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CONTENTS.

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School and University Science.

SEVERAL weeks ago (December 22, p. 889), we referred to a pamphlet by Mr. John Galsworthy, in which it was pointed out that the world was more ready to use science and invention for destructive purposes than for social progress and "more hopeful of perfecting poison-gas than of abating coal-smoke or cancer." In his primitive instincts, man remains what he was thousands of years ago, and science has given him the strength of a giant without a corresponding development of his moral and ethical qualities. This view has often been expressed by men of science themselves, and Mr. Galsworthy's appeal to the civilised world to save itself from destruction is therefore welcome. It must not be forgotten, however, that while the might of science is generally recognised, its light is rarely perceived, and then often only as in a glass, darkly; consequently, a great part of the thinking world is at heart afraid of science and its bewilderingly rapid advances. Yet it cannot be doubted that science has saved millions of lives in comparison with the thousands destroyed by it, and has, in addition, created unbounded riches and human comforts.

In his presidential address to the Science Masters' Association on January 3, Prof. A. Smithells placed some of his own War experiences beside Mr. Galsworthy's dicta. He was in charge of a school of life saving, dealing with three million men, drawn from all classes of society, and in circumstances in which a little real knowledge of elementary science might mean, and often did mean to them, the difference between life and death. "The rudiments of such knowledge," he said, "were not to be found in one man among a hundred." "I think we must reluctantly admit," he added, "that our science has edified and instructed far less than was reasonably to be expected from a movement that has been carried out for so long and with such vigour."

The advancement of science and the spread of scientific knowledge among the people are, broadly speaking, two distinct tasks. The first is pioneer work; the second missionary work. The university teacher is concerned mainly with the training of pioneers and preparation for professions; school teachers are, or should be, the great missionary force. Matter and method should be different in the two departments, since the aims are different.

The university teacher has to contend with great difficulties; he has to deal with a vast accumulation of facts and to cope with rapid advances. This leads him—perhaps compels him—to adopt a series of convenient formalities of procedure of a highly artificial kind. Subjects are segregated by an unnatural delimitation

of frontiers, and dragged not only from their affiliations with history and the rest of human knowledge, but also from their association with life and the things of every day. This is pure or abstract science; it does not appeal to the multitude; many feel that it is too high and excellent for them — they cannot attain unto it.

It is not in any way derogatory to the university teacher to say that his work is not humanistic in the restricted sense in which this word is commonly used; nay, rather, we should honour the man who takes the vow of poverty and leaves all to follow pure science. But text-books and manuals, as W. H. Hudson put it in "The Friendship of Books," and treatises designed by specialists for specialists do not properly come under the head of literature. "A book belongs to literature only when it transcends the interests of what we describe as our daily occupations and appeals to our common humanity. The physician will discover nothing to his purpose in a commentary on judicial procedure; the lawyer will not seek his law in an essay on bridge-building; nor will the engineer be found working out the problems of stress and strain with a volume on typhoid fever at his elbow. . . . The physician, the lawyer, the engineer, alike have to meet, beyond the particular claims of their professions, the general claims of life at large." To prepare men in some way to meet the general claims of life at large is one of the main objects of school education.

There is, however, only one school for pioneers and missionaries alike. The school science teacher is trained in the university; he comes to his life's work at the zenith of his own powers, exulting in the conquest of the greatest heights of accumulated knowledge and eager to carry on research. But teachers, as Sir J. J. Thomson's Committee report on "Natural Science in Education" truly says, "tend to go on teaching as they themselves were taught." The young science master finds in the schools certain examinations—London matriculation, scholarship examinations and others—which are distinctly of the specialist type; he soon realises that successes in these examinations are held in high esteem, and he soon perceives that success is most surely attained by teaching what has been aptly described as "college science and water." A small percentage of pupils from the schools proceeds to the universities, and thus, in the end, the university teacher reaps his own sowing, as it were, once removed. Does he like it?

On this point, Prof. Smithells, in the address already cited, was very emphatic, speaking not only from his own experience, but also from that of others far removed from the stage of *emeritus*. "I have discovered," he said, "no relation between the mere quantity of chemical information a pupil brings from school and his subsequent progress in that science. I am tempted almost to say that I do not know even the type of the ratio. But I do know what it means to have pupils come with even a little well taught, and with an eager appetite for more." Besides the eager zest of the true naturalist, he asked only for literacy, an available knowledge of languages and a reasonable breadth of elementary science.

Thus, even in the case of the small percentage of pupils who proceed to the universities, the previous training in science does not satisfy those most concerned. But what about the rest, whose instruction in science ends with their schooling? The unpleasant truth is that the future needs of many are sacrificed to the immediate interests of the few; foundations are laid upon which nothing is afterwards built, and school science tends less and less to be taught in effective relation with life as it is and with things as they are in the great everyday world, and more and more as it is dealt with by professionals in seminaries.

Many disastrous mistakes have been made in educational policy, and it is not easy to say which has had the most detrimental effect. Among these particular errors, however, must be reckoned the forcing of university matriculation examinations on schools when it ought to have been the other way about (as it is beginning to be now, in part), namely, the acceptance by the universities of some reasonable examination based on a syllabus set up in the schools. To the university teacher, matriculation is often "merely" matriculation, a qualifying examination, a statutory examination which matters not at all, unless the candidate fails. It is not by any means certain that the most competent university teachers are put on the Matriculation Board; indeed, it is not a great honour to be asked to serve on that body; the advice of schoolmasters is rarely sought; in fact, suggestions from schoolmasters are sometimes considered to be impertinent. Yet matriculation examinations have to be taken seriously in the schools, and they have acquired considerable academic value in the minds of business men.

Though university teachers are sometimes appalled at the results of what is, after all, a weak reflection of their own teaching, yet they still persist in shaping the school science course by means of their examination schedules. They are often very conservative, and few of them have given active support to a movement which originated in the schools and is mainly directed towards broadening the basis of school science and getting specialist science entirely out of the school certificate stage of a boy's education.

This general science movement was, in part, a protest

by science masters against the assumption that they stand outside the body of teachers engaged in what is called general education, and are mainly charged with the duty of preparing a few boys for later professional study. A few years ago, the General Medical Council endeavoured to make elementary science part of the professional education of medical students and to take it out of the hands of schoolmasters altogether. In this the Council was supported by some science teachers in the newer universities. Thus, in the *Times Educational Supplement* can be read the following: "With regard to the biological sciences, our opinion is that they cannot be studied with real advantage by the average boy till he is at least 17 or 18 years of age. Further, that 'Elementary Biology,' as embodied in the practical course laid down by Prof. Huxley, will not serve as a sufficient foundation for a high class medical course for the present or immediate future." The date of this is 1911; its effect on the teaching of biology in schools has been disastrous; so much so that, even now, many otherwise enlightened governing bodies cannot be induced to make provision for the teaching of biology because they are convinced that this is part of the professional training of the medical man.

The difficulties are great, but are not insurmountable. The entire abolition of university matriculation examinations from schools would lead to greater freedom; the broadening of the basis of scholarship examinations and a corresponding reduction of the standard required in separate subjects would discourage too early specialisation; and finally, a vigorous campaign on the part of biologists might get rid of the unfortunate misconception about that subject that exists at present. These things together would render possible the introduction into schools of a reasonable course of general science framed on humanistic lines—

"an unerring knowledge of the things that are,
To know the constitution of the world and the operation of the elements;
The beginning and end and middle of times,
The alternations of the solstices and the changes of seasons,
The circuits of years and the position of stars;
The nature of living creatures and the raging of wild beasts,
The violences of winds and the thoughts of men,
The diversities of plants and the virtues of roots."[1]

"When school science has this outlook," as was recently said, "it will lie closer to the human heart than it does at present, and a common bond of sympathy will be formed between all who are guiding the growth of young minds for both beauty and strength."

[1] Book of Wisdom, vii. 16-20.

The Utilisation of Tidal Energy.

Studies in Tidal Power. By Norman Davey. Pp. xiii+255. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 32*s.* net.

WHILE the development of tidal power has attracted inventors for many years, no tidal power scheme of any appreciable size has hitherto been constructed. The last few years have, however, shown a greatly increased interest in the subject, and both in Great Britain and in France specific schemes for large-scale developments have been under consideration by governmental committees.

Schemes involving the use of the Severn estuary have been considered in some detail by the Board of Trade Water Power Resources Committee, the third interim report of which, issued in 1920, dealt exclusively with the question of tidal power. The Committee, as a result of its investigations, came to the conclusion that, while the technical information available was not sufficiently precise to enable it to express a final opinion as to the feasibility of the schemes submitted to it, there was a strong prima facie case for the more detailed examination of the problem. In view of its importance and of the possibilities attaching to its successful solution, the Committee urged that a special Tidal Power Commission composed of technical and scientific members should be appointed to undertake the necessary investigation. About the same time a Severn scheme was put forward in the public Press by the Engineering Department of the Ministry of Transport, and it is possible that the opposition offered to this by an important section of the daily Press was in part responsible for no further steps being taken in the matter of the Committee's proposal.

In France the Senate has now voted a Bill, already passed by the Chamber, providing funds for the construction of a tidal power station of experimental type at Aber-vrach near Brest. The proposed barrage will be 150 metres long and the turbines will have a maximum output of about 1200 h.p. The tidal station is to be worked in conjunction with a second hydro-electric station utilising the waters of the river Diouris, which discharges into the estuary of Aber-vrach. This will be used to supplement and regularise the output of the tidal station. It is estimated that the two stations will give a constant minimum output of 1600 h.p. and a maximum of 3200 h.p. The annual output is estimated at about 11 million B.O.T. units. The construction of this scheme should throw valuable light on many of the problems outstanding in connexion with the operation of such installations.

The work under review is one of the first books in English to deal exclusively with the important subject

of tidal power. A preliminary chapter on tidal phenomena is followed by a discussion of the tidal basin system. This brings out clearly the advantages and disadvantages of many of the various schemes of operation which have been suggested. It would have added to the interest of the section had the case of the single basin double-flow system without sluice gates been considered, and also some of the ingenious systems which have been suggested for use on the Rance at St. Malo.

This is followed by a useful discussion of the limitations imposed by the available length of dam and of the question of the storage required to give uniform output. Possibly in future editions it may be possible to elaborate this section so as to include an examination of the possibilities of methods of storage other than those involving the use of an elevated reservoir into which the primary turbines pump at periods when the energy supply is in excess of the demand.

Chapter vi., consists of a tidal power survey of the British Isles, and indicates some 72 sites at each of which the tidal range exceeds 10 feet, and where a continuous output of at least 1000 h.p. could theoretically be developed. Of these sites 49 are in England, 20 in Scotland, and 3 in Ireland. The author estimates that a total of some 4 million continuous horse-power might be developed from these and other smaller stations. Chapter vii. deals with the general outline of the power plant necessary in a tidal power installation, and indicates how this varies with the system of operation, while in chapter viii. schemes referring respectively to the estuary of the Severn, and to the estuaries at Salcombe, at Fleetwood, and at Barrow, are considered in some detail. Approximate estimates of cost are submitted, according to which the cost of intermittent power generated from each of these stations would be appreciably less than would be possible from any steam power station.

It is probably this part of the discussion which will give rise to most criticism. The figures are, of necessity, in a high degree speculative. Some of the costs, notably those of the power plant and equipment, would appear to have been framed somewhat optimistically, and it is doubtful whether sufficient allowance has been made for operating costs which would, in many cases, be heavy owing to the necessity for continuous dredging in the tidal basin.

At the present time, it is doubtful whether the development of any tidal power scheme designed as an independent unit to supply power for ordinary industrial purposes could be justified economically. On the other hand, there can be little doubt that if and when any chemical or manufacturing process becomes available in which electrical energy developed intermittently can be economically utilised as developed, the question of the utilisation of tidal power will become of very great importance. Under such conditions no storage system would be required, and the cost of the energy would certainly be less than that of energy developed from any other source at present available.

At the same time, the number of technical problems, alike in mechanical, electrical, and hydraulic engineering, which still require to be co-ordinated and solved before a tidal scheme of any large magnitude can be embarked upon with confidence, is large.

The questions of single versus double-way operation of turbines; of the maximum economic capacity of the installation; of the best size and form of turbine and generator; of geared or ungeared turbines; of the use of alternating or direct current generators for the primary turbines; of the effect of a dam on the silting of the estuary and on the regime of the river above and below the dam; and of the effect on navigation, transport, and fisheries, are probably the most important. All these are matters to which present-day engineering experience, augmented by some special experimental investigations, should be adequate to give a definite answer.

As suggested by the Board of Trade Water Power Resources Committee, the whole question requires and would appear to merit investigation, more especially on matters of detail, by a strong technical committee with funds available for experimental work. As a result of such an investigation, it is more than possible that a definite working scheme could be formulated for more than one site which would compete on favourable terms with any coal-fired installation with fuel at its present price.

The book concludes with appendices, giving the tidal constants for 916 stations around the British Isles, along with 66 sketch maps of sites at which tidal power development on a fairly large scale appears feasible. The publishers have done their part of the work excellently. The book is well written and illustrated, and should be in the library of any engineer interested in this question.

Malebranche.

Dialogues on Metaphysics and on Religion. By Nicolas Malebranche. Translated by Dr. Morris Ginsberg. (Library of Philosophy.) Pp. 374. (London: G. Allen and Unwin, Ltd., 1923.) 16*s.* net.

MALEBRANCHE is generally regarded as an idealist philosopher with an interest only for those who care for metaphysical speculation, but he deserves a warm corner in every true scientific

researcher's heart. He was a priest, with a stall at the Oratory in Paris, and he spent there the working years of his long life. Moreover, he was continually drawn into theological controversy and sometimes disturbed and harassed by ecclesiastical authority, yet in his heart of hearts he was a devoted lover of natural science and his boldest speculations had their origin in observation of the facts of Nature and in his keen interest in the discoveries of science. There is a widespread idea that metaphysicians are men of exalted minds who have chosen the *a priori* path to a transcendental reality and despise the lowly work of science as beneath their dignity. It is peculiarly an idea of the materialistic nineteenth century, and whatever ground there may be for it and however far it may still prevail, it had not and it has not any application to the great Cartesian philosophers of the seventeenth century, least of all to Père Malebranche.

Indeed, some modern writers are beginning to recognise that Malebranche occupies an important place in the historical development of the sciences. If Descartes is the father of modern philosophy, Malebranche, his great successor, is the precursor of modern scientific psychology. Dr. James Drever, in his "Instinct in Man," has brought this out very convincingly. It is doubtful if anything in modern psychology is so inspired by the conception of scientific method as the chapters of the "Recherche de la Vérité" which treat of the illusions due to the senses and the imagination. In a certain sense Malebranche presents to us the converse of the picture which Descartes portrayed in his "Principes." Descartes seems to be looking through the telescope at the great external universe with the view of discerning the mechanism which will explain its movement. Malebranche seems to be using the microscope and lost in wonder at its revelation of the infinite extension of the world below and within us. It is not a little curious to find that just as we to-day are likening our new conception of the atom to the solar system, so Malebranche thought he saw the vortex theory of the celestial movements confirmed and mirrored in the minute organisms and structures revealed by the microscope. At least it was the microscope which seemed to him to support the theory that one and the same principle applies to the infinitely great and the infinitely small.

It was the microscope, and more especially Swammerdam's use of it in physiology, which led Malebranche to affirm a principle, first enunciated by Pascal and now seen to be of paramount importance in scientific theory: the principle of the relativity of magnitudes. It was literally based on scientific discovery. Great and small have no absolute reference. They are determined for each observer and are purely relative to the norm supplied by his own range of activity. It is true that some of Malebranche's deductions from his observations were highly speculative and are now no more than historical curiosities, as, for example, his idea that the generations of a plant or an animal lie enfolded in the seed or ovum or germ much as the reflections in two opposed mirrors present an infinite perspective of diminishing images; but the principle of the relativity of magnitudes is receiving a new application to-day in the theories of relativity.

Malebranche's *magnum opus* is the "Recherche de la Vérité." It brought him world-renown. Its theory of vision in God and its exposition of occasionalism established his fame and caused him to be regarded as the leading philosopher of his age. The book went through successive editions and an English translation was published in 1692. It was this established philosophical work which the great Arnauld attacked in his old age, in a vigorous polemic entitled "Des vraies et des fausses Idées." The controversy it led to was bitter, but Malebranche, in the true spirit of philosophy, replied by restating his complete theory in a new and concise form. This is the "Entretiens sur la métaphysique" which Dr. Ginsberg has now translated. The purpose of Arnauld in attacking Malebranche was not, as Dr. Ginsberg in his introduction (misled we think by words and failing to appreciate the seventeenth-century mind) would have his readers suppose, to controvert a theory of knowledge and substitute an anticipation of modern naïve realism. The veteran Jansenist controversialist had too much in common with Malebranche as a fellow Cartesian and brother Augustinian to be concerned about that. Moreover, the Cartesian philosophy was a metaphysic of reality and not an epistemology. The wrath of Arnauld was aroused because he detected unsound doctrine concerning "sufficient grace." Fontenelle, in his *Éloge* of Malebranche, gives us the origin of the controversy. It was le Père Quesnel who drew from Malebranche's theory the consequence which aroused the hostility of Arnauld. "Le fond du système dont il s'agissoit, est que l'âme humaine de Jésus-Christ est la cause occasionnelle de la distribution de la Grace, par le choix qu'elle fait de certaines personnes pour demander à Dieu qu'il la leur envoye; et que comme cette âme, toute parfaite qu'elle est, est finie, il ne se peut que l'ordre de la Grace n'ait ses défectuosités, aussi-bien que celui de la Nature."

Dr. Ginsberg has given us an excellent and most readable translation of the "Entretiens," and has earned the gratitude of all teachers and students of the history of modern philosophy.

H. WILDON CARR.

Scientific Workers in an Historical Setting.

(1) *The Discovery of the Nature of the Air, and of its Changes during Breathing.* By Clara M. Taylor. (Classics of Scientific Method.) Pp. ix+84+8 plates. (London: G. Bell and Sons, Ltd., 1923.) 1*s.* 6*d.* net.

(2) *Stories of Scientific Discovery.* By D. B. Hammond. Pp. ix+199+8 plates. (Cambridge: At the University Press, 1923.) 6*s.* net.

(3) *Makers of Science: Mathematics, Physics, Astronomy.* By Ivor B. Hart. Pp. 320. (London: Oxford University Press, 1923.) 6*s.* net.

IT is not improbable that the historian of a thousand years hence will describe the nineteenth century as the last phase of apriorism. Certainly it augurs well that not only philosophers but also theologians are now showing a growing reluctance to accept cloud-born principles at face value. When a new principle of science is enunciated nowadays, it is rightly treated as an hypothesis; and an hypothesis, however sagaciously chosen, however useful a purpose it may serve for a time, always involves some kind of an assumption, and more probably than not it is therefore doomed to take its turn in being obliterated from the scientific palimpsest. Who twenty years ago would have dared to doubt Newton? And who doubts that Einstein in his turn will come to be doubted? We no longer go behind experience, in obedience to some *a priori* sentiment. The world has become critical of all new appearances; even "facts" have ceased to be accepted unquestioned. We have come to recognise that in all observations and in all measurements there are necessarily errors, for both our sense-organs and our measuring-instruments are imperfect.

It is curious to note how, in the past, most historians have given a distorted perspective to the background of their work. Even at the present time it is not uncommon to find in books on history valuable space devoted to political intrigues, to the squalid doings of royal favourites, and to the adventures of a ruffianly baronage. Historians have thought too much in terms of nationality and creed, and too little of mankind as a whole and of the real causes underlying the development of civilisation.

It is satisfactory to find that many people are at last beginning to realise the part that science has played in making the real history of the world, and are trying to learn something of scientific workers and of scientific method. All three books now under consideration have at least one aim in common—to bring their readers into contact with famous men of science, to show how these men lived and how they worked, what methods they used, what penetrating sagacity they showed in framing hypotheses to bind together their facts, and how at last success came to them.

(1) Miss Taylor's little book is a history of the work of successive investigators into the nature of the air. The early investigators were baffled and made scarcely any headway; as they were dealing with an invisible thing, little wonder that they looked upon it as a "spirit." Boyle made the first solid advance when he investigated the "spring" of the air. Stephen Hales would probably have made a much further advance if his power of interpretation had been equal to his experimental ingenuity. Then came Stahl and the phlogiston hypothesis, an hypothesis which was undermined by Black's quantitative work, and yet Priestley adhered to it, quite failing to realise the inner significance of his own experiments. Eventually, Lavoisier's consistent use of the balance quite cleared away the fog of many centuries, and the rapid progress of chemistry then became a fact.

Miss Taylor gives short extracts from original memoirs, with useful and interesting running commentaries. The extracts are not always quite long enough to enable the reader to get first-hand knowledge of the motive of the investigator for his particular line of research, and no doubt that is inevitable in a book of this size, but in any case the reader's curiosity is whetted if not quite satisfied. Miss Taylor might perhaps have laid a little more emphasis upon the fact that her implicit if not explicit intention all through is to show how, in the history of science, one hypothesis is inevitably superseded by another when new facts and altered conditions refuse to fit into the old picture. Her book is, however, eminently readable, almost remorselessly logical, and certainly achieves the purpose of its general editor.

(2) Miss Hammond says, "I have felt for each man and woman of whom I have written a sense of personal friendship." Her plan has been to choose from "the vast field of scientific discovery" representative workers whose lives seemed to possess "special human and dramatic interests." Priestley, Lavoisier, Rumford, W. Herschel, Fabre, Faraday, the Curies, Darwin, Wallace, and Pasteur are the favoured few. In each case the author contrives to give us a picture of the early home, school conditions, and environment which were to interest the worker in a particular way and to lead him along a particular path of inquiry; it is a picture which reveals intimate touches in his family and social life. The picture shows something of his work, too; but his methods and researches are for the most part only lightly touched upon. Anecdotes abound, and the book will be of special interest to the general reader who may still feel doubtful whether the great leaders of science are anything more than mere unemotional logic-engines.

(3) A little sterner in aim, but almost as easily followed by the general reader, Mr. Hart's book is

designed on somewhat similar lines to the last, inasmuch as it is essentially biographical in character. Although in his voyage over the seven seas of physical science Mr. Hart himself has remained at the helm, he has had within hail a skilful pilot in the person of Dr. Charles Singer. Needless to say, therefore, he has kept clear of the rocks. The summary of the mathematical and scientific work of Aristotle, Archimedes, Euclid, and Ptolemy is lucid and interesting; so also is the account of the work of Roger Bacon. Very readable, too, are the account of the method by which Kepler established his laws of planetary motion, and that of the respective parts played by Pascal, Torricelli, and Boyle in working out the physics of the atmosphere. Newton, Davy, and Faraday receive adequate treatment; but if a future edition of the book is called for it may be hoped that the last 40 pages may be expanded, in order that more space may be devoted to distinguished living workers. F. W. W.

Natural History.

