of the Bushveld igneous complex and of the chromium, nickel, platinum, and tin mineralisations genetically connected with it.

Under Southern Rhodesia the general geology is summarised, and special reference made to the asbestos and chromite mines, and to the Great Dyke and its associated ore-deposits. The section relating to Northern Rhodesia is particularly interesting. It epitomises the geology so far as is at present known, and gives good accounts of the lead-zinc-vanadium ores of Broken Hill, and of the deposits of the great copper mines—Bwana M'Kubwa, Mufulira, Roan Antelope, N'Kana, N'Changa, etc.—now in course of development. It is shown how the Rhodesian geology carries on into the Belgian Congo, and interesting accounts are given of the copper-field of the Katanga and of the remarkable uranium and radium deposits of Chinkolobwe.

The book runs to about 110 pages, and is interestingly written. It is profusely illustrated with photographs, maps, and sections, some of the maps being particularly valuable, because they represent the latest results of geological surveys now actively in progress. Although necessarily based in large measure upon the work of others, it contains much that is original either in substance or interpretation. It is a compilation which many who are interested in the geology and mineral resources of South Africa will greatly appreciate, and of which its author may be justly proud. C. G. C.

Short Reviews.

The Study of Rocks. By Prof. S. J. Shand. Pp. xi + 224. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1931.) 6*s*. net.

Prof. Shand has written a clear and well-proportioned account of modern petrography, which instructs the beginner along sound lines and is well worth reading by mature students. Nearly two-thirds of the book is devoted to igneous rocks, and both in this section and in those dealing with the sedimentary and metamorphic rocks, the treatment of rock-forming minerals, and classification, reveals the author's remarkable capability for adequate summarisation.

Chap. iv., on the classification of eruptive rocks, is a masterly outline of the chief systems that have been proposed from the time of Zirkel onwards, culminating in Shand's own scheme as recently developed in his larger book on "Eruptive Rocks". The difficulty of dealing with rocks that carry both quartz and olivine is met by suggesting that if there is enough quartz to convert all the olivine into pyroxene "the rock should then be considered a saturated one". A welcome feature is the recognition that there are peridotites which are definitely intrusive on their own account and seem to owe nothing to accumulation of early formed crystals from basaltic magma.

Sedimentary rocks are divided into: (*a*) organic residues; (*b*) solution residues; (*c*) crystalline rock-residues; and (*d*) crypto-crystalline and colloidal rock-residues. The main classes of metamorphic rocks recognised are mylonites, hornstones, and crystalline schists; granulites and injection-gneisses are referred to under the third of these categories.

Each chapter is followed by suggestions for reading which provide a useful guide to petrological literature. The book is a model of competent compression, and should prove to be a stimulating introduction to this vast and ever-growing subject.

The Primitive Mind and Modern Civilization. By C. R. Aldrich. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvii + 249. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1931.) 12*s*. 6*d*. net.

Early excursions of the psycho-analysts into the realms of anthropology did not produce any results which inspired confidence. Prof. Malinowski had no difficulty in showing in his well-known examination of the hypothesis of the father-son antagonism, in the light of the customs of a matrilineal society such as the Trobrianders, that they had failed to take actual conditions into account. Mr. Aldrich, a follower of the Zurich school, however, maintaining that anthropology is unable to handle its data unaided, now examines the beliefs and rituals of primitive and savage society in the light of the two principles of the 'racial unconscious' and the gregarious instinct. He attacks the school of Lévy-Bruhl and shows that, so far from the savage standing at a prelogical stage, between which and the thought processes of the civilised mind a gulf is fixed, there is in fact a regular progression from the unconscious, as manifested in an instinct for co-operation, through the conventional morality of the savage and civilised, to the consciously directed social co-operation which is now making itself manifest in certain individual members of society as the place of conventional morality is taken by what he calls 'bio-morality'.

Anthropologists will welcome Mr. Aldrich's critical examination of their data, even if they do not agree with his stimulating conclusions. His 'racial unconscious' is at present no more than hypothetical. Its existence still has to be proved. At present his interpretation of social phenomena, such as reasons for purification of warriors on their return from a successful raid, is metaphysical rather than psychological; but it cannot be ignored and will stimulate further research.

The Life of the Ant. By Maurice Maeterlinck. Translated by Bernard Miall. Pp. 192. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1930.) 6*s*. net.

This book completes the author's trilogy—"Lives" of the bee and the white ant being already well-known works from his pen. Much personal observation has been drawn on for the compilation of this volume, and scarcely a page passes without reference to a prominent myrmecologist, whose views are freely discussed. We read of the habits of ants, their social sense, their community foundation, their adaptability, and their warfare. But so complicated and so biologically big is this communal life that the author appears really to be "writing not the history of a community but the chronicles of a hundred nations".

Ants probably began as insect hunters, and from this predatory life they evolved through the pastoral to the agricultural method of life, thus affording a parallel to the three stages of human history—conquest, defence, industry. What is the secret of this wonderful evolution? We are told that it is rooted in the capacity to live in social communities, and with this capacity has developed a 'mob intelligence' far surpassing that of the individual. Social organisms are endowed with a social organ. For man it is the brain, while for the ant it is a stomach sac used for food storage, and from which regurgitation takes place in response to a caress—that touch of Nature which makes the whole world kin. Their powers of communication—the author suggests the power of speech—and of orientation have been the subjects of research for many naturalists. These powers are seated in the antennæ, organs largely concerned with olfaction, but also, we are told, they are endowed with electric, magnetic, etheric, and psychic perceptive ability. The general point of view is distinctly anthropomorphic. The book is delightfully written and beautifully translated.

The Electrical Equipment of Automobiles: a Book on Principles for Motor Mechanics and Motorists. By Prof. S. P. Smith. Second edition, revised and enlarged. Pp. xii + 198. (London: Chapman and Hall, Ltd., 1931.) 5*s*. net.

This excellent little book, the outcome of lectures given by Prof. Smith at the Royal Technical College, Glasgow, contains just what is required by the motorist who has an elementary knowledge of electricity and wishes to understand the electrical equipment of his car. Its seven chapters deal with the storage battery, the action of electrical machines, the starting motor and the dynamotor, the charging generator and the automatic cut-out, miscellaneous electric equipment, wiring systems and location of faults, and the ignition system.

Explanations in simple language are given of the principles and construction of the various equipments, their action is explained, hints as to their proper use are given, and the likely faults are tabulated, together with the appropriate methods of detecting and remedying them. A study of the book will go far towards heightening the interest of the motorist in the many ingenious pieces of apparatus which discovery and invention have placed at his service.

Introduction à la géométrie projective différentielle des surfaces. Par Prof. Guido Fubini et Prof. Eduard Čech. Pp. vi + 291. (Paris: Gauthier-Villars et Cie, 1931.) 60 francs.

Although the metrical part of differential geometry has been studied for two hundred years, the projective aspect received little attention until much later. Perhaps the earliest work on the subject was that of G. H. Halphen in 1875, but the systematic investigation of the projective differential geometry of surfaces was commenced by Wilczynski about 1906. Since then a great deal has been done, especially in Italy and the United States.

A good account of the history and present state of knowledge is given in the book under review, the authors of which have themselves published many researches in the subject. After an introductory chapter there follow two chapters on curves in the plane and in space. The remaining eleven chapters deal chiefly with surfaces, including an account of Cartan's methods. In addition to historical and bibliographical notes at the end of nearly every chapter, there is an extensive list of research papers, occupying thirty-four pages. It is regrettable to find that among all these papers there is only one by an English author. Possibly this book and the larger Italian treatise in two volumes by the same authors will stimulate the study of projective differential geometry in Great Britain.

H. T. H. P.

Problems in Practical Physical Chemistry. By F. A. Philbrick. (Dent's Modern Science Series.) Pp. xiii + 146. (London and Toronto: J. M. Dent and Sons, Ltd., 1931.) 3*s*. 6*d*.

Mr. Philbrick's book is a joint product of the Oxford school of physical chemistry and of teaching experience at Clifton. In the narrow compass of 146 pages, and at a very modest price, it includes instructions for 33 problems, on reactions, ionic equilibrium, the phase rule, distribution, reaction velocity, electrical conductivity, and indicators. One obvious merit of the book is that a number of exercises in volumetric analysis are set in the form of a physico-chemical problem instead of a mere exercise in analysis, since the student is required to find out the nature of the interaction in question. This procedure not only provides useful experience of chemical methods, but is also a very welcome relief from the too highly standardised exercises which have done duty for a generation in practical courses of physical chemistry.

Villages et Kasbas berbères: tableaux de la vie sociale des Berbères sédentaires dans le sud du Maroc. Par R. Montagne. Pp. ix + 22 + iv + 73 planches. (Paris: Félix Alcan, 1930.) 50 francs.

In this volume, Dr. Robert Montagne has given his readers, literally, a panorama of social development in Morocco according to his interpretation of certain aspects of material culture. The text is reduced to a minimum; the information is conveyed by a series of excellent photographs. In these are shown the different types of villages, fortified and unfortified dwellings, granaries, hill-forts, and structures of a like character, each of which is regarded as appropriate to some phase of the history of the country, ranging from the small independent agricultural community to centralised government through the agency of local governors or tributary chief. The photographs are arranged in groups accordingly, each group being preceded by a brief general account of the social phase it illustrates.

Electron Optics.*

By Prof. G. P. THOMSON, F.R.S.

ALMOST all progress in physics has come from comparing the unfamiliar with the familiar. One could scarcely have a better example than the story of Newton's apple—for this comparison assimilated the motion of the moon to the motion of a falling body. The great essential is to use an idea with which one is already familiar. It is less important that the idea should be really understood—if, indeed, anything in the physical world ever can be understood in any absolute sense. The falling of the apple was not understood then (one may perhaps doubt if we understand it much better now, when we say that it is a consequence of the curvature of space), but it was at least familiar, and the mind needs familiar images with which to work.

Now, in the study of the very small there are two pictures which have proved their use. One is as old as the Greeks: the idea of a particle, hard, small, smooth, an idealised grain of sand. Generally it is pictured as moving, and the universe as an endless game of snooker with every ball played at once. The other view is only seven years old, but it is a promising youngster and in the last few years has come to take an equal place with its elder brother, so producing a curious duality in our views of matter. I refer to the idea of matter as waves, which was invented by Louis de Broglie. Now, light has long been regarded as waves, and to many physicists, at least, waves of light are more familiar in their properties than the more tangible waves of water or of sound. This analogy between matter and light is a good one, but, like all analogies, there are points at which it fails.

According to de Broglie, any piece of matter should have wave properties, but in most cases the wave-length would be too small to detect, even with the most refined experiments. The heavier the piece of matter and the faster it is moving, the shorter is the wave-length, and although recently the wave properties of atoms as a whole have been detected, most of the experimental work has been done with the lightest known pieces of matter, namely, electrons. Even with these, the wave-length is usually much less than that of light. Thus for the electrons which form part of a beam of cathode rays from a discharge in rarefied air, the wave-length is usually about one fortieth of the size of an average atom, and only about one hundred-thousandth of the wave-length of red light. Actually, if the voltage is 30,000 volts, the wave-length is about 7×10^{-10} cm.

The characteristic feature of those waves which one can actually see and feel is the periodic motion of the water or other medium, but when one comes to waves in which one can no longer actually see the medium bobbing up and down, the most characteristic wave property is that called 'interference'. This is the property by which, for example, two beams of light can produce darkness, and is explained at once as due to the superposition of two trains of waves in such a way that the crest of one wave neutralises the trough of another.

In the case of light, this leads to a pattern of light and dark bands, the sharpness of which may be much increased by using not two waves only but a large number of wavelets produced by the scattering of a single wave from a number of obstacles arranged in a regular order. To get a satisfactory pattern, the distance apart of the scattering objects must not be too great compared with the wave-length of the light. This led Laue to use the atoms of a crystal as scattering centres to measure the very short wave-length of X-rays. The use of a crystal, however, introduces a complication, for we are not only concerned with the wavelets from one plane of atoms but also with those from successive planes. The result is that only if the crystal is correctly adjusted to the incident beam will there be a strong beam selected by interference. If the crystal is powdered and the pieces are arranged at random in the path of the rays, there will always be some pieces correctly adjusted, and the beams from them will lie on cones and their intersection with a screen will show as rings. The absolute sizes of the rings are proportional to the wave-length and inversely as the spacing of the atoms, while the relative sizes of the different rings in any one experiment depend on the arrangement of the atoms in the crystal.

Now, electrons are certainly scattered by atoms. If they are like waves, they should give interference and the scattered waves should be concentrated in certain directions; presumably the electrons will show themselves most where the waves are concentrated. In my early experiments, this was done by passing a narrow beam of cathode rays through a thin foil and receiving the scattered rays on a photographic plate. When developed, these plates showed ring patterns which were in agreement with those calculated from de Broglie's theory and the known crystal structure of the metal films used. To get good results the films had to be of the order of 10^{-6} cm., and this limits the substances with which one can work. I have found, however, that equally good results can be got by reflecting the rays from a block of material, the face of which has been suitably prepared. It is probable that the rays pass through minute projections on the surface, so that the reflection is only apparent. In this way ring patterns have been obtained with a variety of substances, such, for example, as spluttered metals and metals which have undergone surface oxidation or other chemical change. The method enables one to examine a very thin layer of the substance, for the effective depth of penetration is of the order 10^{-6} cm. It appears that almost any surface will give some kind of a pattern, providing that it is reasonably flat.

The concentration due to interference is, as we have seen, much more marked if there are many scattering centres arranged in order. This is so in

* Friday evening discourse delivered at the Royal Institution on Dec. 4.

the case of the above experiments; for though the crystals are small enough to be very numerous, even in a small piece of material, they each contain a very large number of atoms. Recently, Wierl has made experiments of the same character with gases. Here the scattering particles are the atoms, of which there are only a few in each molecule; so though rings are formed, they are not very sharp. Nevertheless, the theory holds, and Wierl has calculated the distance apart of the atoms in various molecules from the sizes of the rings. He has been able to draw a number of interesting conclusions about the relative positions of the atoms in the molecules. For example, he finds that the carbon atoms in the benzene rings lie in a plane. Mr. French has recently found similar diffuse rings from the polished surfaces of metals. These rings appear to be due to the noncrystalline Beilby layer.

The apparatus I have described will also serve for single crystals. Here, however, we should expect nothing unless the crystal were suitably adjusted, and then only a small number of spots. With a cleaved surface of rock salt these expectations are approximately fulfilled, though there is enough latitude from various causes for some sort of a spot to appear for almost any setting of the crystal. In addition, there appear a number of black and white lines, which have been ably explained by the discoverer, Kikuchi, as due to double scattering.

Some experiments with single crystals of metals have led to rather surprising results. When cut so that the face is crystallographically a simple one, these crystals give an extended pattern of spots of a very regular character. The pattern is just what we expect from a single layer of atoms arranged in the crystal form and set normal to the rays. The agreement is exact and extends to small details. The pattern is the polar reciprocal of the atomic arrangement known to exist in the crystal, each spot of the pattern corresponds to a line of atoms in the crystal, and the whole plane of atoms behaves like two crossed optical gratings. Clearly, however, a single plane of atoms sticking out at right angles to the main surface is a mechanical impossibility. The surface was actually prepared by etching and was probably covered with pits and pyramids, through which the electrons pass. The reason for the extended pattern is that the thickness in the path of the rays is so small that the successive layers of atoms are not badly out of step over a considerable range of angle. This approximate agreement is helped by the small angle through which the rays are turned out.

Some recent work in conjunction with Mr. Stuart on spluttered platinum films has shown that while the usual structure is that of normal platinum, abnormal types sometimes occur. One of these gives a pattern of straight lines, which is unstable and disappears under the action of the rays. It appears to be due to the presence on the surface of small pieces of some crystalline structure in which the atoms are arranged accurately in layers parallel to the surface but each separate layer is largely chaotic. We have not been able to determine whether the atoms are those of platinum or of a gas. Another abnormal structure shows the presence of extra rings, which may be associated with catalytic activity of the platinum.

While these experiments show the close resemblance between the behaviour of the electrons and that of light in those experiments which were the original proof of its wave character, yet, all the same, one must not entirely abandon the particle idea. When the electron reaches the photographic plate, it seems to forget that it is a wave and becomes a particle. If the plate were examined under a high magnification, the pattern would show up as a number of black specks, each corresponding to one

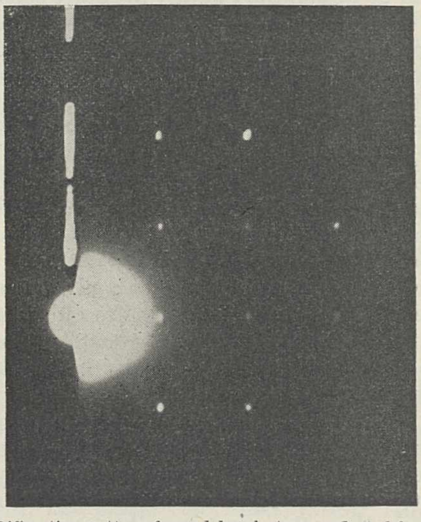

FIG. 1.—Diffraction pattern formed by electrons reflected from a cube face of a silver crystal. The interrupted line was added afterwards.

grain of silver bromide made developable. Each electron affects one grain only. Yet the waves which interfere must have been scattered from atoms over a wide front, and the sharpness of the ring and spots shows that there has been a long train of waves acting, just as a sharp line in an optical spectrum implies a long train of coherent waves. On the wave side of its nature the electron is a widely extended entity which in a sense occupies the whole region in which it might be found. An electron is like an able guerilla leader who occupies a wide area with rumours of his presence, but when he strikes, he strikes with his whole force. No analogy is perfect, and though the analogy between light and electrons even extends to this curious duality of wave and particle, it breaks down in the end.

Electrons are essentially different from light. They are acted on by electric and magnetic forces, and react on the bodies which cause these forces. Light does not: it only affects matter when it actually hits it; there is no action at a distance. Further, the electronic waves are a trifle less real than those of light. No one, it is true, has ever actually observed the frequency of visible light, but that of very long wireless waves can be directly followed, and the difference must be only one of degree. Now, so far as we know at present, the *frequency* of electron waves is quite unobservable. It is always the *wave-length* which we find. Possibly we could observe differences of frequency under very special conditions, but the absolute values seem to have no significance except as mathematical symbols. Different values can be assigned to this frequency, and the calculated results still agree with experiment.

Again, the fluctuating quantities or 'displacements' in the light wave have a definite physical meaning, namely, electric and magnetic intensities. No one has observed the corresponding quantity in the electronic wave. Indeed, in the most successful forms of the theory it is not even a real number. Only the intensity of the wave has a physical meaning, namely, the chance that an electron will appear at the place in question. The two views of electrons, as particle and as wave, are parables, each enshrining a part of the truth. Whether between them they include all that we need to know, as some physicists believe, or whether there are not other aspects, still undreamed of, is for the future to decide.

Dental Caries and Diet.

THE researches of Mrs. Mellanby on the part played by diet in the development of the teeth and jaws in animals have already been referred to in these columns.[1] A report on the relationship between diet and the structure of human teeth is in course of preparation. Mrs. Mellanby's work has also led to the conclusion that it is possible to influence the structure, and thereby the resistance to disease, of teeth after eruption. It was obviously desirable that this conclusion should be confirmed by a large-scale clinical trial. A preliminary report of such a trial has now been issued by the Committee upon Dental Disease.[2]

The investigation was carried out at three residential institutions for children near Birmingham, under the control of the poor law and later the local education authority. The teeth of the children were examined every six months by Mr. A. Deverall: the diets were controlled by Miss E. Brinton and Miss M. Reynolds. The number of children included in the investigation was 332, aged from 5 years to 14 years: the duration of the test was two years. The children were divided into four groups, all of which were on a similar and generous basal diet. At the first institution 1-1·5 oz. treacle daily was added to the diet; at the second 1-1·5 tablespoonfuls (14-21 c.c.) daily of olive oil to that of one group and a similar amount of olive oil containing radiostol (irradiated ergosterol) to that of the remaining children; at the third institution the addition to the diet was 14-21 c.c. cod-liver oil daily.

The dental examination made at each inspection included the number and structure of the fully erupted teeth, the condition as regards caries, of which three degrees were arbitrarily recognised, and the condition of the gums. By using a numerical notation for the degree of caries, it was possible to obtain the total caries figure for any group of children, and also the average caries figure by dividing the total by the number of teeth in the group. All teeth lost subsequent to the first inspection continued to be counted in later inspections, since otherwise the extraction of a carious tooth would appear to lead to a sudden improvement in the condition as regards caries. The incidence of caries in a group was shown by the number of carious teeth: the extent of caries by the average caries figure. The latter could only show a decrease when the number of teeth in the group increased by the eruption of fresh teeth, which were not attacked, or only slightly, by caries, since the total caries figure could not decrease with the passage of time.

