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Science and Empire Building

IT is distinctly unusual for the Governor-General of a great Dominion to deliver an important scientific address; yet that is what recently happened in New Zealand when Lord Bledisloe gave the Cawthron lecture, which is there regarded as the annual pronouncement *par excellence* on modern movements in science and their relation to the life of the community. Lord Bledisloe chose as his title "A Conspectus of Recent Agricultural Research" and the choice was doubly happy in that the subject is of profound importance to the people of New Zealand and that he himself is so well qualified to deal with it. Nowhere in the world is scientific agriculture more highly developed and nowhere can one gather a more discriminating and better informed audience to listen to an agricultural lecture than at the Cawthron Institute on the occasion of this annual function.

The cordial welcome given to the discourse by the New Zealand Press was much more than a compliment to the popularity of the Governor General. The address is admirable both in range of subject matter and in presentation.* Lord Bledisloe begins appropriately with an account of the work on soils and plant growth, this being fundamental to all agricultural systems. The account of the Rothamsted experiments on cultivation and fertilisation of crops and on the making of new pastures is followed by a description of the Jealotts Hill investigations on the intensive manuring of pastures, and of the Aberystwyth work on the improvement of hill grazing. This naturally leads to a survey of the effects of mineral deficiencies on the composition of the herbage and on the health of the animals grazing thereon. Fundamental studies on this subject are made at the Rowett Research Institute at Aberdeen, but New Zealand has contributed in no small measure to the advances made in recent years.

Stress is rightly laid on the need for an adequate soil survey of the country. Much is already being done in New Zealand and appropriate methods are being worked out: meanwhile the underlying principles are being studied at Rothamsted, Bangor, Aberdeen and elsewhere.

Dairy research comes in for a great deal of attention because, as Lord Bledisloe rightly points out, uniformity in the butter and the cheese exported to Great Britain is an essential condition of their saleability and stable reputation in British

* Copies of the lecture can be obtained from Messrs. Whitcombe and Tombs, Ltd., 3 Addle Hill, London, E.C.4, price 1s.

markets. Nothing has contributed more to the attainment of this desirable characteristic than the production of commercial 'starters' commenced in Denmark some forty years ago and now widely used wherever dairying has become a science. So much research has been done on the feeding of animals and so advanced is the good farmer's knowledge of this subject that, in Lord Bledisloe's view, "if the average human being knew as much about the feeding of himself and his children as the average farmer knows about that of his stock, the average standard of human health and physical energy would be at least 33 per cent higher than it is. Probably as much as 50 per cent of the therapeutic activities of physicians, druggists and clinics is referable, directly or indirectly, to avoidable dietetic indiscretions based on ignorance of the fundamental principles of animal nutrition".

This statement is supported by some remarkable evidence. It is stated, for example, that the Plunket or Truby King system of feeding infant children has reduced the New Zealand rate of infant mortality under twelve months from 80 per 1,000 in 1889 to 32 per 1,000 in 1932, a figure which gives New Zealand the best record in the world and compares with 71 per 1,000 in England and Wales, 109 in Germany and 124 in Italy.

The chief export from New Zealand is wool, and no small part of the present depression in New Zealand is due to the low prices now obtained owing to the quantity of this commodity on the market; every penny per pound of wool sold represents £1 million in the national revenue. Naturally New Zealand is deeply interested in the research work on wool now going on in Great Britain: the search at Leeds for definite standards of grading which would enable the manufacturer to tell the farmer exactly what types of wool he wants; the studies at Edinburgh of the inheritance of the more important characteristics of the wool; and the Rowett Institute investigations on the relation between the composition of food and the yield of wool.

Next in importance to wool, and probably of more significance for the future of the country, come the dairy and meat industries, both of which ultimately depend for success on low temperature transport. Great Britain will probably always be New Zealand's best customer and the journey will always have to be across the equator; however much it may be shortened, there will always be

the need for low temperature transport and storage. Research on this subject is now being taken up seriously and scientifically at Cambridge and elsewhere, and further developments may be expected in the near future. It is very gratifying to observe how much of the work that made so strong an appeal to Lord Bledisloe's highly skilled audience had been done in the agricultural research institutes of Great Britain.

The address is important not simply because of its subject matter, but much more because of its significance. The British Empire was founded by adventurous soldiers and sailors; it was developed by courageous farmers and settlers who, often struggling against fearful odds, brought the land into cultivation, built roads, railways and cities, and laid out the countryside as a vast agricultural estate. It has been knit together by bonds of sentiment steadily growing among the people and fostered by wise statesmen, writers and teachers. But the lands of the Empire have nowhere reached the limits of their development. The first feeling of an agricultural expert in visiting any of the great dominions is one of wonder at the vast natural resources still awaiting development.

Courage and hard work have played and must continue to play their part; science has now come in, vivifying with magic touch many an enterprise that seemed beyond hope, and achieving tasks which but a short time ago would have been deemed impossible. No one can tell where the applications of science will stop; for the present, the one thing certain is that they will go on at an increasing pace, playing an ever-growing part in the lives of all who are so directly dependent on natural forces as are the agricultural communities of the dominions. The Empire builders of to-day are the men and women who in Great Britain and overseas are quietly studying the scientific problems that so deeply concern the comfort and well-being of those living in the distant lands.

The change has far-reaching consequences. More and more it is becoming essential that the administrator should have a full appreciation of the part that science should play in the life of the community. Lord Bledisloe's undoubted success in New Zealand is due in no small measure to the fact that he recognises the value of science and so is able to enter more sympathetically into the life and problems of the Dominion than would otherwise be possible. The Cawthron address of this year may well be a significant portent.

The Science of Society

Societal Evolution: a Study of the Evolutionary Basis of the Science of Society. By Prof. Albert Galloway Keller. Revised edition. Pp. ix+419. (New York: The Macmillan Co., 1931.) 12s. 6d. net.

ONE of the most vital and important contributions that science can make to modern thought must surely be in the realm of social science, of sociology, or the science of society—to use the older term now adopted by Yale University. The question of its exact definition and scope, or of its relations with other kindred sciences, such as economics, history, anthropology, politics, psychology, ethics, is of small moment compared with that of making a really worth while contribution to the solution of at least some of the problems of modern civilisation.

The most hopeful line of approach hitherto has been along the lines of evolution as applied to human society. This, however, has been found to be a much more difficult and complicated matter than, in the first flush of Spencerian enthusiasm, was anticipated; and even with the powerful aid of Benjamin Kidd all difficulties were by no means cleared away. The complexity of the subject is strongly emphasised in the remarkably able book by Prof. A. G. Keller under notice, in which the attempt is made to give sociological study a fructifying definite orientation, similar to that given by Darwin in biology. The author insists that the “reasoning by analogy” of previous writers on social evolution has been vague and largely futile. There is, in human society, something more than mere analogy to organic evolution: there is real and specific variation; selection, counter-selection, transmission (in place of heredity) and adaptation.

Keller soon makes it quite clear that he does not identify evolution necessarily with progress. He find it next to impossible to define progress. At best we can only have adjustment. Man remains, physically, “unchanged in a changing environment” because he uses his brain and social organisation to make the necessary adjustments for tolerable existence. Such adjustments, often beginning with individual acts to meet special needs, confirmed by trial and error, and finally adopted by the social group, ultimately reach the status of convention, public opinion, mores, laws, and religious sanctions.

One of the first great principles of social science

here emerges. All social action is controlled by convention. Yet, says Keller, this convention or custom is of such labyrinthine complexity and general pervasiveness that it is a difficult conception to handle, and its reduction to a more manageable shape by Sumner in his “Folkways” was a real *tour de force*. One can readily echo this high praise of Sumner’s work even from the brief synopsis here given. The folkways of primitive society are likened to the cells of organic life. The mores are an advanced stage of folkways and include a judgment that they are conducive to societal welfare. Their origin, the rise of institutions, morals, law, and religion are described, and at the same time the scientific student is warned against

“The philosophers, a term which must be understood to mean medicine men, prophets, law-givers, sages, theologians, and poets, who try to think out into general propositions of world philosophy, or of rights and duties in ethics, those views of welfare which the mores suggest. They want to bring the experience and theory of the mores into relation with the sweeping horizon of ghost-fear or mythology, or with general conceptions of the ‘good’, such as the advantages of courage, truthfulness, hospitality, and fidelity to the spoken word. This is what has been called ‘thobbery’, that is, thinking (wishfully) without interest in actual verification” (from an unpublished fragment by W. G. Sumner).