Histoire Naturelle Illustrée: Les Plantes. Par Prof. J. Costantin et Prof. F. Faideau. Pp. 316+26 planches. 50 francs. *Histoire Naturelle Illustrée: Les Animaux.* Les Invertébrés, par Prof. L. Joubin; Les Vertébrés, par Aug. Robin. Pp. 340+29 planches. 55 francs. (Paris: Librairie Larousse, 1923.)

POPULAR works on natural history vary considerably in scope and in treatment, according to the particular appeal which it is desired to make to the reader. Some appeal exclusively to the sporting instinct and deal entirely with the big-game animals and birds of the world. Others are concerned with the beautiful, the æsthetic in Nature, or with the bizarre and weird, and their appeal is to the artistic sense or to the curiosity of their readers. Others again seek to stimulate a real interest in, and active observation of, the living world by describing in detail the general biology and habits of the animals and plants of the country in which they are published, so that the reader may verify for himself the facts which are given him and so become trained as a field naturalist.

The volumes now under notice belong to none of these types. Their aim is rather to bring home to the general reader the value of a study and a knowledge of living animals and plants by emphasising the fundamental importance of the rôle which they play in the general economy and everyday life of the human race. Special attention is devoted throughout the two volumes to those animals and plants which in any way enter into association with man, either as parasites or carriers of disease, as articles of food, as the bases of industry and commerce or as ministering to the amenities of life by providing luxuries and personal adornment. The work is, however, no mere catalogue of animals and plants of economic importance. The whole of the world of living plants and animals is surveyed and the treatment is strictly scientific. Clear yet simple accounts are given of the morphology, physiology, reproduction, and classification of the various groups of animals and plants and the most important types of all the recognised families indicated.

Especially valuable are the chapters on environment, in which the salient features of the surroundings, whether marine, fresh water, or terrestrial, are described, and the interaction of environment and living organism is dealt with. Animal and plant associations receive special attention, and the influence of man as an agent of dispersal and extermination is emphasised.

It is no mean achievement to have succeeded, within the limits of these volumes, in giving a well-balanced and scientific account of the entire animal and plant worlds, in which each recognised group of animals and plants is included and its place in the general scheme indicated, and at the same time to provide a clear, succinct, and elementary guide to the general principles of zoological and botanical science. The work is, of course, designed for the general reader, and the language is simple and non-technical, but the wealth of information contained within its pages, especially on the economic side, should render it of special service as a general work of reference to teachers and to museum curators. An important and valuable feature of the book is the illustrations. These include drawings showing structure and anatomy; photographs illustrating habits, environment, and the various methods and details of animal and plant industry; maps showing geographical distribution, and beautifully coloured plates of animals and plants in their natural colours. The work is very profusely illustrated (in the volume on animals alone there are more than 2000 text figures, in addition to 29 full-page plates) and the illustrations are admirably reproduced. This has necessitated the use of a specially glazed paper which has made the volumes somewhat heavy and unwieldy, but this inconvenience is forgiven and forgotten in admiration of the clearness of reproduction and the quality of the results.

The editors, Prof. Joubin and M. A. Robin for the animals, and Profs. Costantin and Faideau for the plants, are to be congratulated on the issue of this valuable and useful work, which must be accorded a high place among the recent books on natural history designed for the use of the general reader, for its comprehensive scope, for the treatment of the subject, and above all for the beauty of the illustrations.

Our Bookshelf.

(1) *La Lumière monochromatique, sa production et son emploi en optique pratique.* Pp. 38. 3 francs.
(2) *Les Applications des interférences lumineuses.* Pp. 160. 10 francs. Par Prof. Ch. Fabry. (Paris: *Revue d'Optique théorique et instrumentale.*) 1923.

PROF. CH. FABRY, director of the Institute of Theoretical and Applied Optics at Paris, has produced two books which are interesting as evidence of the attention that is now being devoted in France to the scientific education of the "ingénieur opticien." (1) The first begins with a description of the various means of producing monochromatic light, flames, mercury arc, gelatine films, etc. Then an account is given of the production of interference bands and their application to the testing of surfaces. Forms of apparatus used in Prof. Ch. Fabry's own institute are described, and there is also a short account of Twyman's interferometer method for testing prisms. The treatment is very clear.

(2) The second is devoted to the application of interference methods. Its first chapter gives an account of the principle of interference and the production of monochromatic light and overlaps to a certain extent the other book. Then the case of interference at great path difference is gone into and an account of the properties and preparation of silvered surfaces is given, together with a description of the arrangements for adjusting them. Prof. Fabry's own work in the field makes this part of special value, and the account of silvering by decomposition at a cathode is very interesting. The second chapter deals with the application of interference to the measurement of small displacements; we meet here a half-tone block and some diagrams which already figure in the other book. There is an account of Michelson's work on the tides and the determination of the metre in terms of wave-length, the latter in great detail. Chap. iii. deals shortly with the angular diameter of stars; Chap. iv. with the determination of wave-length, small variations in the latter—there is a reference to Merton's work on the spectra of isotopes—Zeeman effect, satellites of spectral lines, etc. The treatment here is also very clear. The chief criticism that might be directed against the book concerns its scope; those readers likely to be interested in the advanced applications will find much of the work too elementary.

Redwood and Eastlake's Petroleum Technologist's Pocket-Book. Revised by Arthur W. Eastlake. Second edition. Pp. xxiv+546+8 maps. (London: C. Griffin and Co., Ltd., 1923.) 15*s.* net.

THE appearance of a second and enlarged edition of this compendium is a testimony to the popularity which a book of this kind enjoys quite irrespective of the adverse criticism sometimes accorded to similar publications, at least by scientific writers. There are, after all, many occasions when one is at a loss for the hundred and one items of information necessary to the production, refining, transport, storage, testing, and uses of petroleum and petroleum products, and nowadays there are so many text-books dealing with every phase of the industry that to search through these for the facts desired is often a lengthy and tedious business.

Pocket-books of this nature are a sign of the times; they indicate the ever-growing tendency to reduce practice to formulæ, to condense much into little in space, time, and thought. With an industry growing at the rate of the oil-industry, there is less and less opportunity and scope for merely general knowledge, more and more urgency for specialised work; hence the book which co-ordinates the essentials of each phase of the technology, which brings within a small and convenient compass just those facts required at a moment's notice by geologists, engineers, chemists, company executive, or salesmen, is bound to make an almost universal appeal. This second edition contains much new material, but the general plan of the original volume is maintained. The illustrations, diagrams, and tabular matter are clear and well arranged, and there is a useful little atlas included showing the distribution of the world's oilfields. H. B. MILNER.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 29. Pp. x+914+57 plates. (London: The Institute of Metals, 1923.) 31*s.* 6*d.* net.

THE new volume of the Journal of the Institute of Metals contains a large number of papers, of which many deal with one aspect or another of the problems of hardness and of cold-working. The various methods of testing hardness are considered by several authors, and others deal with the changes in the properties of metals by deformation, and the subsequent re-crystallisation when such deformed metals are annealed. This is one of the most interesting topics in metallurgy at the present time, and the work of Prof. Carpenter and others on aluminium, and of Mr. Cook on cadmium, recorded in this and recent volumes, shows how various may be the phenomena when different metals are compared. The investigations on the equilibrium in ternary alloy systems are proceeding, and there are no less than four papers from the National Physical Laboratory on the important and difficult alloys of aluminium, the knowledge of which is being extended very rapidly. A paper from America, by Messrs. Pilling and Bedworth, deals in a novel manner with the oxidation of metals at high temperatures, an aspect of corrosion which has received comparatively little attention, although its study is a necessary preliminary to any theory of the nature of corrosion. Another paper from the United States is that by Dr. Gray on amalgams, in which the striking changes of volume and hardness in dental amalgams are considered. M. Portevin's paper on eutectics is beautifully illustrated, and the contributors in general have reached a remarkably high standard in the quality of the photo-micrographs used to illustrate their communications.

Annals of the Royal Botanic Gardens, Calcutta. Vol. xi., Appendix. Asiatic Palms—Lepidocaryeæ. By Dr. Odoardo Beccari. Supplement to Part 1: The Species of Calamus. Pp. vi+142+x+83 plates. (Calcutta: Bengal Secretariat Press, 1913–1914.) Text, 4.12 rupees (7*s.*); Plates, 23.8 rupees (35*s.*)

A FURTHER instalment of the late Dr. Beccari's work on the Asiatic palms, which, though published in 1913 and 1914, has only recently been received, is like the

other monographs in the Annals of the Royal Botanic Gardens, Calcutta, a remarkably fine contribution to botanical science. Volume xi. of the Annals was a monograph of the great genus Calamus, but since its completion so large a number of new species has been collected, especially in the Philippines, the Malayan Archipelago, and in the interior of Borneo, that the supplement under notice had to be prepared, together with a new index to the whole volume.

The additional material adds 55 new species, so that now the genus Calamus contains as many as 256 species. The length of the stem in some of these climbing species of Calamus is remarkable, and Dr. Beccari refers to the one preserved in the Kew Museums, which is 369 feet long. This specimen, the species of which is not definitely known, came from Ceylon and is one of the longest examples of a flowering plant.

As in the main volume, each species is fully described and critical observations are added. There is also a fine set of plates showing the general characteristics of the different palms with details of the flowers and fruits.

A Theory of Knowledge. By Charles Augustus Strong. Pp. xii+103. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 6*s.* net.

THE distinguished author of "Why the Mind has a Body" is one of the most original and fearless philosophers of the school which labels itself "Critical Realism." The present short volume, though it is written with all the freshness and vigour we associate with his work, is frankly disappointing. This is because, instead of stating his theory and advancing his argument from his own point of view, he develops it by means of a rather tedious criticism of Mr. Bradley, Mr. Russell, M. Bergson, and other philosophers. His own theory rests, he tells us, on two assumptions: first, that there is a world; second, that there is a self. Nature, he is convinced, is really what it appears to be, and the self is an outgrowth of nature, though in some of its manifestations rising above it. It seems to us that the primary difficulty of such assumptions is that they conflict with physical science and are irreconcilable with the scientific concepts of nature and self. In philosophy, assumptions in the premises have a curious knack of turning up in the conclusion so that no real progress can be made, but they are otherwise harmless enough. Scientific reality is a question of real metaphysical interest at the present time, but it finds no place in this theory, which is mainly concerned with the question of sense-data.

Béchamp or Pasteur? a Lost Chapter in the History of Biology. By E. Douglas Hume. Founded upon MS, by Dr. Montague R. Leverson. Pp. viii+296. (Chicago: Covici-McGee. London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1923.) 6*s.* net.

THIS book is an attempt, not the first in recent years, to resuscitate the name of Béchamp and his microzmas theory, which was presumed to have been utterly demolished by the labours of Pasteur. The work is replete with extravagant language on the virtues of Béchamp and a tirade on the defects, if not vices, of Pasteur as an investigator. Béchamp is described as a "rare luminary of science," "a supreme benefactor of humanity." We are told that "he stood on an ethical plane above his fellows," that "truth, not self, was Béchamp's lode-star," and he is compared to Galileo. The solid fact remains that most of his work has been discredited as inaccurate, and although he wrote an immense amount, he plunged deeper and deeper into error. However high the opinion of the author is on the virtues of Béchamp, he has utilised a fair part of the book to exploit his own antimicrobic and anti-vaccination views. W. B.

The Biology of Birds. By Prof. J. Arthur Thomson. Pp. xi+436+9 plates. (London: Sidgwick and Jackson, Ltd., 1923.) 16*s.* net.

THE plan of illustrating biological ideas in reference to a particular group of animals is admirable—by bringing together in a single volume a great range of facts and of theories it is of service even to the specialist, while to the beginner it affords a revelation of "the length and breadth, the depth and height" of biology. Prof. Thomson here with masterly hand and judicial mind applies to birds such biological concepts as adaptation, struggle, sex, heredity, variation, selection, and behaviour. *En passant* we learn not a little of modern vertebrate physiology, and, of course, of avian physiology in particular. To the general biologist, probably the chapters on "Courtship and Sex" and "Birds and Evolution," in which all the most recent work on genetics comes under discussion, will prove of the greatest interest. The book is abundantly and excellently illustrated, and is to biological literature a solid and valuable contribution that every zoologist should possess.

Engineering Mathematics. By R. W. M. Gibbs. Part 1. Pp. iv+64+iv. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1923.) 1*s.* 6*d.*

THIS little book is the first of a series of three, designed to enable an engineering student who works through them to read technical articles intelligibly and without difficulty. It consists entirely of examples dealing with the simplest operations on the use of signs, the first four rules, British weights and measures, the metric system, simple equations, graphs, approximations, square roots and mensuration problems. No explanatory matter is given, nor are there any typical worked examples. This seems rather a pity, for they would have increased the value of the book, especially to private students. Throughout the collection simple practical problems have been introduced. Answers are supplied at the end occupying four pages of rather small print, and some good diagrams are given.

The Power Within Us. By Charles Baudouin. Translated from the French by Eden and Cedar Paul. Pp. 137. (London: G. Allen and Unwin, Ltd., 1923.) 3*s.* 6*d.* net.

ANY one who expects to find in this book a clear scientific account or a calm philosophical consideration of the doctrine associated with what is called the New Nancy School will be disappointed. If, however, he enjoys sermonising and moralising with abundant quotations from philosophers and poets, then this readable book may dispose him favourably towards the method of M. Coué.

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.*]

On the Structure of Solid Solutions.

VEGARD showed in 1917 that, in alkali halides forming mixed crystals, the lattice dimensions lay between those of the pure components, and thus confirmed the theory that in this case atoms of similar kind replace each other in a common lattice. The same view has been adopted later by Bain, Kirchner, Owen and others, who have investigated solid solutions of metals. In all these cases the complex systems have been considered to be formed by a *simple substitution*.

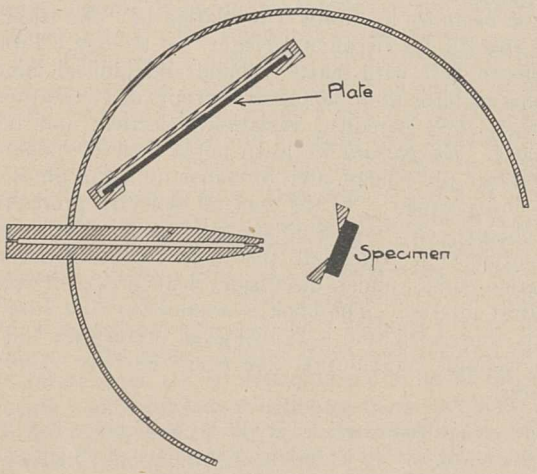


FIG. 1.—Precision camera.

Although this conception no doubt holds good for a great many solid solutions, it is not sufficient to explain the formation of all of them. We have found two distinct exceptions from the type of substitution mentioned above.

By means of a precision camera, the main features of which are shown in Fig. 1, the angles of the most deviated interferences from an illuminated crystal powder could be measured very exactly. In Fig. 2 some photograms taken in this camera are reproduced. As the plate holder and the starting point of the interference radiation have exactly the same position at every exposure, the borders of the thin shadow produced by the diffuse X-ray radiation can serve as reference lines. The camera was calibrated by taking photograms of the substance which forms the standard of X-ray spectroscopy, that is, sodium chloride. Substances of undistorted lattices give very sharp interference lines in this camera, and the K_α-doublet is in some cases resolved into lines lying more than 0·5 mm. apart. Fig. 2, I. is a photogram of an iron tungsten carbide (probably Fe_6W_3C) which in a large amount is present in high speed steel (cubic structure).

Fig. 2, II. contains two photograms of quenched carbon steels, obtained beside each other in different horizontal fields on the same plate by only exposing half of the plate in each experiment, screening off the other. The composition and the treatment of the steels as well as the crystallographic indices of the reflecting planes are noted in the figure. The high carbon steel, quenched in water from 1100° C., contains mainly austenite (solid solution of carbon in γ-iron), while the other one is a mixture of marten-

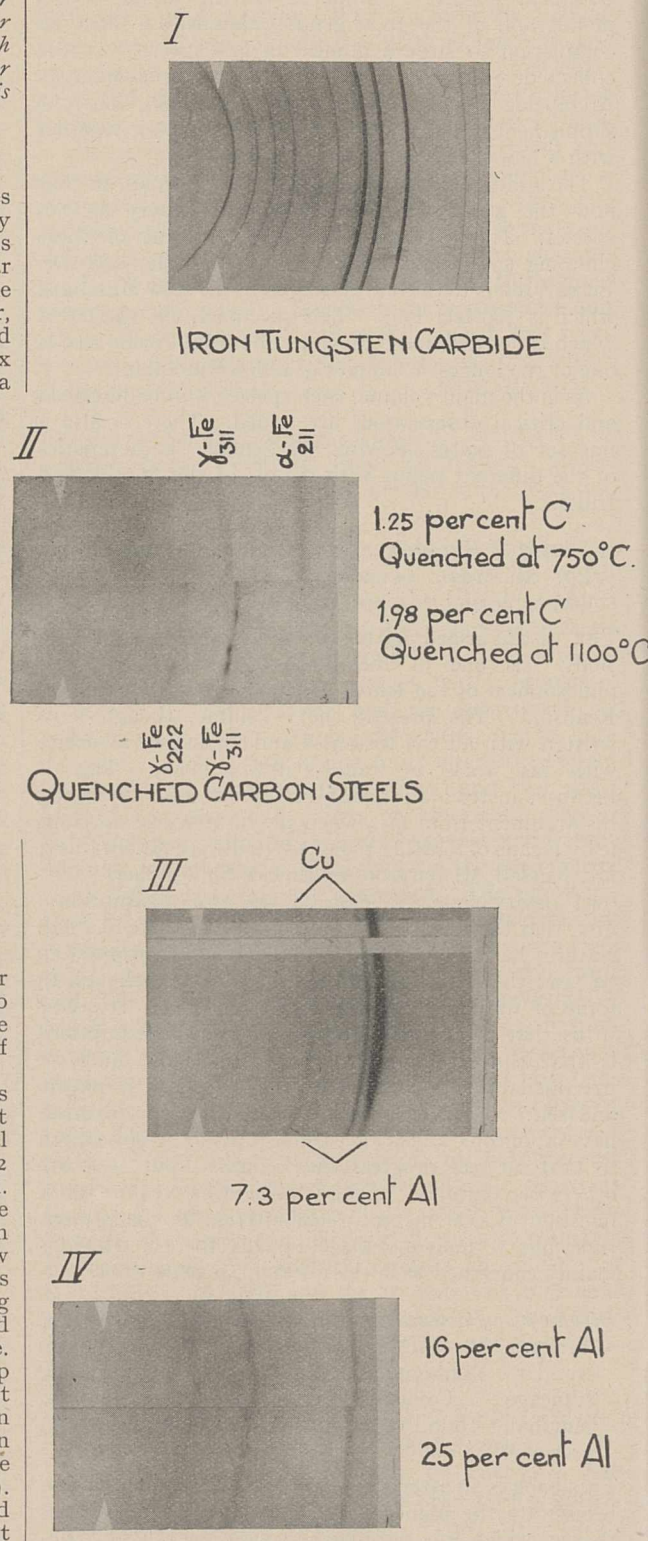


FIG. 2.—Photograms of alloys.

site (α-iron and carbon) and austenite. The most important feature shown by the plate is that the

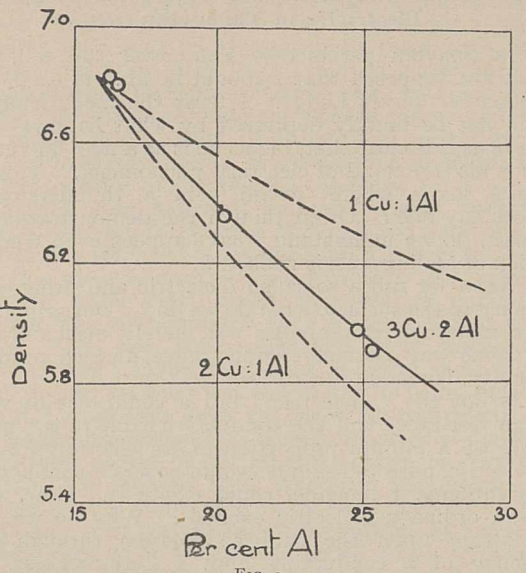


FIG. 3.

lines corresponding to the γ-iron have not the same position in the two photograms. This means that there is a difference in the lattice dimensions of the steels. The face-centred elementary cube of the steel quenched at 1100° is found to have an edge of 3·629 Å (Å = 10^{-8} cm.), while the corresponding value for the steel quenched at 750° is only 3·601 Å. This change in the lattice dimensions can scarcely be explained except by the difference in the carbon content of the two austenitic phases. The fact that the lattice increases in size the more carbon it contains, although the carbon atoms are smaller than the iron atoms, indicates that in this case the solid solution is not formed by a simple substitution.

A precision photogram of a homogeneous austenitic manganese steel containing 12·1 per cent. manganese and 1·34 per cent. carbon was found to have a lattice parameter of 3·624 Å. If we calculate the density of the steel on the basis of the assumption that carbon and metal atoms replace each other in one and the same face-centred cubic lattice, we get the value 7·36; but if we assume that the lattice is formed only by iron and manganese atoms, the carbon atoms being distributed uniformly between them, we obtain the value 7·83. The density of the steel was found to be 7·83. Thus the latter assumption must be the correct one.

The real nature of this addition of carbon atoms cannot be decided on the basis of the results so far obtained. It is not necessary for it to involve anything fundamentally different from a substitution in the case of the atoms of the γ-iron lattice being replaced by complexes consisting of an iron atom combined with one or more carbon atoms.