The investigation reported was actually carried out in two parts: in the first the effects of adding treacle, olive oil, or cod-liver oil to the diet were compared; in the second the effects of olive oil and radiostol. The olive oil group was to a large extent the same in each investigation. Each group consisted of 65-85 children. The results obtained were briefly as follows: the increase in the percentage of carious teeth in the group given treacle was 10, in those given olive oil 8, and cod-liver oil 3, in the first experiment; in the second the olive oil group showed a percentage increase of 7 and the radiostol group one of 2. The percentage increases of the average caries figures for the five groups were respectively 42, 46, 10, 31, and 10. Statistically, all the differences are significant except that between the average caries figures in the second experiment. Further analysis of the figures indicated that similar differences were observed when the deciduous teeth, the permanent teeth or the first and second premolars (upper and lower), or first permanent molars (upper and lower), were considered separately. In the first investigation the actual number of carious teeth approximately doubled at the institutions in which treacle and olive oil were the dietary supplements, but only increased 50 per cent when cod-liver oil was given. In the second investigation the number of carious teeth per child rose from 4·5 to 6·2 in the radiostol group and from 3·8 to 6·4 in the control group; for the permanent teeth the figures were 1·8-3·1 and 1·6-3·7 respectively. Very similar figures were obtained in the first experiment.

Considering the two investigations together, it was found that the increase of the average caries figure of the permanent teeth in the two vitamin groups was about two-fifths of that in the control groups. In general, the results agreed closely with those previously obtained at Sheffield with a smaller number of younger children suffering from surgical tuberculosis and showing a higher initial incidence of caries.

It appears, therefore, that the addition of vitamin D to a standard dietary will reduce the increase in the incidence and extent of caries, which occurs with the passage of time, by about two-thirds.

[1] NATURE, vol. 125, p. 604; 1930: vol. 127, p. 977; 1931.

[2] "The Influence of Diet on Caries in Children's Teeth" (Interim Report). By the Committee upon Dental Disease. Medical Research Council. Special Report Series No. 159. (London: H.M. Stationery Office, 1931.) 6*d*. net.

Obituary.

Major-General Sir David Bruce, K.C.B., F.R.S.

SIR DAVID BRUCE was one of the greatest of the great physicians who deal less in healing of the sick than in the conquest and abolition of disease; he died of a dread disease on Nov. 27, in the seventy-seventh year of his age. His one fear had lately been lest his wife, the comrade of fifty arduous years, should be left helpless, but her release from suffering came four days before his own.

Born in Melbourne (on May 29, 1855) but brought home to Scotland at five years old, Bruce went to Stirling High School, and was sent out into the world, by way of a Manchester warehouse, at the age of fourteen. There he worked for about three years, during which time his wish was to become a professional boxer or footballer, an ambition which those can understand who remember his great figure and his prodigious strength when he was young. About the year 1876–77 he came to the University of Edinburgh and began to study medicine; soon afterwards he was foremost in a little band of friends, of whom Diarmid Noel Paton the physiologist was one, and another helps to-day to write these words. We worked together, fifty-three years ago, at the same table in Turner's old dissecting-room, the ways and appurtenances of which had scarcely changed in two hundred years; and then stepped across the street to see Lister turn up the cuffs of his black frock-coat, and operate under the spray.

Immediately after graduating, Bruce joined the Army Medical Service in 1883, and in the same year he married Mary Elizabeth Steele, a doctor's daughter, of Reigate. The marriage was singularly fortunate. Mary Bruce was a rare helpmeet, tireless and fearless, ready at any moment to follow her husband across the world: growing more and more skilled in all the delicate manipulations of bacteriology, and possessed of no little scientific insight and acumen of her own. Bruce was never tired of praising her, of acknowledging her help, of testifying to her knowledge and ability. Almost his last words were to remind a friend that the story of his own life was never to be told without full credit being paid to Mary for her part therein.

Bruce was a fervid admirer of Pasteur, all his life long. It was Pasteur's example which he followed steadily, to make of medicine "an experimental biological science", and to arrive at "the intelligent, purposive prevention of disease". Pasteur's epoch-making work was already something of an old story when Bruce was a student; but another great epoch was just beginning, with Laveran's discovery of the malaria parasite in the blood corpuscles, and with Koch's discovery of the tubercle bacillus.

In Bruce's presidential address to the British Association at Toronto—an address which seemed to relate every salient fact of modern medicine within the brief compass of an hour—he tells how one day in 1882, in Edinburgh, he heard of Koch's great discovery from a fellow-student just home from Germany. So revolutionary an idea was hard to believe at first; but Bruce sketches the interest and excitement it aroused, in which he shared to the full. The excitement continued: for within two years more the bacilli of glanders, diphtheria, typhoid, and cholera had all been discovered in Koch's laboratory. By this time, in 1884, Bruce—an Army surgeon and a married man—was at work in Malta; and so well did he follow Koch's and Pasteur's example that by 1886 he had discovered *Micrococcus* (now *Brucella*) *melitensis*, and proved it to be the actual cause of Malta (or Mediterranean) fever. This was a cardinal discovery. The bacteriologist of to-day, with his well-stocked laboratory and the experience of fifty years behind him, may well pay tribute to Bruce's splendid insight, which let him see how, by cultivation of a micro-organism from a patient's blood, evidence could be got of the direct relation between the organism and the disease. Bruce went straight to the root of the matter; and his method of blood-culture, a commonplace of to-day, was a pioneer procedure then. The work was done against almost insuperable technical difficulties; the observations were repeated again and yet again. At last, after many disappointments and set-backs, Bruce succeeded in reproducing the disease among his experimental animals.

The discovery of the causal agent of a communicable disease often helps but little towards the finding of means for its prevention; but in this case Bruce's indomitable energy had its ultimate reward. For seventeen years after the discovery of *M. melitensis*, Malta fever continued to prevail. "Almost every sailor who came into hospital even for the most trivial complaint took Malta fever, and after a long illness had to be invalided home." At last the Admiralty and the War Office took alarm, and Bruce was sent out again by the Royal Society, in 1904, at the head of a Commission. After months of hard and disappointing work, Dr. Zammit, a Maltese colleague, happened to examine the blood of a goat—an animal which had been already and repeatedly found immune to the disease; but now it turned out that the goat's blood 'agglutinated' or 'clumped' the micrococcus—a fact which Bruce took to mean that the organism must have been living and multiplying within the apparently healthy goat before this peculiar property of its blood could be brought about. Work went on with new hope and energy; fifty per cent of the island goats were found to carry the micrococcus, and a fifth part of these were actually passing it into their milk. Maltese milk was at once struck out of the dietary; and "from that day to this", said Bruce, "there has scarcely been a case of Malta fever in the garrison. The disease had been blotted out at a single blow." This conquest of Malta fever is one of the greatest, most unequivocal successes of preventive medicine.

In 1894, Bruce began his long study of the trypanosomes; and the story of his investigation of these, and of the diseases of man and beast which are associated with them, is the chief story of his life. In 1895, a severe epidemic of nagana among the native cattle of northern Zululand was reported to the Natal government. Bruce happened to be stationed in Natal, and Sir W. Hely-Hutchinson, the governor, a wise and friendly man, put the task of investigation into his hands. So Bruce and Mary started off on their long trek by ox-wagon to the scene of the outbreak; and the first thing they did was to discover trypanosomes in the blood of the infected animals. Bruce was a first-class naturalist; he had learned the art of outdoor observation on the Ochils as a schoolboy, and on the Grampians in his college years; and his next step, after discovering trypanosomes in the infected blood, was the work of the naturalist rather than of the physician. There happened to be a 'fly-belt' hard by Bruce's camp, between the high ground and the sea; and Bruce, knowing (as every Scotch boy did) all that David Livingstone had to tell about the tsetse fly, took it into his head to see what actually happened when a beast was bitten by the fly. Natives were told to drive their cattle into the fly-belt, and when they came home it was with no little surprise that Bruce found the blood of the fly-struck animals to contain the nagana parasite. But the natural history of the case was not yet all told. The next thing was to seek and to find the same trypanosome living, but living harmlessly, in the wild game of the country—in antelope and buffaloes, which had become, like the Maltese goats, immune to the disease. Bruce had to do all this work with the most primitive appliances; but he surmounted every difficulty. At last, not only was the specific trypanosome (*T. brucei*) of nagana discovered and its relation to the disease established, but the precise way in which *Glossina morsitans* propagated the disease was made clear. This was the first demonstration of the transmission by an insect of any protozoal disease. It won for Bruce his fellowship of the Royal Society in 1899.

It had needed keen insight and a wide outlook to discern how the wild game of the region might act as a reservoir of infection; and it took a deal of hard work to prove that it did so. Later on, when Bruce came to study sleeping sickness in mankind, the lesson so learned of the possibility, or probability, of the malady lurking continually among the huge herds of wild animals must have seemed to him, lover of animals as he was, an appalling problem.

In 1903, not long after the Boer War was over, Bruce, together with his wife and Dr. David Nabarro, went out to Uganda (again at the instance of the Royal Society) to continue and extend Castellani's work on sleeping sickness, done in the year before. The needful clues were now all in Bruce's hand. He knew that trypanosomes had been found in the cerebro-spinal fluid of sufferers from the disease; and his experience told him that the infection was most likely due to a blood-sucking fly, probably to one of the *Glossina* species. How he showed that the area occupied by *Gl. palpalis* and that infested by sleeping sickness were one and the same, is a romance of science.

Bruce was walking through the forest paths one day with the king of the country, telling him about the fly and its effects, and explaining how useful it would be to know just where the fly lived and how far its range extended. The king listened with great attention, then whispered to his viziers, who in turn slipped one by one from the pathway into the bush. Here on either side, silent and unseen, were the king's attendant messengers; and before Bruce had come to an end of his story these men had set off to all parts of the country, with the king's command that the tsetse flies should be sought for, and brought in from wheresoever they should be found. It was a triumph of organisation, and the dusky king shares the credit with the investigator; it was also a complete scientific success. The remarkable fact had already been discovered that the disease kept to the islands and to a narrow belt of country by the shore of the lake; in no part of Uganda were cases found more than a few miles from the lake shore. It was now shown that the distribution of the disease was identical with that of the tsetse fly; where there was no fly, there was no sleeping sickness.

Bruce came home in the autumn of the same year, 1903, but went out to Uganda again five years later, in order to work at the life of the parasite within its insect-host. He found out, among other things—and it must have been a sad disappointment to him—that many animals can harbour *Trypanosoma gambiense* over long periods: a fact which could only mean that the prevention of sleeping sickness was a well-nigh insoluble problem. He found also that *Gl. palpalis* was the insect-host, or 'vector', not only of *Tr. gambiense*, but also of sundry other trypanosomes besides; and his careful descriptions of these species, and their varying behaviour within the insect-host, were very helpful to the next workers in the field. His last work on this subject was done in Nyasaland, between 1911 and 1914, as head of a commission on trypanosome infections of man and animals in that territory. He came to the conclusion that the human trypanosome of Nyasaland was not identical with *T. brucei* though its vector was *Gl. morsitans*. It is perhaps still an open question whether this trypanosome (commonly called *Tr. rhodesiense*) and *T. gambiense* may not both of them be mere varieties of Bruce's own nagana trypanosome, *T. brucei*. Bruce showed often in his later talk how glad he would have been to go out once more, to solve this final problem.

There is far more to tell of Bruce's great and crowded life than can be told here. Happening to be in Ladysmith during the siege, he turned his hand to surgery, with conspicuous success; and with such love and devotion did he sometimes speak of this part of his life that one felt that a great surgeon had perhaps been lost to make a still greater scientist. His wife became a nurse at the same time, and stood beside her husband in his tireless labours; she earned the Royal Red Cross thereby.

Soon after the beginning of the War in 1914, tetanus made its appearance among the wounded, in so alarming a way that no time had to be lost in grappling with the danger; among many thousand wounded (however slight their injuries might be) some 9 or 10 per cent were attacked by tetanus, and no less than 85 per cent of all those affected died. A committee was appointed in haste, with Bruce at its head; and this committee made the crucial discovery that if the appropriate serum (Kitasato's famous *antitoxin*) be administered *at once*, the wound will lead to no lockjaw symptoms. As Bruce put it, there were 2500 cases of lockjaw in the British Army during the War, and 550 deaths; there would have been 25,000 cases and 20,000 deaths, had matters been allowed to go on as they were during the first months of the War, without the prophylactic serum injections.

During the War, Bruce was Commandant of the Royal Medical College, where his knowledge and immense experience were put to good use in controlling the many varied and even divergent activities of that place. He became chairman of a War Office Committee on Trench Fever, as he had been before of that on tetanus; and once more his driving power and his own industry helped and hastened the investigation. Doubtless a large part of the work was done in this case by others; but the success was just as complete as in the other cases where Bruce worked alone. It was amply proved that the louse, and the louse alone, was to blame for spreading the disease; and (as Bruce said in his Toronto address) this meant that very soon trench fever would have been abolished on the western front. In 1917 it had been the cause of some 20,000 out of a total of 100,000 admissions to hospital in the British Second Army alone.

Besides his scientific work, Bruce played many lesser but important parts. He was president of the Physiological Section of the British Association at the South African meeting in 1905, and president of the Association at Toronto in 1924. He was president of the Royal Society of Tropical Medicine from 1917 to 1919; editor of the *Journal of the R.A.M.C.* from 1904 to 1908; Croonian lecturer at the College of Physicians in 1915; and chairman of the governing body of the Lister Institute from 1916 until his death. Honours came to him in their course, and he wore them proudly, as a soldier should; but at heart he was always the humble student, and the untiring friend and helper of younger men.

Bruce's scientific imagination and intuition were as fine as the simplicity of his heart. He had had little of what we understand by laboratory teaching, little or no apprenticeship to research, in Edinburgh fifty years ago; but he had Lister's great example constantly before him, and Pasteur's to think of, and Koch's to learn of later on. He needed no more than these, and his own brains, to enable him to attack the problems which presently faced him, with all the skilled assurance of a master-hand. He had the gift which belongs to the greatest of scientific men, the true Faraday gift, of putting plain questions to Nature, never two at one time, and always such as she can answer in simple words. His imagination kept him always one step ahead of his observations; his judgment told him where that step should lie; energy spurred him on, and the shrewdest commonsense held him back from unsafe conclusions. He took no regard of riches, he was contented to be poor; but his face was set like flint towards his one ambition, the victory over disease.

Those who knew Bruce best found him stern but most lovable, *sans peur et sans reproche*. His heart went out to all those in sorrow, need, or sickness. He closed his Toronto address with solemn words: "We are all children of one Father. The advance of our knowledge of disease is not for the benefit of one country but for all—for the lonely African native, deserted by his tribe, dying of sleeping sickness in the jungle, or the Indian or Chinese coolie dying miserably of beri-beri, just as much as for the citizens of our own towns."

"It is the duty of science", he said (it was his own rule of life), "to go steadily forward, illuminating the dark places in hope of happier times." He never turned aside or knew discouragement. "On, on, and no regrets", was a phrase he often used; it had been his own watchword, and he passed it on, to be a warning and an encouragement to men who had their lives to live.

Bruce died poor and sorely stricken; he had had his troubles and perplexities withal. But he had also (like Greatheart in the story) had the golden hours when great things happen; and they had brought him the supreme reward of triumphant and beneficent discovery.

D. W. T.
W. J. T.

THOUGH David Bruce, whose recent death removes from the field of tropical medical research one of its most brilliant investigators, made discoveries of the utmost importance in connexion with Malta fever, for which he was elected a fellow of the Royal Society in 1899, his name will ever be associated with Africa, that dark continent where mysterious and dread diseases of both man and animals had brought ruin to expeditions of explorers and loss of hope and too often death to those attempting its development. Malaria and blackwater fever, yellow fever and sleeping sickness took their toll of human lives, while tsetse fly disease or nagana and other obscure maladies wrought havoc amongst the domestic stocks, frequently wiping out in a few days the entire animal transport of some luckless adventurer. It is for his work on two of these diseases, nagana and sleeping sickness, that David Bruce attained his world-wide reputation.

Having been sent to South Africa in 1894 from the post of assistant professor of pathology at Netley, Bruce was requested by the Governor of Natal in 1895 to proceed to Zululand to investigate an outbreak of nagana amongst the cattle. Arriving at Umbobo after an arduous journey, any weaker man would have regarded the usual wattle and daub hut provided for living-room and laboratory as quite inadequate accommodation; not so David Bruce, who, with his courageous and gifted wife, began that long series of researches the results of which have served as the foundation of all work on trypanosomiasis. His reports are models of what such reports should be, and display a logical sequence and an inductive reasoning which are remarkable. Published for the most part in the *Proceedings of the Royal Society*, they are brief and concise statements of the experiments and observations and the results obtained, the one following the other in such order and leading so inevitably towards the goal that one feels there must have been, as Col. Hamerton has written, "an indefinable intuition almost mystical in its working".

Shortly after reaching Umbobo, Bruce discovered in the blood of sick animals a trypanosome similar to the one seen by Timothy Lewis in rats in India in 1878 and by Griffith Evans in 1880 in horses and camels suffering from surra in the same country. He demonstrated the pathogenicity of this organism, its transmission by tsetse flies, and its occurrence in the game, which appeared to harbour it without injury to themselves and to be mere reservoirs. In 1896 he sent to England a dog infected with the trypanosome, which was investigated by Plimmer and Bradford, and named *Trypanosoma brucei* in honour of its discoverer. This strain, handed on to other laboratories, was the starting-point of a long series of important investigations. On his work in Zululand, Bruce published a Preliminary Report in 1895, a Further Report in 1897, and an Appendix to the Further Report in 1903. His work was interrupted by the South African War, during which he distinguished himself at the siege of Ladysmith.

In 1902 the Royal Society had sent to Uganda a Commission to study sleeping sickness, and Bruce was requested to take charge at the beginning of 1903. Again accompanied by his wife, he went to Entebbe, where he was informed by Castellani, a member of the Commission who was on the point of leaving for England, of his discovery at the end of 1902 of trypanosomes in the cerebro-spinal fluid of sleeping sickness cases. Further investigation during the remaining three weeks of Castellani's stay showed that the trypanosome could be found in a large percentage of the cases, and it was quickly realised that it was the causative organism. Experiments with the tsetse fly, *Glossina palpalis*, allied to *Glossina morsitans* (or *Glossina pallidipes*), with which he had worked at Umbobo, enabled Bruce to demonstrate that it was the vector of the trypanosome, which proved to be *Trypanosoma gambiense*, described by Dutton in 1902 from the blood of an Englishman who was suffering from fever after having spent six years in the Gambia.

Bruce returned to England towards the end of 1903 and was occupied with other work until 1908, when he returned to Uganda to continue his investigation of sleeping sickness. Though, working with tsetse flies captured in the open, he had effected transmission of the trypanosomes of nagana and sleeping sickness, he adhered to the view that this was a mechanical process, the tsetse fly carrying on its proboscis infective blood for a comparatively short time. Kleine, working with tsetse flies raised from pupæ, was able to demonstrate in 1909 that, fed on infected animals, they quickly lost their power of transmission, but that this was regained after an incubation period of about twenty days. This important discovery was soon confirmed by Bruce, who studied in detail the behaviour of the trypanosome in the tsetse fly and traced its course during the incubation period from the stomach, where it had passed with the ingested blood, back again to the proboscis and thence into the salivary glands, where the flagellate renewed its trypanosome form which it previously lost, and was then, and not until then, infective.

Bruce further studied the trypanosomes of domestic animals and their transmission, and proved that in their case also an incubation period was necessary in the fly, but that the cycle of development was not always the same. The trypanosome of nagana, *Trypanosoma brucei*, had a cycle like that of *Trypanosoma gambiense*, but *Trypanosoma congolense*, referred to by him as *Trypanosoma pecorum*, did not invade the salivary glands but remained in the proboscis after its return from the stomach, while *Trypanosoma vivax* made no return from the stomach, the only forms developing being those which lodged in the proboscis when the fly took up infective blood, the whole development occurring in the proboscis alone. These differences in behaviour in the fly enabled Bruce to classify the pathogenic trypanosomes of Africa in three groups, headed by *Trypanosoma brucei*, *Trypanosoma congolense*, and *Trypanosoma vivax* respectively. The other representative of the first group was *Trypanosoma gambiense*, and those of the other groups allied forms, several of which he had himself discovered.