This is not too clear; but it is characteristic both of Sumner and Keller that they have no undue respect for ‘great men’ either in the classes noted above under the term ‘philosopher’ or any other class.

The agent of variation, which is constantly going on or being attempted, is the individual, often a ‘great man’ or several of these acting independently under a common stress or need. At any stage there are plenty of budding variations in the mores to select from. Ideas tumble over each other in the face of the need which evokes them. In any great crisis, even though world-wide as at present, there is no lack of ideas. The difficulty is to test, judge, select, apply. Experiments must be made. There is, however, says Keller, a kind of automatic regulation of this matter which resides in the process of societal selection.

The intricate processes and methods of selection, irrational and rational, and of counter-selection, the product of humanitarianism, are dealt with at considerable length. Selection is mainly effected

by the masses—the great bulk of the people with the supermen lopped off at the top and the defectives lopped off at the bottom of Sumner's turnip diagram. The Sumner-Keller view is that the masses are conservative, living on tradition and habit, the result of inertia. The folkways are their ways. They accept influence or leadership or new teaching, but not always in the form in which it is offered to them. They assimilate it slowly and with frequent modification. It is wrong to think they have any occult wisdom or inspiration by virtue of which they select what is wise, right, good. The 'great man theory', as expounded, for example, by Carlyle in his "Hero-Worship", is fundamentally different from, indeed it is the complete antithesis of, the views here expressed. Keller says the great man is merely the product of his time and its needs: he is only incidental. The results attributed almost solely to him would have come to pass in any case. He has had the luck, together with some natural endowment, to see and to some extent anticipate the impending changes. Another great principle here then emerges: the determining social cause of change is something very different from the human agency. "The latter is always secondary and relatively incidental and wholly ineffective by itself. To confuse the two is to miss essential truth. *The effective cause lies in the unpremeditated movement of the masses of men.*"

The difficulties are real enough and loom up mountainously, especially in connexion with those irresistible impersonal forces which Keller so often mentions and which, in his view, are the final arbiters of human destiny, though they originally seem to spring from the mores and are thus of human origin. Are they then so completely uncontrollable, irresistible, and impersonal?

Sumner says that the sound student of sociology can hold out to mankind as individuals or as a race only one hope of better and happier living. That hope lies in an *enhancement of the industrial virtues and of the moral forces which thence arise*. Industry, self-denial, and temperance are the laws of prosperity for men and States; without them, advance in the arts and in wealth means only corruption and decay through luxury and vice. The power of the human race to-day over the conditions of prosperous and happy living is sufficient to banish poverty and misery if it were not for folly and vice. This is splendid and should inspire a comprehensive plan of action for the present age. But have we in all this those arbiters of human

destiny, those irresistible impersonal forces on our side? It would seem so; for Keller says that they invariably act in the direction of making the right adjustment, the one that is expedient for any particular time and environment. The old questions again arise: To what extent can man control his destiny, and how far can science alone go?

'The power of the human race' is a fine phrase. That power is undoubtedly greater than is often imagined. With this tremendous latent power awakened under the right stimulus, the urgent need, the national crisis, the faithful lion-hearted leadership, and with all the forces of the modern State, scientific, industrial and the rest, what could not a great nation accomplish, if, to all this, we add intelligent world co-operation? We find it a little difficult to reconcile these possibilities with those mysterious irresistible impersonal forces—resident in the masses—which yet work to human ends to the extent at least of making expedient adjustments. Nor do we think Keller quite appreciates the part played by the great man in history. There is doubtless much in what he says, but his examples here are not too happily chosen, and we still incline to the Carlylean view. Then again, as to progress, quite possibly from a strictly evolutionary point of view, we cannot necessarily expect progress. But yet, even at the risk of being guilty of 'thobbery', we must have some ideal at which we can aim, some sense of progress, or possibility thereof, for without this a science of society is going to be insipid. Perhaps the evolutionary point of view is inadequate. We think, further, that the author has underrated the potential hopes which reside in social experiment, in definitely planned policies of reconstruction and betterment. He says (page 205):

"This kind of thing (experiment and verification) may not be done in the domain of the social sciences, for the mores forbid man to experiment upon man. What goes by the name of social experimentation lacks rigor in its processes and emerges with vague and inconclusive results. The best the social scientist can do is about equal to the worst the natural scientist has to put up with: to wait on nature to perform quasi-experiments for him and to search history for those she may have performed."

The difficulties of social experiment are undoubtedly great, but does the above quotation adequately portray all that lies in this direction? It seems that it is precisely here that the greatest and highest hopes of social science must reside;

just here that it may hope to find means to rise to the rank of a true science based largely on experiment. The present writer has often reflected on the fair and stately prospects of an experimental sociology. In *NATURE* of Sept. 10, pp. 392-3, commenting on the excellent articles by Dr. Jacks and Prof. Miles Walker, it is stated that the time is opportune for courageous and adventurous experiment, and this is only too true.

The prospects of successful experimental methods are closely bound up with environment and the extent to which it can be controlled; but here Keller is comparatively silent. He says little about environment, though it is the supreme and all-important factor in evolution, especially in 'societal' evolution. In this latter it must differ in many fundamental ways from organic or natural environment. Among other things it should be more amenable to control, for example, slum-clearing. Many of the parts or items in environment are themselves subject to evolutionary processes. Keller observes, for example, that religion is a life condition of the first magnitude, yet he considers that, too, is subject to evolution. All this and much other vitally important and interesting matter could be discussed under the heading of environment. It is indeed as much deserving of a chapter to itself as variation or selection.

W. G. L. C.

Land and Fresh-Water Molluscs

Fédération française des Sociétés de Sciences naturelles: Office central de Faunistique. *Faune de France*. 21: *Mollusques terrestres et fluviatiles* (première partie). Pp. 477 + viii + 13 plates. 22: (deuxième partie). Pp. 479-897 + ix-xiv + plates 14-26. By Louis Germain. (Paris: Paul Lechevalier, 1930-31.) 150 francs each.

THE preparation of this work has involved a critical revision of the land and fresh-water molluscs of France, during which the author has made full use of the rich material at his disposal in the Museum d'Histoire Naturelle in Paris. One of the results of the revision is that a large number of species have been reduced to synonyms.

A short account of the anatomy of the gastropods and the lamellibranchs precedes a consideration of the characters of the shells and their anomalies and abnormalities. Passing to the faunistic section, the author distinguishes three principal associations of land molluscs—the hygrophilous, the xerophilous and the forest groups. The

aquatic molluscs also fall into three series according as they live in running water, in quiet or stagnant water, or in large lakes. The most characteristic members of each of the six groups are named. In a short note on the molluscan fauna of the mountains the author states that the maximum altitude at which a large number of species live is known with considerable precision for the alpine region but less fully for the Pyrenees. Only a few terrestrial species, for example *Vitrina nivalis*, can exist under the severe conditions found at a height of about 3000 metres. This species disappears below about 2300 metres. Of the lamellibranchs, *Pisidium casertanum* is found in lakes at an altitude of about 2200 metres in the Pyrenees and up to 2500 metres in the Alps. For most of the species the author states the maximum height at which they have been found.

The molluscan population of France, which includes representatives of the majority of the European genera, falls into three groups—the southern, which is essentially Mediterranean in origin, the Atlantic or Lusitanian, and the northern, though these have not entirely preserved their individuality as migrations have taken place; for example, some of the Mediterranean species have migrated northwards even to the shore of the Channel. Lists of the characteristic species of the three groups are given. Useful observations on polymorphism precede the dichotomous keys to the 41 families of gastropods and the three families of lamellibranchs, to the genera and to the species which comprise the terrestrial and fluviatile molluscs of France.