If less than 8 per cent. aluminium is dissolved in copper the type of the copper lattice is not changed, but it increases in size with rising content of aluminium. This can be seen in Fig. 2, III., where the interference lines of pure copper and of copper containing 7·3 per cent. aluminium are compared. The elementary cube

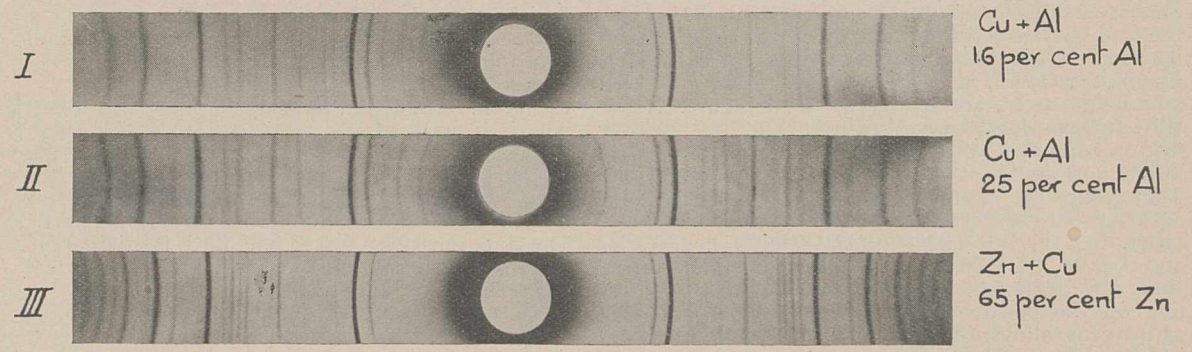
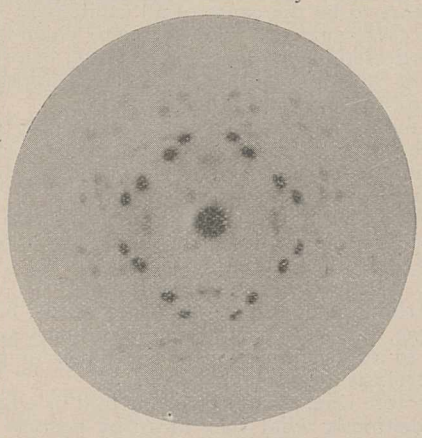
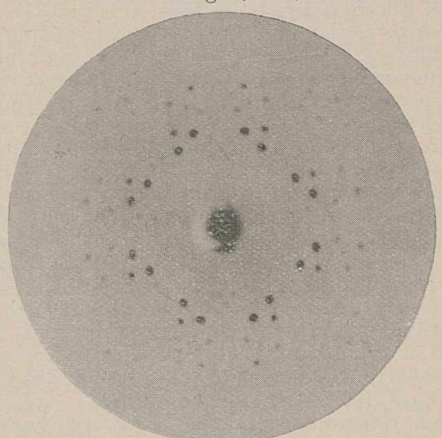


FIG. 4.—Powder photograms of copper-aluminium and zinc-copper alloys.



Laue photogram of copper-aluminium alloy, containing 16 per cent. copper; projection distance, 43 mm.



Laue photogram of zinc-copper alloy, containing 67 per cent. zinc; projection distance, 45 mm.

FIG. 5.

of the alloy is found to have an edge of 3·652 Å, and the density of the alloy is 7·85. If we assume that the aluminium atoms replace copper atoms in a common face-centred cubic lattice, and if we calculate the number of atoms present in the elementary cube on the basis of the data given, we obtain the number 4·002, which is characteristic of the face-centred cubic lattice, and shows that in this case the solid solution no doubt is formed by simple substitution of copper atoms by aluminium atoms.

In the range 16-25 per cent. aluminium of the copper-aluminium alloys we also have a series of solid solutions, but in this case the lattice dimensions decrease with rising content of aluminium, which can be seen in the photograms of Fig. 2, IV. Laue-photos and an investigation of the interference radiation from a rotating single crystal have shown that these solutions too have a cubic lattice. The elementary cube is, however, very large. For the 16 per cent. alloy its edge is found to be 8·701 Å, and for the 25 per cent. alloy 8·656 Å. The number of atoms within the cube is deduced to be about 52 for the 16 per cent. alloy, and about 49 for the 25 per cent. alloy. In these solutions the copper atoms are not substituted by aluminium atoms in the proportion one to one, but a number of copper atoms are evidently replaced by a less number of aluminium atoms. As can be seen in Fig. 3, the density values experimentally determined lie on the density curve calculated from the lattice dimensions by supposing that three copper atoms in the lattice are replaced by two aluminium atoms. For comparison the curves calculated on the basis of the assumption that the substitution takes place in the proportion of one copper atom to one aluminium atom, and two copper atoms to one aluminium atom, are also given in the figure. How this unusual form of substitution can be brought into accordance with the cubic symmetry of the atomic arrangement is still an unsolved question. The groups of atoms present in the elementary cube of the series of solutions correspond very nearly to the formulæ $Cu_{36}Al_{16}$, $Cu_{33}Al_{18}$, $Cu_{30}Al_{20}$ and $Cu_{27}Al_{22}$. It is a curious fact that no difference can be noted in the relative intensity of the lines in the powder photograms of the 16 and the 25 per cent. alloys. These photograms are reproduced in Fig. 4, I. and II.

Fig. 4, III. is a powder photogram of a zinc-copper alloy containing 65 per cent. zinc, which, as can be seen, bears a very close resemblance to the copper-aluminium photograms of the Figs. 4, I. and II. As shown in Fig. 5, Laue-photos of these two different kinds of alloys are also very similar. The parameter of the zinc-copper lattice differs by not more than about 1·5 per cent. from that of the copper-aluminium alloys, and as in the α-solutions of zinc in copper the lattice dimensions of the Cu-Zn phase have been found to increase in size with rising content of zinc. The number of atoms in the elementary cube has been calculated for the alloy containing 65 per cent. zinc, and for another containing 62 per cent. In both cases the value 52 was obtained. It is thus evident that these zinc-copper solutions are formed by a simple substitution. At ordinary temperature the phase is stable in the range 61-70 per cent. zinc, and the groups of atoms contained in the elementary cube thus very nearly correspond to the formulæ $Zn_{32}Cu_{20}$, $Zn_{33}Cu_{19}$, $Zn_{34}Cu_{18}$, $Zn_{35}Cu_{17}$ and $Zn_{36}Cu_{16}$.

The close resemblance of the X-ray photograms of these zinc-copper and copper-aluminium phases indicates an isomorphism that, considering the great dissimilarity in the composition of the alloys, is very strange indeed.

ARNE WESTGREN.
GÖSTA PHRAGMÉN.

Stockholm.

Problems of Hydrone and Water: the Origin of Electricity in Thunderstorms.

IN Shavian parlance—"You never can tell." I had not supposed that I should be able to earth my friend Sir Oliver Lodge. I trust the meteorologists will not be unduly depressed by what he says—the more as it is clear that, big as he is as a man and great as is his command of electrical phenomena, "'e don't quite know where 'e are"—in a thunderstorm! Does any one? Often though the demonstration be given, do we understand what happens even when a stick of sealing wax is rubbed?

When we rub a so-called dielectric and bring electricity to the surface, what do we do? Our grip upon the molecules is probably not merely mechanical—in some way that mysterious force, termed residual affinity, is made operative.

Is not the "dielectric" but a conductor of very high resistance and the conductivity due to the presence of a minute proportion of an electrolyte? A dielectric, pure and simple, would be a non-conductor: no rubbing, I imagine, could excite it. How, too, is an ordinary dielectric excited? Why do we put amalgam upon the rubber? Maybe through the agency of a conducting film, I dare suggest. A Baker-dry dielectric could not be excited, I imagine, by a Baker-dry rubber?

What happens when the dielectric is stressed? Are the molecules merely drawn out of their natural positions, much as the railway signal is when the lever in the signal cabin is pulled over? This was Faraday's view, definitely expressed by him in the following paragraphs:

"1298. Induction appears to consist in a certain polarized state of the particles into which they are thrown by the electrified body sustaining the action, the particles assuming positive and negative points or parts, which are symmetrically arranged with respect to each other and the inducting surfaces or particles. The state must be a forced one, for it is originated and sustained only by force and sinks to the normal or quiescent state when that force is removed. It can be continued only in insulators by the same portion of electricity, because they only can retain this state of the particles.

"1299. The principle of induction is of the utmost generality in electric action. It constitutes charge in every ordinary case and probably in every case; it appears to be the cause of all excitement and to precede every current. The degree to which the particles are affected in this their forced state, before discharge of one kind or another supervenes, appears to constitute what we call intensity.

"1300. When a Leyden Jar is charged, the particles of the glass are forced into this polarized and constrained condition by the electricity of the charging apparatus. Discharge is the return of these particles to their natural state from their state of tension, whenever the two electric forces are allowed to be disposed of in some other direction."

It is, however, conceivable that the distributed electrolyte is operative—in other words, may not the charge, at least in part, be one of ordinary polarisation, due to an accumulation of a product or products of electrolysis at a pole or poles?

It were time that electricians told us what a charge is—distinctly what they mean by positive and negative. They now talk of electricity, as if they knew something. Will they not share some of their knowledge with those few of us who have the effrontery to ask for more, as an Oliver of lesser stature than my friend did of yore?

My distinguished clansman, by his invention of the

hydroelectric machine, Faraday by his masterly study of this engine, have in large measure forestalled Lenard's and Simpson's observations: if not the clue to the thunderstorm, much that is material to the problem may well be sought for in these early inquiries. Scots, in early days, enjoyed a raid into a neighbouring chieftain's valley—the practice has passed into science in these our modern times—the old lust of loot in me would be satisfied if I could lift a few meteorological scalps in developing an hydrono-electric doctrine in accord with the facts.

Faraday was satisfied that the steam became charged through the friction of suspended *water-drops* against the jet. He produced similar effects by discharging air laden with drops of water. He proved that the water must closely approach to purity—when it was contaminated with a trace of salt the charge was not held. Knowing that ammonia increases the conducting power of water only in a small degree, he tried this and found, as he expected, that it did not take away the power of excitement.

Faraday forestalled that ancient mariner of the sea of friction, Hardy, if not all the workers on surface tension. He showed that, whatever the substance rubbed by the water, the water became positive to them all; but an oil film (turpentine) of infinite tenuity sufficed to render the jet of steam strongly negative. This observation seems to me to be of fundamental importance. Faraday thought of the water-drops as coated with the oil and this as the rubbing body—but what of the water behind it?

I suppose no one reads work published in 1843 in these enlightened times—examinations forbid. Short reading, like the short skirt, is the fashion of the day; students hug their nakedness; the dear things just learn what is decreed. Our science is like our religion, mythical in large part.

To me the most illuminating passage in Faraday's account is that near the end. After giving a list of substances, each of which becomes negative when rubbed with the substance above and positive with those beneath it, he proceeds:

"2141. There are, however, many exceptions to this general statement: thus one part of a catskin is very negative to another part and even to rock-crystal: different pieces of flannel also differ very much from each other.

"The mode of rubbing also makes in some cases a great difference, although it is not easy to say why, since the particles that actually rub ought to present the same constant difference. . . ."

Well, we wash flannel in hard or alkaline water and we handle it with acid or oily fingers. Flannel is but protein. As Hardy has shown, protein is inert in an electric field but moves either to the positive or negative pole according as it is made alkaline or acid. Herein, maybe, we have an explanation of the diversity of the effect on rubbing.

Rain is sometimes positive, sometimes negative—why? No one has yet studied the manner in which the hydrogen ikons are consecrated in the two kinds—or inquired after an "oily" impurity: yet such impurity is widespread in the atmosphere.

Here let me quote Faraday's last words on the subject:

"2145. Finally, I may say that the cause of the evolution of electricity by the liberation of confined steam is not evaporation; and further, being, I believe, friction, it has no effect in producing and is not connected with the general electricity of the atmosphere: also, that as far as I have been able to proceed, pure gases—*i.e.* gases not mingled with solid or liquid particles—do not excite electricity by friction against solid or liquid substances."

Being a real dielectric, not a mere approach to one, a gas cannot be excited!

One more question I would dare ask. Can a highly conducting metal, like gold, hold a charge any more than dirty water does? Do we charge the gold leaves of the electroscope or a surface film of electrolyte? We can charge strips of paper; cellulose is doubtless a dielectric; may we not suppose that the charge is held by or through the agency of the associated electrolyte?[1]

We have too long neglected chemistry in physics—perhaps there would be little of physics left if we did not. When a teacher, I had the temerity to preach that the currents produced on rotating a copper disc in a magnetic field were probably due to chemical action—a chemical action being defined as one involving a change in molecular contexture (configuration).

Maybe, in a pure, highly conducting metal, the molecule is coterminous with the mass, as in the diamond; the units are all similarly oriented. In such a metal, it is conceivable, the units are arranged end to end, forming an imperfect "tube of force"—imperfect, because the units, by oscillating against each other, diminish the average effective "bore" of the tube; as temperature falls and the oscillations are damped down, the tube improves and more and more tends to acquire the full bore it would have at zero, when conductivity should be at its maximum. The passage of a current through a wire might have a similar effect in distorting the molecules and straightening out the tubes—bringing it into Faraday's electrotonic state; when the current ceased, the molecules would snap back into the position normal at the temperature. The effect would thus be analogous to that we suppose to be produced in charging a dielectric; the induction of a current in a neighbouring metallic conductor would be an effect corresponding to that of charging one dielectric by another by induction; the self-induction in a conductor might be a phenomenon of the same order. Magnetisation would differ only in that the magnetisable complexes, owing to a peculiarity in their molecular structure, exercise a special directional influence.[2]

As to the now distant thunderstorm—do not Faraday's observations justify the conclusion that no mere division of water-drops against an air current, whatever its velocity, nor even the passage of small into large drops, would give rise to sensible electricity?

[1] My attention has been directed, by a friend, an electrician, to whom, fortunately, I happened to show the draft of this letter, to "A Study of Franklin's Experiment on the Leyden Jar with Movable Coatings," by Mr. Addenbrooke, in the *Philosophical Magazine*, 1922, 43, 489. In the Franklin experiment, a glass jar is first charged, the inner coating is then lifted out by an insulated hook and this inner coating is touched against the outer coating and put back: although, when taken out, the inner coating carries scarcely any charge, yet when it is put back a full or nearly full charge can be got from the reconstructed jar.

It is generally supposed that the charge is held in the dielectric. Mr. Addenbrooke throws doubt on this explanation. Making a jar of paraffin like the glass jar, using the coatings of the glass jar, on carrying out the evolutions above described he found no appreciable charge in the reconstituted jar. Paraffin has little affinity for moisture. He therefore dried his glass jar and putting it into a dry cupboard, he manipulated it through sleeves with rubber gloves: he now got the same effects as with the paraffin jar. No charge was held by this dried glass jar. The coatings of the paraffin jar were found to have opposite, equal charges, it should be said.

Apparently, in the ordinary glass jar, the charge is held by the film of moisture on the glass. Mr. Addenbrooke seems to think of the charge as *on the coatings* of the dried jars—must we not go further and inquire whether these also do not carry a surface film? Metal may well hold such a film more firmly even than glass. The whole subject is in need of complete study.

[2] The fact to which Dr. Ashworth directs attention, in NATURE of Jan. 5, that the loss of magnetism by ferromagnetic substances at the critical temperatures is attended with an abrupt fall of the specific heat, which rises up to this point, is most interesting in this connexion. Sir W. Bragg's statement, that the molecules of iron become more closely packed as the temperature is raised, is also noteworthy—but is this compatible with the expansion?

I would here say to Sir Oliver Lodge that the chemist's molecule (the physical or mechanical unit) has never been "static": he has always thought of it as like that Irish Pig! Of course, what is in the Pig (the atom) is Pig!

If so, the meteorologist will have to seek the lady outside—though she may sometimes be aided by hail, as Faraday was able, by means of compressed ordinary air, carrying water-drops in suspension, to excite a positive charge on ice! HENRY E. ARMSTRONG.

The Formation of Cumulus Cloud above Bush-fires.

THE formation of a cumulus cloud above a column of smoke rising from a bush-fire was observed on two occasions during a recent visit to Australia. Though I scarcely think that this phenomenon can have escaped observation before, it may be of value to put upon record a few details of its occurrence.

On April 30, 1922, while motoring along the shores of St. Vincent's Gulf, South Australia, on a hot autumn day, shade temperature about 85° F., we observed the smoke from a bush-fire about seven miles away rising to a considerable height in still air; though not very dense, the smoke looked black against a background of blue sky, but it appeared

FIG. 1.

capped by a white cumulus mass. To make sure that it was not an illusion produced by a distant cloud behind it, we motored at 45° to the line of sight for about two miles, but there was no parallactic displacement between the smoke column and the cloud.

On the following day, which was characterised by a hot dust-laden north wind, the smoke from another bush-fire near the coast of Encounter Bay was being swept inland by a local sea breeze against the general northerly current. The southerly breeze died out as greater altitudes were reached, until the smoke rose almost vertically; at this point it became capped by a gleaming white cumulus cloud. On this occasion the smoke was seen both before and after the cloud formed upon its summit, so there was no doubt about the reality of the phenomenon; first one peak of the smoke developed a white and billowy crest and then another. So far as could be judged, the cloud, once formed, developed vertically more rapidly than the smoke was rising. The level at which the cloud originated appeared to be sharply defined.

The sketch reproduced in Fig. 1 was made from photographs taken on May 1, which were, unfortunately, not good enough for direct reproduction. It looks towards the west from an indentation in the south coast. The sketch is somewhat at fault in suggesting that the sky was overcast; it was in fact clear of other cloud. But the shapes of the rising smoke and of the cloud cap are shown faithfully, though the contrast between the brightness of the latter and the smoke is scarcely sufficiently emphasised. It represents the stage of development of the cloud about 15 minutes after it first began to form above the rising smoke. W. G. DUFFIELD.

University College, Reading,
November 28.

The Pancreas and Diabetic Metabolism.

THE renewed interest in the nature and metabolism of diabetes mellitus under the influence of the discovery of insulin, prompts me to the following brief communication. A more detailed discussion of the subject will necessarily appear elsewhere.

1. The belief that insulin is a secretion of the islands of Langerhans and that it is directly concerned with the burning of blood sugar stands on an insecure and, as I believe, erroneous basis. The morphological and functional position of these islands is still so uncertain that it is at present not possible to bring them into any definite relation to functions of the pancreas. All the older evidence obtained by tying of the main duct, by special staining methods, their apparent independence in Elasmobranch and Teleostean fishes, together with observations in pathological cases, are open to serious question and different interpretations. (See L. S. Milne and H. L. Peters, *Jour. Med. Research*, Boston, xxvi. 3, 1912, p. 405.)

For these reasons, a number of pathologists, including myself, have come to abandon the strict belief in island independence and function and put the relations of the pancreas to diabetes into the gland as a whole. Moreover, the pancreas is even normally a very fluid organ, presenting constant evolutionary changes. My own studies in relation to these have led me, with others, to believe that the islands are a morphological phase in this phenomenon and that they are interchangeable with parenchyma and ducts. Thus, they may disappear during regressive pathological lesions by this transformation, and no evidences of degeneration or other destructive loss are left behind (Oertel, *Jour. Med. Research*, Boston, xl. 3, 1919; and Oertel and Anderson, Scientific Reports, Royal Victoria Hospital, 1916, B. 1, p. 155).

2. Milne and Peters obtained in my laboratory years ago results (*Jour. Med. Research*, xxvi. 3, 1912, p. 405) which indicated that the tissues in diabetes can utilise dextrose, while the blood of depancreatised animals possessed a marked diastatic action on glycogen, converting it into sugar; and this was increased, sometimes markedly, above the normal. They concluded from this and other evidence that the disease would seem to depend upon an excessive production of glucose from glycogen, and they interpreted the activity of the pancreas in sugar metabolism as a regulator in this conversion. When, therefore, pancreatic insufficiency occurred, increased conversion of glycogen into sugar takes place. The ability to form glycogen, however, remains.

These conclusions did not attract at that time the attention which I think they deserved, evidently because they did not harmonise with prevailing views of sugar metabolism in diabetes, and also because certain evidence like respiratory quotient differences were regarded as against them. Recently, however,

the observations of Geelmuyden on carbohydrate formation in the animal body, and on the intermediary metabolism in diabetes, fit in remarkably well with Milne and Peters' views ("Ergebnisse der Physiologie," 1923, Bd. 21. 1, p. 274; and *Klinische Wochenschrift*, 2. Jhrg., No. 36, 1923, p. 1677). He also comes to the conclusion that in diabetes a hyperproduction of sugar occurs, due to the uncontrolled action of adrenalin. He interprets the beneficial effects of insulin as due to inhibition of sugar conversion, and he explains the rise of respiratory quotient after insulin, not by an increased burning of sugar, but as retardation or cessation in formation of carbohydrate from proteins and fats. In other words, he also believes that the pancreas regulates the conversion of glycogen and fat into sugar.

I must defer a more detailed presentation of this subject to a later date, and for another place, but I would like to emphasise here that there exists enough morphological as well as experimental evidence to question the independence of the islands in the pancreas and their conception as organs of internal secretion which are essential for the combustion of sugar. HORST OERTEL.

Pathological Institute, McGill University.

The Effect of Dispersion on the Interference Figures of Crystals.

CRYSTALLOGRAPHERS are familiar with the fact that the colour-lines in the figures shown by crystal-sections between crossed nicols in the polarisation microscope often deviate to a notable extent from the so-called "isochromatic lines" discussed in the text-books of physical optics. The difference is attributed to the dispersion of the optic axes, and its character enables the type of dispersion to be determined (for details, see for example Tutton's "Crystallography"). Though the phenomenon is thus well known and of considerable importance in practical work with crystals, I have found no record of any attempt to determine *theoretically* the form of the true isochromatic lines for any specified dispersion. Possibly it has been thought that the task would be too complicated and laborious to be worth undertaking. It may, therefore, be worth while to point out a fairly simple way of approaching the matter.

The general principle determining the observed position and colour-distribution of interference-fringes in white light is that the *group*-velocity and the group-refractive index should be considered, and not the wave-velocity and the wave-refractive index. Thus, for example, if a thick parallel plate of glass be placed in the path of one of the interfering beams of a Michelson interferometer, and white light is used, fringes may be observed when the retarding plate is compensated by increasing the air-path of the other beam; they are then less distinct but far more numerous than without the plate, and the colour-distribution is determined by the fact that the compensation for different group-wave-lengths occurs for different retardations.

Taking now the case of a crystal-plate between crossed nicols, the so-called "isochromatic surface" is derived from the equation $\rho(\mu_1 - \mu_2) = \text{constant}$, where ρ is the linear-path within the crystal and μ_1, μ_2 are the two wave-refractive indices. If, however, instead of μ_1, μ_2, we consider the group-indices $\bar{\mu}_1$ $\bar{\mu}_2$, the sections of the surface $\rho(\bar{\mu}_1 - \bar{\mu}_2) = \text{constant}$ would give the lines for which the relative retardation has specified values for any given *group* in the spectrum, and these may be expected to follow much more closely the colour-lines actually observed in the polariscope. C. V. RAMAN.

210 Bowbazaar Street,
Calcutta, November 21.

The French Physical Society's Exhibition.

DANS la chronique consacrée à l'Exposition de la Société de Physique (NATURE, 5 janvier), on peut lire l'appréciation suivante : "The exhibits of the Bureau international des Poids et Mesures and the Conservatoire des Arts et Métiers were somewhat disappointing." La chose était fatale ; pour notre compte, après avoir un peu hésité, nous nous sommes décidés à participer à l'Exposition, surtout pour lui manifester notre sympathie. Mais il ne pouvait être question de transporter nos instruments très délicats, lourds et volumineux, qui, malgré toutes les précautions qu'on aurait pu prendre, étaient susceptibles de subir des avaries irrémédiables.

Pour marquer la trace de cette partie de notre activité, qui est la principale, nous nous sommes bornés à exposer des photographies, et pour le reste, nous avons montré quelques appareils peu encombrants et d'un transport facile, quelques modèles d'étalons, et des diagrammes condensant les résultats obtenus. Mais mes collaborateurs se sont succédé dans notre stand pour donner les explications nécessaires, et ainsi, nous avons suppléé dans la mesure du possible à ce que notre exposition avait d'un peu sommaire.