David Bruce left Uganda in 1910, and in 1913 went to Nyasaland to study *Trypanosoma rhodesiense*, which had been found to produce in man a disease more quickly fatal than sleeping sickness. These studies led him to the conclusion that *Trypanosoma rhodesiense* was no other than *Trypanosoma brucei* of nagana, which was inoculated to domestic animals and occasionally to man by *Glossina morsitans*, a view which was in agreement with that expressed by Kinghorn and Yorke in 1912 from the Luangwa Valley but opposed to that of the great German investigator Kleine, who believed and still believes that *Trypanosoma rhodesiense* and *Trypanosoma brucei* are distinct.

The above account gives but a poor conception of the extent of Bruce's work on trypanosomiasis. It does not deal with the many obstacles and difficulties which his indomitable will was successful in overcoming. It states in briefest outline the main results achieved, each being the outcome of carefully planned experiment and laborious investigation—each trypanosome encountered being subjected to the same exhaustive tests and critical observations. The work of David Bruce in Africa is not only of the highest scientific value but also has a definitely practical bearing in that it has shown the way to the eradication of a group of most serious diseases.

It has already been mentioned that Lady Bruce, who died a few days before him, was his constant companion. No account of the work of David Bruce would be complete, as he himself insisted, without some reference to the important part she played. Being a skilled microscopist and artist, with a practical knowledge of the details of laboratory technique, for which she had a greater patience and aptitude than her husband, she shared the work with him, indeed, to such an extent that it is difficult not to regard David Bruce and his wife as a single unit and to conclude that neither would have achieved success without the other. They worked alone, without help, in Zululand, but on other Commissions were accompanied by various collaborators, whose part in the work was duly acknowledged in the reports, and who contributed in no small measure to the success of the expeditions. C. M. WENYON.

WE regret to announce the sudden death, at his home in Liverpool, of Mr. Andrew Scott, on Dec. 27, at the age of sixty-three years. Mr. Scott had been on the scientific staff of the Lancashire and Western Sea-Fisheries Committee since 1895, and, at the time of his death, was working in the University of Liverpool, mainly on the plankton collections made by the *Discovery* in the Antarctic Ocean. He had a quite remarkable knowledge of Crustacea, and, with his father, the late Dr. Thomas Scott, had described collections of Copepoda from all parts of the world. He is survived by his widow and a son and daughter.

DR. JOHANN KIAER, professor of palæontology in the University of Oslo and head of its Palæontological Museum, died on Oct. 31, at the age of sixty-two years. Dr. Kiaer was distinguished for his work on the palæozoic formations of Norway and Spitsbergen and for his descriptions of their corals, trilobites, and, especially, the Silurian and Devonian fishes. He had often visited Great Britain, where he will be deeply mourned by many friends.

WE regret to announce the following deaths:

Mr. James Ford, superintendent of the Radcliffe Science Library, Oxford, on Dec. 18, aged seventy-four years.

Dr. Edward H. Jenkins, formerly director of the Connecticut Agricultural Experiment Station, who carried out important work on the culture, curing, and fermentation of tobacco, on Nov. 7, aged eighty-one years.

Prof. Olin H. Landreth, emeritus professor of engineering in Union College, Schenectady, New York, known for his work in engineering administration and sanitary engineering, on Nov. 5, aged seventy-nine years.

News and Views.

Isolation of Vitamin A.

FOLLOWING closely on the announcement of the probable preparation of vitamin D by several independent workers (NATURE, Jan. 9, p. 50), come two announcements of the isolation of a substance which *prima facie* appears to be the long-sought vitamin A. In a paper published in the issue of *Helvetica Chimica Acta* for December 1931, Prof. P. Karrer, of the University of Zurich, together with R. Morf and K. Schöpp, describes the isolation and purification from the unsaponifiable fraction of the liver oil of the skipper (*Scombresox saurus*) of an alcohol having the formula $C_{20}H_{30}O$ or $C_{22}H_{32}O$, optically inactive, and possessing the molecular weight 300-320. Esters of acetic and *p*-nitrobenzoic acid were prepared, and the alcohol gave geronic acid on oxidation with ozone. The same substance was obtained by a special method from the liver oil of the halibut (*Hippoglossus hippoglossus*). In an address on "Recent Progress in the Chemical Study of Vitamins", given to the London Section of the Society of Chemical Industry on Jan. 4, Prof. J. C. Drummond stated that he, in collaboration with Prof. I. M. Heilbron and Dr. R. A. Morton, had succeeded in isolating, by a process of fractional distillation, a very potent fraction from the unsaponifiable residue of the liver oil of the halibut. The substance is a heavy, viscid oil of a slightly yellow colour; it is an alcohol, its formula is probably $C_{20}H_{30}O$, and its vitamin potency is of the same order as that of the recently discovered 'calciferol'. Sufficient work has not yet been done to enable us to say that the substance is pure vitamin A, but it seems very probable that its purity is approximately ninety per cent.

Ouabain.

OUABAIN, $C_{30}H_{46}O_{12}$, a crystalline glucoside occurring in the seeds of *Strophanthus gratus* and in the wood of various *Acocanthera* species, was first isolated from *Acocanthera Schimperi* by Arnaud in 1888 and named ouabain, from ouabaic, an arrow poison. It is described in the German Pharmacopœia (1926) and is included in the United States Pharmacopœia (1926) for use as a standard for the biological control of preparations of digitalis and strophanthus. It is particularly suited for use as a standard substance, since it is easily purified and the purity is readily ascertained by the ordinary methods of chemical analysis, so that the standard is easily reproducible. Ouabain for use as a biological standard is distributed by the Bureau of Standards in the United States, and has been recommended for use by the League of Nations Health Organisation. As a pure substance it offers decided advantages, and may eventually replace the by no means uniform strophanthin of commerce, which consists of a mixture of glucosides derived from *Strophanthus Kombé*, probably in many cases contaminated with other species not readily distinguishable. Ouabain has not hitherto been readily available commercially, but it has been prepared for a number of years past in the experimental laboratories of Messrs. Burroughs

Wellcome and Co. for use in the associated research institutions. It has now been put on sale for research purposes and for use in clinical medicine.

New Biological Station in Bermuda.

A new biological station has been established at Shore Hills, St. George's, West, Bermuda. The site for the station and an annual grant for a period of ten years have been provided by the Government of Bermuda, while the Rockefeller Foundation has made a grant of £50,000 for the building and equipment. The station is under the management of an international board of trustees composed of leading biologists of the United States, with representatives of Great Britain and Canada. The president is Prof. E. G. Conklin, and amongst the executive committee and officers are Profs. E. L. Mark, E. V. Cowdry, C. B. Davenport, and R. G. Harrison, and Dr. A. G. Huntsman, the Canadian representative. The two trustees representing Great Britain are Prof. J. H. Ashworth and Dr. E. J. Allen. The station consists of a large building, beautifully situated, with convenient access to the open sea. There is accommodation for a large number of research workers, and every facility will be provided for all kinds of biological work. Dr. J. F. G. Wheeler, who, after a training in marine research at the Plymouth Marine Biological Laboratory, became a naturalist on the *Discovery* Expedition and has published important work on whales, has been appointed director, and is now in Bermuda. According to a telegram from the *Times* correspondent in Bermuda, dated Jan. 6, Sir Thomas Cubitt, Governor of the Colony, has now formally opened the station. It is to be hoped that many English biologists will take advantage of the unique opportunities which the station offers for research.

Association of British Zoologists.

A well-attended meeting of British zoologists was held by the Association in the rooms of the Zoological Society of London on Jan. 9, with Sir Peter Chalmers Mitchell in the chair. After two papers of technical interest, Mr. J. T. Saunders reported on the institution, at Wray Castle, Windermere, of the laboratory of the Fresh Water Biological Association of the British Empire, and invited visiting naturalists to make use of its facilities for research. Prof. E. W. MacBride pointed out the extreme importance of such research for the purpose of guiding legislation and departmental action on river pollution. Lieut.-Col. R. B. Seymour Sewell gave an account of the origin and history of the Zoological Survey of India, and Mr. G. C. Robson urged the need of a comprehensive survey of the fauna of the British Isles. The Council's action in protesting against the curtailment of staff in the Zoological Survey of India was warmly approved by the Association. The Association welcomed the progress made by the Wray Castle laboratory, and agreed with the views expressed of the national and imperial importance of fresh water research, and the immediate need of further help, financial and technical. The meeting requested the Council to examine practical means to be adopted as to the survey of British fauna.

Exhibition of Scientific Instruments and Apparatus.

The catalogue of the twenty-second Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College, South Kensington, on Jan. 5–7 by the Physical and Optical Societies, is an illustrated octavo volume of 160 pages and constitutes a valuable record of the position of scientific and technical instrument making in Great Britain at the present time. Although the number of firms exhibiting was slightly less than last year, the space required for their exhibits was greater, and an additional hall on the lower ground floor of the College was utilised. The circulation of the catalogue a few days before the exhibition opened was of great assistance to those at a distance who wished to purchase apparatus, as it allowed them to see which firms make the apparatus and which stands it was necessary to visit in order to compare their productions. Apparatus not previously exhibited was indicated as usual in the catalogue by an asterisk, but there appears at present to be no sign indicating when new apparatus involves the application of a principle not previously used in that type of apparatus, although there was a number of exhibits to which such a sign might have been attached. The catalogue shows a tendency, which we think should be encouraged, for makers of apparatus to give sectional views and diagrams of electrical connexions instead of pictures of the outsides of the cases containing the apparatus. Present-day purchasers are more likely to be influenced by internal arrangements than by outside appearances. As the exhibits of the firms are given in alphabetical order in the catalogues and the numbering of the stands depends not on the name of the firm but on their position in the exhibition hall, it would save the time of a visitor at a stand, who wishes to turn up in the catalogue the firm exhibiting, if, when the description of the exhibit extends to several pages, the name of the firm appeared either at the head or in the margin of each page.

Exhibition of Electrical Measuring Instruments.

An article by R. W. Paul, published in the November issue of the *Journal of Scientific Instruments*, is of general interest, as it will help to keep green the memory of the Faraday Centenary Exhibition at the Albert Hall, London, in 1931. He gives excellent descriptions of many of the instruments shown, which illustrate the gradual development of accuracy and quickness in measurement. Ammeters were first made having needles of soft iron polarised by a powerful magnet and having a deflecting coil closely adjacent. In 1881, Ayrton and Perry designed such instruments, the scales being graduated in degrees, which were converted to amperes by the application of a constant. They were the first to use the term 'ammeter' instead of amperemeter. It is interesting to remember that Silvanus Thompson strongly discouraged the use of this word, and asked sarcastically why they did not also use the word 'vometer' for voltmeter. The Director of the Science Museum has arranged that much of the apparatus shown at the Exhibition will be displayed at the museum from February until May 1932.

Control and Operation of Cable Telegraphy.

The success of short-wave radio telegraph 'links' during recent years is well known to have led to the merging of the most important of the cable and radio companies. In addition, the rapid strides made in radio telegraphy and in international telephony have produced the impression that submarine cable telegraphy is now of little value. In a paper read to the Institution of Electrical Engineers on Jan. 7 by H. Kingsbury and R. A. Goodman on cable telegraphy, it is stated that there are no signs of the supersession of transoceanic cable telegraphy by radio, due to economic or other reasons. The growth of cable communications between the countries of Europe and the rest of the world is both steady and satisfactory.

Unfortunately, it has always been the general policy of the European States to retain not only the control but also the actual operation of their telephone systems. Hence at the international meetings the majority of the delegates are merely representative of the interests of their governments. The immediate revenue accruing to the State rather than the development of a first-class foreign telegraph service is their main consideration. It is therefore difficult to introduce reforms, no matter how desirable they seem to the engineers of private companies. Cable companies could easily compete with the direct radio beam, provided that the companies had control of all stations and that land lines were available and properly maintained. Many minutes are added to the transmission time of a message by the mere handing over of traffic from a company to a government system. For example, a preferred rate message from San Francisco to Copenhagen handed in over the counter in the ordinary way occupies about fifteen minutes from the time it passes out of the sender's sight until it is in the hands of the addressee. On the other hand, a sender offering a short telegraph message by telephone in New York for London is reasonably certain of delivery in two minutes from the moment of completing dictation of the message in New York.

Weather of 1931.

In a pamphlet entitled "Notes on the Weather of 1931", issued by the Meteorological Office (Air Ministry), the topsy-turvy character of last year's weather is clearly brought out. New 'records' for cold were set up in March and October, months that are only on the fringe of winter and sometimes provide summer warmth. On March 3 temperature fell to 1° F. at Braemar, and on March 10 to 5° F. at Rickmansworth. On the latter date temperature failed to rise above 30° during the day in many places in south-east England. The night frosts of the last week of October were in some parts of England the most severe ever recorded in that month. There was a pronounced tendency for the worst weather in the south-east of England to be reserved for week-ends and public holidays, and the August holidays provided some days that were much colder than those experienced at Christmas. The gale in the English Channel on Aug. 24 would have been noteworthy had it occurred in mid-winter. No temperature within three degrees of the reading of 61° that was recorded at Aberdeen on Christmas Eve has ever been known there in December for at least sixty years. Mention should be made also of the very rare event of a tornado of the American type, on June 14, at Birmingham. Although not to be compared with the worst tornadoes experienced in America, this storm was violent enough for roofs to be stripped, and there was loss of life. The zone of destruction was, fortunately, a characteristically narrow one, varying from 200 yards to 800 yards. The year must be regarded meteorologically as one of the most eventful known since the Meteorological Office was inaugurated nearly eighty years ago.

Prehistoric Stock of South Africa.

At a meeting of the Royal Anthropological Institute (Section of Human Biology) on Jan. 8, Sir Arthur Keith exhibited a series of human skulls from the Matje River Rock Shelter, a newly discovered prehistoric site in the Zitzikamma District, on the coast of the Cape Province. The deposits in this rock-shelter, amounting to 21 feet in depth, were excavated by Prof. T. F. Dreyer, of Grey University College, Bloemfontein. The rock-shelter was first inhabited during the age of the 'Mossel Bay' culture, which is usually equated with one of the later palæolithic cultures of Europe, and this culture was richly represented during the formation of the deeper strata, amounting in depth to 14 feet. All the remains from the Mossel Bay strata manifest racial traits, which were first revealed by the discovery of the large-brained Boskop skull in 1913. Three of the skulls from the deepest Mossel Bay strata have peculiar features of the forehead; the frontal bones appear compressed from side to side, with a high median keel. This malformation, known as trigonocephaly, occurs occasionally in modern races. A tendency to trigonism is not uncommon among Bushmen and Hottentots, who may be regarded as descendants of the prehistoric stock of South Africa. Sir Arthur Keith added that South Africa was the home of the most remarkable of all prehistoric peoples known to us, a people or stock tending to produce individuals with brains of remarkable dimensions and with a tendency for infantile and juvenile characters to persist into adult life, a tendency which Prof. M. R. Drennan has termed 'pedomorphism'. Although remains of Bushmen have been found so far north as Lake Nyassa and Boskop remains in Northern Rhodesia, all the evidence at present points to South Africa as the evolutionary home of this prehistoric pedomorphic race.

Prehistoric Gold Ornaments from Cornwall.

Two torques and six penannular armlets have been found by a farm labourer in a bank of earth on Amalveor Farm, in Towednack, near St. Ives, Cornwall. According to the *Times* for Jan. 2, one of the torques consists of three strips of twisted metal; the other, a single twisted coil, is of considerable length, its circle being 13 in. in diameter, and, being flexible, it may have been worn twined several times round the neck or waist. Both have the ends bent back to form the familiar interlocking hook. Of the armlets four are simple metal rods; the remaining two are heavier, one being hexagonal and the other lozenge-shaped in section. The find is assigned to the middle or late bronze age; but it is to be noted that the simple armlets do not show the thickening of the wire at the ends characteristic of the developed type of armlet, which, in the British late bronze age, expanded into the cup-shaped terminals.

THE number, character, and distribution of finds of prehistoric gold ornaments in Cornwall, of which that of a lunula, or crescent-shaped gold neck ornament, associated with a flat axe found at Harlyn Bay is the best known, would suggest that intercourse with Ireland, the undoubted source of these ornaments, began early, possibly at the very beginning of the bronze age, and was extensive. Not only did Cornwall provide tin, in which Ireland was poor, but it served as a stage in the voyage to Brittany and Iberia. Close intercourse between Ireland and Cornwall lasted well into Christian times, as is shown by the legends of the Cornish saints, though their many obviously mythical details point to a much earlier tradition. It is to be hoped that lack of funds will not stand in the way of the proposed excavation of the site on which this latest find was made. If it should prove a habitation site, as is conjectured, it should furnish much needed evidence corroborative of the dating of Cornish gold ornaments.

American Patent Law System.

UNDER the auspices of Science Service, Dr. E. J. Prindle gave, on Nov. 13, a radio talk on the American patent law system. He pointed out how backward agriculture and manufacturing were prior to the introduction of the patent system, which gave the inventor the exclusive right for seventeen years to make, use, and sell his invention. So great is the transformation made by the introduction of machinery, that in garnering wheat crops one man can, by its use, do the work formerly requiring ten men. Only one man is now required for every 250 acres. The making of agricultural machinery is a very large industry. The expense of developing a single invention often runs into hundreds of pounds, and sometimes, as in the case of the Curtis steam turbine, into hundreds of thousands of pounds. Without the possibility of recovering this sum and making a profit on the invention, neither individuals nor companies can afford to make and perfect inventions. Without the patent law, Edison could not have accomplished his great work which has benefited humanity. In connexion with electric lighting alone, Edison took out 375 patents. As a patent for an invention gives a monopoly, some think that it is therefore harmful, as many monopolies undoubtedly are. But a patent only gives an inventor a monopoly of that which he creates; it takes nothing from the public, and at the end of seventeen years the public receives the invention free. In normal times, the patent system has greatly increased the field of employment.

Hawks as Decoys.

MARTIAL'S epigram on the hawk (Book 14, 216) has been taken as an indication that falconry was practised by the classical ancients; but as the hawk here deceives (*decipit*) the birds, it would seem rather as if it were used, like an owl, as a decoy to entrap birds coming to mob it; and in the *Field* for Dec. 26, 1931, Col. Nawab Malik Sir Umar Hayat Khan, in writing on falconry, indicates a similar practice in modern India; for he says that if a sparrow-hawk be kept under a net or in a cage and nooses made around, and the receptacle put where ' seven sisters ' are common, these birds (the common Indian babbler *Turdoides terricolor*) can be caught by the dozen. Being weak flyers, they are particularly likely to be attacked by hawks, but being also sociable and strong in beak and claws, they often succeed in rescuing the bird attacked, so that the hawk is an enemy with which they contend on more or less equal terms. The use of the captive hawk as a decoy, however, is no more falconry than is the employment of wild hawks in fowling by bribing them to ' wait on ' and make birds lie, a practice also followed in classical times and in India and Argentina in our day, when the former country is still the stronghold of the perfected art.

Statistics of Cancer in East London.

THE Ministry of Health has issued a report by Dr. Janet Forber (*née* Lane-Claypon) dealing with incurable cases of cancer in east London (*Reps. on Pub. Health and Med. Subjects*, No. 66. H.M. Stationery Office. 1*s*. net). There appears to be no shortage of medical and nursing care and hospital accommodation for these patients. The sample of 1983 cases investigated brings out (as other investigations have done) a contrast in sex incidence of the disease, namely, the great preponderance of cancer of the lip, tongue, mouth, pharynx, and larynx in the male, and cancer of the reproductive organs in the female. The mean age at death is low for fatal cancer of the uterus, ovary, and, in both sexes, the lung and pleura, and high for fatal cancer of the skin and prostate. The mean duration of in-patient care for those who seek hospital treatment is only 2·28 months, being less than one month for 46 per cent, suggesting that the terminal and troublesome stage of fatal cancer is, happily, of short duration.

Researches in Chemical Engineering.

WE have received the *Proceedings of the Chemical Engineering Group, Society of Chemical Industry*, vols. 11 and 12, 1929 and 1930 (in one volume). This contains a number of valuable papers, dealing with such subjects as surface energy, flotation, water treatment, alloy steels, gas and electric heating furnaces, and welding. The standard of the papers is high, and they are usually followed by interesting discussions. The *Transactions of the Institution of Chemical Engineers*, vol. 8, 1930, has also been received, and contains important papers on various subjects related to chemical engineering, such as cellulose products, crystallisation, high pressure reactions, tannery waste, wood pulp, pulverised fuel, and the recovery of metals from waste materials. Both these volumes are very well printed and illustrated, and form valuable contributions to the literature of applied chemistry and engineering.