Carefully devised dichotomous keys form a special feature of the "Faune de France" series and the present author has devoted much care to their preparation in this work. The characters of each genus and species are concisely but adequately described and notes are added under each species on the habitat, biology and distribution. The illustrations consist of twenty-six good collotype plates reproducing photographs of the shells of large or moderate size, and 860 text-figures of the small shells, considerably magnified, of characteristic details of shells and of the reproductive organs of the genera and subgenera of the gastropods. A bibliographical list (pp. 46) and a full systematic index are added. This work is commendable for its careful attention to the biology as well as to the systematics of the terrestrial and fluviatile molluscs.

Electrochemistry

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 12: *Elektrochemie.* Herausgegeben von K. Fajans. Teil 1: *Leitfähigkeit und Überföhrungszahlen in flüssigen und festen Elektrolyten.* Von Prof. Dr. L. Ebert und Prof. Dr. C. Tubandt. Pp. xvi + 496. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 45 gold marks.

THE last decade witnessed a violent revolution in our fundamental conceptions of the electrochemistry of solutions, in the course of which the classical theory of Arrhenius, postulating incomplete ionisation of strong electrolytes and constant ionic mobilities, was dethroned in favour of the Debye-Hückel theory, postulating complete ionisation with ionic mobility a function of concentration. In a sense, this revolution is still incomplete, since several important points in the Debye-Hückel theory are not yet satisfactorily developed and the original ideas of Arrhenius must still be called into service in connexion with weak and transition electrolytes, but remarkable changes have been effected in a domain where conditions were long regarded as settled and, after a great deal of natural hesitation in certain quarters, practically all the experts in the field have now reconciled themselves to the new regime.

The work under review offers a comprehensive account, both practical and theoretical, of the present state of affairs with regard to electrical conductivity and transport numbers in liquid and solid electrolytes, leaving electromotive force and polarisation for a second 'half-volume'. It is true that many portions of the field here covered have already been more or less satisfactorily treated in smaller separate monographs, but the difficulty of correlating these with one another has considerably diminished their usefulness, and awkward gaps in their alignment frequently rendered the original literature the only safe guide for the inquiring investigator.

The greater part of the book, naturally, is occupied with a discussion of the conductivity of liquid electrolytes. Methods of measurement, with all the modern refinements thereto, are described in detail, and the interpretation of the experimental results is systematically and simply presented. This section, together with the succeeding chapters on transport numbers in liquid

electrolytes, is the work of Prof. L. Ebert of Würzburg. The concluding portion, which deals with conductivity and transport numbers in solid electrolytes, has been written by Prof. C. Tubandt of Halle, and is largely a description of his own important contributions to these very difficult topics.

It is interesting to note that the scope of the volume throughout is international rather than national, the contributions of British and American research workers being very generously acknowledged. Altogether, the volume is one which can be commended without hesitation to electrochemists of all ages and all stages.

JAMES KENDALL.

Blackwater Fever

Researches on Blackwater Fever in Southern Rhodesia. By Dr. G. R. Ross. (No. 6 of the Memoir Series of the London School of Hygiene and Tropical Medicine.) Pp. vi+262. (London: London School of Hygiene and Tropical Medicine, 1932.) Paper, 8s.; cloth, 10s. 6d.

THIS report is the result of the work done by the author during his tenure of the Rhodesian research fellowship from April 1925 until April 1929. It is divided into three parts, the first of which is concerned with the epidemiology of the disease.

In a chapter describing the distribution of blackwater fever among the population of Southern Rhodesia, there is an interesting table which records the number of cases of the disease admitted to hospital and the number of fatal cases during each of the years 1914-28. The total cases numbered 679 and the deaths 152, giving a fatality rate of 22.2 per cent. It is significant that whilst the fatality rate varied considerably in different years, it showed no general tendency to decrease during the 15 years under consideration; in the four years, 1914-17, it was 24.2 per cent and in the last four years of the period, 1925-28, it was 27.9 per cent. These figures, which are by no means unique, might with great advantage be borne in mind by those who, being more highly endowed with optimism than with critical judgment, see fit to make extravagant claims for the success of particular lines of treatment based upon the observation of half a dozen cases or even, alas, of only one or two.

Part 2 is concerned with the changes in the blood and urine occurring in the disease. The author has rightly assessed the importance of

examination of these fluids in any investigation designed with the object of elucidating some of the many mysteries of blackwater fever. Much valuable information has been collected, but it is unfortunate that Dr. Ross was unable to make any quantitative estimations on the degree of hæmoglobinæmia during the passage of blackwater. The matter is of such importance for an understanding of the mechanism of the disease, and so many diverse statements, based frequently on careless and inadequate observations, appear in the literature of the subject, that new, and carefully made, quantitative estimations of the hæmoglobinæmia in blackwater fever are greatly to be desired.

On the all-important subject of the mechanism of suppression of urine in blackwater fever, the author writes as follows :

"One is thus forced to conclude that suppression cannot be entirely explained by the assumption that it depends principally upon the sodium chloride content and the acidity of the urine. If the phenomenon is to be explained by purely physicochemical reasons, the part played by other electrolytes present in the urine would seem to be equally important to that played by sodium chloride. It seems preferable to adopt the view of *Yorke and Nauss* (1911) that precipitation depends upon the degree of concentration of the urine and is facilitated by any factor which interferes with the secretion of water by the malphigian body. This may result from damage as a result of the excretion of the foreign protein hæmoglobin, from lowering of the blood-pressure, or for more obscure reasons."

In Part 3, which consists of clinical observations and of remarks on prophylaxis and treatment, the author discusses in some detail the question of the alkaline treatment of the disease. He writes that this method of treatment has received such extensive publicity that there is some danger of its being regarded as a panacea. Whilst he agrees with Baker and Dodds that in *in vitro* experiments precipitation of hæmoglobin takes place according to the conditions they describe, Dr. Ross considers that the time necessary for precipitation to occur makes it difficult to imagine such changes taking place during the passage of urine down the renal tubule. He favours the older view of *Yorke and Nauss* (1911), as stated above, that precipitation depends upon the concentration of the urine and is facilitated by any factor interfering with the secretion of water by the malphigian body. He is thus not inclined to favour the alkaline treatment more than any

form of treatment which has copious diuresis as its object.

Dr. Ross is to be congratulated on an excellent piece of work, for not only has he made many valuable observations himself, but also he has collected together from an enormous and scattered literature the relevant observations of other workers; and he has brought the whole mass together into a single volume of moderate size wherein it is possible to discover the present position of knowledge on any of the many problems which this mystifying disease presents.

Short Reviews

Natural Varnish Resins. By T. Hedley Barry. Pp. xii + 294. (London: Ernest Benn, Ltd., 1932.) 42s. net.

ALTHOUGH we hear much of synthetic resins nowadays, the natural resins lose none of their importance in the industrial arts, and it is useful to have a comprehensive work on the subject by an author of such repute in the varnish industry. To some extent it is a development of a previous book, covering also the synthetic resins, by Barry, Morrell and Drummond, and the experience then gained has been used in bringing the present work thoroughly up to date. It is divided into two parts, the first, covering some forty pages, dealing with such general questions as the physical properties, solubility, constituents and chemical examination of resins. In the second part the individual resins are described at length.

Copious references are given to the original papers. The book is illustrated with maps and a considerable number of photographs. It is well produced, but the high price will tend to restrict its sale to industrial laboratories.

The salient facts as regards any particular resin relate to its origin and collection in different parts of the world, its analysis, and its chemical composition. The chemist has still a lot to do in elucidating the composition of these substances: they consist essentially of acids and neutral bodies, and their 'acid value' is one of the criteria applied to them. Some of them are phenanthrene derivatives, as, for example, pimanthrene from copal and retene from rosin, and a good deal is beginning to be established about the constitution of the resin acids. It is believed that in the tree they are built up by condensation of isoprene, which is now considered to be the basic building stone of so many plant products—the terpenes, rubber, carotene. In the past the chemist has studiously avoided in the laboratory all those reactions which led to the formation of resins, but the march of industry is forcing him both to study them and even to seek to imitate the tree in making them synthetically. Of course, the chief characteristic of the resins is that they are colloids,

and their diverse applications in the industrial arts are in virtue of this property.