Ajoutez à cela l'impérieuse nécessité, en raison de la modicité de notre dotation, de vivre avec une stricte économie, et vous aurez toutes les raisons pour lesquelles notre exposition était "somewhat disappointing." Mais j'ai constaté moi-même que, lorsque les visiteurs prenaient la peine de poser des questions, ils obtenaient des explications abondantes, qui les satisfaisaient pleinement. CH.-ÉD. GUILLAUME.

Pavillon de Breteuil, Sèvres, 8 janvier.

Clean Milk.

MY attention has been directed to the article on "The Problems of Pasteurisation" in NATURE of December 15, p. 853, in which it is stated "Clean milk is necessarily expensive." "Certified" milk (although cheaper than beer) is necessarily expensive owing to the high cost of freight for milk in bottles, the comparatively high cost of bottling on the farm, but above all, owing to the cost of maintaining a herd of animals no one of which reacts to the tuberculin test. But the production of milk that is clean costs but a trifling amount more than that of milk that is not clean.

All milk that is offered for liquid consumption should be at least "Grade A" milk, not necessarily "Certified" or "Grade A tuberculin tested." Any farmer can produce it in any premises. The idea is prevalent that "Grade A" is special milk, beyond the ability of the ordinary farmer to produce. Yet few farmers will admit that their product is not clean. Then why do they not take the trouble to obtain a license from the Licensing Authority to dispose of it as Grade A milk and thereby obtain an advantage over the sellers of market milk through the assurance given to the consumer, and why does any intelligent consumer remain satisfied to purchase milk in regard to which he does not obtain that assurance? WILFRED BUCKLEY.

Moundsmere Manor, Basingstoke,
January 5.

The Continuous Spectrum of Hydrogen.

A CONTINUOUS radiation from hydrogen beginning in the blue violet and extending into the ultra-violet is well known and has been commented upon in the columns of NATURE before. Recently we have developed it with unusual intensity and observed it up to the yellow-green in discharge tubes having hot cathodes and operating at potentials as low as 100 volts. Its colour to the eye is a brilliant blue,

probably synthetic, since spectroscopically it shows no unusual intensity at the corresponding shade in the spectrum.

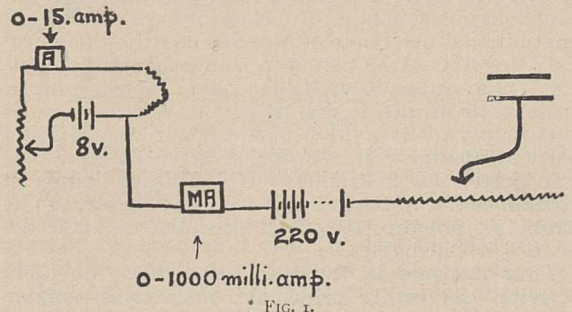


FIG. 1.

The cathode is a braided platinum filament coated with oxides of strontium and barium and capable of delivering electron currents of nearly an ampere, although operating in these experiments at much less. The anode plate is cylindrical in form and about 10 cm. distant. The enclosing tube of pyrex glass with quartz side-window tapers from about 6 cm. around the filament to 2 cm. at the plate.

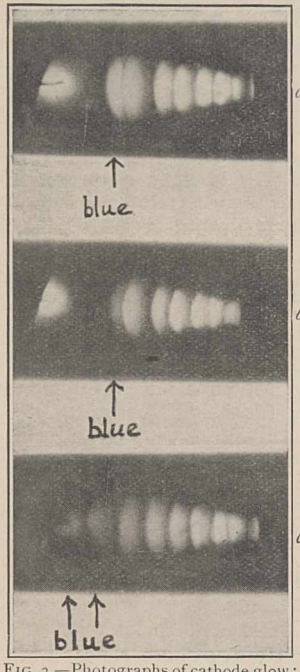


FIG. 3.—Photographs of cathode glow; filament current 9·0 amp., plate current 50 milliamp.

The filament operates from a storage battery, through a resistance, on currents of from 5 to 15 amperes. The most convenient potential between filament and plate is 200 volts, although a range of from 50 to 500 volts may be used. The ionisation current, dependent on the filament excitation, gas pressure and a variable series resistance, may be as large as 0·5 ampere, although 0·05 has been found most suitable for prolonged exposures during which the tube will operate steadily for hours at a time.

Under such conditions the spectroscope is directed at the region immediately in front of the filament but screened from the light of the filament itself. Either one of three spectra may be excited at will. The Balmer series comes out almost alone (faint traces of the brighter portions of the secondary sometimes appearing) at relatively low filament current. Increasing the filament current brings out the secondary spectrum and finally quenches the series lines completely. A still greater increase of the filament current results in the glow around the filament suddenly changing from pink to the deep blue mentioned above, and this radiation is seen to be a continuous radiation very brilliant from the yellow-green to the violet limit of transmission of quartz. It shows no trace of either series or secondary lines.

At lower filament currents when the radiation at the cathode is either pure secondary spectrum, or a mixture of secondary and series, the first striation in the positive column is of a deep blue, whereas the others are pink, and this striation has the same spectral characteristic as the blue glow when developed at the cathode.

Fig. 1 is a diagram of the simple connexions.

Fig. 2 is a photograph of the spectrum at the cathode, (*a*) when series lines comprise the chief radiation,[1] (*b*) when the secondary spectrum shows almost pure, (*c*) when the continuous spectrum is developed.

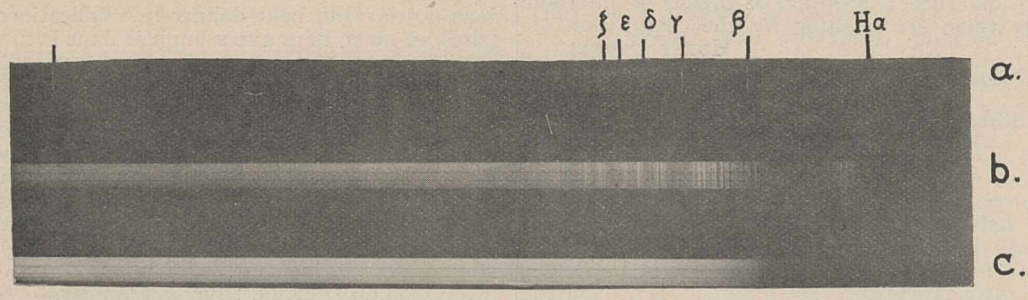


FIG. 2.—Spectra at the cathode; (*a*) series lines; (*b*) secondary spectrum almost pure; (*c*) continuous spectrum.

The insensitiveness of the plate (Wratten Panchromatic) in the yellow-green makes the spectrum weak in this region, but visually it is very strong and shows distinctly on the original negative.

Fig. 3 is a photograph of the glow itself:

(*a*) with secondary spectrum at cathode and blue first striation. The first striation here appears as intense as the second, which is due to the excessive sensitivity of the plate for the blue.

(*b*) is identical with (*a*), but is taken on orthochromatic plate with ray filter to give the relative visual luminosities of the striations.

(*c*) shows the filament hotter and the blue continuous spectrum immediately in front of the cathode as well as in the first striation.

The conditions described may all be found at a single gas pressure if this be in the vicinity of 1·5 mm. of mercury. Lower pressure favours the series radiations and may prevent continuous emission. Higher pressure favours the continuous spectrum.

The experiments are seen to be quite in line with our prevailing ideas as to the origin of these spectra, at least the series lines and the secondary.

The continuous spectrum has received but scant attention, and the main purpose of this note is to direct the attention of spectroscopists to it again under conditions when its brilliance is the most conspicuous thing in the tube. It seems to have no sharp limits nor any relation to the secondary nor to the series lines, and is thus quite different from similar spectra in the X-ray region.

Further quantitative work regarding its energy distribution and the precision ionisation conditions limiting its appearance, if such exist, is in progress.

HARVEY B. LEMON.

Ryerson Physical Laboratory,
University of Chicago, December 17.

[1] These lines are too faint to show clearly in the reproduction of the photograph, but their positions are indicated by the Greek letters at the top of the Fig.—ED. NATURE.

Some Prehistoric Sites of France.

By Dr. H. M. AMI.

FRANCE is making rapid strides in the field of research in prehistory and archæology. These branches of science are closely linked with anthropology, which, in itself also, forms part of those broadening studies coming under the general designation of human palæontology. Les Eyzies, in the Dordogne country, along the southern slopes of the *Massif Central*, is described as "the Second Louvre of Western Europe," in a recent number of *L'Illustration* of Paris. This same locality has also been styled "the palæolithic capital of Western Europe." It is certainly one of the cradles of modern man, of modern culture, and of modern art. A short time ago the Musée Préhistorique des Eyzies was inaugurated and formally opened by M. Paul Léon, Directeur des Beaux-Arts of France, in very solemn yet popular fashion. On that occasion many questions and problems of world-wide interest with respect to human affairs in the past, and bearing upon the present, were brought to light or noted in the twenty-five or more addresses given during the day in that psychological spot.

FIG. 1.—Rock-shelter of Le Château des Eyzies, Dordogne. Site of the Prehistoric Museum.

In and around Les Eyzies are numerous rock-shelters and caves that have been inhabited from early palæolithic or pre-Mousterian times (Fig. 1). The caves have their walls and ceilings decorated, engraved, painted, or sculptured. The discovery of these exquisite works of art does not date back very long, yet these places are now centres of attraction, and constant visits or pilgrimages by people from every land are paid to them. The rock-shelters themselves are, many of them, still inhabited, troglodyte-like villages lining the base of the cliffs in the valleys of the Beune and of the Vézère rivers, both tributaries of the Dordogne. Many of these villages are probably very little different from what they were in medieval times, but under them and in the cultivated ground near them are remains of the Stone Age in great abundance. Caves and rock-shelters, prehistoric sites and museum collections, as well as excavations under way and undertaken by experts under the ægis of the Beaux-Arts of Paris, may be seen to advantage at Les Eyzies, especially during the summer season.

FIG. 2.—Portion of frieze of horses (Abri du Cap Blanc near Les Eyzies, Dordogne).

Artistic sense and taste were early developed in France, so that the Mousterian culture or civilisation followed by the evidences found in the Aurignacian, Solutréan, and Magdalenian deposits characterising Magdalenian civilisation, as well as the next stage or Grenelle civilisation, saw the beginnings of design, engraving, carving, and painting, together with remarkable examples of sculptured rock-faces in Palæolithic times. These culminate in the remarkable frieze of horses in L'Abri du Cap Blanc, situated between Les Eyzies and L'Abri de Laussel, so renowned for the discoveries made by Dr. Lalanne of Bordeaux (Fig. 2). In the Grotte des Combarelles, and in Font de Gaume, close to Les Eyzies, in La Grotte de la Mouthe, and in other caves may be seen to-day excellent representations of the animals of the Stone Age, including the reindeer, bison, musk-ox, hairy elephant, bear (cave-bear), rhinoceros, horse, antelope, and oxen, many of which can truly

be reckoned as masterpieces, so faithful are the lines to those of Nature. It is remarkable, and perhaps worthy of note, that the figures or pictures of man, or of ancestors in the line of man, do not in any measure equal in skill, in precision, or beauty the representations of the animal creation.

La Grotte des Eyzies, made famous by the early researches of MM. Lartet and Christy; L'Abri de Cro-Magnon, opposite and close to the Paris-Orleans railway station of Les Eyzies, where the five skeletons were found by M. Berthon-Méroux with characteristics which mark the peoples of the British Isles as well as those of France and Western Europe, are spots of real classic value well worth visiting.

FIG. 3.—Slab of limestone with engraving of reindeer and ox (La Madeleine shelter, Dordogne).

Some forty members of the Geologists' Association of London, accompanied by a group of French savants, spent the best part of three days last year in and around Les Eyzies, where, besides the points of interest already mentioned, they saw Laugerie Haute, Laugerie Basse, Les Missalgues, La Grotte d'Enfer, La Grotte du Poisson, Le Roc de Tayac, Le Rocher de la Peine, L'Abri Pateau, L'Abri du Château, La Ferrassie, La Madeleine, La Micoque, etc. On all sides could be seen those delicately and artistically made *stone* implements, together with worked, carved, and ornamented *bone* implements associated with human remains of great antiquity (Fig. 3). It is evident that these primitives had a decided belief in a future state. Care was given to the burial of the dead. Their faces were turned towards the rising sun, and their arms and legs folded as if in an attitude of comforting sleep.

In the Museum of Les Eyzies, altogether due to the initiative, industry, and painstaking perseverance of M. Denis Peyrony, are to be found the gems of recent discoveries up-to-date, from the various layers, stages, hearths, abodes, and sites of Palæolithic and Neolithic man in the district. This museum is soon to become the home of a School of Archæology and Prehistory. It is admirably fitted for receiving students from any part of the world who have at heart the desire to carry on systematic studies in that attractive field. There will be no dearth of material, untouched and unexplored as yet, and also of great interest, where opportunities for close application under a master like Peyrony (careful scientific investigator that he is) will be afforded in surroundings that are themselves inviting as well as inspiring.

Périgueux, in the Périgord, not far from Les Eyzies, is also a famous centre of prehistoric value and interest. The Musée du Périgord, in Périgueux, contains one of the best and most complete and systematically arranged collections to be seen in Central France (the Musée de Saint Germain-en-Laye, near Paris, being, of course, the museum not to miss seeing). M. le Marquis de Fayolle, and M. Féaux, of Périgueux, and M. L. Didon, have investigated in most zealous and able manner the many sites of the region, including L'Abri Blanchard, Les Fourneaux du Diable, La Grotte de Raymonden, which have revealed a treasury of choicest implements and other remains characteristic of Palæolithic times.

Toulouse and its vicinity form another centre of prehistory in France. The discoveries of M. le Comte Bégouen and his school of workers, following close upon the results of MM. Noulet and de Cartailhac, in Haute-Garonne, are arranged in careful scientific fashion in the Musée de Toulouse. The palæolithic caves around Toulouse have yielded remarkable mouldings in clay, of bison, and of bear, in subterranean and aquatic tunnels, passages, and chambers.

The Pyrenees country of Southern France—hard by the Spanish districts so famous for their caverns and paintings—has also yielded its treasures to many zealous investigators. In Ariège, at Le Mas d'Azil, and elsewhere, remains marking the close of Magdalenian civilisation must be seen to be appreciated.

Solutré has been for many years the classic spot for one at least of the stages of the Magdalenian civilisation which has become celebrated. Besides remains of not less than 100,000 palæolithic horses which were found here years ago, and magnificent examples of flint implements known as the laurel-leaf pattern, and *pointes à cran*, etc., there have just been found, at the Croc du Charnier, three complete and well-preserved skeletons of the Cro-Magnon type and Aurignacian in age, very similar to those of Les Eyzies. The work of Depéret, of Dr. Arcelin, and Lucien Mayet of Lyons at Solutré in 1923, has shown that this portion of Saône-et-Loire still yields remains of great importance.

Another interesting and important series of finds in prehistory are those of Abbé Lemozi in the Grotte des Cabarets and La Grotte de Murat. These also were described and illustrated in *L'Illustration*, and are referred to in an article in NATURE of November 10, p. 695.

For some years past Chelles and Saint-Acheul, two

classic spots of France—one east, the other west, of Paris, seem to have been closed to view. The old *sablières* of Chelles (Seine-et-Marne), and the *sablières* and *ballastières* of Saint-Acheul, near Amiens, in the Somme Valley, have been practically abandoned; but new ones have been opened which yield, every once in a while, really fine implements and remains of extinct animals marking those remote periods known as Chellean and Acheulean. These are found underneath stratified shore and river deposits varying in thickness from fifteen to twenty feet.

All these localities of France and many more have been, or are being, carefully studied by a modern school of enthusiastic workers which has arisen; and the State, recognising the importance of these studies, and the value of the sites themselves, has declared many of the latter national property, placing them under government care, and protecting them from just such depredations as were carried on by Germans and pro-Germans before the War at Les Eyzies.

Careful studies in Mousterian, Aurignacian, and Solutréan deposits have revealed many striking facts; for example, periods of flood, periods of desertion of shelters for a time, sudden changes in the character of the inhabitants of the rock-shelters, marking varying types of culture, each layer or series of layers being differentiated by variously wrought implements of bone or stone, some carefully and artistically made, others crude, rude, and very clumsily wrought.

FIG. 4.—Solutréan hearth, where bones of bison, reindeer and horse, and "laurel-leaf" pattern stone implements and worked bone implements occur (Laugerie Haute, Les Eyzies).

The Solutréan stage, for example, at Les Eyzies, in Laugerie Haute, is subdivided by M. Peyrony into three distinct parts, one marked by the flint implements known as *feuilles de laurier*, another by *pointes à cran*, and still another by *lames à face plane*. To look over a Solutréan fireplace or hearth and examine carefully its contents is truly a revelation (Fig. 4). Solutréan inhabitants of Les Eyzies, sitting beside the fireplaces or hearths, built of rounded and polished granite and quartzite-blocks, must have been very industrious. The hundreds and thousands of flakes or fragments of flint in making the laurel-leaf pattern implement, show clearly the careful selection of the flint rock itself, of homogeneous and uniform grain and texture, and the patience and perseverance displayed in their making. First the larger flakes were removed, then smaller ones, and smaller again until the very smallest, almost microscopical chips or flakes, were removed and the laurel leaf is the result. The climate and conditions of existence in these caves can also be read and interpreted owing to the presence of certain definite types of animal life.

Whilst much has already been done in prehistory in France, there is nevertheless much work ahead for successive generations. There will no doubt be greater results achieved in the near future. Everything points in that direction. Only a small fraction, not a thousandth part of the material left by prehistoric man in the shelters and caves, has been excavated. Every month reveals new sites and new treasures. Henceforth, under the able guidance and direction of the sympathetic and erudite M. Paul Léon, prehistory will make rapid strides, and France directs these researches in a thoroughly scientific way. All comparative studies are of value and interest when carried on in the spirit of search after truth, finding the facts and classifying them, and later, perhaps, attempting to draw some conclusions, and instituting parallels.

Britain is also a treasure-house in prehistory. Surprises are no doubt in store for the diligent student. Encouragement could well be given by the State, or by institutions that can afford means for scientific researches. The more man keeps himself in touch with Nature, the more will be revealed to him, and the more that is revealed to him, the better he will know himself.

Long-Range Weather Forecasting.[1]

THE past half-century has witnessed a steady growth in the theory and practice of day-to-day weather forecasting by means of synoptic charts. Every few years has recorded some new advance, and it is scarcely a matter for surprise that, in developing the methods already in existence, the forecaster has had little time to spare for alternative lines of research directed towards a totally different class of forecasts—those known as "seasonal" or long-range forecasts.

[1] Calcutta, Indian Meteorological Department. Memoirs, vol. xxiv., Part IV. Correlation in Seasonal Variations of Weather, viii. A Preliminary Study of World Weather. By Dr. Gilbert T. Walker. Calcutta, 1923.

It is chiefly in India, where the importance of knowing the weather of the next day is insignificant compared with the importance of knowing the character of the coming monsoon, that seasonal forecasting has been seriously studied, and Dr. G. T. Walker is upholding the traditions of the Indian Meteorological Department by his important series of memoirs on correlations of seasonal variations of weather. The eighth of this series is a valiant attempt to elucidate the processes connecting the weather in the same or successive seasons in different parts of the world. Connexions are traced by the method of correlation coefficients, thus determining the degree of relationship between two variables quantitatively, instead of merely qualitatively by the comparison of curves.

The origin of almost all "weather" is the sun, and the first step in the investigation was to examine the relations between variations in the solar radiation and in terrestrial weather. In the past, solar variations have been represented by Wolf's sunspot numbers, and we have the well-known paradox that while high sunspot numbers are usually associated with high values of solar radiation, they also give relatively low temperatures on the earth's surface, especially in the tropics. Dr. Walker finds that this effect persists after allowance has been made for the effect of variations of rainfall on temperature, and he accordingly supposes that the type of radiation associated with sunspots alters the opacity of the atmosphere towards heat rays. This opacity effect is largely discounted by substituting for sunspot numbers the actual values of solar radiation found at Mount Wilson, and the latter in most cases agree with the variations of terrestrial temperature. The correlation coefficients are, however, small except in a few localities such as South America, and variations of solar radiation do not give an adequate explanation of variations of terrestrial weather. It should be noted that doubt has recently been cast on the accuracy of the early measurements of solar radiation, because, with the improvement of methods, the variability of the measurements has tended to decrease.

Solar variation as a direct influence on terrestrial weather being almost entirely ruled out, the explanation of seasonal abnormalities is next sought in previous weather conditions. The greater part of the memoir is devoted to the examination of relationships between contemporaneous and successive seasons in different parts of the world, and this is done in great detail. It should be premised that, according to the theory put forward by H. H. Hildebrandsson, the weather of the world is governed by the conditions in the principal areas of high and low pressure, which are accordingly termed "centres of action." Dr. Walker selects fourteen such centres, and as he finds that the rainfall at other places, such as Java, which are not centres of action in Hildebrandsson's sense, also exercises an important control, he adds the data for six precipitation centres, namely the Indian peninsula, Java, Rhodesia, Zanzibar district, Seychelles, and the western Himalayas (snowfall). The pressure values employed are the quarterly means for December to February and June to August. Each of these variables is correlated with the contemporary values and with those two quarters before and two quarters after at all the other centres, and in promising cases various other relationships are investigated—an immense piece of work, involving the calculation of nearly a thousand correlation coefficients.

The areas examined fall into two groups, the first including the Pacific Ocean and the sub-tropical high-pressure belts of America and the Atlantic, and the second the Indian Ocean, Australia, Asia, and the Icelandic minimum. When pressure is high at any station of one group, it tends to be high also at the other members of the same group, and low at members of the opposite group. There is an obvious tendency for centres of high pressure to be in the first group and of low pressure in the second group. The classification is nearly the same as that found by F. H. Bigelow from a study of the relation between variations of pressure and temperature and solar prominences. There is evidently a surging of pressure on a large scale between the two regions; this surging is accentuated or checked according as solar conditions are favourable or adverse, but the latter are not the dominating factor. That being so, the cause of the surging must be related in some way to terrestrial conditions.

The crucial area in which the variations arise is found in South America and the Antarctic regions south of it. There appear to be great oscillations of pressure between South America and the Antarctic continent at Snow Hill. In winter, high pressure in South America means low pressure in the Antarctic, and high temperature in the great ocean current which travels eastward from Cape Horn in high latitudes. This high temperature in turn lowers the pressure, so that a wave of low pressure travels eastward from the South Orkneys and reaches first Cape Town and finally Australia. On the other hand, with high pressure in South America the cold Humboldt current is strengthened, and a wave of high pressure travels westwards across the Pacific Ocean, taking nearly a year to reach Samoa and another three months to reach Australia. Thus the opposition between the Indian and Pacific Oceans is mainly due to the propagation of pressure waves of opposite signs eastward and westward from South America; but these would soon be damped out unless they were reinforced, either by further Antarctic influences, or more probably because in the monsoon regions of India and Australia "an increase of rainfall diminishes pressure and so amplifies the decrease of pressure to which it is due."