U.S. Bureau of Standards.

Miscellaneous Publication No. 131 of the Bureau of Standards, Washington, constitutes the Annual Report of the Bureau for the year ending June 1931. Notwithstanding the decrease in industrial activity in the United States, the demands on the Bureau for its services were greater than in the previous year, and the working costs were 2,600,000 dollars, an increase of 5 per cent on last year. The staff number nearly 12,000, and the salaries 710,000 dollars. A new hydraulic laboratory, capable of dealing with 300 cubic feet per second, and two new radio stations have been built, and a new administrative building and a high voltage laboratory are in contemplation.

Announcements.

The gold medal of the Royal Astronomical Society has been awarded to Dr. Robert Grant Aitken, director of the Lick Observatory, Mt. Hamilton, California, for his work on double stars.

Sir Roy Lister Robinson, technical commissioner in the Forestry Commission, has been appointed chairman of the Commission, in succession to Sir John Stirling-Maxwell, who is retiring on March 25 next.

The following appointments in the Colonial agricultural services have recently been made by the Secretary of State for the Colonies : Mr. A. J. Findlay, deputy director of agriculture, Nigeria, to be director of agriculture, Zanzibar ; Mr. T. Y. Watson, to be agricultural officer, Kenya.

The Melchett Medal for the year 1931 of the Institute of Fuel has been awarded to Prof. William A. Bone, professor of chemical technology in the Imperial College of Science and Technology, London. This medal was founded in 1930 by the late Lord Melchett, and is given for original research or professional, administrative, or constructive work involving the scientific preparation or use of fuel, which has recently been made available to the community. The first award was to Dr. Kurt Rummell, of Düsseldorf.

A joint committee of the British Empire Cancer Campaign and the Mount Vernon Hospital has appointed Dr. A. E. Barclay, lecturer in medical radiology and electrology in the University of Cambridge, to the Radiological Research Fellowship founded by Sir William Morris at the Mount Vernon Hospital.

It is announced in *Science* that the Henry Draper Medal of the U.S. National Academy of Sciences has been awarded to Dr. Annie J. Cannon, of Harvard College Observatory, for her work on the classification of stellar spectra. This medal is given " for notable investigations in astronomical physics ". Dr. Cannon is the first woman to receive a medal from the National Academy of Sciences. The Agassiz Medal of the Academy, given for contributions to oceanography, has been awarded to Prof. H. B. Bigelow, director of the Oceanographic Institution at Woods Hole.

The course of open lectures in anthropology at the Royal Anthropological Institute for the second half of the session 1931–32 is announced. The course has been arranged in co-operation with the School of Oriental Studies, and will deal with African life and customs. The list of subjects and lectures is as follows : Jan. 20, F. H. Melland, on natural resources of Africa ; Jan. 27, Prof. C. G. Seligman, on races of Africa ; Feb. 3, C. W. Hobley, on the development of native education in Kenya ; Feb. 16, Capt. R. S. Rattray, on Hausa poetry ; March 2, Rev. E. W. Smith, on the place of folk-tales in African life ; March 9, H. J. Braunholtz, on the craft of the African potter ; March 16, J. H. Driberg, on African systems of education. The lectures begin at 5 p.m. on each day, and admission is free and without ticket.

A list (C. 1931) of some 1586 works relating to science, including publications of the Geological Survey of Great Britain, Smithsonian Miscellaneous Collections, and publishers' remainders, has been issued by Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2.

The latest catalogue of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1 (No. 452), should be of much interest and service to librarians and others, giving as it does particulars of some 1300 works relating to science, mainly in the form of periodical literature, transactions of learned societies, and records of voyages of exploration. Many of the entries have valuable bibliographic notes appended.

Applications are invited for the following appointments, on or before the dates mentioned : A demonstrator in pathology and bacteriology at the Welsh National School of Medicine—The Acting Secretary, University Registry, Cathays Park, Cardiff (Jan. 21). A senior chemistry master at Emanuel School, Wandsworth Common—The Headmaster, Emanuel School, Wandsworth Common, S.W.11 (Jan. 23). A temporary senior technical assistant in an Admiralty establishment near London, with experience in the design of light precision machinery and small accurate gearing—The Secretary of the Admiralty, C.E. Branch, Admiralty, Whitehall, S.W.1 (Jan. 29). An expert under the Egyptian Government, for the study of sugar-cane pests and methods of control and to organise the application of control measures, also for the study and carrying out of research work on the varieties of sugar-cane most adapted to local conditions, methods of cultivation, and other factors tending to improve sugar culture—The Minister of Agriculture, Cairo (Feb. 15). A head of the mathematics department of the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, Woolwich, S.E.18 (Feb. 17). A director of the Indian Institute of Science, Bangalore — The Selection Committee, Directorship Indian Institute of Science, Bangalore, c/o The Universities Bureau, 88a Gower Street, W.C.1 (before end of April).

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.*]

Velocities of the Spiral Nebulæ.

THE extraordinary velocities of recession which are derived from the shift toward the red of the spectral lines of remote galaxies have led to much scepticism of the interpretation of this shift as a Doppler effect; and this scepticism is enhanced when it is learned that the velocities are proportional to the distances of the galaxies. No other interpretation in terms of ether waves seems to be satisfactory, but there is an interpretation in terms of light quanta, or photons, that is much less disturbing.

The energy of a photon is $\epsilon = h\nu$, where h is Planck's constant and ν is the frequency. If one supposes that there is a leakage of energy from the photon in its long journey of millions of years, due perhaps to an inherent instability in the photon, or, possibly, to collisions with other photons, it is evident that the frequency declines with the energy, and the lines of the spectrum are shifted toward the red.

For the Doppler effect $\nu = \nu_0(1 - v/c)$, where v is the velocity of recession and c is the velocity of light. Hubble and Humason [1] find, from observation of these distant objects, the relation

$$v \text{ (in km. per sec.)} = \frac{x \text{ (in parsecs)}}{1790},$$

so that

$$\frac{v}{c} = \frac{x \text{ (in parsecs)}}{3 \times 1790 \times 10^5} = \beta x.$$

If, instead of this linear relationship between velocity and distance, one takes $v/c = (1 - e^{-\beta x})$—and the two hypotheses are indistinguishable on the basis of the observational data—then the relation between frequency and distance due to Doppler effect is $\nu = \nu_0 e^{-\beta x}$.

On the other hand, if one supposes that the percentage loss of energy from the photon per unit distance is constant, one has

$$\frac{1}{\epsilon}\frac{d\epsilon}{dx} = -\alpha,$$

where α is some constant. Consequently, $\epsilon = \epsilon_0 e^{-\alpha x}$, or, on dividing through by Planck's constant, $\nu = \nu_0 e^{-\alpha x}$. That is, the assumed tendency of the energy of the photon to evaporate in its long journey through space leads to a law of frequency which is indistinguishable in form from the law of Doppler effect as given by Hubble and Humason.

On the basis of energy leakage and the observed shift of the spectral lines, a light quantum loses one per cent of its energy in 5,400,000 parsecs, or 17,600,000 years. It requires 372,000,000 parsecs, or 1,210,000,000 years, for one-half of its energy to escape. Such an interpretation of the extraordinary shifts that are observed will be more acceptable to many than an interpretation which makes our galaxy a centre from which all others are fleeing with speeds that are proportional to the distances.

If the energy which has evaporated from the photon continues to exist as radiant energy, there should exist an abundance of radiation of very low frequency, and there is at present no evidence of such radiation. Another possibility, however, is that it disappears into the fine structure of space and reappears eventually in the structure of the atom. The process by which this is accomplished, however, lies far outside the range of our experience, and until we know much more about the atom than we do at present, it is useless to speculate about it.

W. D. MACMILLAN.

University of Chicago,
Dec. 9, 1931.

[1] *Astrophys. J.*, **74**, 76, July 1931.

Oxygen and Everest.

MR. ODELL'S interesting letter [1] re-emphasises conclusions drawn from the Everest expeditions as to the value of oxygen breathing apparatus and upholds the importance of acclimatisation. He states that acclimatisation at 27,000-28,000 feet should be aimed at, and then oxygen used for the last 1000 feet of ascent. As it takes weeks for the party to reach 27,000 feet, experiments in pressure chambers conducted on normal men for a few hours' duration are of no significance. We know, however, that natives do not go and live in the summer months above 18,000 feet, and the question arises whether it is the altitude or the extent of the pastures which sets this limit.

It was on account of this that Dr. Argyll Campbell carried out many experiments with animals while I was in charge of the Department of Applied Physiology at the National Institute of Medical Research. He used monkeys, cats, rabbits, guinea-pigs, rats, and mice, enclosing these animals almost continuously in chambers for many weeks, either the oxygen partial pressure, or the barometric pressure being lowered gradually to resemble the conditions on the mountains. In the latter case, use was made of a chamber at the works of Messrs. Siebe Gorman. His results have been published and clearly show that at 20,000-29,000 feet the oxygen tension in the tissues is not kept at normal, but is markedly subnormal; further, there result pathological changes, particularly in the heart, liver, and brain. Also, he found that breathing oxygen at normal pressure for one hour daily did not help these animals materially.

Thus in the so-called acclimatisation at these great altitudes the members of the expeditions will be deteriorating continuously; that they did so in the past expeditions is proved not only by the fact that climbing became most difficult, but also that they all lost weight and appetite. The climbers who persevered at 28,000 feet or above all came to grief.

Another expedition of the same type is likely to end similarly unless other precautions are taken. Dr. Campbell found that out of more than a hundred healthy animals only about ten could tolerate the low oxygen partial pressure which pertains at 29,000 feet for any length of time. A few animals survived for eight days—a record—under this pressure, and recovered their health again when put under normal conditions.

It is obviously very difficult to pick men able to tolerate such a low oxygen pressure for such a prolonged period as is necessary on the mountain. The climbing party should be increased in numbers, and thus the chance of one of them carrying on after 28,000 feet, with or without the use of oxygen breathing apparatus, will be increased. All the evidence from the expeditions and from these experiments on animals leads to one conclusion, namely, above 28,000 feet deterioration is rapid and excessive, and no acclimatisation prevents this. If the climbers were continuously supplied with oxygen at normal pressure they could, of course, proceed straight up to the summit. Some day, perhaps, a liquid oxygen apparatus will be established at the 18,000 feet level and Everest thereby conquered in safety.

LEONARD HILL.

Nicholls Wood,
Chalfont St. Peter.

[1] NATURE, 128, 1037, Dec. 19, 1931.

WITH most of what Mr. N. E. Odell says,[1] in commenting upon my paper "Oxygen and Everest", I am entirely in agreement. There are one or two points, however, on which I would like to reply.

Though Mr. Odell does not actually suggest it, it might possibly appear that I had cast doubt on the possibility of acclimatisation to 29,000 feet. There is, of course, no reason to doubt the possibility, on lines either theoretical or practical. There is, however, an element of doubt as to whether so high a degree of acclimatisation can be obtained in the time available, owing certainly to the slowness of the process and possibly to the onset of altitude deterioration.

I agree that "there is nothing to warrant Dr. Greene's supposition that their [Mallory and Irvine's] failure to return was due to a breakdown in the oxygen apparatus". I have never supposed such a thing. It has never even occurred to me. I did, however, suggest as a possibility that their *lateness* might be due to this cause. This is a very different matter, and it remains a possibility, but not a supposition.

Many climbers certainly believe that Everest should be climbed without "such artificial aids as may reduce a sport to a mere laboratory experiment". Others believe that such aids may raise a mere sport to the dignity of a laboratory experiment. But I do not follow the sentence with which Mr. Odell follows up this appeal to all that is best in British sport. No one wants to repeat the steel chamber experiment he has mentioned. Some even wonder why it was ever done. But we do want to know by direct experiment whether oxygen is of use to an acclimatised man: and we do want to know whether a man can acclimatise fast enough to climb Everest in the time available. Where, as Mr. Odell says, can these things be better studied than on Everest?

I made no mention of my ammonium chloride experiments because they are still in their infancy and any conclusions based upon them would be premature and unsound.

Through my carelessness, two misprints appeared in my article. In paragraph 4 'exponents' should read 'opponents,' and in the last paragraph 'mid' should read 'wind'.

RAYMOND GREENE.

10 Holywell, Oxford.
Dec. 23, 1931.

[1] NATURE, 128, 1037, Dec. 19, 1931.

L-Discontinuities in X-Ray Absorption.

BY definition, the absorption coefficient is the factor of proportionality of absorption in an infinitely thin layer. The atomic absorption coefficient, then, is the factor of proportionality for a very small number of atoms. This factor, therefore, can be said to be a measure of the probability of absorption for each photon passing the atom.

It is also obvious from Kossel's atomic model that if an electron has been removed from a certain level by an absorption process, this must be accompanied by an emission process corresponding to an electronic transition into the vacant position. Therefore the absorption processes of the highest excited level must be as frequent as the emission processes from this level. The coefficient of absorption therefore must be a measure not only of the probability of absorption but also of the probability of emission.

We shall now consider the special case when the frequency of the absorbed radiation has reached the L_{III}- and L_{II}-absorption limits but not L_I. The excited levels are then L_{22} and L_{21} and, of course, lower levels. Now the unusually well-established rule of Burger and Dorgelo can be used. It is possible to arrange the lines, originating from those levels, in doublets or triplets in such a way that the ratio of intensity of the components is 1 : 2, according to the rule mentioned. For example, $\beta_1/(\alpha_1+\alpha_2)=1:2$, $\gamma_1/(\beta_2+\beta_{15})=1:2$, $\eta/l=1:2$. Generally 1 : 2 is the ratio of the numbers of quanta emitted from the two levels. Therefore the numbers of absorption processes must have the same proportions. We then conclude that when the frequency of the absorbed radiation exceeds the L_{II}-absorption limit, the probability of absorption will increase with 50 per cent of the probability of absorption in the L_{22}-level. If we take in account also the M-absorption, we can give the expression $dL_{II}=\frac{1\cdot5a+m}{a+m}$, where m is proportional to the absorption in the $M+N+\ldots$-levels and a to the L_{22}-absorption. For elements with low atomic number, m will be negligible and therefore $dL_{II}=1\cdot50$. The only experimentally determined values available are: Ag(47) $dL_{II}=1\cdot47$; Pt(78) $dL_{II}=1\cdot37$; Au(79) $dL_{II}=1\cdot38$; Hg(80) $dL_{II}=1\cdot39$. They also confirm that $dL_{II}\to1\cdot50$ with decreasing atomic number.

E. Jönsson calculates the absorption using formulæ such as $dL_{II}=\frac{E_{L_{II}}}{E_{L_{III}}}$, where E represents the ν/R value of the designated absorption limit. In the case of silver, for example, we get in this way $dL_{II}=1\cdot05$. Although the formula holds for the K and the total L discontinuity, in the case of dL_{II} it has no justification.

It is not possible to calculate in the same way as dL_{II} the other L-discontinuities. The lines of L_{II}, for example, cannot be arranged in groups with lines from the other L-levels, the components having a constant ratio of intensity. One would suppose that the experimentally found sum of the intensities of all the lines originating from a certain level would give a value of the probability of absorption in this level. The agreement is not good, however. In the case of silver we calculate $dL_I=1\cdot10$, but experimentally it is found to be $dL_I=1\cdot25$.

On the basis of the new quantum mechanics, Wentzel calculated the relative intensities of a number of lines in the L-series. In several cases his values are considerably higher than the observed data. Wentzel suggests that the failure may depend on 'non-radiating transitions' or inner absorption, that is, the photons emitted are partially reabsorbed in the lower levels before leaving the atoms. But such emitted quanta must also be included in the calculated rate of emission from different levels. If Wentzel's explanation of the difference between the calculated and observed values is quantitatively correct, we can best make the correction for the inner absorption by using his calculated values. This gives $dL_I=\frac{1\cdot79a+m}{1\cdot46a+m}$, giving 1·23 as the upper limit to which the dL-discontinuity tends with decreasing atomic number. In fact the observed values are Ag(47) $dL_I=1\cdot25$; Pt(78) $dL_I=1\cdot25$; Au(79) $dL_I=1\cdot25$; Hg(80) $dL_I=1\cdot18$. Perhaps this can be said to provide the experimental agreement to Wentzel's calculations not given by the directly observed intensities of the emitted lines.

E. OLSSON.

Laboratory of Physics,
University of Stockholm, Dec. 6.

Atomic Moments of some Metals.

M. CH. SADRON a fait, dans mon laboratoire, une étude de l'aimantation à saturation des solutions solides des métaux dans le nickel ou dans le cobalt, dans les champs intenses et aux basses températures. Il a trouvé ainsi que de nombreux métaux possèdent des moments ferromagnétiques et a déterminé leur grandeur.

Si l'on ajoute au nickel un métal M, le moment atomique moyen est représenté par la droite *AC* (Fig. 1), d'après la loi des mélanges. Le commencement *AB* de cette droite est observable et son prolongement donne en *C* le moment du métal M.

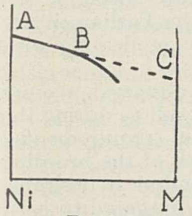

FIG. 1.

On trouve ainsi pour le palladium et pour le platine le moment de 3 magnétons (1 magnéton = 1126·5) qui est aussi celui du nickel. Donc les éléments situés, comme le nickel, le palladium et le platine, dans une même colonne du système périodique ont le même moment.

Les solutions du manganèse dans le nickel ont donné + 15 magnétons pour manganèse, par contre celles du manganèse dans le cobalt ont donné – 15 magnétons. Dans le nickel, le moment 15 du manganèse se place parallèlement, dans le cobalt antiparallèlement au moment du solvant. L'orientation antiparallèle est la plus fréquente ; c'est celle du cuivre, du chrome dans le nickel. Mais aussi bien que l'orientation parallèle, elle permet la détermination du moment. On trouve ainsi pour le chrome, le molybdène, le tungstène, qui sont situés dans la même colonne, le même moment de 19 magnétons.

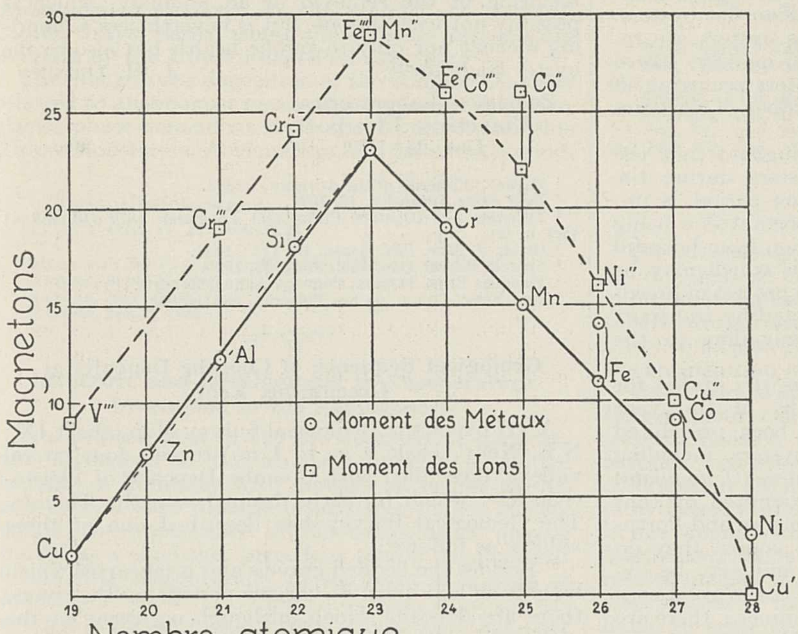

FIG. 2.

La détermination des moments de la ligne horizontale du fer a été faite soit sur les éléments eux-mêmes, soit en les remplaçant par d'autres éléments de leur colonne. Ainsi le scandium a été remplacé par l'aluminium, etc.

Les résultats sont représentés en trait plein dans la Fig. 2. (La ligne interrompue est la courbe de Cabrera du moment des ions.)

Les moments ferromagnétiques se placent sur deux droites se rencontrant au vanadium, qui a le moment le plus élevé, égal à 23 magnétons. La pente de la partie ascendante est voisine de 5 magnétons, ou un magnéton de Bohr, celle de la partie descendante est exactement égale à 4 magnétons.

PIERRE WEISS.
Institut de Physique,
Université de Strasbourg,
4 décembre.