The book makes no attempt to indicate, other than very briefly, the use of the resins, either individually or collectively.

E. F. A.

(1) *Proceedings of the Second International Congress for Sex Research, London, 1930*. Edited by A. W. Greenwood. Pp. xi + 637 + 33 plates. (Edinburgh and London: Oliver and Boyd, 1931.) 21s. net.

(2) *The Conquest of Old Age: Methods to Effect Rejuvenation and to Increase Functional Activity*. By Dr. Peter Schmidt. Translated by Eden and Cedar Paul. Pp. xvii + 319 + 40 plates. (London: George Routledge and Sons, Ltd., 1931.) 21s. net.

(1) THE Second International Congress for Sex Research was held in London in 1930, when more than 250 members from about thirty different countries were present. Nearly all the papers delivered have now been published in the proceedings of the Congress. The editor has arranged them in five sections, biology, hormones, therapy, contraception and sociology. The majority of the papers deal with the physiology and biochemistry of the sex hormones and afford an excellent summary of recent work on this subject, since they are given *in extenso* with figures and tables, instead of in abstract as is more usual in the published reports of congresses.

(2) The other volume before us deals with only a small corner of the field of sex research, namely, the problem of rejuvenating the organism by stimulation of the internal secretion of the sex glands or by provision of this secretion from an external source. The author devotes a certain amount of space to refuting the criticisms which have been levied against the grafting of sex glands or the operation of vaso-ligature and also to attacking his critics. Perusal of the numerous case histories quoted shows the difficulty of maintaining a critical attitude in the evaluation of the results of the operations. It must, however, be remembered that all the functions of the body, and not the sexual alone, on which the emphasis is sometimes laid, are stated to be rejuvenated: thus digestion is improved, intellect functions more sharply and movements are brisker.

Both these volumes may be studied by those interested in the effects produced on the body by the most recently isolated hormones and in the therapeutic possibilities opened up by these investigations.

Archæology in England and Wales, 1914-1931. By T. D. Kendrick and C. F. C. Hawkes. Pp. xix + 371 + 30 plates. (London: Methuen and Co., Ltd., 1932.) 18s. net.

THIS book, the authors explain in their preface, is an enlarged English version of an article in German to be published under the auspices of the Romisch-Germanische Kommission of the Deutsche

Archäologisches Institut. Chapters have been added which deal with Roman and Anglo-Saxon antiquities.

The preparation and publication of this version was a happy thought, upon which archaeologists will congratulate the authors, and for which they will be duly grateful. A critical survey such as this is useful as a reminder of how much fresh evidence has accrued during the last seventeen eventful years—and the amount is indeed considerable—and it serves to stimulate research by bringing into relief points upon which further evidence is required before anything approaching certainty in conclusion is attainable. For confirmation we need only refer to Mr. Kendrick's admirably impartial summary of the evidence available, at the time of writing, which relates to the earliest stone age industries in England. On the other hand, the considerable advances that have been made may be gauged—to take one example only—from the chapter on the 'Henge' monuments.

Of the twelve chapters into which the book is divided, Mr. Kendrick is responsible for Chaps. i-viii and Chap. xii, while Mr. Hawkes has written Chaps. ix-xi. The numerous illustrations have been chosen with sound judgment and a discrimination which has kept in view the needs of the text.

Astronomy. By Dr. F. R. Moulton. Pp. xxiii + 549. (New York: The Macmillan Co., 1931.) 18s. net.

THIS is an elementary textbook suitable for a general introductory course in descriptive astronomy, and differs from most books of a similar nature in the order of development of its subject and in its balance of emphasis. After introductory chapters on the constellations and telescopes, the earth is considered as an astronomical body. Its nature, motions, and problems connected with time, occupy three chapters, leading naturally to a consideration of the various bodies and phenomena of the solar system. All this occupies the greater portion (400 pages) of the book, and questions relating to sidereal astronomy or astrophysics (apart from solar physics) are relegated to the last two chapters.

The brevity and necessary condensation in the final section leads occasionally to an unfortunate obscurity of style. It also, however, allows other questions to be dealt with more fully than is usual in elementary textbooks; the chapters on gravitation and the evolution of the solar system, as well as parts of the final chapter on sidereal structure, being specially noteworthy in this respect. Nothing of fundamental importance is omitted, and many of the latest advances are well described, such as the discovery of Pluto, axial rotations of stars, and the new constellation boundaries (to a rough approximation). Apart from a few errors and minor blemishes, the illustrations (including numerous reproductions of photographs) form an attractively useful feature of the book.

Bronze Age Mining Round the Aegean*

By O. DAVIES

DURING the bronze age, Greece was remarkably wealthy in gold; though the most sensational finds have been those of Mycenæ, there is little doubt from the amount that has been turned up elsewhere that the contents of the shaft-graves only represent a small portion of the gold that was at one time available. Homer still has many lines reminiscent of the riches of Mycenæ, but seems no longer to be living himself in times of such plenty, and thus many of the gold objects which he describes are said to have been of foreign workmanship. In the early iron age gold was even rarer, as is seen by the astonishment of the Greeks at the regal wealth of a man like Cræsus. One may therefore ask oneself what happened to all the gold, seeing that only some of it seems to have been laid in tombs, and it is not possible for it to be destroyed by rust. Some may have been carried off by pirates, but if we look to the history of the period of reconstruction at the beginning of the iron age, we find two figures noted for their wealth, Midas in Phrygia and Solomon in Palestine; to Solomon may have gone some of the Aegean gold, brought originally to the Levant by the sea-raiders of the twelfth century B.C. or by Phœnician traders; and it is not unlikely that Midas made a good profit by selling to the Greeks the new metal iron before they had learnt to produce it for themselves, though it is probable that he also had gold mines of his own.

It is more difficult to decide where the Aegean peoples obtained their gold. The test by chemical impurities is unsatisfactory owing to the fact that gold, unlike copper, does not have characteristic impurities which are found in one mine but not in others. All the Aegean gold which has been analysed contains a good deal of silver, in amounts varying from 8 to 25 per cent, which suggests the use of native electrum; though some of the early gold, as the early bronze age pieces from Mochlos and Leucas, is of very good colour, there is no record of pure gold having been found in analysis, and in Egypt at least it is certain that the knowledge of purifying gold did not come in until later, probably at the time of the Persian invasion, while Cræsus probably started it in Lydia. On the whole, the late bronze age gold from the Aegean varies in colour, the more massive pieces being yellower than the leaf, which suggests that some method of faking the surface by dissolving the silver was already known, though it was not practicable for thin leaf.

As to mines, Macedonia seems to have been working a little stream gold from early times, as is seen by gold slags found on various sites. Herodotus¹ mentions the gold and silver mines of Siphnos in the seventh century, which were probably at H. Sosti; I have been told that two

golden eggs were found here, ready to be sent as an offering to Delphi, but as they have now been lost this story must be considered doubtful. At any rate, stone hammers have been found in and above the mine, and I found a sherd which seemed to belong to some local sixth century ware, and a number of crucibles. Bronze age sherds, however, have not been found, and there are not many relics of the later bronze age on the island, so that it is probable that gold was not worked here until the iron age and that we shall not find here the source of the gold of Crete and Mycenæ.

To some extent probably local sources, which have since been exhausted, were used in the bronze age; for example, some gold objects have been found in Arcadia, not far from the placer of Doliana. Egypt produced much gold early, and, as there was frequent contact between it and the Aegean, gold may have been one of the articles of commerce. The placers of west Anatolia, especially Lydia, were probably not tapped much before the iron age, considering their wealth and reputation in later times. It may even be that the Danube valley was supplying Greece so early; it has been claimed that some gold found in Egypt came from Transylvania owing to the presence of tellurium*; and though the inference is not certain, since telluride of gold is reported from Andros, yet as there was for a long time a trade route from Egypt and Syria to the Danube, such a source is by no means unlikely.