It is also found from a number of examples that heavy rain in any region alters the pressure distribution in the surrounding areas; these variations may then travel forward and affect the subsequent rainfall of distant countries. Thus we have a number of waves of weather travelling about the globe in different directions, and the problem of long-range forecasting becomes the problem of discovering and keeping track of these waves and their modifications. The world-wide importance of such studies is shown by the present investigation, which, although primarily directed towards forecasting Indian monsoon rainfall, incidentally points the way towards long-range forecasts for South Africa and offers an improvement on the methods already adopted in Java.

Obituary.

PROF. FUSAKICHI OMORI.

DURING the last few years we have lost three of our leading seismologists. G. W. Walker died in 1921, C. G. Knott in 1922, and, late in 1923, Fusakichi Omori, the well-known professor of seismology in the Imperial University of Tokyo and president of the Japanese Imperial Earthquake Investigation Committee. At an early age he was fortunate in coming under the inspiring influence of John Milne and, encouraged by him, took up the study of the after-shocks of earthquakes. For a time he worked on other subjects with Milne, who left Japan in 1895, and with S. Sekiya, the first professor of seismology in the Imperial University. On the death of the latter in 1896, Omori succeeded to his chair, and about the same time became secretary of the Imperial Earthquake Investigation Committee. In this position he attained great influence. He became the natural leader in all Japanese investigations on volcanoes and earthquakes, and kept in close and friendly touch with the heads of other scientific departments. At the time of the great earthquake of September 1 he was absent from Japan, on a voyage apparently in search of health. He returned to the ruined city and died there on November 8.

Few students in any branch of earth-physics have worked harder than Omori, and not many to better purpose. His papers in English alone occupy more than four thousand pages. His labours were prolonged far into the night. In one of his latest papers he describes observations on the behaviour of pheasants during earthquakes made while at work in his study at 2 A.M. He could speak and read German with ease; several of his papers are written in Italian, but the great majority were in English, not always of course with absolute precision in grammar, but never admitting any doubt as to his meaning. His papers show no evidence of wide reading, references to workers in other lands being rare or altogether absent. Thus, in a few respects, he seemed to be not quite in sympathy with recent work. If anything, he suffered from too great wealth of material, and tried to carry out work that might well have been left in the hands of assistants. We have, for example, among his papers preliminary notes on the San Francisco and Messina earthquakes, the complete reports on which were never written. He was one of the most kindly, modest, and upright of men, courteous with that courtesy that we now call old-fashioned, as if the manner of it were dying out from among us.

Omori's first important work was his memoir published in 1894 on the after-shocks of earthquakes, in which he stated his well-known law that governs their decline in frequency. Five years later he described his mechanically recording horizontal pendulum, an instrument thut has done useful work in Japan and elsewhere. With this and a horizontal tremor recorder he made many observations and experiments on the vibrations of brick buildings, lofty chimneys, bridges and their piers, railway trains and torpedo-boats. Several of his papers are occupied with discussions on the nature of earthquake-motion founded on the records of Japanese and distant earthquakes. The duration of the first preliminary tremor was of special interest to him, and by its means he made several estimates of the depth of the focus in local earthquakes. His papers include many careful studies of Japanese earthquakes and of the laws which rule their distribution in space. He investigated personally the Kangra, San Francisco, and Messina earthquakes. On several occasions Omori worked at the annual and diurnal periodicity of earthquakes in Japan, and traced a relation between variations in earthquake-frequency and in barometric pressure. Also, in connexion with the same inquiries, he considered the annual variation in the height of the sea-level at different seaports in Japan.

The volcanic eruptions, as well as the earthquakes, of Japan fall within the purview of the Imperial Earthquake Investigation Committee, and Omori had several excellent opportunities of studying such eruptions from the physical point of view. The strictly geological inquiries were left in the capable hands of his colleague Prof. B. Koto. Within twelve years he published three admirable series of memoirs: the first on the eruption of the Usu-san in 1910, with its remarkable formation of a new mountain; the second on the explosions of the Asama-yama in 1910–14; and the third on the great eruption of the Sakura-jima in 1914. In all three the numerous preceding and accompanying earthquakes were carefully recorded and their relations with the eruptions studied. In the Asama-yama and Sakura-jima explosions the sound-areas and intervening silent zones were mapped and the distribution of the areas of multiple reports determined; while in the Sakura-jima the changes of level that accompanied and followed the great eruption were measured by re-levellings on the land and new soundings in the sea-areas. Some idea of the value of these memoirs may be gathered from the fact that the three series contain respectively 81, 709, and 520 pages, and are illustrated by 21, 101, and 114 plates.

At any time the death of our leader in seismology would have been a serious loss. But when we think of Omori's memoirs on the Sakura-jima eruption, or, as he characteristically calls them, his "modest geometrical and seismological reports," we can realise what a monograph he would have written on the most destructive earthquake known to this generation.

C. DAVISON.

WE regret to record the death, on January 14, of Mr. Charles Welch, formerly librarian at the Guildhall, London. Mr. Welch was born on July 21, 1848, and served for more than forty years on the staff of the Guildhall Library, retiring in 1906. He was the author of a number of books on the history and antiquities of London, among them being "Mediæval London," written in conjunction with the late Canon Benham, and the "Modern History of London," a book of great value. He was also a contributor to the "Dictionary of National Biography" and the "Victoria County Histories." Mr. Welch was an active member of the Middlesex Archæological Society, the Society of Antiquaries, the Bibliographical Society, and the Library Association, and was connected with several of the City Companies.

Current Topics and Events.

THE third annual report of the British Electrical and Allied Industries Research Association has just been issued. This Association is supported by the Department of Scientific and Industrial Research, the Institution of Electrical Engineers, and the British Electrical Manufacturers' Association. The Association continues to follow closely the activities of similar bodies all over the world, but it carries out many independent researches. In determining whether a research is to be undertaken or not, the primary consideration is whether it will benefit the industry. At the same time, however, confidential work has been carried out under the direction and for the benefit of particular sections of manufacturers in cases where adequate support has been forthcoming. The tests on synthetic resins prove that there is a quantity of inferior material on the market. They have also demonstrated that there is a very marked difference in the electrical properties of these materials at the working temperatures met with in apparatus and at atmospheric temperatures. The Institution of Electrical Engineers has published a very comprehensive report on the heating of buried cables. The results of this research prove that electrical engineers can safely run many of their underground cables at higher current densities. It has been pointed out that the savings effected to the industry by this discovery amount annually to a much larger sum than the total expenditure on the Association. We notice that many researches on the electric strength of all kinds of materials are being carried out. It is found to be difficult to get consistent results. Factors of safety, however, can be specified which are useful. Preparations are being made for experimental work on a large scale on the subject of interference in communication circuits produced by the electric pressures and currents used in power distribution. We hope that the Association will not neglect the mathematical researches which are an essential preliminary to sound development.

THE Air Ministry announces a reorganisation of the arrangements for the control of aeronautical research. Hitherto the director of research has been responsible, under the Air Member for Supply and Research, on one hand, for the direction of scientific research on all aeronautical matters, and, on the other, for the application of the results of such research, as well as of practical flying experience, to the technical development of aircraft, aero engines, and all accessories, in order to meet the requirements of the Royal Air Force and of Civil Aviation. The rapid development of aeronautical science and the increased requirements of the Royal Air Force have now made necessary a re-allocation of the responsibilities of the director of research; and, as from April next, the control of one side of the work will be transferred to a director of scientific research, while the other side will be assigned to a director of technical development. The appointment of director of research will then lapse. The director of scientific research and the director of technical development will both serve under the Air Member for Supply and Research. Appointments to the new posts will be announced in due course. The effect of this reorganisation will be to give scientific research the free scope for development which the recent growth of service and civil flying renders necessary.

AT University College, London, on January 17, Prof. E. C. Williams, the recently elected Ramsay professor, gave to a large audience his inaugural lecture on "The Aims and Future Work of the Ramsay Memorial Laboratory of Chemical Engineering." To clear the ground, Prof. Williams defined a chemical engineer as a scientific man whose duty it is to plan the large-scale operation of chemical processes and to design and operate the plant required for the chemical reactions and physical changes involved. Emphasising the economic aspect as the primary consideration in any industrial process, he went on to give an analysis of examples from a wide range of operations, and showed how, with increasing scale of work, physical and physico-chemical factors become the controlling influences on the process and on the plant which is needed for it. Attention was specially directed to the formulation of accurate balance-sheets for material and for energy. Prof. Williams quoted the definition "Engineering = Applied Physics; add Chemistry to each side of the equation, and Chemical Engineering = Applied Physical Chemistry." The course of training was outlined, weight being laid on practical and theoretical instruction in the application of physical and physical chemical principles to the design of plant rather than on the study of a series of particular manufactures. Prof. Williams regarded a close co-operation with industry as essential for the benefit of the department, and looked forward to the conferment of benefits in return.

ON July 20 last, as reported in the *Kew Bulletin*, No. 10, for 1923, General Smuts, Prime Minister of South Africa, opened a central herbarium at Pretoria. This institution will assist in the botanical survey of the Union of South Africa, which was started in 1918 and owes its inception and conduct to Dr. I. B. Pole Evans. General Smuts is reported as saying that "what Kew is to England and the British Empire the herbarium must be to South Africa. You want here a herbarium to which you can bring together all that vast material of the African continent which will enable you to see the plant distribution of the whole continent, and then only will you be able to answer some of the questions of the past." To this one may add that many of the economic problems of the future will also receive material aid in their elucidation by such a herbarium. As the *Kew Bulletin* points out, General Smuts apparently made no allusion in his speech to the National Botanic Garden at Kirstenbosch. Whilst a good herbarium is an essential part of the activity of Kew, an equally essential part is the museum of living plants provided by the Botanic Gardens and their glass-houses,

and it is to be hoped that General Smuts will, at the proper time, show as active an interest in the further development of the Gardens at Kirstenbosch, near Cape Town, where the site is provided for a really magnificent garden, but where development is at present greatly hindered by the lack of adequate financial support, support which in part must always be received from the Government.

ALTHOUGH it was announced that *Discovery* would cease publication with the December issue, as we stated in our issue of January 5, p. 22, the January number has appeared after some little delay. The revival of this interesting periodical is due to the generous support of a guarantor who prefers to remain anonymous, and the co-operation of an educational trust with which he is associated, and of which the object, it is stated, is closely allied to that of those who are responsible for the policy and management of *Discovery*. Mr. R. J. V. Pulvertaft will act as editor, as Mr. E. J. Liveing, the former editor, has accepted other engagements which will not permit him to continue in that position. The distinctive characteristics of the periodical, and in particular its efforts to secure that the latest results of scientific research shall be presented to the public in as simple and popular form as is possible, consistently with the soundness of the matter, are to be preserved; but some new features may be added to make its survey of the scientific field more complete and the practical fruits of research more conspicuous. *Discovery* is an experiment which has been watched carefully by all who are interested in promoting a wider appreciation of the results of scientific work, and from this point of view its efforts are deserving of wide support.

THE 28th volume of the Transactions and Proceedings of the South Eastern Union of Scientific Societies is published as the *South Eastern Naturalist* for 1923 and contains many papers of interest. The Mosquito Investigation Committee, under the chairmanship of Dr. Clarence Tierney, has been carrying out for the Ministry of Health an investigation of the distribution and frequency of occurrence of mosquitoes in the area covered by the Society, in connexion with the occurrence of malaria contracted by persons who have never been out of Great Britain. As the result of experiments at the Liverpool School of Tropical Medicine, it was known that an elusive tree-hole breeding species of mosquito, *Anopheles plumbeus*, which occurs in England, was capable of becoming an intermediary host and of transmitting malaria. Until the work of this Committee, the Reports of which are now published, very little was known as to the occurrence of this mosquito in this country. The late Arthur W. Bacot, whose death in Egypt whilst engaged upon typhus research was referred to in NATURE of May 13, 1922, p. 618, acted as second chairman of this Committee, and the present chairman pays a tribute to the value of his counsel and guidance in their work. The presidential address, by Dr. Alex Hill, deals with the antipodean flora; under the heading "The Fungus Root" R. Paulson contributes some interesting observations on the mycorhiza of the birch; whilst even those who are well versed in philological problems can probably learn from the erudite and well-documented study of the names of some of our common garden plants presented by Sir David Prain.

THE strongest after-shock of the Japanese earthquake of September 1 occurred shortly before 6 A.M. on January 15 (9 P.M. on January 14, G.M.T.). It caused the death of about fifty persons in Tokyo, Yokohama, and the surrounding district. Railway communications between Tokyo and Osaka were severed, and seven trains were derailed and overturned on the line to Tokaido. According to Dr. Nakamura, the great earthquake originated in two foci, one (the more important) between Oshima and Atami, the other near Yokosuka. The centre of the recent after-shock is supposed to be in the Miaura peninsula or not far from the former focus.

IT has been decided that an experimental explosion like that carried out at Oldenbroek on October 28, 1922 (see NATURE of November 4, 1922, p. 619), shall be made in Central France next May on three different days and hours. This experiment will of course be free from the disadvantage under which the Oldenbroek explosion laboured in the presence of the sea so close to the west. But it may be pointed out that the time of the year is not a suitable one for the development of the silent zone. In Europe, the months in which silent zones have been observed are October, November, December, January (twice), and February, and once in June in Eastern Europe. On the other hand, there was no silent zone noticed during the naval reviews of July 17, 1867, and June 26, 1897, at Spithead.

IN response to requests put before it by the Australian National Research Council, acting on behalf of the recent Pan-Pacific Science Congress, the Commonwealth Cabinet has warmly approved a general scheme for promoting ethnological work in the Pacific. Details have yet to be arranged, but it may be taken as practically certain that the Government will establish a chair of anthropology in the University of Sydney with an endowment of about 1700*l.* per annum. The chief work attaching to the position will be the organisation of research in the islands and the training of young investigators; but, in addition, all officers appointed to Government service in New Guinea and the Mandated Territories will be given a preliminary training in ethnology before taking up their positions.

THE expeditions sent forth by the American Museum of Natural History are already famous in the annals of vertebrate palæontology, and we must leave it to the future editions of text-books to collate and summarise the details so liberally published in successive bulletins. But we cannot pass over the striking and picturesque photographic representations of skulls of Stegodon, Arctonyx, Rhinopithecus, and other mammals contained in the paper by W. D. Matthew and W. Granger on material collected from the Pliocene of the province of Sze-chuan in western China (1923). We note that a species has been named after Dr. Ting, the first Director of the Geological Survey of

China (see NATURE, vol. 113, p. 18, 1924), who, as we understand, at one time studied in the University of Glasgow.

DR. J. J. SEDERHOLM, Director of the Geological Survey of Finland, has issued a circular to geologists interested in the problems of Pre-Cambrian rocks, inviting them to visit the islands and coast near Åbo in south-west Finland for an excursion of about three days' duration in the early part of June. The region is easily and cheaply reached *via* Stockholm, and the country eastwards, as far as Helsingfors, can be visited after the main meeting. Dr. Sederholm discusses the questions of metamorphism that can be so well studied in these lands laid bare by glaciation, and his memoir, written in English, forming Bulletin 58 of the Commission géologique de Finlande, provides an admirable guide as well as a basis for discussion. The large part played by thermal metamorphism and the production of composite gneisses and "migmatites" in Pre-Cambrian times can be nowhere better illustrated than in Finland, where, as Dr. Sederholm has demonstrated, a concentrated picture is provided of what went on in Canada and other regions on a truly continental scale. Those who would wish to take advantage of the meeting should write to Dr. Sederholm, 29 Boulevardsgatan, Helsingfors, who will send further particulars in due course.

ON January 14 a meeting of the following representatives of the societies named was held in the Board Room of the Natural History Museum, by permission of the Trustees: Society for the Promotion of Nature Reserves (Viscount Ullswater, Sir Sidney F. Harmer, Mr. E. G. B. Meade-Waldo, Dr. P. R. Lowe, Dr. G. F. Herbert Smith); Zoological Society and Society for the Preservation of the Fauna of the Empire (Dr. P. Chalmers Mitchell); Royal Society for the Protection of Birds (Mr. and Mrs. F. E. Lemon, Mr. Rudge Harding); British Ornithologists' Union (Major A. G. L. Sladen); National Trust (Dr. F. Dawtrey Drewitt); Linnean Society (Dr. W. T. Calman and Captain J. Ramsbottom). Lord Rothschild, a Trustee of the British Museum, was also present. The meeting had been convened by the Society for the Promotion of Nature Reserves, and the chair was taken by Lord Ullswater, its president. The object of the meeting was to discuss the question of linking together the activities of the various societies in Great Britain interested in the protection of Nature. After some discussion the meeting unanimously approved of the proposal to form a Central Correlating Committee for the protection of Nature, to be composed of one delegate from each of the societies represented at the meeting, to act as a liaison body between them, and to have the power of inviting any similar societies not yet represented, to join. It was further resolved to request the Trustees of the British Museum to appoint a representative on the Committee, and to allow it to have office accommodation at the Natural History Museum.

WE learn from the *Chemical Age* that Dr. L. H. Baekeland, known for his invention of bakelite, and honorary professor of chemistry in Columbia University, has been elected president of the American Chemical Society for 1924.

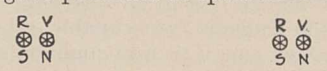
COMMANDER E. A. MARTIN has been elected secretary of the South-Eastern Union of Scientific Societies in succession to Mr. H. Norman Gray, who has resigned after many years of office. Commander Martin will be assisted in his duties by Mr. R. W. Strickland.

A MEETING in support of The British Empire Leprosy Relief Association, and to launch a campaign on behalf of the 300,000 lepers in the King's dominions, will be held at the Mansion House, London, on Thursday, January 31. The Lord Mayor will be in the chair, and the other speakers will be: Viscount Chelmsford (Chairman of the Association), the Duke of Devonshire, Viscount Peel, Sir H. D. Rolleston (President of the Royal College of Physicians), Sir Leonard Rogers, and Mr. Frank Oldrieve.

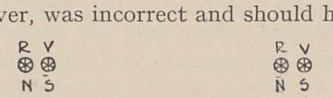
IN accordance with the recommendation of the Broadcasting Committee, which reported in October last, the Postmaster-General has appointed the following members to a Broadcasting Board: Major-General Sir Frederick Sykes (chairman), Lord Riddell, Sir Francis Ogilvie, Mr. F. J. Brown, Mr. Guy Burney, Mr. Walter Payne, Mr. J. C. W. Reith, Mr. A. A. Campbell Swinton, and a representative of Labour (to be nominated later).

THE Royal Irish Academy held a meeting in the Queen's University, Belfast, on January 14 at 3 P.M., the first that has ever been held outside Dublin. The president, Dr. S. Young, presided, and an address was presented by the Academy to the Governor of Northern Ireland, the Duke of Abercorn. A paper on the glaciation of north-west Ireland was read by Prof. J. K. Charlesworth. The Vice-Chancellor of the Queen's University, Mr. R. W. Livingstone, who entered on the duties of his office that day, was present at the meeting.

PROF. G. E. HALE sends an important correction for Fig. 12 of his contribution on the magnetic polarity of sun-spots which appeared in last week's issue of NATURE. The illustration showed the approximate variation in mean latitude of sun-spots, and the corresponding magnetic polarities of spots, at different parts of three solar cycles from 1908. The curve of the second cycle in the sun's southern hemisphere gave polarities of spots as follows:



This, however, was incorrect and should have been



MR. ERNEST TAYLOR, 4 Moore Street, Chelsea, while experimenting recently with a small home-made wireless receiving set, found that reception could be obtained without the use of the crystal in the set, and he inquires whether this is generally known. He obtained clear and distinct reception of speech and music using only the "cat's whisker" (gold wire) and the empty crystal cup, and also with various other forms of contact. Capt. P. P. Eckersley,

chief engineer of the British Broadcasting Company, Ltd., to whom we referred the inquiry, suggests that the probable explanation is that crystal and other contact rectification is caused by a thermo-electric effect. He points out that it is quite possible to get rectification by contact of dissimilar metals, or even if these metals are oxidised between metals of the same nature, although usually these types of rectifier are inferior to the more generally used crystal contacts.

MR. WILLIAM HUGHES, of Bedford Modern School, has issued through Messrs. Philip Harris and Co., Ltd., a "Classification of the Chemical Elements with Explanatory Notes," in the form of a small pamphlet of 7 pages and a table of atomic numbers and atomic weights. The inert gases occupy the central vertical column of this table, and the various periods are divided in a regular but somewhat arbitrary manner into sections which precede and sections which follow an inert gas. The main advantage of this arrangement is that both the halogens and the metals of the alkalis are maintained in vertical columns without the gaps which are usually produced when the octaves of the two short periods are stretched so as to cover periods of 18 or 32 elements. This arrangement also shows rather more clearly than the ordinary scheme the fact that certain elements lose valency electrons in acquiring the configuration of an inert gas, whilst others such as platinum in its co-ordination compounds may gain quite large numbers in this process. This conception makes it possible to indicate in the table some, but not all, of the co-ordination properties of the elements as well as their ordinary valencies. The author is in error in stating that in Sir Joseph Thomson's formula for benzene the sharing of three electrons corresponds to a covalency and an electrovalency, or gives rise to atoms which are alternately + and −. This formula is in fact completely symmetrical and contains no electrovalencies, since every carbon atom is surrounded by 8 L-electrons, all shared, thus balancing exactly the positive charge on the kernel, and giving rise to completely neutral atoms.

THE University of London Press is to issue "A Short History of Birkbeck College," by O. Delisle Burns. The volume will contribute an interesting chapter to the history of English education, tracing the remarkable evolution of Birkbeck College from the first London Mechanics' Institution to its admission a century later as one of the Colleges of the University of London.

Our Astronomical Column.

APPROACHING MAXIMUM OF MIRA CETI.—The last two maxima of Mira have been difficult to observe, owing to proximity to the sun. The conditions are better this year, the maximum occurring early in February, when the star is due south about 6 P.M.

Astr. Nach. 5262 contains a discussion of the light-curve by A. A. Nijland. The mean light-curve for the period 1895–1922 shows that the decline of light lasts twice as long as the increase, this being a common feature of long-period variables, shared by the sun-spot cycle. At the steepest part of the ascent the star gains a magnitude in 9 days. The limiting magnitudes in the mean light-curve are taken as 3·0 and 10·0.