Diamagnetism of Liquid Mixtures.

CRITICISMS of our magnetic susceptibility measurements of mixtures of acetone and chloroform [1] have been made by Ranganadham,[2] van Aubel,[3] Buchner,[4] and Ramachandra Rao and Sivaramakrishnan.[5] We have therefore repeated the susceptibility measurements of this series of liquids by the Gouy method, using a magnet with a field strength of about 3300 gauss. The apparatus not being available in this laboratory, Dr. S. Sugden, to whom we wish to express our thanks, kindly permitted us to make use of his apparatus at Birkbeck College. With this particular apparatus values of the susceptibility can be obtained which are accurate to within $\pm 0 \cdot 02 \times 10^{-6}$.

The results of the new set of measurements show that we are decidedly in error, whilst our critics are right in respect of the sign of the susceptibility of mixtures of acetone and chloroform and of the compound formed by these two substances. Our critics, however, are not in agreement as to the amount by which the susceptibility of mixtures of acetone and chloroform diverges from the simple mixture rule. Dr. Buchner finds that the maximum deviation is 2 per cent. Messrs. Ramachandra Rao and Sivaramakrishnan find no deviation from the mixture rule, and Mr. Ranganadham finds a maximum deviation of 3 per cent.

Dr. Buchner points out that we give the density of dimethyltrichloromethyl carbinol as 0·66 ; this figure is due to an error of transcription and should have read 1·66. Freshly sublimed material has been prepared and this specimen, which is white, has the value $d_4^{25°} = 1 \cdot 49$. The following mass susceptibilities have been obtained : acetone $- 0 \cdot 60 \times 10^{-6}$, chloroform $- 0 \cdot 51 \times 10^{-6}$, and dimethyltrichloromethyl carbinol $- 0 \cdot 59 \times 10^{-6}$. The maximum deviation of the susceptibilities of the mixtures from the straight line is not more than 5 per cent, and it lies at the equimolecular mixture.

The values given above agree reasonably well with those given by Dr. Buchner, and our new value for acetone is now in agreement with the figure given by Pascal.

So far as we are able to judge, the error in our measurements has arisen through a mechanical defect in the arrangement for moving the magnet from one fixed position to the other, thus leading to an inaccurate deviation being recorded. From our laboratory notes it is fairly clear when the defect occurred, and therefore we propose to remeasure, and correct where necessary, the whole of our magnetic measurements, using a new apparatus which we are installing at the moment and which will be capable of furnishing a very much stronger field.

Since the above was written, Dr. J. Farquharson has published a letter[6] giving results which are in complete agreement with those above.

JAMES F. SPENCER.
C. G. TREW.
Physical Chemistry Laboratory,
Bedford College,
University of London.

[1] Trew and Spencer, *Proc. Roy. Soc.*, **131**, p. 209; 1931.
[2] Ranganadham, NATURE, **127**, 975, June 27, 1931.
[3] van Aubel, NATURE, **128**, 455, Sept. 12, 1931.
[4] Buchner, NATURE, **128**, 301, Aug. 22, 1931.
[5] Ramachandra Rao and Sivaramakrishnan, NATURE, **128**, 872, Nov. 21, 1931.
[6] Farquharson, NATURE, **129**, 25, Jan. 2, 1932.

Oysters in Law.

THE European oyster, or flat oyster, *Ostrea edulis*, Linn., occurs in many places off the Atlantic and Mediterranean coasts of Europe. In all these localities this oyster in the warmer periods of the year reproduces its kind by extruding eggs from the body; but it retains and incubates these eggs within its shell-spaces until the resulting larvæ have developed organs which permit an independent free-swimming life. The incubation of eggs to the larval stage is thus a common character of English, Irish, Scotch, Norwegian, Danish, German, Dutch, French, and Italian flat oysters. At present all these flat larviparous oysters are regarded as belonging to one species, namely, *Ostrea edulis*, Linn., except for certain oysters occurring in the Adriatic Sea,[1] albeit a large number of varieties have been given special names.[2]

It has long been recognised in England that the consumption of English native oysters during the warmer months, that is, the breeding period, is undesirable for many reasons, one important one being the danger to the consumer of infection from harmful bacteria and other noxious materials which may be passed on by oysters weakened by the process of breeding, and otherwise deleteriously affected by transport in the warm conditions usually prevailing in the breeding period.

The sale of English native oysters (*O. edulis*) for consumption during certain months of the year (usually the breeding months) has been prohibited by law since 1877;[3] but *foreign* oysters, including American (*O. virginiana*) and Portuguese (*O. angulata*) as well as foreign *O. edulis*, were exempted by that law, and remain exempted. The American and Portuguese oysters do not incubate their young, they do not spawn much in Great Britain, and may be expected normally to maintain themselves in good condition for consumption during the summer: there are therefore fewer objections to the sale of these forms for consumption in summer than apply to *O. edulis*. On the other hand, foreign *O. edulis* are in essentially the same category as English *O. edulis* with regard to their liability to weakness in the warmer months of the year, for there can now be little doubt that *O. edulis* may breed in the sea in varying percentages in any locality at any time the sea-water is maintained steadily above the level of about 58°-59° F.[4, 5, 6] Thus every objection to the sale of native, or English-grown, *O. edulis* during the breeding period on the ground of safeguarding public health is equally applicable to foreign *O. edulis*, whether these be reared in English waters or not.

Efforts have been made in the past to bring foreign flat oysters (*O. edulis*) under the same regulations as English,[7] but the objects have been confused by (*a*) the lack of recognition that foreign oysters may be of three kinds, namely, (1) American (*O. virginiana*), (2) Portuguese (*O. angulata*), which are both non-larviparous forms, and (3) European flat larviparous oysters (*O. edulis*), which are conspecific with English natives; and (*b*) the desire to protect and husband the English oyster beds during the breeding season. At the present day, probably little opposition would be offered to a law prohibiting the sale of foreign *O. edulis* in the British Isles during the same period and under the same conditions as the sale of English *O. edulis* is prohibited. The present time is also highly propitious for the passage of such a law, as the economic disturbance would be slight—owing to the relative scarcity of *O. edulis*—and the Parliamentary machinery may find little difficulty in dealing with the matter.

English oyster beds, it may be observed, require nursing during the non-breeding as well as during the breeding period, according to local requirements; moreover, the variation in the length of the breeding period in different localities also renders it desirable that a measure of power should be delegated to local authorities—as in fact exists at present—to modify, within limits, any general prohibitionary regulation.

The biological facts given above are presented independently as a biological duty now somewhat overdue, but there would seem to be little doubt that if the oyster merchants and others concerned could meet to discuss this problem, agreement might soon be reached resulting in the removal of an anomaly, which is possibly not very serious, but is nevertheless a haunting menace not only to public health but also to the oyster trade itself.

J. H. ORTON.
Zoological Laboratory,
University, Liverpool,
Dec. 24, 1931.

[1] Faber, "Fisheries of the Adriatic", 1883.
[2] Bell, *Essex Naturalist*, **19**, 1921.
[3] Fisheries Act (Oysters, Crabs, and Lobsters), 1877 (40 and 41 Vict. c. 42).
[4] Orton, *J. Mar. Biol. Assoc.*, **15**, 417; 1928.
[5] Spärck, Report Dan. Biol. Stat., **35**, 1929.
[6] Fisheries Expt. Station, Conway, Annual Reports.
[7] Rep. Select Comm. on Sea Fisheries, 383; 1893.

Geological Sequence of Coombe Deposits at Greenhithe, Kent.

A STUDY of the Geological Survey Map (Sheet IX., N.E. Kent; scale 6 in. to 1 m.) reveals four lateral valleys, now filled with Coombe Deposits of Pleistocene age, which formerly drained into the Thames. The Geological Survey has described one of these valleys as follows:

"Besides the bedded gravels and brickearths which have been laid down at various periods by the rivers, there are deposits which, although occurring in the valleys, show little sign of arrangement by running water. In many of the smaller valleys, more particularly in Kent, we find the bottom filled with an accumulation of mixed material to which the name 'Coombe Deposits' may be given. These masses have been formed by the descent of material from the sides of the valleys, and take their character from that of the deposits available at any spot: thus, in the valley starting near Bean and opening into the Thames at Greenhithe the Coombe Deposits include gravel from the High Terrace deposits, a sandy loam formed of Tertiary material and best described as brickearth—it has, indeed, been used on a small scale for brick-making—and chalk rubble. The last resembles the deposit known as 'Combe Rock', the origin of which has been discussed by Clement Reid, and the whole assemblage has probably been formed in the same way; the period of formation appears to be that of the down-cutting between the Middle and the Low

Terraces and of the cold period at the base of the latter." [1]

The deposits composing the infilling of the lower part of this valley are shown by the Survey to be "Brickearth 2 to 4 feet", "Gravel with big flints 0 to 6 feet", and "Chalk Rubble 6 feet"; whilst in the tramway-cutting immediately west of Cobham Terrace a section is recorded as "Brickearth 2 feet", "Gravel 4 feet", and "Chalk Rubble 8 feet".

Here, as in the lateral valley to the east,[2] I have found the stoneless brickearth, which rests upon the melt-water gravels of the Coombe Rock and underlies the stony loam, to contain artefacts of Upper Palæolithic types together with calcined flints. In places the Bean-Greenhithe brickearth is calcareous and tufaceous, when, in addition to the implements exhibiting a white porcellanous patination, the shells of various land molluscs of temperate species have been preserved in the deposit.

The researches I have undertaken within the area included on Sheet IX., N.E. Kent, 6 in. to 1 m., definitely establish a break in the deposition of the Coombe Deposits, a break which occurred after the melt-waters of the Coombe Rock glaciation had subsided, but prior to the deposition of the stoneless brickearth.[3]

In the geological sequence the Survey places the Coombe Deposits between the formation of the Middle and Low Terraces: this correlation is supported on archæological evidence in the vicinity of Belmont Castle, Grays, Essex, where the Coombe Deposits are overlain by the Upper Flood Plain gravels.[4]

The break in the deposition of the Coombe Deposits referred to above must necessarily represent the interglacial phase coincident with the Upper Palæolithic (Upper Mousterian, Aurignacian, and Solutrian) period.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2, Dec. 12.

[1] *Mem. Geol. Survey* (London District), 1922, pp. 59-60.
[2] NATURE, Sept. 26, 1931.
[3] NATURE, Nov. 28, 1931.
[4] NATURE, Jan. 2, 1932.

Structure and Development of Temperature Inversions in the Atmosphere.

THE present view of the development of temperature inversions in the atmosphere with a sudden decrease of humidity with increase of height as due to a general slow descent of air from higher levels,[1] regards the appearance of the temperature discontinuity as a condition precedent to the development of humidity discontinuity in the form of a haze or cloud layer below it. Kopp,[2] however, from the experience of his aeroplane flights, pointed out that after the passage of a cyclone, humidity discontinuity in the form of haze or cloud layer precedes the temperature discontinuity, the latter being probably brought into existence as a result of radiation from the haze or cloud layers. An examination of Lindeberg and Berlin kite and aeroplane ascents confirms the view that dry inversions in the free atmosphere can and do owe their origin to humidity discontinuities in the form of haze layers or cloud sheets.

In a forthcoming publication, we have discussed the rôle of subsidence and radiation in the production of inversions both qualitatively and quantitatively. It has been shown that subsidence combined with turbulence up to a definite limit [3] cannot adequately explain the development and maintenance of dry horizontal inversions in anticyclonic weather, but that radiation from the top of cloud or haze layers combined with turbulence up to a definite limit offers a more satisfactory explanation. Taking, for example, a cloud sheet at a temperature of 273° abs. with air of 40 per cent humidity above it, and assuming the eddy conductivity within the cloud to be 10^3 C.G.S. units, the cooling of the top of the cloud by radiation in 10 hours comes out to be of the order of 25° C. If the eddy conductivity is increased to 10^4 C.G.S. units, the cooling becomes 8° C.; with another cloud sheet above with the temperature of its base at 263° abs. the cooling comes out to be 5° C. and 2° C. respectively. The spreading upward of this cooling by radiative diffusion and eddy conduction has been calculated in the way suggested by Brunt.[4] The temperature-height curves thus obtained above the cloud agree with observed results.

On the basis of Mendenhall and Mason's experiments [5] on the "stratified subsidence of suspended particles", a mechanism has also been suggested for the production of a number of haze layers in the atmosphere met with in one single aeroplane ascent after the passage of a cyclone. These haze layers give rise to humidity discontinuities, and in some cases to cloud sheets later, which in turn are responsible for the development of dry inversions.

SOBHAG MAL.
S. BASU.
B. N. DESAI.

Meteorological Office,
Ganeshkind Road, Poona 5 (India),
Nov. 21.

[1] Hann Suring, "Lehrbuch der Meteorologie", 1926, p. 164.
[2] Beit, "Zür Phy. der freien Atmos.", Hergesell-Festschrift, p. 266; 1929.
[3] Douglas, *Q.J.R. Met. Soc.*, **55**, p. 137, paras. 4, 7; 1929.
[4] *Proc. Roy. Soc.*, A, **130**; 1930.
[5] *Proc. Nat. Acad. Sci.*, U.S.A., **9**, pp. 199-207; 1923. See also Morrison, *Proc. Roy. Soc.*, A, **108**, pp. 280-284; 1925.

Thermal Chlorination of Methane.

ON correlating the data in two recent papers [1, 2] on the thermal chlorination of methane and methyl chloride, it appears that there is a possibility that the four hydrogen atoms of methane are not simultaneously equally available for chlorination, but that after the substitution of one of them the other three are.

Pease and Waltz [2] have shown that the chlorination of methyl chloride proceeds more rapidly than the chlorination of methane, that is, the relative reaction velocities of methane and methyl chloride chlorination are not in the proportion of the numbers of hydrogen atoms in the molecules, and therefore not in agreement with this postulate in the derivation of Martin and Fuchs's [3] kinetic formulæ. The published results of Mason and Wheeler's experiments on the chlorination of methyl chloride (these are, of course, liable to error on account of the approximate fractionation methods used, though the error has been corrected for so far as possible) are in agreement with Martin and Fuchs's kinetic formulæ for a three-stage reaction, from which it would appear that the three remaining hydrogen atoms are equally available for chlorination, and that the relative reaction velocities for the successive stages are proportional to the numbers of residual hydrogen atoms.

Although Mason and Wheeler's results with methane are in fair agreement with the kinetic four-stage formulæ of Martin and Fuchs, it is apparent on close inspection that the amounts of methyl chloride and methylene chloride formed are respectively less and more than the amounts demanded by theory, although it would be expected from calculation that the methyl chloride would not be underestimated in the experiments with a large excess of methane. The results are in general agreement with those of Martin and

Fuchs (loc. cit.), who showed that the last three stages had velocities proportional to the numbers of residual hydrogen atoms.

The point cannot definitely be decided until more complete experimental data are available. Further investigations are being carried out; these, it is hoped, will throw more light on the matter, or provide a different explanation.

The conclusions, however, are in harmony with those of Harkins and Bowers [4] on the carbon-halogen bond as related to Raman spectra, in that the frequency of the C-Br bond is constant in normal compounds with the exception of CH_3Br. The results of West and Farnsworth [5] on normal chlorides show that the frequency of the C-Cl bond is constant except in methyl chloride. J. MASON.

Department of Oil Engineering and Refining,
The University, Edgbaston, Birmingham,
Dec. 9.

[1] Mason and Wheeler, *Jour. Chem. Soc.*, 2282; 1931.
[2] Pease and Waltz, *J. Am. Chem. Soc.*, 3728; 1931.
[3] Martin and Fuchs, *Zeit. für Elektrochemie*, **27**, 150; 1921.
[4] Harkins and Bowers, *J. Am. Chem. Soc.*, 2425; 1931. *Physical Review*, **38**, 1845; 1931.
[5] West and Farnsworth, *Trans. Faraday Soc.*, **27**, 145; 1931.

Preparation of Sulphuric Acid free from Nitric Acid.

FOR the analysis of the nitrate content of sea water, and for certain tests on alkaloids, it is necessary to have sulphuric acid free from all but the most minute amounts of nitric acid. After testing a number of British and foreign samples of pure sulphuric acid, Harvey [1] reported that he had found the 'nitrogen free' sulphuric acid specially supplied by the British Drug Houses, Ltd., to be satisfactory, though the 'analytical reagent' acid was not so. Even in the purest acid the reduced strychnine reagent of Denigès demonstrated the presence of nitric acid, which was estimated by extrapolation after adding known amounts of nitrate, reckoned as milligrams of nitrate nitrogen per cubic metre of sea water.

Early this year I encountered the same trouble owing to nitric acid when applying the diphenyl benzidine method of Letts and Rea [2] to the estimation of nitrate in sea water. It was found, however, that all nitric acid could be removed from the sulphuric acid by the cautious addition of ammonium sulphide. It was later found preferable to use hydrogen sulphide. This reduces the nitric acid, and the amount of sulphur formed is too small to be visible or to render the acid even slightly turbid. In practice it is better not to remove all the nitric acid, but to leave a trace sufficient to give the faintest perceptible colour with the reagents. Excess of the reducing agent would, of course, render the test insensitive through the production of sulphur dioxide. The last supply of 'nitrogen free' acid received gave no perceptible colour with the reagent after standing for a day.

W. R. G. ATKINS.

Marine Biological Laboratory,
Plymouth, Dec. 12.

[1] *Jour. Marine Biol. Assoc.*, **14**, 72; 1926.
[2] *Jour. Chem. Soc.*, **105**, 1157; 1914.

National Needs.

I AM glad to have occasioned the rejoinder of H. E. A. in NATURE of Dec. 26, though I am frankly horrified at his proposal for a *coup d'État* followed by the dictatorship of the Royal Society. I fear the adventure would end with that august body in the tumbrils.

H. E. A.'s other suggestion, that there should be inaugurated a kind of educational crusade to develop the scientific attitude of mind in the ordinary citizen, is one of the most important ever made to the world of science. In spite of the immense social importance of the work and temper of science, her disciples do not make any effort to explain themselves to the public comparable with the electioneering effort of a political party or the missionary effort of a church.

Something more is needed than gentle remonstrances addressed to schools and universities, begging them to include some science in the courses followed by their non-specialist students. Schools and universities are only part of the wider problem of the insufficiency of public thought to manifest social needs. I should like to see the scientific world dealing with the public mind by every modern device of persuasion, including school, university, press, radio, cinema, and the various institutions for adult education, in an organised attempt to influence the thought of this generation. I believe that such an effort, generously conceived and carried into effect, would be astonishingly successful.

I share the doubt, expressed in the leading article in the issue of Jan. 9, as to the appropriateness of the Royal Society as a pivotal body for such a task. The Society could contribute the reflected glory of its immense prestige, but so far as I know it possesses no machinery for carrying out this kind of work.

The various concrete projects which peep out from time to time from beneath the generalities of the present discussion could be carried through by a comparatively small group of people, with the assistance of allies called into co-operation for special purposes. The members of such a group would need to be people of scientific training with a flair for public work and with the proper contacts within and without the scientific world. It would not be difficult to find a score of such men and women. The really difficult problem would be to finance their work. Such expenditure would in the end repay the scientific profession very handsomely in hard cash.

LOUIS ANDERSON FENN.

Birmingham, Jan. 5.

Discovery of *Eurytemora thompsoni* at Lancing.

THE discovery of *Eurytemora thompsoni* by Mr. Lowndes at Lancing [1] adds one more puzzle to the problem of the distribution of the fresh- and brackish-water fauna. A rather similar case of unaccountable distribution is that of *Acartia tonsa*, a copepod which was discovered in 1927 in brackish water in a canal at Caen (Normandy). This is a coastal species of very wide distribution, recorded from the Pacific, Indian Ocean, and North American coast of the Atlantic, but not from its eastern shores. In the case of the anemone, *Sagartia luciæ*, the agency of ship transport is fairly obvious; but it is not very convincing for Calanoid copepods, especially when, as in the case of *E. thompsoni*, the locality has no connexion with any harbour. Still, such transport cannot be excluded. I have found *S. luciæ* myself in a brackish pond in Norfolk far from any port.

It may be worth mentioning here that I specially looked for, and found, *S. luciæ* in Port Said harbour, though it is not mentioned in the reports of the Cambridge expedition to the Suez Canal. Presumably the specimens were lost.

ROBERT GURNEY.

Boars Hill, Oxford.

[1] NATURE, **128**, 967, Dec. 5, 1931.

Research Items.