The early bronze age objects of silver from Amorgos which have been analysed contain much gold and more copper than should remain in the metal after cupelling; they are probably therefore derived from native silver or a silver mineral. But a bar from Troy II and a vase from Mycenæ shaft-graves with a good deal of copper and some lead may have been cupelled badly or debased after cupellation.† The lead found is remarkably pure and almost free of silver, which makes it likely that it is derived from a mineral containing very little silver.

The Laurium mines perhaps were not opened before the seventh or sixth century; nor did they become prosperous until the discovery of the rich lower zone of mineralisation at the beginning of the fifth.² On Mytilene, at Argeno 1½ hours east of Molyvo, are old silver workings in which I found pieces of a black bucchero pot of the seventh or sixth century, now in the Ashmolean Museum. On Kuponisia have been found some ancient mines for argentiferous lead with stone tools,

* The antimony in this gold which was held to prove the presence of tellurium may be an early and sporadic instance of the use of stibnite for de-silvering, a technique otherwise thought to be medieval.

† The presence of a little lead in silver is no convincing proof that cupellation had been practised; cf. Friend and Thorneycroft, *J. Inst. Metals*, 41, 105, 1929, who do not believe that cupelling was known in Greece so late as the seventh century; only the knowledge of cupellation must precede that of liqutation, which probably accounts for the large quantities of lead found in the iron age *aes rude* in Italy.

* From a paper read before Section H (Anthropology) of the British Association on Sept. 7.

which may therefore be quite early, though the use of stone hammers is not confined to the bronze age.³

Other early silver mines are not known in the Aegean⁴ nor is silver common early in Egypt, but there is much in Anatolia. The date of the old mines near Hector's grave in the Trojan Plain⁵ is exceedingly doubtful. Balia was perhaps working early, but the mention in an alchemical author of silver from Adramyttium suggests rather a late date. Silver mines are known at Myndus, but classical writers are silent about them, and the modern name Gümüşlü suggests that they are Byzantine or medieval.⁶

Farther east, there is certainly very early silver mining in Taurus at either Bulgar or Bereketli Ma'den; the Kara Öyük tablets mention the export of silver from this region in the third millennium. In Homer⁷ we read of Halybe as the birthplace of silver; this seems to be located on the eastward land route from Troy along the southern shore of the Black Sea. Such data as we have would point either to the Taurus mines, reached by a road which followed the coast to perhaps the Halys mouth and then turned inland, or to the mines of argentiferous copper behind Tireboli, which are certainly Greek though it is not known how much earlier they go. Again, the story of the golden fleece in Colchis suggests early mining activity in the south-eastern corner of the Black Sea.

The copper of the early bronze age in Crete and the Cyclades seems to be almost entirely free of nickel but usually contains small quantities of lead, arsenic and antimony, while arsenic is sometimes added to colour the surface. These characteristics remain, on the whole, constant throughout the bronze age in Crete, but so far as one can judge from the scanty analyses of mainland objects, the metal contains only lead, arsenic and antimony being rare impurities.

Of the ores which have been analysed, that from Chrysokamino near Pachiammo was not tested for impurities, while that from Gavdos is incomplete but seems to contain about the right amount of antimony and arsenic. The Othrys ores have no nickel and contain little if any antimony and arsenic, though most have a small quantity of lead.

If we compare Aegean copper with that of neighbouring regions in the bronze age, we find that the Italian and Anatolian seem to correspond most closely to it. Analyses of ores from these regions are rare; that from Boccheggiano seems to contain rather too much silver, bismuth and nickel but otherwise agrees fairly well. The ore from Sacili in Macedonia is very similar to Aegean copper, but the mine is small, and I do not think it possible that it can have supplied the whole Aegean for fifteen hundred years; Othrys might also suit. On the whole, the analyses seem to show a constant source for copper in Crete throughout the bronze age, though the mainland copper is more variable and occasionally contains nickel.

We shall see that it is probable that the mainlanders exploited a number of local mines of small importance, so that the compositions of their metal are likely to vary considerably.

To turn to the sites of mines known, I have found in the early bronze age stratum at Volo some copper slag, which I have described elsewhere. The numerous copper mines of Othrys were being worked in Hellenistic times, and for most of them there is no earlier evidence, while prehistoric sites in this area are infrequent; but some bronze double axes and celts were found in a mine at Gardiki⁸. Further, the hoard of ingots shipwrecked at Cyme might suggest the transport of copper from the mines of Othrys to southern Greece rather than the other way, it being by no means certain that these quadrangular ingots come from Cyprus. But it is difficult to say how important Othrys was in prehistoric times as a centre for copper production.

There is a persistent tradition in the ancient authors of a mine of copper and iron at Chalcis, and of an early metal industry there. One can scarcely believe that these stories are a mere invention due to the name of the town, though modern travellers have been unable to locate the mine. I have searched the territory of Chalcis thoroughly, without success; but the most likely locality is in the serpentine ridge just behind the town, which is now partly built over, and in which the mines would have soon been inundated if they had reached any depth. I have found stray pieces of copper slag to the south-east of the town; but the fact that no slag heaps of any size are known makes it probable that the mine was small and only working for a short period.

At Athens I have found pieces of copper slag on the slopes of the Acropolis, with a fragment of crucible which is perhaps early or middle bronze age. This probably comes from the working of some very small deposit; for example, malachite is reported at Colonus and on Ardettus, but the extent of the modern town makes adequate exploration of these sites now impossible.

At Mycenæ, apparently in late bronze age levels, copper slag has been found, and there is in the Athens Museum a tray of malachite galena and sulphur, which was found during Tsoundas' excavations here; unfortunately, it is not recorded where he found it. On both sides of the pass from Mycenæ to Phlius is a little copper ore; I could not find signs of ancient working, but a small opencast might easily be denuded completely or a shaft be filled in. Just above the deposit is a site with rough sherds which looked like early iron age ware. Other mines are reported behind Mycenæ; on the path to the Heraeum are several caves, one of which seemed to have been cut out with a pick, though whether as a mine or shelter I could not tell, while in another was a slight stain of malachite in the conglomerate. This information is at present unsatisfactory, but it is not unlikely that Mycenæ was an important centre of copper working during part of the bronze age.

On Seriphos there is much copper slag and a number of galleries in the iron mine which may have been seeking veins of copper; such rejection of the iron ore might point to early working, though there is some evidence that mining was being practised here in the later centuries B.C.

On Paros, copper slag was found in an early bronze age tomb at Abyssos. Near Naussa is a small mine of malachite, much overgrown, with a gallery leading off at each end; all the ore had been removed, as is usual in prehistoric mines; but otherwise the evidence for its early date is weak.

On the early bronze age acropolis of Syra a piece of copper slag was found.

The cave of Chrysokamino has yielded early and middle bronze age pottery, and was probably a copper mine, though all the ore has been extracted; slag, burnt clay and pieces of perforated crucible have been found outside. Gournia nearby was probably a manufacturing centre, considering how many moulds it contained, but Chrysokamino is too small to have supplied the whole of Crete with copper during the bronze age.

The copper mines of western Crete which are claimed as prehistoric were opened in Hellenistic times and continued until the Middle Ages. Much

copper ore is also reported from Gavdos, but there is no reliable information as to when it was worked.

As to more distant sources, the direct evidence for bronze age mining in Cyprus is not strong, and it must be considered doubtful if the island supplied copper to the Aegean so early. The mines of Sinai are doubtful, the ore being apparently always poor, and it is likely that such copper as was produced was largely absorbed by the Bedouins, save at the times of Egyptian expeditions. The Kara Öyük tablets mention copper as an object of trade, but it is not common in western Anatolia. Italy seems to have been working copper sporadically from early times, and the Homeric Temesa is probably to be sought in this direction, whether Etruscan or south Italian ores were used. Largely, however, the Greeks seem to have used small local deposits which they completely exhausted.

¹ Herodotus, 3, 57; cf. Bent, *J. Hellenic Studies*, 6, 195.