EARTHQUAKE OR METEOR.—On the evening of Christmas day, about 7 h. 30 m. G.M.T., loud detonations were heard at various places in Devonshire, and they were followed by rumblings and earth tremors. An extensive correspondence has been carried on in the newspapers of Devon and Cornwall with regard to the phenomena alluded to, and the writers ascribed the visitation either to a fireball or earthquake. Mr. T. H. L. Hony, of Fowey, has collected all the evidence possible, and it appears that the meteoric theory is favoured by the weight of the evidence. Though the night was generally cloudy and wet in the south-west of England, three observers in Devon have reported seeing either the fireball or the illumination it afforded, and their independent descriptions are in fair accordance. The observations are not, however, sufficiently exact for the real path of the fireball to be calculated. But it is hoped that further details will come to hand and enable this to be done.

The period from December 20 to 25 appears to be rather a special one for large meteors, and several radiant points are active at this time; namely, at 161° +58°, 216° +66°, 219° +76°, 248° +73°, 167° +32°, and 133° +19°.

CONJUNCTION OF MARS AND JUPITER.—At the present time Mars and Jupiter are visible as morning stars. The former rises about an hour before the latter, and the two planets are separated by a distance of about 13°, Jupiter being east of Mars. These planets are now approaching each other owing to the more rapid easterly motion of Mars, and a very interesting and close conjunction will occur on February 13 next, when the two objects will be distant from each other less than half a degree. This event will provide an attractive spectacle for the unaided eye before sunrise during the period from about February 10 to 16, and it will be entertaining to watch the changes taking place each night in the relative positions of the two objects. Jupiter will be much the brighter of the pair, and will shine with a pale-yellow lustre, while Mars will give its usual red light. The bright-red star Antares in Scorpio will be situated about 10° W.N.W. of the planets we have named on the day of their conjunction.

VARIATION OF SOLAR FACULÆ IN THE SUN-SPOT CYCLE.—Mr. H. W. Newton read a paper at the Royal Astronomical Society on January 11, dealing with the measures of faculæ on the photographs taken at Greenwich since 1874. A diagram was prepared on the same lines as Mr. Maunder's "Butterfly diagram" of spot distribution, but giving in addition some indication of facular areas by using lines of varying thickness. As faculæ are both more extensive and more enduring than sun-spots, while the general laws of their variation both in area and latitude during the sun-spot cycle are naturally similar to those of the spots, they give a considerably fuller record, and the blank equatorial region in Mr. Maunder's picture is to a large extent filled in. It was pointed out in the discussion that faculæ may also give a clue to unseen spot formation on the hemisphere turned away from us, since the faculæ often remain after the spot has disappeared.

The photographs showed a considerable number of small faculæ in the polar regions, far outside the spot zones; these, however, appeared to be sporadic, and there was not much evidence that their number varied according to sun-spot cycle. The faculæ and the calcium flocculi seem to be closely related, their distribution on the sun being similar.

Research Items.

DECORATIVE DESIGN OF THE HALLSTADT PERIOD.—In *Man* for January, Mr. S. Casson discusses the origin of the compass-drawn concentric circle and semicircle, which is one of the earliest and most frequent decorative elements in pottery of the geometric period in the Ægean. There are, however, no criteria in that area for determining the relative chronology of the pottery exhibiting these designs. Mr. Casson figures vases from Gösing, on the Danube near Wagram, and Sommerein in Lower Austria, and cites other examples, belonging to the earliest Hallstadt culture, which have this design engraved on them and form the closest parallel in effect and conception to the Macedonian *Skyphoi* with painted semicircles. He suggests that these designs may have come down to the Hallstadt potters from the earliest culture of the copper and salt miners of the Salzkammergut. The connexion between the Danube and the Ægean in the Iron Age (as well as in the Bronze Age) is clear. When the Hallstadt culture of the north came into contact with the culture of the Macedonian plain, fine wares replaced the crude Danubian vessels; but the designs and some elements of the shapes survived. As the earliest probable date for geometric ware in Greece proper is about 1000–900 B.C., whereas the Hallstadt A period is fixed at about 1100–900 B.C., the Gösing and other examples would antedate the Ægean, and would suggest a Danubian origin for this persistent design.

THE ARCHÆOLOGY OF FLORIDA, U.S.A.—A tentative scheme for the systematic investigation of the archæological problems of Southern Florida has been mapped out by Mr. J. Walter Fewkes, Director of the Bureau of American Ethnology. He has just returned from a visit of reconnaissance, during which he was the guest of Mr. E. S. Elliott of St. Petersburg, Florida. Mr. Fewkes began the excavation of a large mound at Worden's Island near St. Petersburg. The work, which is still in progress, has already yielded some interesting results, among the objects found being shell dippers, celts, ornaments, charm stones, fragments of crude pottery, and a circular stone for grinding roots, which indicates that the people were agriculturists as well as fishermen. Shell heaps at Charlotte Harbour and at Caxamba were also examined, and some further trial excavations were made. The result of Mr. Fewkes's visit has been to indicate a considerable field for investigation, and the work is to be continued by the Bureau of American Ethnology through the generous assistance of Mr. Elliott.

INHERITANCE OF ACQUIRED CHARACTERS.—The papers presented in a symposium on the inheritance of acquired characters are published in Proc. Amer. Phil. Soc., vol. 62, No. 5, and include discussions of some of the most striking American results in the inheritance of germinal modifications. After a short historical introduction by Prof. W. B. Scott, Prof. Guyer gives further results of his experiments in producing eye-defects in rabbits by injecting a cytolysin into the mother. It is believed that the action on the lens of the eye is a specific one, and other experiments, as in the inheritance of the effects of immunisation of rabbits to typhoid bacilli, are being carried out. These experiments have recently been repeated by Finlay, Huxley, and Carr-Saunders (*Brit. Journ. Exptl. Biol.* vol. i. No. 2) with negative results. Of equal interest is Detlefsen's account of the experiments of Dr. Griffiths with rotating rats, which the former is continuing. Griffiths placed rats on a rotating table for periods of 2 to 18 months. Those which survived the experience recovered in a few weeks and appeared normal, but months later deep-seated effects of rotation appeared. Griffiths claims that some of the later descendants of these rats are also disequilibrated, although they have not been rotated, and that the effect is inherited through the male as well as the female. It is also claimed that the direction of disequilibration is specific, depending on whether the original rotation was clockwise or counter-clockwise. Mr. F. B. Hanson describes experiments on the effects of alcohol fumes and X-rays on albino rats, which give contradictory results. Alcoholic treatment had no immediate effect on growth in these animals, but the second generation of offspring were significantly smaller than the controls. In the following generation, however, the normal growth curve was restored, perhaps through germinal selection. X-ray treatment produced eye-defects, which the writer considers were not specific, and the descendants of such defective animals all had normal eyes. Finally Stockard summarises his extensive experiments with alcoholic guinea-pigs. The results of treatment are a doubling in the pre-natal mortality, with the consequence that the F_4 animals from an alcoholic ancestry are superior to the controls and are born in smaller litters. These are all general results of the selective elimination of weaker germ cells and zygotes. Ocular defects frequently occur, but the effects of alcohol are considered to be general on vigour and constitution rather than specific.

FOOD OF PLANKTON ORGANISMS.—It is now well established that many of the smaller planktonic medusæ catch and devour young fish. The fish are caught by the long outstretched tentacles, which react to contact with living organisms. The fish is stung, the tentacles contract, and with the assistance of other tentacles and the lips of the umbrella the food is conveyed to the mouth and digested in the stomach. A considerable amount of food selection occurs, as is shown by Miss M. V. Lebour in Journ. Mar. Biol. Assoc., Dec. 1923, vol. xiii. p. 70. Medusæ of one species do not as a rule eat each other, although they devour those of other species voraciously. If young fish are available, many medusæ entirely neglect the smaller crustacea in the plankton. Others, on the other hand, appear to neglect the fish and restrict their diet to the crustacea. The amount and size of the food consumed by some medusæ is very remarkable. In some cases the prey is much too large to be taken into the stomach, and partial digestion appears to take place in the region of the mouth, the liquid food being then sucked into the stomach. Essentially the same type of feeding appears to exist in ctenophores, Sagitta, and Tomopteris, although the method of catching and handling the prey is of course different. The description of these facts forms a most interesting and valuable paper.

EFFECTS OF COLD ON VITALITY OF BLADDERWORMS.—Dr. Annie Porter has investigated the effect of continued cold on the viability of the cysticerci of *Tænia solium* and *T. saginata* in Publications of the S. African Inst. for Med. Research, No. xvi., 1923. The embryonic forms of these human tapeworms occur in pork and beef respectively. It is concluded that in the case of slightly infected meat, freezing at −10° C. for a period of 12 weeks probably destroys the cysticerci. Staining reactions proved the most trustworthy test of viability. Dead cysticerci are deeply and rapidly stained by a slightly acid solution of methyl green, while the living forms are only feebly stained by this solution. Other experiments were performed with *T. echinococcus* and *T. crassicollis*.

ANTARCTIC ASCIDIANS.—Sir William Herdman describes the simple ascidians collected by the Australian Antarctic Expedition (Scientific Reports, vol. iii. pt. 3). These fall into twenty species, five of which appear to be new. Most of the species of arctic and antarctic Tunicata grow to a large size, and a very bulky collection may consist mainly of a large number of individuals belonging to comparatively few species. The warmer Indian Ocean, in contrast to the colder antarctic region south of it, shows a large number of species each represented by few individuals of small size. One of the most striking features of the present collection is the large *Ascopera mawsoni*—a stalked species, 8 to 9 in. long—of which nearly a thousand specimens came up in the dredge off Wilkes Land from a depth of 110 fathoms.

CANNED FRUITS.—Dr. W. G. Savage and Mr. R. F. Hunwicke detail investigations on the spoiling of canned fruits in Special Report No. 16 of the Food Investigation Board (H.M.S.O., price 1*s.* 3*d.*). None of the sporing bacillus types, anaerobes, sporing aerobes or thermophilic bacteria, was found to be of any significance as a cause of ordinary unsoundness. The types which are associated with unsoundness are yeasts, coccoid bacilli, gas-producing non-sporing bacilli and micrococci. All these, being sporeless, have comparatively low resistance to heat, and the practical problem of the canner is therefore much simplified. In practice, gas production and "blown" tins seem never to occur apart from microbial infection of the contents. Botulism, due to ingestion of the toxin produced by a sporing anaerobic bacillus, comes under a different category, and is separately dealt with (section 4).

PERMEABILITY.—With the last number of volume 22 of the *New Phytologist* (December 1923) Prof. W. Stiles completes his monograph upon permeability, which has run through several volumes of the journal and has been of a very thorough, comprehensive and critical nature. The extent of the literature covered by the work may be judged from the bibliography of 817 papers and monographs which is appended to this last instalment. The main general conclusions of Prof. Stiles appear to be that we have far too many theories as to permeability, whilst "not even the membrane theory of the cell and the simple view of the plant cell as an osmotic cell surrounded by an elastic envelope are really proved," and that the great need for progress towards a proper understanding of the phenomenon of permeability in plants are facts, and particularly quantitative data. It may be added that no doubt one valuable requirement for progress is provided by this critical and extensive summary of the theories and data relating to permeability.

TETRACORALLA AND HEXACORALLA.—W. L. Robinson (*Amer. Journ. Sci.* vol. 206, p. 424, Nov. 1923), writing on the ancestry of the hexacoralla, emphasises the distinction between this group and the tetracoralla, relegating all Palæozoic types of corals to the latter, and regarding supposed tetracorallan types in Mesozoic strata as in reality hexacorallan. He argues against the suggestion of P. C. Raymond (see NATURE, vol. 109, p. 657, May 20, 1922) that the tetracoralla were killed off by the cold of Permian seas, leaving a group that existed in Cambrian times to adopt calcareous skeletons in waters now more highly charged with salts. The author regards with favour the view of Yakovlev that the hexacoralla arose through the central attachment of the septa, which obscured the bilateral symmetry of the first stages of growth. Surely we may expect in that case some overlapping of genera from the two groups, and not so sweeping a charge as is postulated at the end of Permian times.

INVERTEBRATE FAUNA OF THE ATLANTIC REGION.—The Smithsonian Institution issues as a National Museum Bulletin, No. 104 (1923), the fourth part of J. A. Cushman's "Foraminifera of the Atlantic Ocean," covering the Lagenidæ. In the forty-two excellent plates the scale of magnification is usually about 25, and a comparison is easily made between the sizes of the species drawn. The variety of form from the simple flask-shaped types through Nodosaria to the closely coiled forms of Cristellaria provides an artistic study in itself. The dual method of indexing, by species arranged under the genera, and, in the same columns, by specific names, to which the generic name is in each case attached, has much to commend it to systematists, especially where transfers from one genus to another are made. Another elaborate memoir that appeals to students of living as well as fossil forms is the quarto bulletin No. 125 (1923), published by the same institution, by F. Canu and Ray S. Bassler, on "North American Later Tertiary and Quaternary Bryozoa," which contains a bibliography of all papers on bryozoa published since 1900. It is remarked that some defects may be expected owing to the difficulties of the War-time; but librarians will be grateful for this extensive chronological list. The form of publication, like that of the Palæontographical Society in England, allows of very great clearness in the specific details recorded in the plates, which will be referred to with pleasure by workers on the Pliocene deposits of East Anglia, whether in search of contrasts or correlations.

MAGNETIC VARIATION IN NORTH POLAR REGIONS. The *Geographical Journal* for December contains a chart, drawn by Mr. H. Spencer Jones, showing lines of force and curves of magnetic variation between the North Pole and lat. 60° N. This chart differs to some extent from the North Polar magnetic variation chart, 1922, published by the Admiralty. Mr. Jones has utilised observations published since that date, including those of the recent Canadian Arctic Expedition, Amundsen's *Maud* expedition, and some researches of the Carnegie Institution of Washington. But the data on which the present chart is based comprise all observations during the last twenty-five years. The position of the North Magnetic Pole has been assumed to be lat. 70° 50′ N., long. 96° W. This is based on the determinations of Ross in 1830 and Amundsen in 1903–5. A short descriptive article accompanies the chart.

WEATHER IN MYSORE.—The thirtieth annual report prepared by Mr. C. Seshachar, Meteorological Reporter to the Mysore Government, has recently been received. The report contains the results of observations at Bangalore, Mysore, Hassan, and Chitaldrug. For each station monthly means are given of atmospheric pressure, temperature, humidity, cloud, rainfall, wind velocity and direction; comparison is made in each case with the normal for 30 years, 1893–1922. The extreme monthly values are also given for the several elements. The diagrams aid materially in the better understanding of the several results. Atmospheric pressure ranges very regularly throughout the year, the mean in the winter standing two or three tenths of an inch higher than in the summer; the lowest reading is in June and the highest in December. Air temperature is highest in April and lowest in December, the monthly means differing by about 15° F. Of the four State observatories, Chitaldrug records the highest temperature, 100·3° F. on April 2 and 5. The velocity of the wind is greatest

in July and least in October to December; the direction is westerly in the summer and easterly in the winter; the times of greatest change are February to March and September to October. The heaviest rainfall is in October and November; very little rain fell from December to March. The report on rainfall registration in Mysore for 1922 is issued as a separate publication. There were 226 stations recording rainfall on December 31, 1922. The greatest rainfall gauged on any one day was 22·16 in. at Agumbi in the Shamoga District on July 23; the heaviest record for a day in the previous year was 14·60 in. at the same place. Diagrams are given showing the monthly rainfall compared with the average for the several districts, and a map shows the distribution of the rainfall in 1922 over the whole of Mysore.

MOTION IN VISCOUS FLUIDS.—The hydrodynamics of a viscous fluid lead to such complex mathematical equations that very few cases have yet been solved accurately. Some interest therefore attaches to a paper published recently by K. Terazawa in the Report of the Aeronautical Research Institute of the Tôkyô Imperial University, entitled "On the Decay of Vortical Motion in a Viscous Fluid." The problem is to determine how vortices in a viscous fluid dissipate, the fluid being assumed inelastic and the motion symmetrical about an axis, and two-dimensional. In the first instance it is assumed that there is no radial motion, each particle of fluid moving in a circle, and curves are drawn showing how the vorticity decays. One interesting result is that vorticity decays more quickly at high altitude than near the ground, owing to the kinematic viscosity increasing with height. There is also an application to the equaliser in a wind-channel, and to the mutual attraction or repulsion of cyclones in the earth's atmosphere recalling Okada's law. The case where radial motion exists is also studied in some detail, and curves of decay are given. If this radial motion is positive, the maximum vorticity travels away from the axis of symmetry, but even with negative radial motion, no case has been found where the maximum vorticity travels towards the axis of symmetry.

AFFINITY OF NEUTRAL IODINE ATOMS FOR ELECTRONS.—In 1921 J. Franck showed that it should be possible to measure the affinity between the atoms of electronegative elements and electrons by optical methods, since the union of free electrons would produce a continuous spectrum of a special kind. In 1919 K. Fajans made similar suggestions. If the electron, before union, has no kinetic energy, the frequency of the light emitted will, in accordance with the quantum theory, be $\nu = \epsilon V/h$; where $\epsilon V = E$ is the affinity between the atom and the electron; if the electron has kinetic energy $\frac{1}{2}\mu v_i^2$ the frequency ν_i will be given by the equation $h\nu_i = E + \frac{1}{2}\mu v_i^2$. Thus when a number of electrons, with velocities v_i ranging from zero upwards, unite with neutral atoms, a continuous spectrum will be produced, with a boundary on the red side at $V_0 = E/h$, and extending a certain distance towards the violet. Franck considered that Stenbing's plates showed such a continuous spectral band, with its red boundary at $\lambda = 4800$ Å; but Messrs. W. Gerlach and F. Gromann, in the *Zeitschrift für Physik*, 18. 5, p. 239, 1923, describe a very complete investigation of the iodine spectrum, in tubes without electrodes, and with varying temperatures and pressures, which shows that the only band which satisfies all the conditions, becoming stronger at high temperatures and low pressures, when the dissociation of the molecule becomes complete, and being devoid of all structure, is one bounded at the red end at $\lambda = 3460$ Å ± 3 Å, and extending to 3340. The affinity for electrons, calculated from the above boundary wave-length, is $81{\cdot}8 \pm 0{\cdot}2$ calories per mol. This agrees with the values calculated from other data, so it certainly appears that the evidence that the $\lambda = 3460$ Å band is due to the union of neutral atoms and electrons is very strong.

INDUSTRIAL TESTING APPARATUS.—Messrs. Gallenkamp's catalogue of apparatus for industrial research (Part 2) should find a place on the shelf of those engaged in chemical or physical test work, for it lists a wide range of apparatus and constitutes a comprehensive volume on technical apparatus. Amongst the instruments catalogued a number are of considerable interest—the Mitchell viscometer, consisting of a hardened steel ball and a cup in which there are three raised spots giving a constant initial thickness to the oil film, while a channel around its edge contains a supply of oil. The action of the instrument is based upon the rate at which an oil film thickens under a given force. For tests on viscous fluids it appears to be a very useful workshop appliance. One notes that in "research outfits" for temperature measurements the base metal couple is specified to have a range up to 1300° C. It might be as well to point out that the life of a base metal couple at 1300° C. is a short one. The recent forms of the disappearing filament type pyrometer are also listed. Apparatus for the works laboratory in connexion with iron and steel analysis occupies a prominent place, as well as that for ultimate organic analysis. Owing to the quality of paper used, the photographs of apparatus have reproduced very poorly. As the cost of production has to be considered nowadays, one cannot complain if the manufacturer economises, but in this case the substitution of perspective drawings for the photographs would have enhanced the value of the catalogue.

RADIO SIGNAL FADING.—A troublesome phenomenon in radio communication with very short wave lengths is known as "fading." This is shown by a rapid variation in the intensity of the signals received. The signals may be heard satisfactorily during one minute and be almost inaudible the next. Mr. Dellinger, of the U.S. Bureau of Standards, has made a careful experimental study of the problem in No. 476 of the Scientific Papers of the Bureau. It is well known that fading is more pronounced with short wave lengths and occurs generally in the night time. As a rule also it is more pronounced the greater the transmission range. The very large number of radio broadcasting stations using short wave lengths has brought this phenomenon into prominence. Although numerous observations have been made by Mr. Dellinger and his colleagues, it is very difficult to draw definite conclusions from them as so many variables are involved. He gives a theory of fading. Assuming that the Heaviside layer is at a distance of 100 kilometres from the earth's surface, that it is not absolutely horizontal, but that its surface is continually changing and that the stratosphere is ionised in the day-time only, he shows that the conclusions which may be deduced are in exact agreement with the facts. The Heaviside layer is assumed to be almost a perfect conductor and the region above it is assumed to be a perfect conductor. In daylight transmission, the waves cannot reach the Heaviside layer because of the intervening ionised stratosphere. Hence in the day-time, we have only to consider the waves which travel along the earth's surface. At night the waves can travel and slide along the layer without appreciable absorption. He points out that fading might therefore be caused by irregularities in the surface of this layer.

Colour Production and Chemical Constitution.

IN the Proceedings of the U.S. National Academy of Sciences for September 15, 1923 (vol. 9, p. 303), Prof. Julius Stieglitz, of the University of Chicago, puts forward in outline a theory of colour, which is based upon the electronic theory of valency, but can for the most part be discussed apart from that theory. His fundamental suggestion is that Otto Witt's *chromophoric* or "colour-carrying" groups are essentially oxidising radicals and that the *auxochromic* or "colour-intensifying" groups are essentially reducing radicals. He is impressed by the fact that nearly all dye-stuffs contain both of these opposite constituents, and seeks for a key to the origin of colour in the well-known fact that all dye-stuffs on reduction yield colourless leuco-bodies, which therefore usually contain two reducing and no oxidising centres. He illustrates his argument by reference to the case of indophenol, thus:

Phenylimido-quinone, $O : C_6H_4 : NC_6H_5$, is yellow.
Indophenol, $O : C_6H_4 : NC_6H_4 . OH$, is red.
Indophenol salts, $O : C_6H_4 : NC_6H_4 . OMe$, are indigo-blue.

The progressive development of colour in this series corresponds closely with the progressive development of reducing-power in the series

$NH_2 . C_6H_5$ (Aniline.) $NH_2 . C_6H_4 . OH$ (Aminophenol.) $NH_2 . C_6H_4 . ONa$ (Sodium aminophenate.)

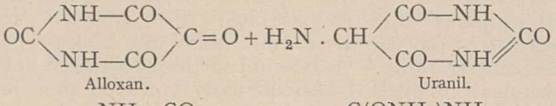
Conversely, basic dyes like pararosaniline give a maximum depth of colour when combined with acids, *e.g.*

$HN : C_6H_4 : C(C_6H_4 . NH_2)_2$ is yellow.
$ClH_2N : C_6H_4 : C(C_6H_4 . NH_2)_2$ is brilliant red.