Egyptian and Peruvian Mummies under the X-Rays.—An X-ray study of the unopened Egyptian and Peruvian mummy-packs in the collections of the Field Museum of Natural History, Chicago, by Mr. Roy L. Moodie, has yielded valuable material bearing on our knowledge of diseases in ancient times. An account of the investigation, accompanied by 76 plates, mostly from X-ray photographs, is published in vol. 3 (Anthropology) *Memoirs* of the Museum. The employment of X-rays has made possible the examination of whole skeletons, but it is subject to limitations, of which the most serious is that it does not reveal all lesions, especially when they are slight or covered by more or less dense tissue. Nor does it show trepanning or injuries from clubs and the like. Percentage of disease or injury among the fifty-three mummy-packs examined is high, 10·52 per cent of the Peruvian pre-Columbian mummies and 40 per cent of the Egyptian being affected. The examination of the Peruvian children showed no evidence of rickets, but there is a trace among the Egyptians. The Egyptian mummies showed arthritis, arteriosclerosis, and absorptive osteitis resulting from pyorrhœa. Owing to the masses of pitch or sand-sprinkled tar which obstructs the head, and masks, ornaments, etc., the interpretation of the teeth is not possible. There is a doubtful case of hypertrophied liver. In the Peruvian mummies arthritis and arteriosclerosis are rare. Few cases of caries can be identified, owing to the intervention of various objects. Pyorrhœa and calculus are common. A rare example of impaction of the mandibular third molars was observed. Nasal disturbances of the turbinates was revealed, though none is sufficiently clear to admit diagnosis. Aural exostoses were a frequent cause of partial or complete deafness. Otitis media occurred, and mastoid infection was detected. Mummified animals from both Egypt and Peru were also examined.

Habits of Californian Red Tree Mouse.—The red tree mouse, *Phenacomys longicaudus*, builds its nest as a rule amongst the branches of a Douglas fir or a great fir (*Abies grandis*), but this seems to be simply because it finds there suitable support in proximity to a rich food supply consisting of the green leaves of the fir trees. In eating these leaves, the mice show a curious habit, described by Seth B. Benson and Adrey E. Borell (*Jour. Mammalogy*, vol. 12, Aug. 1931). The needle, bitten off a twig, would be held in both fore paws ; then a stripping process commenced, the outer side of the needle being shred off from base to tip, as it was passed from right to left. Then the needle would be reversed and turned over, and the mouse, passing the leaf from right to left as before, would start at the apex and strip off the other edge of the needle. Thus the resin ducts, placed in the margins of the leaf, were got rid of, and the remaining edible portion, held in the left fore paw, was eaten as one would eat a stalk of celery. That the object of the stripping was to remove distasteful portions of the leaf was indicated by the habit of the mice of eating, without preliminary treatment, very young needles in which resin ducts were not fully formed. They were never seen to eat the resin duct portions and discard the medullary portion of the needle.

Wild Sheep Hybrid.—In 1906 and later, a few Mouflon sheep, described as from Sardinia and Corsica, were introduced by Lord Revelstoke on Lambay Island, Co. Dublin, and bred there successfully, increasing for a number of years. Some were shot during the War, and by 1927 two males only were left alive. A large flock of Black Welsh Mountain sheep were free on the island at the same time, but no interbreeding took place while there were any Mouflon ewes alive. Dr. J. A. Fraser Roberts (*Jour. Genetics*, vol. 25, no. 1) has made a study of the later crosses, after carefully describing the Mouflon coat. In the years 1928-29, twenty-eight F_1 lambs were born, 15 self-blacks, 8 black reversed badger-faces, and 5 whites. F_2 and back-crosses are also described. The results show that the Mouflon is a recessive black, bearing the factor for reversed badger-face pattern. Nine other factors are shown to be absent : dominant black, dominant brown, white, badger-face, black head, white collar, the factor or factors for grey colour, and the two factors that give coloured or spotted faces and legs in a white sheep. Photographs are given of some of the hybrids and of several wild species of sheep. The paper concludes with notes on the coat colours of various wild species. The Mouflon has the darkest pattern of any except the Himalayan Bharal. The undercoat in all is brown, or white, not black, and all members of the Mouflon and Urial groups show reversed badger-face pattern. The Barbary sheep of North Africa is reddish fawn self-coloured, without this pattern.

Deep Sea Fishes.—Mr. Albert Eide Parr in two papers published in the *Bulletin of the Bingham Oceanographic Collection*, Peabody Museum of Natural History, Yale University, vol. 2, Art. 4, and vol. 4, Art. 1, October 1931, revises the classification of a number of deep sea fishes and gives useful keys for their identification ("Deep Sea Fishes from the Western Coast of North and Central America" and "A Practical Revision of the Western Atlantic Species of the Genus *Citharichthys* (including *Etropus*"). Among the fishes described in the first paper there are many interesting new forms. The new genus *Dolichodon* is suggested for Norman's *Dysalotus macrodon* and a new species named *Dolichodon normani*. These differ from *Dysalotus*, here restricted in having only two rows of teeth in each jaw, the inner series sharply differentiated from the outer by an abrupt and very great increase in the size of its teeth and by their strong curvature. In the second paper, there are special observations on *Citharichthys crossotus* from both the Atlantic and Pacific side of central and southern North America. The author was unsuccessful in differentiating the full grown individuals, but shows that there is a considerable difference in the relative body widths with increasing size, the Atlantic specimens only showing a very slight indication of a gradual increase in relative width with increasing size, whilst those from the Pacific show a very marked and consistent difference. A new subspecies is based on this difference, the two forms being named *Citharichthys crossotus atlanticus* and *Citharichthys crossotus crossotus*. There are very distinct secondary sexual characters in *Citharichthys unicornis*. The young males less than 35 mm. are like the females outwardly, but very soon the width of the interorbital space in the male rapidly increases and also there is a great development of cephalic spines.

Genetics of the Dahlia.—The common dahlia, *D. variabilis*, is well known to show great variability. Mr. W. J. C. Lawrence has brought forward further evidence (*Jour. of Genetics*, vol. 24, No. 3) that it is an octoploid species (with sixty-four chromosomes) produced by the crossing of two tetraploid species, one carrying factors for ivory and magenta flowers, the other for the yellow-orange-scarlet series. Several species are found to have thirty-two chromosomes and one (*D. Merckii*) thirty-six. From a study of the various pigments and their inheritance, it is suggested that the yellow flavone colour is determined by a factor (Y) which is tetrasomic and segregates at random, while the ivory factor (I) gives disomic ratios only. Flavone inhibitors are also present, as well as anthocyanin factors—A, paler and cumulative in effect when present in multiple; B, deeper and probably also cumulative. The genetic evidence indicates that I and Y are carried by homologous chromosomes derived from different ancestral species. Similarly, A and B are carried by two differentiated quadrivalent sets of chromosomes, which probably underwent their chemical differentiation parallel respectively to I and Y. It is further suggested that the tetraploid species have been derived from a diploid ancestral stock in which the two flower-colour series differentiated. In *D. variabilis*, secondary chromosome associations of four or more chromosomes are found in meiosis, and in crosses with *D. coronata* ($2n = 32$) many of the *coronata* chromosomes pair with *variabilis* homologues, indicating that *coronata* is perhaps one of the ancestors of *variabilis*.

Tuber Indexing for controlling Potato Virus Diseases.—The production of stocks of potatoes free from virus diseases is an urgent problem. Large sums of money are lost annually by the potato-growing community through the depredations of crinkle, mosaic, and leaf-roll. It seems that any method of ensuring freedom from these maladies would turn potato-growing from being somewhat of an incubus to an economic success. Americans for many years have practised the cutting-out of a small part of a tuber containing an eye, which is grown in a warm greenhouse in winter. The state of health of the plant thereby produced shows whether the original tuber (which is afterwards planted in the field) was infected with any virus disease. A report by J. E. Kotila (*Michigan State College Tech. Bull.*, No. 117, 26 pp., 1931) has recently been published. This shows that the method of tuber indexing works well on a large scale in Michigan, so far as the production of disease-free clones is concerned. Such testing must be followed by adequate isolation of the improved stocks from diseased crops. The report is rather disappointing, however, in that there are too few comparative yields of unimproved stocks. The high summer temperatures of the middle-west States mask the symptoms of virus diseases and cause less reduction in yield than would occur in cooler climates. Masking takes place in Great Britain only when summers are hot; there was little masking last year. If tuber indexing gives good results in America, would it not give better results in Great Britain, where reductions in yield by the diseases are more serious than in the United States ?

Water in Granitic Magmas.—The results of an important investigation by R. W. Goranson on the solubility of water in granite-glass (a) as a function of pressure from 500 bars to 4000 bars at 900° C. and (b) as a function of temperature from 600° to 1200° C. at 980 bars, are presented in the *Amer. Jour. Sci.* for December 1931. The granite-glass was obtained by melting the normal biotite-bearing muscovite-granite of Stone Mountain. The solubility of water in this glass at 900° C. increases from 3·75 per cent at 500 bars to 9·35 per cent at 4000 bars. The solubility at 980 bars decreases by 0·3 per cent per 100° C. rise in temperature over the range 600°-1200° C. Essentially the same results were found in the case of a natural rock-glass (obsidian) from Mount Kiamis, Japan. It is concluded that natural glasses with 8-10 per cent of H_2O+ should be extremely rare, and this is shown to be borne out by published analyses of fresh obsidians. Reasons are presented for considering that granitic magmas may have had a relatively high water content, and that such water would have an important effect in lowering the crystallisation temperatures. At 10 km. depth and 1000° C., the amount of water held in solution could be as much as 6 per cent. If the magma could ascend between impervious walls, the solubility would fall and the excess water would accumulate until the overlying rocks became incompetent to withstand the pressure. Rupture would then take place with explosive force, and lead to the development of volcanic phenomena.

Earthquakes of the Channel Islands.—Though among the strongest that are felt in the British Isles, the earthquakes of the Channel Islands have not received the attention that they deserve. In a memoir recently published by the Société Jersiaise, Mr. A. E. Mourant has thus well supplied a long-felt want. The list of all the known earthquakes since the year 824, contains four (in 1799, 1878, 1889, and 1926) that must have disturbed areas of more than 115,000 sq. miles, an area greater than that of any earthquake of strictly British origin. The earthquakes since 1926 have been investigated by the author, and of these more detailed accounts are given, especially of those of July 30, 1926, and Feb. 17, 1927. The stronger shocks have certain characteristics in common. Most of them originated in a focus in lat. 49° 11′ N., long. 1° 42′ W., or about nine miles east of St. Helier, thus nearer to France than to Jersey. They tend to recur at regular intervals of 12 yr. 2·7 mon., while an examination of all the Jersey earthquakes, great and small, shows some evidence for periods of four years and one year.

Thermal Conduction in an Electric Field.—The *Zeitschrift für Physik* for Oct. 30 contains an account of experiments performed by W. Bonwitt and G. Groetzinger at Vienna, which show that heat losses in a gas are changed to a slight extent by an electric field. The method used was that in which a wire supported in the gas is heated electrically, and the equilibrium temperature which it assumes under the influence of the electric current and thermal loss through the gas is measured from its resistance. Air and carbon dioxide give only a very small effect, but it is much larger and can be readily followed with certain organic vapours. With acetone vapour at a pressure of 175 mm. of mercury, for example, a decrease of one-tenth of a degree in the temperature of the wire was recorded in a field of 1000 volts per cm. The magnitude of the effect depends upon the dielectric constant of the gas, increasing rapidly with the permanent electric moment of the molecule, and its sign always corresponds to an increase of thermal conductivity in the field.

Photographic Photometry.—In view of the many applications of the measurement of the blackening of photographic plates for photometric purposes, it is disturbing to find in a paper by P. C. Keenan in the September issue of the *Astrophysical Journal* that large errors may arise if the time between exposure and development is not standardised. It appears that the effect is somewhat erratic, depending upon a variety of conditions, but what is generally observed is that the latent image increases in intensity for a few hours after exposure and then tends to fade off again. In the tests which are described, increases of density of the order of ten per cent were found to occur after two hours, the increase being greatest for moderately strong blackening. It is concluded that although the effect is normally likely to be quite small, yet in exceptional cases it may be important, so that in photometry which aims at any considerable degree of precision, images of which the densities are to be compared directly should be developed at as nearly the same time after exposure as possible.

A Possible Hydrogen Isotope of Mass 2.—There is some evidence from atomic weight determinations that hydrogen should have isotopes of masses 2 and 3. If they exist, it can be shown from thermodynamical reasoning that molecules of the types H^1H^2 and H^1H^3 should concentrate relative to the common H^1H^1 molecules in residues from the evaporation of hydrogen near the triple point, whilst it is known from simple spectroscopic theory that the heavier atoms would have a displaced Balmer spectrum. Work undertaken on these considerations is reported by H. C. Urey, F. G. Brickwedde, and G. M. Murphy in the last issue of the *Bulletin of the American Physical Society* for 1931. The atom H^3 has not been detected, but it has been found that the lines $H\beta$, $H\gamma$, and $H\delta$ are accompanied by weaker lines which agree within the experimental error of 0·01 A. with the positions calculated for an isotope of mass 2. The reputed isotope lines have the same width as the main lines and are definitely more intense with the treated material, although they are present when ordinary hydrogen is used.

Chromium Plating.—The chromium plating now so much used to prevent tarnishing of metal fittings of all kinds has been found to be slightly porous and not to afford sufficient protection against corrosion of the base metal, such as steel, on which it is deposited. It has been necessary to deposit copper or nickel on the base metal before the chromium is applied, and the Bureau of Standards, in co-operation with the American Electroplaters' Society and the American Society for Testing Materials, has been investigating the possibility of producing less porous deposits and so reducing the thickness of the copper or nickel protection necessary. The results are summarised in a paper by Messrs. W. Blum, W. P. Barrows, and A. Brenner in the October issue of the *Journal of Research* of the Bureau. Both the porosity and the cracking of the chromium deposit increase rapidly in the first twenty-four hours and more slowly for several weeks at room temperatures. Heating for a short time to 200° C. increases the ultimate cracking. A slight increase in the chromic acid and of the ratio CrO_3 to SO_4 in the depositing tank, an increase of temperature of the tank to 55° or 65° C. and a decrease of current density, all decrease the porosity of the deposit.

Purification of Radon.—G. H. Henderson, in the *Canadian Journal of Research*, p. 466, describes a simple apparatus for the purification of radon for radium therapy, which differs in some respects from the ordinary practice. Potassium hydroxide is used to remove carbon dioxide and most of the water, and since phosphorus pentoxide is dispensed with, only one Toepler pump and fewer valves and stopcocks are necessary. The impurities are removed by sparking and the excess of hydrogen is allowed to escape through an electrically heated palladium tube. The apparatus, which was designed by W. G. Moran, has been in use in the Victoria General Hospital, Halifax, for three years with very satisfactory results. The radon is readily concentrated to 100 millicuries per cubic millimetre, the actual purification taking from two to five minutes. The amount of radium in solution in the apparatus is 200 mgm., but there seems no reason why it should not work equally well with larger quantities.

Vitamin B and Phytase.—Since Teru-Uchi has shown that experimental beri-beri of pigeons (avitaminosis B) is caused by the action of a toxic substance, orizotoxin, extractable from polished rice, and Iwata has found that lysocitin, a substance formed from lecithin by the action of certain enzymes, occurs in polished rice, the possibility of a relationship between lysocitin and orizotoxin arises. A series of experiments made by Cuboni and described in the *Rendiconti of the Reale Istituto Lombardo di Scienze e Lettere* (vol. 64, parts 11-15, 1931) shows that all the symptoms of beri-beri may be reproduced in chickens by injections of orizotoxin, whereas injection of lysocitin has no such effect. Various analogies in behaviour between phytase—which, as Belfanti and Contardi showed, prevents and cures beri-beri—and vitamin B are pointed out, and the conclusion is drawn that these two substances are certainly closely related and probably identical. Further similarity between phytase and vitamin B is revealed by experiments—described in the same issue—carried out by Arnaudi, who finds that the growth of yeast and certain other micro-organisms is accelerated in the same way by the two substances.

Astronomical Topics.

The Orbit of 61 Cygni.—This well-known double star has always attracted much attention from the wide distance between the components and the large proper motion; it was for the latter reason that Bessel selected it for parallax tests with the Königsberg heliometer, obtaining the first reliable stellar distance. Though it is such a near neighbour, the period is so long that its determination has baffled many investigators. In fact, at the end of the last century some American astronomers denied that it was a binary at all. However, Mr. T. Lewis, in his memoir on the Struve double stars, gave a diagram on a large scale of the observations up to 1900, which exhibited the curvature of the path in a palpable manner. At an even earlier date Dr. Peters had published an orbit in *Astr. Nach.*, with a period of nearly eight hundred years.

Mr. Fletcher read a paper on this star at the January meeting of the Royal Astronomical Society. He considers the binary character absolutely established, and anticipates that the period would be found to lie between 700 years and 1000 years, agreeing with the estimate of Peters. In the discussion, Dr. Jackson pointed out that the uncertainty in the period does not introduce much error into the determination of the masses, as this depends in the main on the curvature of the arc over which the observations extend. Mr. Fletcher also considered the observations of radial velocity of the components, but as the difference between them is small, they do not add much to the accuracy of the orbit-determination.

Possible Early Observation of the Bielid Meteors.—*Pop. Astr.* for December contains a translation by Willard J. Fisher of an article by W. Klinkerfues that appeared in *Göttinger Nachrichten*, April 3, 1873. It is evidently very little known among astronomers. It establishes with great probability, on the basis of a record by Theophanes, that Biela's comet and the accompanying meteors were both observed at Byzantium in the year A.D. 524. It is noted that the record mentions both comet and meteors together, so that a connexion between them was suspected even then. Klinkerfues also concluded that the comet observed in China in November A.D. 1162 was Biela's. In both the years mentioned the comet, if correctly identified, would have been near the earth, so that its visibility with the naked eye is not improbable.

Prize Awards of the Paris Academy of Sciences.

AT the annual meeting of the Paris Academy of Sciences, the prizes and grants awarded for the year 1931 were announced as follows:

Mathematics.—The Francœur prize to Jacques Herbrand, for his work on the theory of bodies of numbers.

Mechanics.—The Montyon prize to Hippolyte Parodi, for his work on the electrification of railways and on ballistics; the Poncelet prize to Henri Chipart, for his work in mathematical physics and mechanics.

Astronomy.—The Lalande prize to Irénée Lagarde, for work relating to astronomical calculations; the Valz prize to Henri Chrétien, for his work in astronomical optics; the G. de Pontécoulant prize to Jean Chazy, for his work in analytical and celestial mechanics.

Geography.—The Gay prize to Henri Roussilhe, for his work on the use of aerial photography in topographical surveys on the large scale; the Tchihatchef prize to Charles Crevost and Alfred Pételot, the two authors of vol. 5 of the catalogue of the products of Indo-China (medicinal products); the Alexandre Givry prize to André Gougenheim, for his work in hydrography.

Navigation.—The Prix de la Marine between Eugène Burlot (3000 francs), for his theoretical and experimental studies on explosives, Charles Bertin (1500 francs), for his method of marine and aerial navigation, and Gabriel Voitoux (1500 francs), for his book on trans-Atlantic aerial navigation; the Plumey prize to Marcel Edmond Gautier, for his memoirs dealing with combustibles used in Diesel motors.

Physics.—The Kastner-Boursault prize to Francis Perrin, for his work on fluorescence; the Gaston Planté prize to Émile Pierret, for his researches on high frequency electromagnetic waves; the Hébert prize to Gustave Ribaud, for his treatise on pyrometry; the Henri de Parville prize to Georges Darrieus, for the whole of his work in electrotechnics, especially the calculations on high tension lines; the Hughes prize to René de Mallemann, for his work on magnetic rotatory polarisation; the Pierson-Perrin prize to Georges Reboul, for the whole of his researches on the properties of semi-conducting substances; the Clement Félix foundation to Mlle. Madeleine Chenot, for the continuation of her researches on the high frequency discharge in rarefied gases.

Chemistry.—The Montyon prize (unhealthy trades) to Léon Brunel, for his contributions to various important problems of public hygiene, and an honourable mention (1500 francs) to Georges Champetier, for his work on the protection of civil populations against mustard gas; the Jecker prize to Ernest Fourneau, for the whole of his work in organic chemistry; the Cahours foundation between Arthur Brunel, for his work on plant ferments, and Jean Dœuvre, for his studies on citronnellol and rhodinol; the Houzeau prize to Henri Marcelet, for his work as a whole.