² Cf. Ardaillon, "Le Laurium"; also Davies, *Man*, 6, 1931.

³ Stephanos, *Cong. int. Archéologie*, I, Athens, 216; 1905.

⁴ For Siphnos see above.

⁵ Freise, *Z. Berg. Hütten, und Salinenwesen im preuss. Staat*, 56, 347; 1908.

⁶ Paton and Myres, *Geog. J.*, 9, 38; 1897.

⁷ "Iliad", ii, 856.

⁸ Bosanquet, *Rep. Brit. Ass. Adv. Sci.*, 722, 1904. Athens Nat. Mus., Inventory No. 12445.

Electrical and Magnetic Units

THE British Association has done a great service to the electrical industry by fostering the study of electrical standards and it was with considerable interest that Section A listened to two papers given by Sir Richard Glazebrook at the recent York meeting. Sir Richard has been an active member of the British Association committee on electrical standards which has laboured for a period of fifty years. In 1913 a single volume edited by Sir Frank Smith was published, giving the complete series of thirty-nine reports. Sir Richard was present at the York meeting in 1881 when Section A met at the same centre—St. Peter's School—and received the eighth interim report of the committee for constructing and issuing practical standards for use in electrical measurements. One of the papers* presented by him at the recent meeting showed the changes which have taken place in the British Association wire resistance coils over the period of half a century. The conclusion reached is that platinum is the most stable material to use for the construction of standard coils. This paper has already been referred to in NATURE (Oct. 22, 1932) and will be published in full in the Report of the British Association for 1932. The other paper† dealt with a topic which is still under discussion, namely, the definition of electric and magnetic units.

Sir Richard Glazebrook is president of the Com-

* Material Standards of Resistance: the British Association Coils, 1881-1932. By Sir Richard Glazebrook and Dr. L. Hartshorn.
† Electric and Magnetic Units. International Congress of Electricity, Paris, July, 1932. By Sir Richard Glazebrook and Dr. Ezer Griffiths.

mission of the International Union of Pure and Applied Physics which was set up by the General Assembly at Brussels in 1931 to consider the symbols, units and nomenclature used in physics.

The Commission at its first meeting decided that the most urgent problem awaiting solution was the definition of electrical and magnetic magnitudes. The first step taken therefore was to prepare a questionnaire which was circulated to the national committees working under the auspices of the Union of Physics in various countries.

The principal issues raised by this questionnaire related to:

(1) The basis on which a connected account of electromagnetic phenomena should rest. Should the starting point be Coulomb's law of force between magnetic poles or some other physical law?

(2) Should μ (the permeability) be treated as a quantity having dimensions in length, mass and time, or as a pure number? In other words, are H , the strength of a magnetic field, and B , the magnetic induction, quantities having different dimensions or are they quantities of the same kind?

The British reply to this questionnaire was agreed to at a meeting held in the rooms of the Royal Society in May last, at which were present, besides the members of the National Committee for Physics, representatives of the British Association Committee dealing with Magnetic Units and British representatives of the International Electrotechnical Commission, which had also been dealing with this matter.

The British view is that :

- (1) Coulomb's law is acceptable as a starting point.
- (2) Permeability should be regarded as a quantity having dimensions.

Meanwhile, replies to the questionnaire had been received by the Commission from national committees abroad and from individuals; many of the latter submitted memoranda running into fifty typed pages. To advance matters a stage further it was decided to take advantage of the presence in Paris of a number of experts attending the Electrical Congress, to call an informal conference. This conference was attended by: Sir Richard Glazebrook (chairman), Prof. Wilberforce, Dr. Ezer Griffiths (secretary), all of Great Britain; Profs. Abraham (secretary of the Union of Physics), Fabry, Paul Janet, Brylinski, Cotton, P. Bunet, Lienard (France); Prof. Verschaffelt (Belgium); Profs. van Staveren and van de Well (Holland); Prof. Wallot (Germany); Prof. Lombardi (Italy); Prof. Bjerknes (Norway); Profs. Kennelly and Pender, and Dr. Curtis (United States).

The conference had before it a summary of the replies received to the questionnaire and after consideration of these a series of proposals were submitted by the chairman. Some of these proposals were accepted unanimously and on others an informal vote was taken.

It was unanimously agreed that :

- (1) Any system of units recommended must retain the eight internationally recognised practical units: joule, watt, coulomb, ampere, ohm, volt, farad, henry.
- (2) The C.G.S. system is suitable for the physicist.
- (3) A system of practical units, including the above eight quantities, can be derived from these by multiplying the C.G.S. unit by appropriate powers of 10.

One important proposition before the Conference dealt with the basis on which to build any system of magnetic units.

Should a start be made from :

- (a) the force between two poles (coulomb).
- (b) the force between two current-carrying elements (ampere) or
- (c) the idea of 'flux' ?

There was no decided majority in favour of any one of these. The view expressed by the British Committee was that the force between two elementary magnetic poles provides the most satisfactory basis. On the other hand, a number of French physicists were in favour of taking the force between two elements of current as the basis.

The chairman explained the system formulated by Maxwell, but with the proviso that μ_0 and K_0 are both quantities having dimensions.

MAXWELL'S SYSTEM

$$\text{Force} = \frac{\epsilon \epsilon'}{K_0 r^2} \dots \dots (1)$$

$$\text{Force} = \frac{m m'}{\mu_0 r^2} \dots \dots (2)$$

$$\text{Force} = \frac{m i \sin \theta ds}{A r^2} \quad (3)$$

Where $\frac{A^2}{\mu_0 K_0} = (\text{Velocity})^2$

This velocity is shown by experiment to be the velocity of electromagnetic waves. Also A is a constant for all media. Maxwell puts $A = 1$ and alternatively :

$$K_0 = 1 \text{ Electrostatic system.}$$

$$\mu_0 = 1 \text{ Electromagnetic ,,}$$

In a vacuum we are to have

$$F = mm' / \mu_0 r^2$$

and in any other non-magnetic medium

$$F = mm' / \mu_1 r^2$$

where μ_1 is characteristic of the medium.

For such media we have for the magnetic induction B_0 or B_1

$$B_0 = \mu_0 H. \quad B_1 = \mu_1 H.$$

where H is the strength of the magnetic field.

Hence $B_1 = \frac{\mu_1}{\mu_0} B_0 = \mu B_0$

where μ is the specific permeability: a non-dimensional quantity given by the ratio μ_1/μ_0 .

In a magnetic medium we have $B_1 = \mu_1 H$ but in this case μ_1 is no longer a constant; its value is given by $\mu_0 (1 + \frac{4\pi I}{\mu_0 H})$, where I is the

intensity of magnetisation and H is the field strength measured by the force on a unit pole placed at the centre of a long narrow tunnel-shaped cylinder with its axis parallel to the lines of magnetisation.

The alternative (b) is referred to as the *electrodynamic system*; in this, following Ampère's equations, (2) and of (3) of Maxwell's system referred to above are replaced by

$$\text{Force} = i' ds' \int \frac{[r i \sin \theta ds]}{r^3}$$

or possibly

$$\text{Force} = \mu_0 i' ds' \int \frac{[r i \sin \theta ds]}{r^3}$$

Each equation represents the force on an element $i' ds'$ due to a closed circuit of which ds is an element carrying a current i . The expression in the brackets represents a vector in a plane perpendicular to r and ds and these vectors are to be compounded vectorially.

The other suggestion (c) is that a system of units should be based on magnetic flux. The space inside a hollow anchor ring over the surface of which is wound a single layer of wire carrying a current, is found by experiments with iron filings or a magnetic needle to be in a peculiar condition, and the magnetic disturbance at each point within the ring has not only a direction but also a magnitude. The disturbance is said to be in the form of flux.

Both the electrodynamic system and the system based on flux spring from a desire to avoid the

necessity of introducing the idea of an isolated magnetic pole.