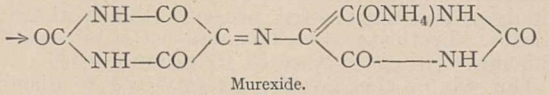
In this case it is noteworthy that the acid combines with the quinonoid nitrogen, and probably increases its oxidising power; but when the reduced radicals are also united with acids, their reducing power is decreased, and the colour diminishes again, *e.g.*

$ClH_2N : C_6H_4 : C(C_6H_4 . NH_3Cl)_2$ is yellow.

The colour is therefore associated with strongly developed oxidising and reducing centres in the same molecule. This view is confirmed in the case of murexide, which is formed by the union of an oxidising and a reducing compound as follow:



Alloxan. Uranil.



Murexide.

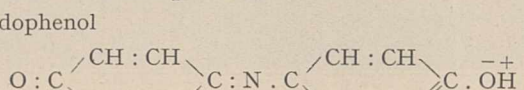
These views are linked up with the electronic theory as follows. A reducing agent is regarded as one which readily parts with electrons, whilst an oxidising agent is one that readily absorbs electrons.[1] This view is confirmed by a comparison of quinone with the ions of hydroquinone, thus:

$\overset{+}{Na}\left[\overset{-}{O} . C_6H_4 . \overset{-}{O}\right]\overset{+}{Na}$ Quinol in alkali. $[O : C_6H_4 : O]$ Quinone.

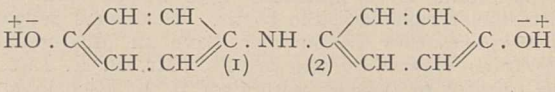
From these formulæ it appears that removal of two electrons from the quinol ion converts it into quinone and conversely.

Prof. Stieglitz seeks to identify the electron, of which the vibration gives rise to the absorption of visible light, as one that belongs primarily to the reducing-group (or auxochrome), and is already free to vibrate, since it is, by the definition of a reducing-agent, free to escape under the influence of the attraction of an oxidising agent. In a dye-stuff, this oxidising agent is represented by the chromophore group; and visible colour is attributed to the altogether exceptional looseness of the binding of an electron which is on the point of being expelled from a reducing agent and drawn away by an oxidising agent. In comparing indophenol with its reduction-product,

Indophenol



Leuco-compound



Prof. Stieglitz assumes that, in the formation of indophenol by oxidation of the leuco-compound, the proton of the central NH group is removed with a proton from one of the terminal hydroxyl groups, but that the two electrons are taken from the carbon atom (1), which thus becomes positively charged, and differs by two electrons from the carbon atom (2), which retains the negative charge originally assigned to both carbon atoms. The colour of indophenol is therefore attributed to the vibrations of an electron which belongs to the carbon atom (2), but is only weakly held by it (since this half of the molecule might equally well have been oxidised), whilst its attachment is still further weakened by the attraction of the positively charged carbon atom (1) of the oxidising radical. T. M. L.

[1] This may be contrasted with the definition of an acid as a substance which liberates protons, whilst a base is a substance which absorbs them: a reducing agent is then in a sense the converse of an acid and an oxidising agent the converse of a base.

The Work of the American Museum.[1]

THE American Museum of Natural History lays itself out largely for the education of the people, and this aim is emphasised in the title of Prof. H. F. Osborn's introductory article, "The American Museum and Citizenship," in the fifty-fourth annual report. That is an aspect of the museum with which we have dealt in previous articles, and we would here direct attention to the large amount of scientific research carried out by the same museum. The greater and more important part of the activities of every large natural history museum is connected with the advancement of science, but not all make so prominent a feature of it as is made in the present report.

The numerous expeditions sent out by the American Museum are well known, but stress is laid here on the systematic attempt to save specimens of the vanishing wild life of the world, more particularly of the mammals, before these become completely extinguished by the expansion of the human race. The mere collection of specimens might seem to accelerate this extinction, but the museum is actively

[1] American Museum of Natural History. Fifty-fourth Annual Report for the year 1922. 264 pp., xv plates. 1 folding plan. May 1923.

co-operating with other institutions, both at home and abroad, and with various governments, in an attempt to retard the inevitable close of the Age of Mammals.

Interesting lines of research are indicated in the reports by the various curators; here we can only mention a few. One of these is in co-operation with the National Research Council's committee on the biological relations between flowers and insects.

FIG. 1.—Night photograph of the giant tree frog of Santo Domingo.

Experiments have indicated that insects can see ultra-violet rays invisible to us. If flowers reflect ultra-violet, they would then have an ultra-violet colour as viewed by the insects. Mr. F. E. Lutz, the Curator of Insects, with Prof. F. K. Richtmyer, has found that some flowers do indeed have ultra-violet colour, and that flowers differ in this respect just as they differ in their reflection of the ordinary wave-lengths of light. The characters of the pollen belonging to different kinds of plants have also been tabulated, so that, by the examination of the pollen found on an insect, inference may be drawn concerning flowers it has been visiting.

A novel mode of research has been the photographing of various reptiles and amphibians at night with a flash gun (Fig. 1). This investigation has been carried out in the neighbourhood of New York and in Santo Domingo, where the life-histories of most of the frogs and toads have been determined with an approach to completeness. In this island occur not only the largest tree frog in the world but also the most powerful, if not the largest, lizard in the Americas—the Rhinoceros Iguana. A museum group illustrating the home life of the latter is being installed. Since it lives in small colonies, digging its burrows through cliffs of well-preserved fossil corals, it is possible to illustrate the chief features of its biology without overcrowding or detracting from the artistic effect.

Under the direction of Dr. W. K. Gregory, the Museum has a special Department of Comparative Anatomy. We cannot here list the numerous important researches carried out in connexion with that department, but we must direct attention to the serious attempt being made by the Department of Anthropology under Mr. Clark Wissler to complete a survey of the physical characters distinguishing the various races of man. Particular attention has been paid to the Polynesian, Malayan, and Indonesian peoples. Models will be constructed from the data obtained, and placed on exhibition.

These are just a few of the points that we have selected to illustrate the scientific work accomplished by this great museum. Others will be found in the report itself, which is, as always, a delightful source of inspiration to those in Great Britain who have set before themselves a high ideal of museum work.

F. A. B.

The Position of Scientific Workers in Russia.

AFTER the Bolshevist revolution in 1917, Russian men of science adopted two courses of action. Those who engaged in active or passive opposition to the Soviet regime emigrated or were shot, and some were deported abroad by the government, so that there are now about 500 Russian scientific workers outside the borders of Russia. Others took up a strictly non-political attitude and decided to remain at their posts to safeguard and carry on Russian science. All teaching of moral sciences was abolished or "adapted to communist principles." Those professors who refused to comply were dismissed, and some died of starvation in spite of the existence of a government commission for improving the conditions of scientific workers, some of whom received extra food rations.

Russian men of science are now working under most difficult conditions. Their salary is far below a minimum living wage; some receive only about 9-12 per cent. of their pre-War salary, while the cost of living is far higher. They work in living-rooms and laboratories where the temperature is scarcely above freezing point; they chop wood, carry water, hunt for cheaper food, etc. There is acute shortage of gas, chemicals, implements, and books. Nevertheless, Russian science is not dead and has recorded many important achievements, but purely scientific works are difficult to publish. This is not so with works based on "Marxist principles," which are specially commended. Those men of science who have joined the communist party have been given special privileges.

An Institute of "Red" professors has been founded to supplant the old workers. The students are recruited from the communist party and lack proper scientific training. Admission to the universities and technical colleges is also officially confined to communists, raw uneducated peasants and workmen's youths. Lecturing to such an audience is particularly difficult.

This winter the government proposed to dismiss most of the old professors and replace them by "Red" ones. Faced by starvation or loath to hand over their beloved work to incompetent people, some of the former rallied to the Soviet platform. A congress was called in Moscow, at which an alliance was staged between science and the proletariat. All resistance was so far broken that the professors elected Zinoviev, the president of the International, whose activities are quite outside the realm of science, as honorary member of one of the sections of the congress.

Without a doubt Russian scientific workers are most depressed, not alone by the low living wages, but by the Bolshevistic regime of control, which exceeds the most difficult times during the Czarist regime: because the true development of science can, of necessity, take place only in an atmosphere of freedom.

Changes in the Indo-Gangetic Alluvial Plain.

IN a paper on this subject to Section E (Geography) of the British Association at Liverpool, Mr. W. H. Arden-Wood threw interesting light on the past geography of the country as read from tradition, history, and the deserted sites of towns. The enormous changes in the river systems of the Indo-Gangetic alluvial plain make it certain that it is quite fallacious to assume that the topography of, say, the Punjab was the same 2000 years ago as it is to-day. No doubt many of the ancient cities of India owed their abandonment or decline to changes in the political importance of the states to which they belonged or to changes which made them no longer suitable as a seat of government; others to the result of warfare. But most of the cities stood on rivers which in some cases washed them away or in other cases deserted them.

A deserted river reach becomes full of stagnant water choked with vegetation. This provides an excellent breeding ground for the malarial mosquito. Thus a town bereft of its river may become so unhealthy that it is virtually abandoned. Gaur, once the capital of Bengal, was deserted by the Ganges three centuries ago and abandoned after the ravages of a frightful pestilence. In times of flood extensive changes in the river courses are specially apt to occur. Examples were cited in the case of the Damodar and the Hooghli.

Mr. Arden-Wood went on to show how interference with the flow of rivers caused by the construction of canals has had far-reaching effects in certain cases where the gradient of the river is low. Thus the confluence of the Indus and Chenab is now sixty miles below the old confluence, owing to the construction of an irrigation canal between the two. Both from geographical evidence and from the many important towns on its banks, it would appear that the Hooghli was once the main stream of the Ganges. But the Hooghli has now reached a stage where it is ceasing to hold its own as a live river. For the greater part of the year it receives little or no water from the Ganges; its bed is probably at a higher level than that of the main stream and it is steadily deteriorating as a navigable river. Changes in the Bidyadhari, a tidal deltaic river east of Calcutta into which the city drainage flows, are rapid and threaten the health of the city. Remedial measures are being taken, but may not be sufficient to overcome the tendency for the Bidyadhari, as a flowing river, to die.

Alternation of Generations in the Ectocarpaceæ.

A PAPER by Miss Margery Knight, published in the Transactions of the Royal Society of Edinburgh, vol. 53, part ii., No. 17, upon the life-history and cytology of *Pylaiella litoralis* Kjellm., provides data of very considerable interest to the student of the Algæ. The paper is unusually full of the marine student's equivalent for "field" observations, and Miss Knight must have given some time and trouble to her studies of these small plants in their natural habitat and also to their cultivation under experimental conditions.

As a result, she reports a most interesting interdependence of the spore forms of Pylaiella and the Fucoid supports upon which the filamentous alga usually develops. In the spring, young Pylaiella plants are mainly met with upon *Ascophyllum nodosum*; in the early summer the new fronds of *Fucus vesiculosus* are covered with young Pylaiella plants, the latter soon outstripping in size the plants growing upon Ascophyllum; towards the end of the summer another series of plants are found upon *Fucus serratus*. Miss Knight reports that 90 per cent. of the Pylaiella plants on Ascophyllum have plurilocular sporangia only, whilst the plants upon the Fucus hosts consistently bear unilocular sporangia, with the exception of some 2 per cent. of the plants on *F. serratus* and 15 per cent. on *F. vesiculosus*.

The cytological investigation has established a reduction of the chromosome number in the formation of the unilocular sporangia. From these structures a haploid generation must arise, but the prevalence of diploid plants with plurilocular sporangia necessitates the acceptance of nuclear fusion as an integral part of the life-cycle of at least some of the plants. Miss Knight has frequently observed gametic fusion, particularly under certain cited conditions, but she has also to report a strongly developed tendency to parthenogenetic spore development. The basal alternation would thus seem to be, in this member of the Ectocarpaceæ, a transition from a diploid plant through unilocular sporangia with haploid spores, to the haploid individual with gametes in plurilocular gametangia the fusion of which re-establishes the diploid condition. But the rapid completion of the life-cycle may be delayed, either by a long succession of diploid individuals with plurilocular sporangia in which nuclear reduction fails to take place or by a long succession of haploid individuals reproducing parthenogenetically.

Algal systematists will be interested by the polymorphism of the species of Pylaiella revealed by Miss Knight's study of the same individual plants at different seasons of the year, and under different experimental conditions. The dependence of the form of Algal reproductive cell upon external conditions is indeed strikingly emphasised by this work, especially in the remarkable instance cited in which, by removing a screen of Fucus fronds above it, a patch of *Plumaria elegans* lying on a sunken breakwater was caused to produce tetrosporangia within eight days, this patch lying in a carpet of Plumaria still shaded by the Fucus fronds which uniformly produced cystocarps.

On Continuous Radiation from the Sun.

DR. W. ANDERSON, in a paper in the *Astronomische Nachrichten*, No. 5239, directs attention to the fact that Wilsing has recently raised serious objections to the theory that the continuous spectrum of the photosphere is due to light from the gaseous interior of the sun. Dr. Anderson explains the difficulty of assuming the existence of solid or liquid particles in the photosphere; and shows that even particles of carbon could only exist, at an assumed photosphere temperature of 5400° A., if the total pressure were several hundreds or even thousands of atmospheres, which seems quite impossible; the actual temperature according to Hirayama is 7040° A. A "mist" of minute particles, could such be produced, would be of a most ephemeral nature, since it is possible to deduce from Stefan's observations on the velocity of evaporation that the time of evaporation is proportional to the square of the radius, and so will be very small indeed for spheres of small radius.

It is suggested that a solution of the difficulty may perhaps be obtained as follows: the Zeeman effect in the sun-spots proves that the photosphere is

negatively charged. This can be explained by the presence of "electron gas," free electrons moving between the atoms and molecules of the material gas. In *Astronomische Nachrichten*, No. 5224, Dr. Anderson has shown that the spectrum of electron gas, and also of a fully ionised gas, must be continuous; and has endeavoured to explain the continuous spectrum of the inner corona in this way. He suggests that possibly the continuous spectrum of the photosphere may be due to the same cause.

In a letter to the Editor of NATURE, dated September 15, Dr. Anderson directs attention to the fact that Prof. N. Saha recognises the importance of free electrons in the sun's photosphere, in connexion with its radiation (NATURE, Aug. 25, 1923). He cannot, however, agree that the hollow enclosure or "black body" condition is not realised; the radiation of the photosphere has its origin, for the most part, in the deeper strata, where this condition holds. It may be stated, however, that Saha's argument is that the large percentage of free electrons and positive charges in the photosphere endow it with a large reflecting power; and that a good reflector cannot act as a good radiator. Metals owe their reflecting power to the presence in them of a large number of electrons, which are easily excited to vibration by incident radiations, and presumably their deviations from black body radiation is connected with the same cause. Similar deviations certainly seem probable in the case of the photosphere if Saha's theory is correct.

University and Educational Intelligence.

ABERDEEN.—The University Court has appointed Mr. O. F. T. Roberts to be Cruickshank lecturer in astronomy and meteorology. Mr. Roberts is at present assistant in the Meteorological Department of the Chemical Warfare Station at Porton.

CAMBRIDGE.—It is announced that Dr. Morton Prince, of Boston, U.S.A., will give a short course of lectures on "Subconscious Phenomena," commencing on February 12.

LONDON. — The following free public lectures (admission to which will be by ticket) are announced for delivery at Bedford College for Women: "The Influence of Biological Discovery on Human Progress: a Forecast," by Sir F. W. Keeble (on February 15); "The Social Thought of To-morrow," by Dr. Graham Wallas (on February 22); "How Physical Science has altered the Economics of Life," by Prof. F. Soddy (on March 7); and "The Future of Psychology," by Dr. C. S. Myers (on March 14). The lecture hour in each case will be 5.15.

SIR WILLIAM BRAGG will distribute the prizes and give an address on "Research Work and its Applications" at the Sir John Cass Technical Institute, Aldgate, E.C., at 8 P.M. on January 30.

DURING the present year the trustees of the Albert Kahn travelling fellowships will elect one fellow. Candidates must be British subjects and graduates of a university of Great Britain or Ireland. The fellowships, which were founded by M. Albert Kahn, of Paris, are intended to allow persons of proved intellectual worth to undertake a year's travelling with the view of making a survey of different civilisations and acquiring a generous and philosophic outlook on human life. The present value of the fellowship is 1000*l*. Details of the conditions of award can be obtained from the secretary of the trustees of the fellowship, at the University of London, South Kensington, London, S.W.7.

Two prize essay contests have been arranged by the League of Nations Union in co-operation with the American School Citizenship League, and open to both British and American schools. Two sets of prizes of 75 dollars, 50 dollars, and 25 dollars, to be known as Seabury prizes, are offered for the best essays on the following subjects: (1) "Methods of Promoting World Friendship through Education"; and (2) "The Organisation of the World for the Prevention of War." The first is open to all under twenty-one on May 15 attending a Training College in the British Isles; the second is open to all students between sixteen and eighteen on May 15 who are attending an educational institution in the British Isles. Essays, not exceeding 5000 words in length, must reach the League of Nations Union, 15 Grosvenor Crescent, S.W.1, where full particulars can be obtained, not later than May 15.

THAT the British Empire Exhibition of 1924 will have great potential value as a source of educational stimulus and a storehouse of educational material is a reflection which must have occurred to many. The Board of Education has outlined in Circular 1320 an admirable scheme providing not only for the employment of such traditional methods as organised visits to the Exhibition, at reduced charges, of groups of pupils under the guidance of their teachers, but for substituting for the usual lessons in history and geography in the schools, during perhaps three hours a week for a period of six months, a special intensive course in the history, geography, and resources of the British Dominions and the civilisation of the British Commonwealth, and for the circulation during these six months of a weekly Bulletin corresponding, step by step, with the programme of these special studies. If the schools respond well, the Board will have set in motion the greatest experiment in the "project" method of teaching which has ever been attempted in Great Britain or any other country, and one that will be watched with keen interest by teachers in all parts of the world.

THE International Federation of University Women is one of the many international associations which came into being during the short period of optimism and expansiveness which succeeded the War. Its report for 1922–23 contains evidence of considerable vitality. Its membership includes national associations in Austria, Belgium, Czecho-Slovakia, Denmark, Finland, France, Great Britain, Holland, Italy, Norway, Spain, Sweden, the United States, Canada, Australia, New Zealand, South Africa, and India: others in Ireland and Greece are expected to join shortly. In pursuance of its main purpose—"to promote understanding and friendship between the university women of the nations of the world"—the International Federation has advocated with some success the provision of international fellowships and of residential clubhouses in university centres. Recent awards by the national associations are: America: 1000 dollars for research in a foreign country, to Dr. Leonore Brecher of the University of Vienna, and 1000 dollars to Miss Ann C. Davis of the Royal Holloway College; Great Britain: 100*l*. for research in arts to Dott. Cecilia Dentice di Accadia of the University of Naples; Sweden: 1000 kronor for research in science to Mrs. Onslow of Cambridge. A scheme has been elaborated by the Council of the Federation for creating and administering an International Fellowship Fund. Clubhouses offering hospitality to foreign members of the Federation have been established in Washington, New York, Philadelphia, Paris, Brussels, and London. The third biennial conference of the Federation will be held at Christiania in July next at the invitation of the national associations of Denmark, Finland, Norway, and Sweden.

Societies and Academies.

LONDON.

Royal Society, January 17.—M. **Brotherton**: Experiments on the emission of electrons under the influence of chemical action. The emission of electrons from drops of the liquid alloy of sodium and potassium when acted on by $COCl_2$ has been examined over a wider range than in Prof. Richardson's work. Two methods were devised. In the first; a large volume of gas is used; it gives consistent results at higher pressures. In the second method a stream of active gas is pumped continuously through the apparatus; it gives consistent results at very low pressures. Saturation currents ranging from 2×10^{-11} amp. to $3{\cdot}8 \times 10^{-8}$ amp. have been obtained. At the higher pressures of $COCl_2$, the shape of the characteristic varies with the pressure, but it is independent of it at low pressures, although the saturation current may vary considerably.—M. D. **Hart**: On the degradation of acoustical energy. The paper forms part of the general problem of sound signalling over long ranges. Theoretically, the transmission of sound is likely to be accompanied by degradation of acoustical energy into other forms. Degradation coefficients can be derived. Experimental results support this theory, and in particular demonstrate that the law commonly assumed to hold between the pressure amplitude of the sound emitted by a source and the distance therefrom is invalid, even for relatively small amplitudes. The efficiency of transmission can be calculated from known values of the degradation coefficients.—F. W. **Aston**: On the velocity of the positive ions in the Crookes dark space.—W. L. **Bragg**: The structure of aragonite.—G. H. **Hardy** and E. **Landau**: The lattice points of a circle.—D. **Brunt**: The dynamics of cyclones and anticyclones regarded as atmospheric vortices.—C. D. **Ellis** and H. W. B. **Skinner**: (1) The absolute energies of the groups in magnetic β-ray spectra. It is only necessary to measure in absolute units the energies of certain of the stronger groups. Those chosen were the prominent ones of radium-B. The method used was to determine the radius of curvature of the path of the β-rays in a uniform magnetic field by the usual focussing device and to measure the magnetic field in absolute units, thus obtaining HP, and from this the energy is calculated by the relativity formula. The field was measured by a modified balance method in terms of the area turns of a search coil and the value of a mutual induction. The field used in each experiment was separately determined, and special attention was paid to errors arising from non-uniformity of the field and the susceptibility of the core of the search coil. The final values of $H\rho$ have an accuracy of 1 in 500. (2) A reinvestigation of the β-ray spectrum of radium-B and radium-C. Many new lines have been found, and the β-ray spectrum of radium-C up to $H\rho$ 2400 has been remeasured. Since the β-ray lines are due to conversion of γ-rays in the various electronic levels, it is possible to deduce the wave-lengths of the monochromatic γ-rays emitted by the disintegrating nucleus. There are curious changes in relative absorbing powers of the L sub-groups for different frequencies. Further, whereas the majority of the γ-rays emitted from the radium-B nucleus is converted in the radium-B electronic system, atomic number 82, one γ-ray from radium-B gives groups which undoubtedly come from the actual disintegrating atom, but correspond to conversion in an atom of atomic number 83. (3) The interpretation of β-ray spectra. Accurate values for the frequencies of the monochromatic γ-rays emitted by radium-B and radium-C confirm the conclusion that the γ-rays are due to transitions between stationary states in the nucleus. The nuclear levels of radium-B and radium-C are similar in structure, those of radium-C differing from those of radium-B only by having greater energy differences. The relative absorbing power of the L sub-groups changes with the frequency of the absorbed radiation. This is probably true for the absorption of radiation in general.—H. D. **Smyth**: Further studies in ionisation: hydrogen and oxygen.—L. F. **Bates** and J. S. **Rogers**: Particles of long range emitted by the active deposits of radium, thorium, and actinium.—G. M. **Shrum**: The doublet separation of the Balmer lines. The doublet separations of the first five lines of the Balmer series are almost in exact quantitative agreement with the theory of Sommerfeld. The intensity of the Balmer lines relatively to the secondary spectrum has been increased, but no evidence of the fine structure was observed. The spectrum of pure hydrogen was studied when the discharge tube was at $-252°$ C. At this temperature the greater part of the gas is in the molecular condition.