Mineralogy and Geology.—The Delesse prize to Léon Carez, for his geological work on the Pyrenees; the Victor Raulin prize to Eugène Raguin, for his geological work in the Alps and the Central Massif: the Joseph Labbé prize to Lucien Thiébaut, for his work on the clay-limestone sediments of the Paris basin.

Botany.—The Desmazières prize to Gaston Ollivier, for his work "Étude de la flore marine de la Côte d'Azur"; the Montagne prize to Pierre Frémy, for his memoir on the Myxophyceæ of French Equatorial Africa; the Jean Thore prize to Georges Deflandre, for his monographs on *Trachelomonas* and *Arcella*; the Fons Mélicocq prize to Jean des Cilleuls, for his work on the plankton of the Loire: the de Coincy prize to Adolphe Prunet, for his work on the diseases of the chestnut tree; the Jean Rufz de Lavison prize to Émile Michel-Durand, for his memoirs on the variation of the carbohydrate substances in leaves and on the tannic compounds.

Anatomy and Zoology.—The Cuvier prize to François X. Lesbre, for the whole of his work on comparative anatomy, morphology, and teratology of mammals; the Savigny foundation to Robert Dollfus, for his work in the Red Sea and Suez Canal.

Medicine and Surgery.—The Montyon prizes. A Montyon gold medal to Edoardo Perroncito, for the whole of his scientific work. Prizes of 2500 francs to Maurice Auvray, for his memoir on diseases of the skull and brain; to Henri Chabanier and Carlos Lobo-Onell, for their memoir on functional exploration of the kidneys; to Maurice Villaret, François Saint-Girons, and Louis Justin-Besançon for their memoir on the physiological, clinical, and therapeutic study of peripheral venous pressure.

Honourable mentions (1500 francs) to Émile Césari, for his researches on the antigenic function of the lipoids; Paul Génaud, for his researches on the exchanges of ions between yeast cells and saline solutions; Mme. Mélina Lipinska, for her memoir on women and the progress of medical science.

The Barbier prize to Casimir Peirier, for his contribution to the study of the oil-bearing plants of the Cameroons; the Breant prize between (2500 francs each) Maurice Langeron, for his studies on the pathogenic fungi, and Pierre J. Teissier and Florent Coste, for their book on the physio-pathology of scarlet fever; the Godard prize between (500 francs each) Louis Berger, for his memoir on the internal secretion cells in the sexual glands in man and woman, and Fritz Busser, for his book on epithelial tumours of the kidney in the adult: the Chaussier prize to Victor Morax, for the whole of his medical work; the Mège prize to Jean Gautrelet, for his work on the influence of adrenalin on the variations of the alkaline reserve; the Bellion prize to Raoul Lecoq, for his book on food and life; the Larry prize to Maurice Pilod, for his studies on tuberculosis, Louis Izard and Jean des Cilleuls receiving an honourable mention for their book on military hygiene; the Argut prize to Pierre Ernest Roucayrol, for his memoir on direct 'd'arsonvalisation' in the treatment of blennorrhagia.

Physiology.—The Montyon prize to Charles Dhéré, for his studies on biological fluorescence; the Pourat prize (in equal parts) between Maurice Fontaine, for his experimental researches on the reaction of living beings to high pressures, and Fernand Obaton, for his memoir on the evolution of mannitol in plants; the Philipeaux prize to Robert Bonnet, for his work on metabolism.

Statistics.—Montyon prizes (1000 francs) to Pierre Caloni, for his memoir on the statistics of accidents and organisation for their prevention, and to Jean Fischer, for his statistical studies of the rivers Adour, Garonne, and Gironde.

History and Philosophy of Science.—The Binoux prize to Louis de Nussac, for his book on "Pierre Andre Latreille".

Works of Science.—The Henri de Parville prize between Émile Guyénot (2500 francs), for his books on variation, evolution, and heredity, and Paul Dorveaux, for his researches on the members and correspondents of the Royal Academy of Sciences, 1666–1793.

Medals.—The Berthelot medal was awarded to Henri Marcelet.

General Prizes.—The Grand prize (physical sciences) to Paul Fallot, for his geological work in the Balearic Islands, Andalusia, and Morocco ; the Bordin prize to René Garnier, for his work on the problem of Plateau ; the Lallemand prize to Albert Chauchard and Mme. Berthe Chauchard, for their physiological researches on the sympathetic and parasympathetic nervous system and on the brain ; the Maujean prize to Gustave Bouffard, for his work on tropical diseases ; the Petit d'Ormoy Prize (mathematical sciences) to Gaston Julia, for the whole of his mathematical work ; the Petit d'Ormoy prize (natural sciences) to Pierre Lesne, for his entomological work ; the Jean Reynaud prize to the late Paul Appell, for the whole of his scientific work ; the Baron de Joest prize to Gustave Hinard, for his work on sanitation and oyster culture ; the Parkin prize to Marius Dalloni, for his work in connexion with the expedition to Tibesti ; the Saintour prize to Henri Devaux, for his work on the properties of thin layers deposited on the surface of liquids ; the Lonchampt prize to Eugène Derrien, for his work in biochemistry ; the Henry Wilde prize to Edmond Rothé, for his geophysical work ; the Gustave Roux prize to Henri Bésairie, for his work on the geology of Madagascar ; the Thorlet prize to Adolphe Richard.

Special Foundations.—The Lannelongue foundation to Mmes. Cusco and Rück ; the Hélène Helbronner-Fould prize to Mme. Marc Bel, in recognition of the exploratory work done by her late husband.

Prizes of the Grands Écoles.—The Laplace prize to Jean Latourte ; the L. E. Rivot prize between Jean Latourte, Albert Gabriel Bureau, Jean Gaston Chauchoy, and Alphonse Desiré Charles Louis Cachera.

Foundations for Scientific Research.—The Trément foundation to Maurice Lebrun, for his work on electric welding ; the Gegner foundation to Eugène Estanave, for his work on photography ; the Hirn foundation to Yves Milon, for geological and palæontological work in Brittany ; the Henri Becquerel foundation to Edgar Pierre Tawil, for his work in piezo-electricity.

THE LOUTREUIL FOUNDATION.

The Academy has made the following grants from this fund :

1. *Researches on Definite Problems.*—Julien Costantin (3000 francs), for researches on applied botany in the Alps ; Gabriel Marotel (2000 francs), for experimental researches on the disease of the fluke worm and its treatment ; A. Aron (2000 francs), for prosecuting researches on the properties of thin metallic plates ; James Basset (500 francs), for laboratory researches on the influence of high pressures on physical and chemical phenomena ; Claude Gautier (1000 francs), for work on the physiological synthesis of the proteins ; Charles Marie (3000 francs), for researches on the ammonia-oxygen gas battery ; Raymond Ricard (2000 francs), for spark spectra of metals by means of electrodeless discharges ; Gaston Delépine (10,000 francs), for the continuation of work commenced by him and by his pupils, especially on the Carboniferous of Asturia ; Abel Gruvel (2000 francs), as a contribution to his scientific and applied researches on the fauna of the hydrographic network of Syria.

2. *Purchase of Material.*—Emilio Damour (2000 francs), for the purchase of an apparatus controlling combustion by thermal conductivity ; René Dubrisay (5000 francs), for the purchase of a microscope ; Augustin Mesnager (2000 francs), to contribute to the purchase of an apparatus for measuring the distribution of the stresses in various elastic solids ; Casimir Monteil (5000 francs), for the purchase of a Jacquet tachygraph.

3. *Libraries.*—École polytechnique (10,000 francs). for the library ; École nationale vétérinaire d'Alfort (10,000 francs), for its library ; École nationale vétérinaire de Lyon (13,000 francs), for assisting the replacement of the library destroyed by fire ; École nationale vétérinaire de Toulouse, for its library.

4. *Publications.*—" Faune des Colonies françaises " (5000 francs), for its publications ; Albert Peyrot (6000 francs), for the completion of the " Conchologie néogénique de l'Aquitaine " ; Section of Terrestrial Magnetism and Atmospheric Electricity of the National Committee of Geodesy and Geophysics (6000 francs), for the publication of charts of magnetic anomalies in France ; Georges Perrier (10,000 francs), for the calculations contained in the publication dealing with latitudes by meridional observations of the Mission de l'Équateur ; Ministry for the Colonies, Service central de la Météorologie coloniale (15,000 francs), for starting a publication on the scientific observations made in the French overseas dominions ; Office international de Documentation et de Corrélation pour la Protection de la Nature (2000 francs), for the publication of leaflets concerning the French colonies ; Mme. Victor Noury foundation, between Paul Vignon (3000 francs), for his introduction to experimental biology ; Raymond Decary (2500 francs), for his work entitled " L'Androy " ; the late Gabriel Grimaud (2500 francs), for his book on the Rohan-Chabot expedition, and Jehan Albert Vellard (2500 francs), for his studies of the poisonous spiders of southern Brazil ; the Charles Bouchard foundation to Serge Metalnikov, for his memoir on the rôle of the conditional reflexes and of the nervous system in immunity ; the Roy Vaucouloux foundation to Antoine Lacassagne, for his work on the action of radiations on healthy and cancerous tissues.

Measuring Atmospheric Pollution.

AT the present time, the investigation of atmospheric pollution—conducted in Great Britain by the Department of Scientific and Industrial Research through the agency of a Research Committee—is mainly carried out with the aid of three instruments, all designed by Dr. J. S. Owens, Superintendent of Observations to the Committee. The first, known as the deposit gauge, is designed for the purpose of measuring the total amount of impurity deposited on a given area. It consists essentially of a rain-gauge, in which the ordinary copper collecting funnel is replaced by a large glass receiver. The rain, with the impurity, is collected for a definite period, usually a calendar month, and then analysed. The second and third instruments are respectively the automatic air filter and the jet dust counter. The former gives a semi-continuous record of the concentration of suspended impurity in the atmosphere. The latter provides a means of determining the number of solid particles in a given volume of air and of ascertaining the physical nature of the individual particles. Dr. Owens has recently made important improvements to both these instruments, and, although no new principles are involved, their range of usefulness has been very greatly extended.

In the automatic air filter a known volume of air (actually two litres in standard instruments) is drawn at intervals into the apparatus through a nozzle, $\frac{1}{8}$ in. in diameter, over which is pressed a piece of white blotting paper. In passing through the blotting paper the suspended impurity is filtered out and a darkened spot, varying in shade according to the concentration of the impurity, is left on the blotting paper. From the results of a long series of preliminary experiments with large volumes of air, it has been possible to construct a scale of shades each representing a definite number of milligrams of impurity per cubic centimetre. The reading of the record thus consists in matching the spot against a corresponding shade in a numbered scale, an operation which can be done quite readily with sufficient accuracy. The spots are obtained in succession round the edges of the blotting paper, which is in the form of a circular disc, rotated once in twenty-four hours and controlled by clockwork.

In the earlier form of the instrument the mechanism for drawing in the air was operated by water entering a vessel provided with a syphon, which caused the water to rise and fall between two fixed levels. During the fall, air was drawn through the filter disc, an arrangement being provided for making an airtight joint between the filter nozzle and the air inlet pipe during this operation. During the rise, the filter disc was unclamped and rotated to a point fixed by the clock, the filtered air being meanwhile expelled by the rise of water in the main vessel. This form of apparatus had certain disadvantages, of which the present writer can speak feelingly as a former Superintendent of the Instruments Division of the Meteorological Office, where one of these instruments is working. The necessity for a continuous water supply is a serious drawback, and experience has made it obvious that improvements were necessary in other features of the instrument.

In the new design, the filtering mechanism is operated entirely by a falling weight which is wound to the top of its travel once a day. No outside source of power is required, and the installation of the instrument is thus not restricted to sites where these are available. The descending weight operates a crank through a train of gearing, and this crank is connected to a reinforced rubber bellows, so that at each revolution the bellows is expanded and contracted. On the down stroke one litre of air is drawn in very slowly through the filter disc, which is gripped meanwhile between the top of the filter nozzle and a corresponding 'nose' above the paper. On the up stroke air is expelled from the bellows, the filter nozzle being meanwhile lowered out of contact with the paper. By means of an ingenious auxiliary clamping device operated by cams, the paper can be held in the same position while air is drawn in on one, two, four, or eight successive revolutions of the crank. In this way the volume of air contributing to each spot may be varied from one to eight litres, to suit the locality and season. This feature is, in my opinion, one of the chief advantages of the new instrument.

In the jet dust counter a sample of the air to be examined is caused, by means of a pump, to pass through a narrow slit behind which is a cleaned microscope cover glass. Before entering the slit the air passes through a cylindrical 'damping chamber' lined with wet blotting paper, and the velocity in the jet is such that a fall of pressure takes place and condensation occurs as a result of the adiabatic cooling. The water droplets and dust particles strike the cover glass, the dust adheres, and the water evaporates. In this way the dust in a known volume of air is obtained in the form of a narrow ribbon-like deposit on the cover glass, which can be examined quantitatively and qualitatively under a microscope. In the older apparatus only one record could be obtained on each glass, and, as several operations are involved, it was distinctly troublesome to get a series of records, for example, in different rooms of a building. In the new instrument, which has been put on the market by Messrs. C. F. Casella and Co., Ltd., the cover glass is carried on a rotatable head which can be operated from the back of the instrument. A two-way tap also is provided, by means of which the jet can be put out of action while the damping chamber is being flushed with the new sample of air. By the aid of these devices a series of, say, eight or ten separate records can be obtained on a single cover glass, the lines of deposit intersecting at the centre like the spokes of a wheel. With a suitable eyepiece and objective in the microscope, a rough preliminary comparison of the records can be made by inspection, since portions of two or more records can be brought into the field of view simultaneously. In this way the scope of the instrument has been greatly extended and the ease of manipulation much improved. E. G. BILHAM.

Importation of Scientific Specimens and Apparatus into Great Britain.

AS the result of a report by the Association of British Zoologists, the Council of the British Association in February 1931 appointed a committee to consider action with the view of the amelioration of the customs regulations affecting the importation of scientific specimens and apparatus. Following upon discussion between officers of the Association and the Custom House authorities, the latter have most kindly supplied the Association with a memorandum on the reliefs from customs duties on scientific instruments and cinematograph films, and from the import prohibitions on plumage likely to be of use to scientific workers, together with a note on procedure in respect of the importation of scientific specimens preserved in spirit.

The memorandum on scientific instruments and cinematograph films was supplied confidentially to enable the Association to advise *bona fide* scientific workers, but not for general publication, since some of the relaxations are extra-statutory and liable to modification or withdrawal as the interests of the revenue may demand. The British Association is, however, prepared to advise on specific applications from scientific workers or societies. Inquiries should be addressed to the Secretary of the British Association at Burlington House, London, W.1.

It clearly emerged in the course of discussion that some of the difficulties which have been encountered by scientific workers under the customs regulations might have been avoided by previous communication with the Board of Customs and Excise, Custom House, Lower Thames Street, London, E.C.3.

The procedure with regard to the importation of scientific specimens in spirit which will apply in future is as follows.

It will be necessary that the person by whom the specimens are imported into Great Britain (or the person or institution to whom they are addressed, in the case of specimens dispatched by a consignor abroad) should be formally authorised to receive spirits free of duty for use in an art or manufacture, under the provisions of the Finance Act, 1902, Section 8. Where, however, the importer or consignee does not already hold such an authority, the collector of customs and excise at the port of importation will grant it, subject to the conditions in the next paragraph.

If the specimens are imported as ship's cargo, the necessary customs entry must describe them as specimens preserved in spirits, with a sufficient description of their nature and the approximate quantity of spirits, and must show the name and address of the importer or consignee. With the entry must be produced letters or other documents sufficiently establishing the status of the importer or consignee and the purposes for which the specimens are imported. The collector of customs and excise will be at liberty to request further information, if he considers it necessary. Where specimens are imported in personal baggage, similar information will be asked for.

If these requirements are satisfactorily complied with, the necessary authority will be granted forthwith and the specimens admitted immediately free of any charge of spirit duty.

It is not necessary that scientific workers proceeding on expeditions abroad should take any action before leaving Great Britain. It is, however, advisable, with the view of avoiding delay, that scientific workers returning with specimens should have the letters or other documents required to establish the facts readily available, and, in the case of specimens which are being received from senders abroad, that the forwarding agent who is entrusted with the work of clearing the goods should be supplied with the necessary information and letters, etc., in good time.

University and Educational Intelligence.

London.—The following honorary appointments to the staff of the London School of Hygiene and Tropical Medicine are announced:—Dr. James Fenton, medical officer of health for the Borough of Kensington, to be an additional lecturer on public health administration and practice; Mr. L. W. G. Malcolm, conservator of the Wellcome Historical Medical Museum, to be a lecturer on racial hygiene.

A course of nine lectures on television will be given by Mr. J. J. Denton, honorary secretary of the Television Society, at the Borough Polytechnic, Borough Road, London, S.E.1, on Thursdays at eight o'clock, commencing on Jan. 21. Further information can be obtained from the Principal of the Polytechnic.

The finance of public elementary education as exemplified, on one hand, in certain Tyneside areas and, on the other, in a number of wealthy watering-places, forms the subject of a pamphlet entitled "The Finance of Public Elementary Education", by Mr. Ernest Dyer, issued in November by the Tyneside Council of Social Service (17 Ellison Place, Newcastle-upon-Tyne). The gist of the problem discussed is indicated in the following comparison between Hebburn and Bexhill urban districts. In 1929–30 Hebburn (a Tyneside town) had 4683 elementary school children and a 1*d*. rate yielded £395 or 1*s*. 8¼*d*. a child, so that an education rate of 3*s*. 2*d*. in the £ was needed to finance an expenditure of £8 19*s*. 9*d*. per child. Bexhill, with an equal population, had only 1339 elementary school children, a 1*d*. rate yielded 16*s*. 8½*d*. per child, and a rate of 7½*d*. in the £ (one-fifth of the Hebburn rate) enabled it to spend £13 3*s*. per child (fifty per cent more than Hebburn expenditure). The following year, under the operation of the Derating Act, Hebburn's rate had to be raised from 3*s*. 2*d*. to 4*s*. 7*d*., while Bexhill's position remained unchanged. The conclusion drawn is that the formula under which grants-in-aid are fixed is becoming increasingly ineffective as a means of rectifying such disparities between rich and poor authorities, and there can be no satisfactory advance in education in the poorer districts, such as those of the Tyneside, until the State can be persuaded to accept a greater share of financial responsibility. The conclusion is to some extent invalidated by a number of important recent modifications of the grants-in-aid rules. A summary of these is given at the end of the paper.

Calendar of Geographical Exploration.

Jan. 17, 1773.—Crossing the Antarctic Circle.

In the sixteenth and seventeenth centuries there was a widespread belief in the existence of a great southern world. The revival of interest in geography in the eighteenth century led the Royal Society to urge on the British Admiralty the importance of research in southern waters. In 1768, James Cook sailed under orders of the Admiralty to prosecute astronomical and geographical researches in the Southern Pacific. In July 1772, under similar orders, he set out to examine and determine once and for all the question of the supposed great southern continent. His vessel, the *Resolution*, accompanied by the *Adventure*, commanded by T. Furneaux, crossed the antarctic circle on Jan. 17 of the following year. This voyage, during which he thrice penetrated the antarctic, effectively disposed of the long-cherished illusion. For it became evident that if such a continent existed it was frozen and uninhabitable. In addition, his explorations outlined the main features of the southern portions of the globe much as they remain to-day. Of further scientific interest is the fact that this voyage marked the conquest of scurvy. Cook lost but one man out of 118 on a voyage lasting 1000 days. For this service to hygiene, the Royal Society awarded him the Copley Medal in 1776.

Jan. 17, 1839.—Balleny Islands.

John Balleny, in the schooner *Eliza Scott*, left Campbell Island, south of New Zealand, to search for new land. He reached the antarctic circle in 178° E. on Jan. 29, but later, meeting heavy ice, turned westwards and discovered the group of rocky islands which bears his name. The islands were mapped and geological specimens collected. Balleny was sent out by the firm of Enderby Brothers, a London ship-owning firm trading in seal oil. This firm showed a keen interest in geographical discovery, and one of the brothers was an original fellow of the Royal Geographical Society. They had previously, in 1830, dispatched John Biscoe on a two years' voyage combining sealing and exploration. Biscoe sailed through nearly fifty degrees of longitude south of the antarctic circle and discovered the coast of Enderby Land. He did not know of Bellingshausen's discoveries, but entered that sea and discovered Biscoe Islands and the coast of Graham Land.

Jan. 18, 1912.—The South Pole.