Sir Richard Glazebrook in his paper to the British Association at York points out that an ammeter or a voltmeter depends for its effects on the forces between a current and a permanent magnet, whereas the object of both the systems (*b*) and (*c*) referred to above is to avoid reference to permanent magnetism. As he points out, we may measure a current by its electrolytic effects and having done so, its E.M.F. by the heat generated in a coil in a calorimeter. In practice, we have to connect the quantities so measured with the accepted units, the ampere and the volt, thus complicating our fundamental definitions with the value of the electro-chemical equivalent of silver, or, if preferred, hydrogen. He directs attention to those who object to Coulomb's law to Appendix C of the Second Report (Newcastle 1863) of the Electrical Standards Committee of the British Association. It is by Clerk Maxwell and Fleeming Jenkin and deals with the elementary relations between electrical measurements.

Those who favour the basis of the system of magnetic units as the force between the two elements of current were invited to put forward a consistent plan of a series of definitions of electrical and magnetic units.

Another topic which came up for discussion at Paris was—

“Are *B* and *H* quantities of the same kind and is their ratio μ a pure numeric? Or should μ be treated as a dimensional quantity?”

In submitting the point of view of the British

National Committee that *B* and *H* are quantities not of the same kind, Prof. Wilberforce pointed out that *B* has been defined according to one method by Maxwell in the early part of his work when considering the electromagnetic system; later, when treating the possibilities of other systems, he defined *B* in a different manner. According to Maxwell's first method, *B* and *H* would be quantities of the same dimensions and according to his second method they would be of different dimensions. Until it can be decided what method of definition is to be adopted, it is impossible to state whether *B* and *H* are to be looked upon as quantities of the same kind. The British view is based on the more general method following Maxwell's later work. The view of the Dutch Committee is that *B* and *H* are quantities of the same kind.

In the course of the discussion, the chairman referred to the fact that he was one of the last surviving pupils of Maxwell and he felt convinced from recollections of Maxwell's teaching that he was of the opinion that *B* and *H* were quantities of a different kind. When a vote was taken, nine were in favour of treating *B* and *H* as quantities of a different nature, whilst three were in favour of regarding *B* and *H* as quantities of the same nature.

Another issue raised was whether the factor $4\pi/10$ be retained in the definition of magnetomotive force. One speaker remarked that if one omits 4π in one place it occurs elsewhere. The consensus of opinion was against its omission.

EZER GRIFFITHS.

News and Views

Sir Frank Dyson, K.B.E., F.R.S.

SIR FRANK DYSON, Astronomer Royal, will terminate his official connexion with the Royal Observatory, Greenwich, on February 28. He went to Greenwich in 1894, when he was appointed a chief assistant. After retaining this position for ten years, he was appointed Astronomer Royal for Scotland. He returned to Greenwich after six years absence, being appointed as the successor of Sir William Christie. Throughout his career, Sir Frank has taken a keen interest in all the departments of the Observatory; it may perhaps be said that his greatest interest has lain in the determination of the proper motions of the fainter stars. In company with Mr. W. G. Thackeray, he made a careful re-reduction of the catalogue of faint stars observed by Groombridge at Blackheath a century earlier; these were compared with recent Greenwich observations, providing proper motions of several thousands of faint stars. The later Greenwich catalogues have all been planned with the view of the determination of proper motions for successive zones of the sky. Sir Frank has been a keen observer of solar eclipses, obtaining successful results in 1900 (Portugal), 1901 (Sumatra), 1905 (Tunis), 1927 (England); he wrote a paper in the

Phil. Trans. for 1906, which is still regarded as providing the standard determination of coronal wavelengths. It was also under his auspices that the expedition went to Brazil in 1919 to test the Einstein shift of starlight. Both the magnetic department and the time-service have been revolutionised in recent years; the former was moved to Abinger, as the electric railways in London were a disturbing factor. For the latter, a series of Shortt clocks in air-tight cases give very precise results; also daily comparisons with other observatories are made by wireless signals. Sir Frank has considered his successor in obtaining the provision of a new reversible transit-circle, which is nearing completion. The present circle is eighty years old, and its shutters are too narrow, not permitting free circulation of air.

Dr. H. Spencer Jones, F.R.S.

DR. HAROLD SPENCER JONES, His Majesty's Astronomer at the Cape, has been appointed Astronomer Royal in succession to Sir Frank Dyson, and will commence his duties next March. Dr. Spencer Jones is well-known at Greenwich, for he went there in 1913 and served for ten years as chief assistant. The study of optics is one of his favourite pursuits;

during the War he gave much time to testing lenses that were required for military purposes. He observed the solar eclipse of 1914 in Russia, and went to Christmas Island for that of 1922, but it was cloudy. He has been ten years at the Cape and has made a very careful study of the motions of sun, moon and planets; he has discussed the lunar elements both from the meridian observations and from occultations, of which a great number have been observed. He is also a keen spectroscopist, and has contributed many papers on Nova Pictoris, deducing its distance from the rate of expansion of the nebulous envelopes. The heliometer measures of the planets, inaugurated by Sir David Gill, have been continued, and will shortly be published. Prof. de Sitter testified, in his discussion of the satellites of Jupiter, to the value of the results obtained with that instrument. A reversible transit-circle has been in use at the Cape for many years, of somewhat similar type to the new Greenwich instrument; experience with it will doubtless be of service to Dr. Spencer Jones at Greenwich. He will also find the new Yapp reflecting telescope nearly complete.

Dr. J. Jackson

DR. J. JACKSON, chief assistant at the Royal Observatory, Greenwich, has been appointed H.M. Astronomer at the Cape Observatory in succession to Dr. H. Spencer Jones. Dr. Jackson hails from the University of Glasgow, and went to Trinity College, Cambridge, where he was a scholar from 1909 until 1914, and made researches in dynamical astronomy, particularly the perturbations of Jupiter's eighth satellite. He became chief assistant at the Royal Observatory, Greenwich, in October, 1914, where he took a considerable part in the observing activity of the Observatory. He served with the survey section of the Royal Engineers from December, 1917, to the end of the War. Attention may be directed to Dr. Jackson's work on double star orbits and the determination of hypothetical parallaxes with Mr. Furner; to the very interesting results he obtained from his study of the Shortt clocks; and to his determination of the constant of nutation from observations with the Cookson telescope. During the last seven years, he has co-operated with Dr. Knox Shaw and Mr. Robinson in the reduction of Hornsby's observations at the Radcliffe Observatory, Oxford. Quite recently he has published corrections to the orbit of Mercury for the epoch 1774-98. These results are of special importance as they confirm the motion of the perihelion of the planet, discovered by Leverrier and explained by Einstein. With Prof. F. J. M. Stratton he edited vol. 5 of the collected works of Sir George Darwin. From 1920 until 1927 he was editor of the *Observatory* magazine, and was secretary of the Royal Astronomical Society from 1923 until 1929.

Boyle Medal of the Royal Dublin Society

THE council of the Royal Dublin Society at its meeting on December 15 decided, on the recommendation of the Committee of Science and its Industrial

Applications, to confer the Society's Boyle medal on Prof. Paul A. Murphy, professor of plant pathology at University College, Dublin, for his important contributions to plant pathology. Prof. Murphy's researches on the fertilisation, cytology, and life history of the potato blight (*Phytophthora infestans*), and his investigation on the infection of the new by the old crop, have been at once an important contribution to pure science, and an advance of high economic value. He early recognised the economic importance of mosaic virus, and pointed out the close connexion between the deterioration of new varieties and their infection with virus. He also established the compound nature of mosaic and recognised the fact that the disease might be transmitted by symptomless carriers. This knowledge has greatly facilitated the finding and propagating of virus-free plants. His researches have also very materially increased our knowledge and means of control of onion mildew (*Peronospora Schleideni*) and of dry rot in swedes (*Phoma lingam*).