Optical Society, January 10.—T. **Smith**: The relation between aperture, axial thickness, and form for a single lens. The thicknesses to be given to lenses of known shapes to enable a given aperture to be attained can be determined in two ways: (1) Ray tracing, and (2) algebraic calculation. In (1) any convenient solution may be used—for example, the direct graphical method of drawing a section of the lens on a convenient scale with the required curvatures, the centre of the second surface being found by striking intersecting arcs of the given radius from points on the first circle the distance apart of which is equal to the assigned aperture, and measuring the axial thickness on this diagram. In (2) the simplest form occurs in connexion with the converse problem of finding the maximum aperture which is attainable with a given thickness.—J. W. **Perry**: The determination of aberrations as expressed in geometrical optics from the indications of the Hilger interferometer. The aberrational defects are given in terms of the departure from ideally perfect focal ray-union, as measured longitudinally at the focal plane and as obtained in the course of computation of an objective.—D. **Baxandall**: Two Galileo telescopes. Copies of the two instruments have been placed in the collections in the Science Museum. Both of the telescopes, as well as the famous broken object-glass of Galileo, have been tested by Prof. G. Abetti and Prof. V. Ronchi. The results are published in *L'Universo*.

Royal Statistical Society, January 15.—Lord Emmott in the chair.—N. **Crump**: The distribution and inter-relation of prices, and their incidence on the problem of price stabilisation. Mathematical analysis, and the relation between a geometric mean index-number, such as that of the Board of Trade or the *Financial Times*, and an arithmetic mean index-number, such as that of the *Economist*, *Statist*, or *Times*, shows that there was no real quarrel between the advocates of the two means. Dealing with phase differences between the general index-number and group indices, the data show that in 1921–22 the groups reached their minimum in the following chronological order: cotton, non-ferrous metals, other textiles (than cotton), meat, the general index-number, iron and steel, and fuel. Cotton leads the general index-number by eleven months, and fuel lags by ten months. The cereals group has scarcely reached its minimum. The groups also reached their peak in 1920 in the same chronological order, cotton and non-ferrous metals leading by two months, and cereals lagging by ten months.

EDINBURGH.

Royal Society, January 14.—Prof. F. O. Bower, president, in the chair.—R. A. **Sampson**: Studies in clocks and timekeeping. No. 3. Comparative rates of certain clocks. The problem of timekeeping, the most interesting problem of metrology, has gained in interest since wireless comparisons have shown that different observatories failed to keep accordant time. The paper is a report on the going of four clocks: (1) Riefler 258, the standard mean time clock of the Royal Observatory, Edinburgh; (2) a clock constructed by W. H. Shortt of the Synchronome Company, and erected by him at the Observatory; (3) Riefler 450, a clock for the India Survey, on test at the Observatory; (4) Leroy 1230, a sister clock to the *directrice* of the clocks of the Observatory of Paris. Riefler 258 and Shortt have performed best, Shortt being somewhat superior. Each will hold its rate within a range of ±0·01 second per average period of 45 days. Accidental daily variation of rate does not exceed one half this amount.—A. E. M. **Geddes**: Observations on the Balmer series of hydrogen. An attempt to find, by direct observation of the hydrogen line spectrum, the separation between the components of the first two members of the Balmer series, is described. Observations were carried out both at ordinary temperatures and at the temperatures of liquid air. The agreement between calculated and observed values at low temperatures is fairly close, the results thus tending to support the Bohr-Sommerfeld theory of the fine structure of the hydrogen lines.—Sir T. **Muir**: Note on the m-line determinants whose elements are (m − 1)-line minors of an m-by-(m+k) array.—E. T. **Whittaker**: The theory of graduation. The difference-equation which is fundamental in the theory of graduation is solved by a direct method which can supersede the method of successive approximation used hitherto.—R. C. **Gray**: The control field in magnetic hysteresis. It follows from Ewing's theory of magnetism that the atomic magnetic field, g, exerted on the Weber element is given by $g = I_s/2k_0$, where I_s is the saturation magnetic intensity and k_0 is the initial susceptibility. Results show that the value of g is about four times that of the saturation coercive force. The fields for different stable positions of the Weber element are not all equal, the process of demagnetisation by reversals leaving the elements under the control of the strongest atomic fields.

PARIS.

Academy of Sciences, January 2.—M. Guillaume Bigourdan in the chair.—Émile **Borel**: Games where chance is combined with skill of the players.—G. **Bigourdan**: The organisation of an experiment on the propagation of sound up to great distances. Various effects produced by powerful explosions. Three explosions for experimental purposes have been arranged to take place on May 15 and May 24 next. Ten tons of explosive will be fired each time, and arrangements are being made to make exact observations on the range of audibility, intensity of sound, etc.—F. E. **Fournier**: Unpublished details of low barometric readings in observatories during the passage of cyclones and typhoons.—Louis **Gentil**: The remains of quaternary glaciation in the region of Telouet (Moroccan Haut Atlas).—H. **Douvillé**: The earliest Nummulites in the Eocene of Béarn. A detailed description of the forms found, with fourteen drawings. The two megaspherical forms *N. parvulus* and *N. mamillinus* appear to represent the earliest Nummulites of this region.—Morin **Molliard**: New researches on the formation of organic acids by *Sterigmatocystis nigra* in media with constituents in abnormal proportions. Cultures of this mould have been made in media in which the ratios of the constituents have been systematically varied: the weights of the dry mycelium, acidity, oxalic acid, and citric acid produced and sugar consumed were determined. The reduction of nitrogen present caused an increase in the amounts of gluconic and citric acids produced, whilst the reduction of the whole of the mineral substances (phosphate, sulphates of magnesium, iron, and zinc) led to increased formation of oxalic and citric acids.—André **Blondel**: The resonance of the shaft of an explosion motor with multiple cranks carrying a flywheel or a receiving organ. The influence of an elastic connexion.—Charles **Nicolle**, Paul **Durand**, and E. **Conseil**: New experimental data on the prevention, treatment, and ætiology of acute conjunctivitis caused by Weeks's bacillus. Prophylaxy of acute conjunctivitis can be realised by the use of the specific vaccine and serum. Horse serum is preferable. It is necessary to take into account the lengthy persistence of the Weeks's bacillus, virulent on the conjunctiva, after cure.—Georges **Bouligand**: The harmonic problem of Dirichlet.—J. L. **Walsh**: The determination of an analytical function by its values on a contour.—Paul **Flamant**: A functional differential equation.—Ph. Le **Corbeiller**: The modular group of an imaginary quadratic body.—Paul **Urysohn**: Separable classes and Hilbertian space.—D. **Sensaud de Lavaud**: The gyroscopic regulation of automatic transmission. The use of a gyroscopic governor gives a correct working not obtainable by compensation alone.—M. **Rateau**: Remarks on the preceding communication. Completion and extension of M. Lavaud's proofs.—R. **Risser**: The introduction of secondary terms in the potential of the velocities, in the case of waves by emersion.—M. **Michovitch**: Variable stars of the Algol type.—H. **Chipart**: The electromagnetic theory of natural rotatory polarisation.—Edmond **Bayle** and Henri **George**: The application of optical methods to the examination of works of art. Pictures may be examined with X-rays, or illuminated with light of known composition variable at will. Both methods give information on certain points, and additional results can be obtained by examination by ultra-violet light, by photography or a prepared plate with a black screen, by spectrography, and by the microscope.—H. **Cardot**, H. **Laugier**, and R. **Legendre**: A block giving a series of constant temperatures. A massive bar of aluminium of rectangular section has its ends maintained at constant temperatures, one hot, the other cool. Cavities are made in the upper surface of the block, and glass vessels placed in each hole can be maintained at constant temperatures, and these can be varied at will by altering the temperatures at the ends of the block. The apparatus has been employed for the exact determination of melting points, in experiments on the optimum temperature for the action of diastase, and for the culture of micro-organisms.—N. **Perrakis**: The specific heat and heat of mixing, in the neighbourhood of the critical state of miscibility.—F. **Bourion** and E. **Rouyer**: Ebullioscopic study of the double salts formed by mercuric chloride with alkaline chlorides.—A. **Bigot**: Kaolins, clays, etc. Colloidal plasticity. The phenomena of *gel* and *sol*. Slips have been prepared from eighteen materials from different sources, and submitted to the action of various reagents (acids, alkalis, and salts) and *gel* or *sol* formation noted. No general explanation of the results can be deduced.—Maurice **Piettre**: The separation of the proteids of white of egg by the acetone method. A modification of the acetone method is detailed, which possesses advantages in the separation of the various proteids and is of service as

a general analytical process.—Mme. P. **Ramart**: α-α-β-Triphenylpropionic acid and some of its derivatives. A new method of preparation from the sodium derivative of benzyl diphenylacetate and benzyl chloride in the presence of sodium amide is described, and the properties of the acid obtained are compared with the acids resulting from other syntheses. —M. **Thiébaut**: The presence of a white mica in clay sediments.—Mme. E. **Jérémine**: The supposed syenite from Coutances. This rock, both on account of its mineralogical and chemical composition, must be considered as a quartz diorite, containing amphibole and biotite.—Const. A. **Kténas**: The volcanic nature of the Caloyeri rocks in the centre of the Egean Sea.—V. **Agafonoff**: Some properties of loess. The formation and distribution of the carbonates in loess can be best explained by the theory of deposition by wind.—G. F. **Dollfus**. The geology of the valley of the Vézère.—Pierre **Viennot**: The structure of the French western Basque country.—Raymond **Furon**: The climate of the east of Afghanistan. According to observations extending over a year, temperature ranged between 36·4° C. (August) and −18° C. (February). The rainfall is small, nothing usually falling between June and September.—G. **Rempp**: Wind in the valleys and the theory of the Föhn.—G. **André**: The composition of plant juices extracted by pressure. Juice was expressed from potatoes after keeping for varying periods and determinations were made of the total nitrogen in the liquid expressed, after filtering through a collodion membrane, and after coagulating by heat. The nitrogen was practically the same in filtered and in coagulated juice: the nitrogen in the extract increased with the age of the potato.—P. P. **Stanescu**: The quantitative variations of starch in the leaves of green plants during twenty-four hours.—Jules **Stoklasa**: The physiological function of iodine in the organism of the sugar beet. Plants behave differently according to the species, when grown in the presence of minimal amounts of alkaline iodide: some are poisoned, others are apparently uninjured. After some preliminary laboratory experiments with sugar beet plants with and without potassium iodide, some field experiments (1·72 grams iodine per hectare as potassium iodide) showed an increase in the iodised plots of 8 per cent. on the leaves and 24 per cent. on the roots, the proportion of sugar remaining practically unaltered. —H. **Hérissey** and J. **Cheymol**: The synthetic action of α-δ-mannosidase in the presence of some monovalent alcohols.—E. **Sollaud**: The "pœcilogonic polymorphism" of *Palæmonetes varians*.—Marcel **Duval**: The remarkable constancy of the internal medium of the marine teleosteans. In previous communications it has been shown for several fishes that a modification in the salinity of the water in which the fish lives causes a corresponding change in the osmotic pressure of the body fluids. In the conger and other teleosteans, on the contrary, the osmotic pressure of the blood serum as measured by the depression of the freezing point is remarkably constant, and almost independent of the salinity of the medium.—E. F. **Terroine**, A. **Feuerbach** and E. **Brenckmann**: The global composition of the organisms in various diet deficiencies.—Alphonse **Labbé**: Allelogenesis in the Metazoa and Protozoa.—Aug. **Michel**: Histogenesis of the elytra in regeneration in *Halosydna gelatinosa*.—Ph. **Joyet-Lavergne**: Golgi's apparatus in gamogony of the Coccidium *Aggregata Eberthi*.—Claude **Gaillard**: The fishes of the Nile figured in Egyptian tombs of the ancient empire.—E. **Topsent**: The young state of the Ectyonines.—Armand **Dehorne**: Asexual multiplication in the Dodecaceria of Portel by metameric fragmentation, or process of ctenodrilisation.—L. **Hédon**: Basal metabolism in experimental pancreatic diabetes' according to the gaseous exchanges. The action of insulin on this metabolism.—L. **Panisset** and J. **Verge**: Bird diphtheria and contagious epithelioma. An experimental study.—Léon **Marchand** and Raymond **Moussu**: Experimental and anatomo-pathological researches on enzootic encephalitis of the horse (the Borna disease).—H. **Vallée**: The tubercle bacillus and an irresorbable excipient. The comparative results of the inoculation of cattle with an attenuated virus in emulsion with water and with talc or vaseline oil.—Et. **Burnet**: The micro-organism of epizootic abortion (*B. abortus*) vaccinates man and the ape against Mediterranean fever (*M. melitensis*).

MELBOURNE.

Royal Society of Victoria, November 17.—Mr. Wisewould in the chair.—F. **Chapman** and F. A. **Cudmore**: New or little-known fossils in the National Museum. Pt. xxvii. Some Cainozoic fish remains: with a revision of the group. Some of the well-known living genera have an antiquity of at least three or four million years. Amongst these are the nurse sharks (Carcharias), the hammer-headed shark (Sphyrna), the bulldog shark (Odontaspis), the blue pointers (Lamna and Isurus), and the great white shark (Carcharodon). The latter, in Miocene times, reached its acme of gigantism, for the teeth that are found in the Miocene of Eastern and Western Victoria indicate a fish which must have attained a length of nearly a hundred feet. Several of the species here newly recorded have been known from New Zealand deposits.—W. J. **Harris**: Victorian graptolites (New Series). Pt. i. Some Lower Ordovician graptolites are described, and with them an important zonal graptolite, *Didymograptus v-deflexus*. Then Upper Ordovician graptolites from the Gisborne district are discussed.—G. G. **Heslop**: Further studies in contagious bovine pleuro-pneumonia: experiments to demonstrate the occurrence of two distinct types of the virus in Victoria. Two cultures were obtained which showed marked differences in their behaviour with known positive sera when used as antigens in agglutination tests. (1) Culture X used as antigen with several known positive sera gave some positive and some negative reactions. (2) Culture Y used as antigen with the same known positive sera as in (1) gave positive reactions with those sera reacting negatively with culture X, and gave negative reactions with those sera reacting positively with culture X. Culture X and culture Y represented two distinct strains or types of the causal organism of contagious pleuro-pneumonia; each strain or type capable only of reacting positively with a known positive serum of a homologous type. It is therefore necessary, when conducting agglutination tests with this disease, to ascertain first the type of the organism present in each particular outbreak. It is possible that, for the purposes of preventive inoculation in the tail, a type Y culture will only confer immunity against a type Y infection, and a type X culture against a type X infection.

SYDNEY.

Linnean Society of New South Wales, November 28. —Mr. A. F. Basset Hull, president, in the chair.—E. **Cheel**: New or noteworthy plants from the National Herbarium, Sydney. Notes on 17 species and 2 varieties, of which 2 species (1 each of Dillwynia and Diploglottis) and 1 variety (of *Isopogon anemonifolius*) are described as new.—J. R. **Malloch**: Notes on Australian Diptera, with descriptions. Notes on species which have usually been placed in the family

Anthomyiidæ. All the genera dealt with belong to the group which has the first posterior cell of the wing not or but little narrowed at apex, the fourth vein but slightly or not at all curved forward apically and never angularly bent some distance from its apex. Nineteen species are described as new.—M. B. **Welch**: The occurrence of secretory canals in certain Myrtaceous plants. Secretory canals or oil ducts occur in certain species of Tristania and Syncarpia, not only in the medulla, but also in the cortex. The ducts are more numerous than in Eucalyptus and Angophora. Their function is probably protective, since they are found in close proximity to the vascular tissue and in the kataphylls protecting the leaf buds as well as in the secondary phloem in certain species.—P. **Brough**: Preliminary note on the embryo sac of *Styphelia longifolia* (R.Br.). An important phase (megasporogenesis) in the life-history of *Styphelia longifolia* (Epacridaceæ). The micropylar megaspore functions in place of the chalazal spore, a rare occurrence in the Angiosperms, and especially so in the Sympetalæ.—May M. **Williams**: A contribution to our knowledge of the Fucaceæ. An account of the branching, oogenesis, and parasitism of *Notheia anomala*, and of the oogenesis and spermatogenesis of *Phyllospora comosa*.—R. **Greig-Smith**: The high temperature organism of fermenting tan-bark. Pt. iv. The effect of chill. The inability of the high temperature organism to ferment solutions of citrate was traced to the fact that the bacterium was sensitive to chill. Taken from the incubator at 60° C. and distributed in fluid at the laboratory temperature, it was so affected that, while capable of existing or growing slightly, it was unable to ferment the organic salt.—M. **Bezzi**: Fissicorn Tachinidæ, with description of new forms from Australia and South America. A general account of the fissicorn Tachinidæ, containing keys to the known genera, and descriptions of a new genus and species from South America and a new species of Schizotachina from Sydney, N.S.W.

Official Publications Received.

British Research Association for the Woollen and Worsted Industries. Second Report on Sheep Breeding. (Publication No. 29.) Pp. 12. (Headingley, Leeds.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 41: Consolidation of Schools and Transportation of Pupils. By J. F. Abel. Pp. iv+135+13 plates. (Washington: Government Printing Office.) 25 cents.

Queensland Department of Mines: Queensland Geological Survey. Publication No. 274: The Geology of the Cairns Hinterland and other parts of North Queensland. By Dr. H. I. Jensen. Pp. iii+75. (Brisbane: Anthony J. Cumming.)

The Indian Forest Records. Vol. 10, Part 3: A *Sal* (*Shorea robusta*) Yield Table for the United Provinces; with an Account of the Types and Distribution of *Sal* Forests in the United Provinces. By E. A. Smythies and S. H. Howard. Pp. vi+25+5 plates+10 graphs. 9 annas. Vol. 10, Part 4: The Constituents of some Indian Essential Oils. By John Lionel Simonsen. Part 12: The Essential Oil from the Oleo-resin of *Pinus Merkusii*. Pp. ii+7. 2 annas. (Calcutta: Government Printing Office.)

Records of the Indian Museum (a Journal of Indian Zoology). General Index to Vols. 1-20, 1907–1920. Pp. ii+282. (Calcutta: Zoological Survey of India.) 3 rupees.

South Australia: Department of Mines. Mining Review for the Half-year ended June 30th, 1923. Pp. 62. (Adelaide: R. E. E. Rogers.)

Madras Fisheries Department. Bulletin No. 15: Fishery Reports for 1922. Edited by James Hornell. Pp. 166. (Madras: Government Press.) 2.2 rupees.

Scottish Marine Biological Association. Annual Report, 1922. Pp. 47. (Glasgow.)

Diary of Societies.

SATURDAY, JANUARY 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. Reynolds: The Couperin Dynasty.

MONDAY, JANUARY 28.

INSTITUTE OF ACTUARIES, at 5.—C. H. Maltby: Some Suggested Amendments to the Assurance Companies Act, 1909.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. F. Cook: Observations on the "Toxæmias" of Pregnancy.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. K. Rideal: Colloid Chemistry (Cantor Lectures (2)).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—P. S. Campkin: A Lens Permeable by Ultra-violet Ray—used by Patient.—Sir Frank Colyer: A Note on Caries of the Teeth of Old-World Monkeys (with lantern demonstration illustrating "Irregularities of the Teeth of Old-World Monkeys").

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—S. C. Bullock: The Tocantins and Araguaya Rivers, Brazil.

TUESDAY, JANUARY 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. Dendy: What is Heredity? (1).

INSTITUTION OF MARINE ENGINEERS, INC., at 6.30.—H. Campbell: The Gas Turbine.

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill, E.C.3), at 7.—Dr. A. C. Thaysen: The Effect of the Action of Micro-organisms on Fibres and Fabrics.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. Williams: Book Illustration previous to Photography.

WEDNESDAY, JANUARY 30.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Fleming: The Employment of Antiseptics in the Treatment of Local and General Infections.

ROYAL SOCIETY OF ARTS, at 8.—Sir Richard A. S. Paget, Bart.: The History, Development, and Commercial Uses of Fused Silica.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—A. Mallock: Summary of the Results obtained from Experiments made during the years 1918 and 1923 of the Effects of Temperature on the Properties of Metals.—A. K. Goard and Dr. E. K. Rideal: Catalytic and Induced Reactions. Parts I. and II.—*To be read in title only*:—Prof. H. B. Dixon and G. Greenwood: The Velocity of Sound in Gases and Vapours, and the Ratio of the Specific Heats.—Prof. J. R. Partington and A. B. Howe: The Ratio of the Specific Heats of Nitrogen and of Oxygen.—S. Barratt: The Absorption Spectra of Mixed Metallic Vapours.—E. P. Metcalfe and B. Venkatesachar: Selective Absorption by Luminous Mercury Vapour.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Dr. W. J. Smith Jerome: The Physiological Action of the "Dry Inhalation of Sodium Chloride": an Italian Method of Treatment.—Dr. Mahomed: Sea-Water Injections.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. W. M. Thornton: Some Researches on the Safe Uses of Electricity in Coal Mines.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. C. Tilney: An Impromptu: Naturalism in Photography.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Clinical-pathological Evening.

FRIDAY, FEBRUARY 1.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. Jefferson: Injuries of the Cervical Spine.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Ward: Torsion Meters.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. A. Mawer: English Place-name Society.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Recent Research on Crystalline Structure.

SATURDAY, FEBRUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Wallace: Influence upon Composition of Improvements in Musical Instruments.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—H. Main: A Pilgrimage to Provence.

PUBLIC LECTURES.

SATURDAY, JANUARY 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Tombs and their Contents.

MONDAY, JANUARY 28.

IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES (Metallurgy Department), at 5.15.—Prof. H. H. Dixon: The Transpiration Stream. (Succeeding Lectures on January 29 and 30.)

UNIVERSITY COLLEGE, at 5.15.—Dr. A. S. Parkes: The Mammalian Sex-Ratio. (Succeeding Lectures on February 4, 11, 18, 25, and March 3.)

ROYAL SANITARY INSTITUTE, at 5.30.—Dr. C. Porter: Introductory Lecture to Courses of the Institute.

TUESDAY, JANUARY 29.

LONDON (R.F.H.) SCHOOL OF MEDICINE FOR WOMEN, at 5.30.—Dr. G. Fitzgibbon: The Treatment of Contracted Pelvis. (Succeeding Lectures on January 30 and 31.)

UNIVERSITY COLLEGE, at 5.30.—G. A. Sutherland: Acoustic Demands in Auditorium Design.

FRIDAY, FEBRUARY 1.

KING'S COLLEGE, at 5.—Dr. W. D. Lang: Some Recent Work in Palæontology bearing on Evolution. (Succeeding Lecture on February 8.)

SATURDAY, FEBRUARY 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. N. Bromehead: A Geologist's History of London.