Capt. R. F. Scott found the tent with the record that Roald Amundsen and four other Norwegians had reached the south pole on Dec. 16, 1911. Scott had reached the pole on the night of Jan. 17, but had realised from the tracks that his party had been forestalled. Scott and his companions, Wilson, Evans, Oates, and Bowers, set out on their tragic return journey. Evans fell ill and died, and the time involved in caring for their sick companion considerably delayed the party. A strong surface wind wiped out the track they were trying to follow; weather conditions were persistently adverse; the oil in the tins at the depots was insufficient, weather conditions having resulted in the perishing of the leather washers with consequent evaporation. Yet in spite of weariness and hunger, the party continued to the last to carry the geological specimens collected on the Beardmore glacier. The fossils in the specimens threw much light on the age and past history of this part of the antarctic continent; the gain to science was, however, obtained at the cost of heavy sacrifice. Oates fell ill, and Scott noted in his diary that in spite of the extra burden which this involved, Wilson and Bower remained " determinedly cheerful ". Oates not only made no complaint, but also, when he realised that the burden of helping him meant death to his comrades, walked deliberately into the blizzard. The weather continued adverse, and finally a prolonged blizzard held them prisoners when but eleven miles from their next depot. Their bodies were found, with Scott's diary and the geological specimens, by a party led by Atkinson in the following season. Scott's previous journey to the antarctic in 1902–4 had resulted in new topographical data about the southern continent and its fringing islands and new information about Ross Sea. Moreover, the sledge journeys carried out by Scott, Shackleton, and Wilson had for the first time thrown light on the interior of the antarctic land. The name of Scott is thus associated not only with the first attainment of the south pole by a British party, and with much sacrifice and heroism in the face of disappointment and disaster, but also with valuable contributions to scientific knowledge. His successful rival, Amundsen, later met his death in going to the rescue of a fellow-explorer in the arctic.

Jan. 22, 1821.—The Russians in the Antarctic.

Admiral Bellingshausen sighted Peter I. Island, the first land discovered within the antarctic circle. The Emperor Alexander I. of Russia had decided to embark on a scheme of polar exploration in 1819, and later sent out two expeditions, one to the arctic and one to the antarctic regions. Bellingshausen was in charge of the latter and sailed from Kronstadt in July 1819. In January 1820 he discovered three small islands north of the Sandwich group, and later penetrated into the antarctic, following the edge of the icepack for nearly forty-five degrees in latitudes from 63° to 60° S. His two vessels later put into Sydney harbour for repairs, and spent some time exploring the South Pacific, discovering seventeen new islands. On Dec. 7, 1820, they crossed 60° S., and remained south of it for two months and three days, during which time Peter I. Island and Alexander Island were discovered. Bellingshausen's voyage gained greatly in importance because the Russian explorer made every effort to supplement rather than to repeat Cook's voyage. He thus demonstrated the existence of a continuous open sea south of lat. 60° S.

Jan. 23, 1895.—First Landing on the Antarctic Continent.

Capt. Kristensen and C. E. Borchgrevink made the first landing on the southern continent. The voyage was made in a whaling vessel rechristened the *Antarctic* and fitted out by the enterprise of Commander Foyn, a Norwegian whaling merchant, then eighty-four years of age. The *Antarctic* started on her voyage in September 1893, and spent some time sealing at Kerguelen. In September 1894 the vessel left Melbourne, and on Jan. 16, 1895, sighted Cape Adare for the first time since Ross's voyage in 1839-43. On Jan. 18, 1895, Borchgrevink discovered a lichen growing on the rocks of Possession Island, the first evidence of plant life obtained within the antarctic circle. The same lichen was found when the party landed on Cape Adare on Jan. 23. The voyage confirmed Ross's discovery of an open sea south of the pack ice as a permanent phenomenon at this season.

Societies and Academies.

DUBLIN.

Royal Dublin Society, Nov. 24.—E. J. Sheehy : The effect of an insufficient supply of vitamin D on the growth of the skeletons and internal organs of chickens. Chickens which had been exposed to sunlight for ten days after hatching were thereafter kept indoors for thirteen weeks. Half received a diet totally deficient in vitamin D, the other half receiving in addition one per cent of cod-liver oil daily. The second batch developed normally, but the first, even in those cases where the usual symptoms of rickets were absent, failed to develop even on subsequent exposure to sunlight. Their skeletons were stunted and deformed, the breast bones being crooked.—A. D. Delap, A. Farrington, R. Lloyd Praeger, and L. Bouvier Smyth : Report on the recent bog-flow at Glencullen, Co. Mayo. The chief points of interest about this bog-flow are : (1) the fact that it occurred after a spell of dry weather; (2) the fact that a comparatively small area moved out of a very large area apparently similarly situated. The bog slid from a site where the slope was about 3° into the valley of a stream and thence for several miles down the valley, the gradient of which is about 2°, at a considerable speed. It is suggested that the bog was held in position by the vegetation on the surface and that this shrank and split owing to the drought. The underlying layer was probably kept in a semi-liquid condition by the drainage from a small tarn on the crest of the hill just above the slide. The total volume of the slide was about 400,000 cubic yards.—H. H. Jeffcott : The performance of a reservoir subjected to flood. Simple graphical and tabular methods are given for finding the rise of the water above the sill of the spillway at any time owing to any assumed combination of rainfall and local circumstances. This enables a spillway to be designed which will ensure the safety of the reservoir without an undue sacrifice of capacity.— J. Lyons and W. Finlay : The influence of heating and agitating milk before separation on the fat loss in skim milk. Experiments carried out under the conditions prevailing in a working creamery show that the increased yield of fat caused by heating the milk before separation rises as the season advances. Agitation always tends to reduce the fat separation, apparently by breaking up the clusters of fat globules. It is doubtful whether in creameries of moderate size the amount of butter fat obtained by initial heating pays for the cost of the heating.

CRACOW.

Polish Academy of Science and Letters, June 12.—St. Mrozowski : The hyperfine structure of the resonance line of mercury (2). This study, with experiments on the Zeeman effect, suggests that the components of the line 2537 A. are due to various isotopes of mercury.—S. Szczeniowski and L. Infeld : The effect produced by a cloud of electrons on the structure of the de Broglie wave. In certain exceptional cases, the combined influence of the cloud of electrons and the crystal may result in an effect analogous with abnormal dispersion.—Mlle. A. Dorabialska : Microcalorimetric measurements of the period of polonium. The period of polonium determined by this method has been found to be 137·6 days $\pm$ 0·4 per cent.—M. Hlasko : The differences between the conductivity coefficients of strong electrolytes in the same solvents.—M. Hlasko and W. Klimowski : The conductivity of certain mineral acids and the mobility of the hydrogen ion. The mobility of the hydrogen ion, calculated from the limit of conductivity (λ_∞) of the acids HCl, HBr, HI, HNO_3, and $HClO_4$ are (at 25° C.) 355·0, 355·2, 355·1, 355·1, 355·1.—K. Dziewoński, W. Kahl, and Z. Olszewski: Study of compounds derived from naphthalic acid. The synthesis of 3-4-dihydroxynaphthalic acid.—E. Mnich: The phosphorus compounds of plants (6). The solubility of the phosphorus compounds of bean flour and the faculty of phytine of combining with the protein substances contained in this flour.—Tymrakiewicz: The stratigraphy of the peat bog situated near Dublany, Olesko, and Opaki. The method of pollen analysis has been applied to these three peat bogs in the Haut Bug basin.—J. Jarocki and A. Demianowicz: The presence of a ponto-caspian amphipod, *Chœtogammarus tenellus*, in the waters of the Vistula.—L. Ejsmont: The identity of *Proshystera rossittensis* and *Tanaisia fedtschenkoi*, with some remarks on trematodes with united cæca.—J. Hirschler: Observations concerning the reciprocal influence of the larvæ of insects.—Z. Grodziński: The development of the blood-vessels in the pectoral fin of fish belonging to the genus *Salmo*.—F. Rogoziński: Experimental rickets (3). The influence of ammonium chloride on the mineral metabolism of the rachitic rat. No favourable effect is produced by the addition of ammonium chloride to the Steenbock and Black diet.

July 6.—L. Lichtenstein: Contribution to the study of partial differential equations of the elliptic type.—J. Blaton: The quantisation of atoms by a light wave.—K. Koziel: The exactitude of the proposition of Laplace and Oriani relating to astronomical refraction.—T. Olczak: Measurements of the acceleration of gravity in Poland in the period 1926–30.—Mme. W. Zablocka: The fossil fungi of the Tertiary epoch in the rock salt mines at Wieliczka.—Mme. W. Zablocka: *Boletus parasiticus* and *Pisolithus arenarius*.—A. Demianowicz: The terrestrial isopods of Bessarabia.—Mlle. M. Gasowska: The cestodes of the birds in the neighbourhood of Kiew (Ukraine).—J. Ruszkowski: Studies on the evolutive cycle and the structure of the maritime cestodes. The larvæ of *Gyrocotyle urna*.—Mme. B. Konopacka: The behaviour of the fat in the development of the embryo of the fowl.—St. Smreczyński: Embryological researches on the development of the head of *Silpha obscura*.

GENEVA.

Society of Physics and Natural History, Nov. 18.—P. Rossier: The statistical distribution of the stars as a function of the type of spectrum (2). The statistical discussion of the complete collection of spectrum photographs of the Observatory of Geneva has led to a distribution of the stars practically identical with that which had been obtained from a fraction of the series of plates.—P. Rossier: The absolute colour index and stellar statistics. Application to the statistics of the Geneva Observatory. The stellar statistics based on visual brightness show a proportion of less hot stars than that which would have been obtained if the eye had possessed the same sensibility for all wave-lengths. For statistics of the hot stars the use of photographs seems to be indicated.—G. Tiercy: A remark on the problem of comet orbits. The author presents a note on the first equation of the problem (the equation of the trajectory), when the condition of visibility of the comet is taken into account. This condition requires, as is known, that the perihelion distance should be below a certain limit.

ROME.

Royal National Academy of the Lincei, June 21.—G. Vitali: A result of F. Hausdorff and the compressibility of matter.—G. A. Crocco: Aerodynamic bodies of negative resistance.—L. Laboccetta: A new class of circular functions.—T. Viola: Further work on the dextro derivative of a function continuous towards the right and derivable towards the right.—B. Hostinský: The integration of linear functional transformations.—G. Krall: Adiabatic transformations in systems vibrating within stable equilibrium configurations.—E. Segrè: New Raman bands of water. A new Raman band for water with its maximum at about 140 cm.$^{-1}$ from the primary band is described. This band is moderately intense on the low frequency side, but the anti-Stokes band is scarcely perceptible. Its origin is attributed to oscillations in the polymerides of H_2O, the low frequency of oscillation being explainable by the appreciable mass of the oscillating parts and the tenuity of the linking. This view is supported by photographs taken at temperatures ranging from 4° to 97°.—N. Apolloni: Fauna of the bottom of the lagoon of Orbetello.—C. Cappelletti: Resistance of the stolophyll of *Tulipa silvestris* L. to the penetration of mycelia. The inability of mycelia to penetrate this organ is to be attributed to the peculiar epidermic structure of the stolophyll, this excluding all infection, whether by micorrhiza or other more or less saprophytic mycelia of the microflora of the soil. Owing to such protection, the plant assures to the bud a condition of absolute sterility, so that the symbiotic root life is to be regarded as a phenomenon subsequent to the development of new roots, and is not connected with any infection contracted by the mother plant.

Forthcoming Events.

Societies.

MONDAY, JANUARY 18.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Malformations of the Human Body considered from a New Point of View (Hunterian Lecture).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Presidential Address and Presentation of Prizes.

ROYAL SOCIETY OF ARTS, at 8.—Capt. O. A. Barrand and G. A. Green: Life-saving Appliances on Merchant Ships (Thomas Gray Lectures) (1).

TUESDAY, JANUARY 19.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. C. A. Edwards: The Progress of Research relating to Physical Metallurgy (1).

INSTITUTE OF BREWING (Scottish Section) (Annual General Meeting) (at Caledonian Hotel, Edinburgh).

WEDNESDAY, JANUARY 20.

INSTITUTION of MINING ENGINEERS (at Geological Society), at 11 A.M.—Annual General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Malformations of the Human Body considered from a New Point of View (Hunterian Lecture).

ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting) (at B.M.A. House, Tavistock Square), at 5.30.—Prof. R. R. Gates: Nuclear Structure (Presidential Address).

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—Presentation of the Symons Medal to Prof. V. F. K. Bjerknes.—R. G. K. Lempfert: The Presentation of Meteorological Data (Address).

THURSDAY, JANUARY 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. G. Cannon: Feeding and Digestion in Invertebrates (1).

INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (Annual General Meeting) (at Queen's Hotel, Leeds).

FRIDAY, JANUARY 22.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Malformations of the Human Body considered from a New Point of View (Hunterian Lecture).

Society of Chemical Industry (Liverpool Section) (jointly with Manchester Section) (at Liverpool University), at 6.—Dr. A. E. Dunstan: Liquid Fuels, To-day and To-morrow (Jubilee Memorial Lecture).

Royal Institution of Great Britain, at 9.—Sir Arthur Eddington: The Expanding Universe.

SATURDAY, January 23.

Mathematical Association (London Branch) (at Bedford College for Women), at 3.—A. R. Green: Some Interesting Practical Problems in Elementary Geometry.

Public Lectures.

FRIDAY, January 15.

London School of Economics and Political Science, at 5.—Prof. L. Hogben: Genetic Principles in Medicine and Social Science.

University College, at 5.—Dr. A. S. Parkes: The Physiology of Reproduction. (Succeeding Lectures on Jan. 15, 22, and 29, and Feb. 5, 12, and 19.)—G. P. Wells: Comparative Physiology. (Succeeding Lectures on Jan. 15, 22, 29, Feb. 5, 12, 19, 26, and March 4, 11, and 18.)—At 5.30.—N. H. Baynes: The History of Asia and Eastern Europe.

Imperial College of Science (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: The Instability of the Earth (Swiney Lectures) (5).

SATURDAY, January 16.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: The Ancient Egyptians at Home.

MONDAY, January 18.

Guy's Hospital (Physiological Theatre), at 5.—Prof. J. M. W. Morison: The Use of X-Rays in Physiological Investigations (1): The Use of Opaque Substance with special reference to the Investigation of the Gall-bladder and Kidneys.

University of Leeds, at 5.15.—Prof. E. T. Whittaker: The Life and Work of Clerk Maxwell.

Imperial College of Science (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: The Instability of the Earth (contd.) (Swiney Lectures) (6).

St. Thomas's Hospital, at 5.30.—Prof. W. J. Tulloch: Serological Studies on Vaccinia. (Succeeding Lectures on Jan. 19 and 20.)

TUESDAY, January 19.

University College, London, at 5.—Dr. H. R. Ing: Chemotherapy (1). (Succeeding Lectures on Jan. 26, Feb. 2, 9, 16, and 23.)

University College Hospital Medical School, at 5.15.—Dr. R. A. O'Brien: The Preparation, Testing, and Use of Antitoxin.

Gresham College (Basinghall Street), at 6.—A. R. Hinks: Celestial Spectacles. (Succeeding Lectures on Jan. 20. 21, and 22.)

Institute of Industrial Administration (at Institute of Hygiene), at 6.30.—T. Keens: Some Problems of Industrial Administration and Accounting.

University College, London, at 8.15.—Miss E. Jeffries Davis: Some Descriptions of London, *c.* 1175–1830 (1). (Succeeding Lectures on Jan. 26, Feb. 2, 9, and 16.)

WEDNESDAY, January 20.

Royal Institute of Public Health, at 4.—Sir William Willcox: The Etiology of Rheumatism, with special reference to Infective Causes.

King's College, London, at 5.15.—Prof. J. H. Rose: The Mediterranean in Ancient History: The Mediterranean, the Nursery for Navigation. (Succeeding Lectures on Jan. 27, Feb. 3, 10, and 17.)

School of Oriental Studies (jointly with Royal Anthropological Institute), at 5.15.—F. H. Melland: Natural Resources of Africa.

Imperial College of Science (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: Land Sculpture (Swiney Lectures) (7).

University College, London, at 5.30.—J. H. Helweg: Denmark, the Land and the People (1). (Succeeding Lectures on Jan. 27 and Feb. 3.)

Belfast Museum and Art Gallery, at 8.—H. Lamont: Story of Milk.

THURSDAY, January 21.

Science Museum, South Kensington, at 4.30.—Dr. G. C. Simpson: Weather Forecasting.

University College, London, at 5.30.—Dr. S. V. Keeling: The Philosophy of J. Ellis McTaggart (1). (Succeeding Lectures on Jan. 28 and Feb. 4.)—H. P. Vowles: Whence came the Windmill?

Society for Constructive Birth Control and Racial Progress (at Essex Hall, Essex Street, W.C.2), at 8.—G. Bedborough: Recent Developments in the Birth Control Movement in America.

FRIDAY, January 22.

Imperial College of Science (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: Mountains (Swiney Lectures) (8).

University College, London, at 5.30.—Prof. H. A. R. Gibb: The Expansion of the Arabs, A.D. 600–750.

SATURDAY, January 23.

Horniman Museum (Forest Hill), at 3.30.—M. A. Phillips: In the Haunts of the Sea-Birds.

Official Publications Received.

British.

Indian Journal of Physics, Vol. 6, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 15, Part 4. Conducted by Sir C. V. Raman. Pp. 263-366. (Calcutta.) 2.4 rupees; 3*s.*

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Shropshire. A Progress Report of Instructional and Experimental Work in Poultry and Rabbit Husbandry. (No. 5.) Pp. 68. Bulletin No. 6: Methods of Artificially Lighting Winter Layers (Single Comb White Leghorn Pullets). By I. W. Rhys and Raymond T. Parkhurst. Pp. 16. (Newport.)

The Hannah Dairy Research Institute: its Origin and Work; with a Description of the Buildings, Equipment and Farm Stock, 1931. Pp. 30+2 plates. (Auchincruive.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 70, No. 420, December. Pp. 104+xxii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

The University of Leeds. Pp. 8+4 plates. (Leeds.)

Foreign.

Zum Klima der Türkei: Ergebnisse dreijahriger Beobachtungen 1915–1918. Herausgegeben von Prof. Dr. Ludwig Weickmann, unter Mitwirkung von Prof. Dr. Heinrich Koppe, Prof. Dr. Harald Koschmeider und Dr. Peregrin Zistler. Heft 4: Der Anstieg des Toten Meeres 1880–1900 und seine Erklärung. Von Johannes Enge. Pp. 42+8 Karten. (Leipzig: Geophysikalisches Institut der Universität.)

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig. Serie 2: Specialarbeiten aus dem Geophysikalischen Institut. Band 4, Heft 5: Zur Theorie polarer Temperatur- und Luftdruckwellen. Von Werner Schwerdtfeger. Pp. 253-317+2 Tafeln. Band 5, Heft 1: Zur Theorie der Wellenbewegungen in Luft und Wasser. Von Bernhard Haurwitz. Pp. 106. Band 5, Heft 2: Theoretische Ableitung und physikalischer Nachweis einer 36 tägigen Luftdruckwelle. Von Heinz Lettau. Pp. 107-167. (Leipzig: Geophysikalisches Institut der Universität.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 115: The Diagnosis of Species of Fusarium by use of Growth-Inhibiting Substances in the Culture Medium. By G. H. Coons and M. C. Strong. Pp. 78. (East Lansing, Mich.)

Regenwaarnemingen in Nederlandsch-Indië. Een en vijftigste Jaargang 1929. Pp. ii+133. (Batavia: Landsdrukkerij.)

Catalogues.

A Catalogue of Periodical Literature, Transactions of Learned Societies, Narratives of Important Voyages, etc. (No. 452.) Pp. 144. (London: Bernard Quaritch, Ltd.)

Zeiss Surveying Instruments. (Geo. 123.) Pp. 24. The New Zeiss "Lodis" Tacheometer for Rectangular Coordinates. (Geo. 103E.) Pp. 8. The Zeiss Telemeter for the Measurement of Distances by Readings on a Vertical Staff. (Geo. 106.) Pp. 4. The Zeiss Self-reducing Tacheometer. (Geo. 59.) Pp. 4. The New Zeiss Universal Theodolite III. (Geo. 94 Ie.) Pp. 8. Zeiss Precise Level I. (Geo. 104.) Pp. 4. Economic Aspects of the Optical Measurement of Distances in Surveying and the Zeiss Reducing Tacheometer. By R. Bosshardt. (Geo. 78e.) Pp. 8. (Jena and London: Carl Zeiss.)