Native Lands in Kenya

ON December 20 question was raised in the House of Commons by Sir R. Hamilton as to the situation which has arisen in Kenya in regard to native rights in the land and the leases which are to be granted by the Crown for mineral development in the new goldfield in the district of Kakamega and elsewhere. Certain amendments to the Native Lands Trust Ordinance have been embodied in a Bill which was read for a second time in the Legislative Council of Kenya on December 21. Under these amendments, it is proposed to exclude temporarily from a native reserve, land leased for mineral development, without the provision of an equivalent area of land in exchange and without the requirement of notice to the local native council concerned. Sir R. Hamilton asked whether these proposals were made with the approval of the Secretary of State for the Colonies, and further, whether the amendment of the Native Lands Trust Ordinance had been considered by the Morris-Carter Commission. In his reply, Sir P. Cunliffe-Lister stated that not only had the provisions of the Bill been agreed to both by the Morris-Carter Commission and by the Central Lands Trust Board, but that he was satisfied that the arrangements for compensation and consultation provided ample safeguards for the interests of the native occupants of the area in question.

THE Secretary of State justified his approval of the amendments on the ground that they are necessary, as an interim measure to deal with immediate practical difficulties which might operate to retard the development of valuable minerals; while provision has been made for compensation in the form of a money payment. His statement that the development of the goldfield would be for the benefit of the native was repeated by the Chief Native Commissioner when introducing the amendments in the Kenya legislature; but he candidly admitted that they would be unpopular with the natives. That admission was an understatement of the case.

If these amendments become law, of which at present there seems every prospect, the outlook is indeed grave. No limit can at present be set to the area which will be affected by the exploitation of mineral rights. Difficulties have arisen when compensation has been given for expropriated native rights in land in the form of substituted areas. The consequences of a money payment in its effect on tribal feeling and on tribal character will be serious. To divorce the native from his land, which to him is sacrosanct, is to incur the risk of causing unrest and creating a native problem no less, and possibly even more, serious than the problem of the detribalised native in South Africa. Matters should not be allowed to rest here.

Imported Books in Australia

EARLY this year (NATURE, Feb. 20 and April 2), we commented on the unfortunate effect on scientific and educational progress in Australia likely to be produced by the primage duty and sales tax on books, periodicals and magazines. We welcome, therefore, the announcement made on November 10 in the House of Representatives by Mr. Lyons, the Prime Minister, that these taxes are to be abolished (*Sydney Morning Herald*). They were introduced, with much other taxation, as part of the emergency measures necessary to meet the financial situation in Australia. A duty of 10 per cent on imported books and a sales tax of 6 per cent, together with the depreciation of Australian money, was clearly a heavy burden for scientific workers and others anxious to keep abreast of the times to bear, and an influential deputation waited upon Mr. Lyons asking for the remission of these taxes. As we pointed out at the time, and also when the Import Duties Bill proposing a duty of 10 per cent on goods imported into Great Britain was before the House of Commons, the revenue to be expected from the taxation of scientific literature in particular is negligible; such duties increase the cost of research and thereby hamper progress. Now that the budgetary position in Australia has improved to the extent that reduction of taxation can be considered, we are glad to find that the abolition of the primage duty and sales tax on literature is in the first group of measures brought forward.

Jubilee of the Basic Steel Process in France

THE basic steel process was introduced into France in 1882, and to mark the fiftieth anniversary, a special meeting of the Société des Ingénieurs Civils de France was held in Paris on December 5, the President of the Republic, M. A. Lebrun, honouring the proceedings by presiding. Four addresses were given dealing with the history of the basic process, and another on the iron ore district of Lorraine. The Iron and Steel Institute was represented by the president, Sir Charles Wright, Mr. F. W. Harbord and Mr. G. C. Lloyd, who prior to the official proceedings were received in private audience at the Palais de L'Elysée by the President of the Republic. The basic steel process which made possible the

utilisation of huge deposits of hitherto practically useless phosphoric ores, was the invention of Sidney Gilchrist Thomas (1850-85) who worked at the subject while a clerk in a London police court. His first paper, written in collaboration with his cousin Percy Carlyle Gilchrist, "On the Elimination of Phosphorus in the Bessemer Converter" was to have been read at the Paris meeting of the Iron and Steel Institute in 1879, but for want of time had to be omitted. Thomas, however, was brought into contact with E. W. Richards and then J. E. Stead, and a successful demonstration of the process was made on April 4, 1879, at the Cleveland Steel Works. Thomas unfortunately did not live long to enjoy his triumph, for after travelling in search of health, he died in Paris on February 1, 1885, and was buried in the Passy cemetery.

Education and International Organisation

THE report of the Sixth Committee to the Assembly of the League of Nations on the work of the International Organisation for Intellectual Co-operation stresses the importance of the educational questions with which the International Committee has been concerned, particularly those concerned with instruction in the aims and work of the League. Inquiries on the training of primary and secondary school teachers and the efforts made to facilitate the revision of school textbooks are of the greatest importance for the development of a spirit of world citizenship and the replacement of the partisan and nationalistic teaching of history and geography by a presentation alike scientific in method and world-wide in sympathy. Links are being created between university organisations and national educational information centres, and the report stresses the advantages obtainable from a new orientation of broadcasting and the cinema, with the assistance and guidance of teachers.

EFFORTS in the field of continuation courses and adult education have continued, while the research work on international relations, of which the report on the intervention of the State in economic life at the Milan Conference last May was the outcome, is being pursued, and the results of inquiries carried out in an objective and disinterested spirit will be discussed at a further meeting of men of science. Stress was laid on the work to be done by the Press in raising the intellectual level of mankind and a resolution adopted by the Assembly requests the organisation to study the methods by which the Press might contribute to a better understanding between the peoples of the world by perfecting their knowledge. Reference is also made in the report to the successful co-operation established with the Chinese Government to facilitate the extensive schemes of educational re-organisation drawn up by the latter, and the report of the mission of educational experts sent to China, like the report presented by a representative of the Educational Cinematographic Institute, embodies ideas regarding the establishment of a system of public education which should be of value to all governments.

Calakmul, Yucatan

FURTHER particulars of the recently discovered Maya city of Calakmul, in the south of Campeche, Yucatan, dated by its sculptured monuments as belonging to the Old Empire, A.D. 364-551, have been published by the Carnegie Institution of Washington (*News Service Bulletin*, vol. 2, No. 34). The information is derived from a report by Dr. S. G. Morley on the results of an expedition of the Institution which left Washington for Calakmul in April last. Forty-one additional monuments were discovered, bringing the total number up to 103, the largest number yet found on any Central American site. The dates on 45 monuments have been deciphered. Among the more notable discoveries were the quarry from which the stone was taken with two large blocks side by side, partially quarried, just as they were left by the builders, a huge flat outcrop of limestone in which were sculptured figures of six prisoners with their arms tied behind them by ropes and a large sculptured monument portraying a priest grasping a spear in his right hand, which was erected in A.D. 472. Owing to the luxuriance of the vegetation only a single building has been left standing. A survey map of the central part of the site, the civic and religious centre, has been made. The importance of the site lies in the fact that, lying half way between the earlier cities of northern Guatemala and the later cities of northern Yucatan, it fills in a geographical 'blind-spot' and bridges the gap between the two regions. It is within four days' journey by mule from Uaxactun, the oldest city of the Maya civilisation in northern Guatemala. The foundation of the city, or at least its attainment of sufficient economic importance to permit the inhabitants to mark the five year periods by the erection of monuments, would appear to coincide with the later part of the First Period of the Old Empire, when Maya culture was expanding throughout the Yucatan peninsula.

Paintings in Ancient Palestine

A DISCOVERY of special interest at Teleilat Ghassul in Palestine is reported by the Rev. J. G. Duncan in the current issue of *Ancient Egypt* (Pt. 3, 1932). On this site, which is conjecturally identified with the ancient Sodom, three buildings, evidently not temples or palaces, but dwelling-houses, have been brought to light which date, at the latest, from 2,000 B.C., when the city was finally destroyed. In two of them the room-walls proved unexpectedly large, being 19 ft. and 20 ft. in length respectively. It was not known previously that dwellings of this size were in use in Palestine at this early stage of civilisation. What, however, was of even greater interest was the fact that these walls had been decorated with paintings, a single subject covering the whole wall, thus arguing developed artistic skill. With the exception of a cistern at Ophel, attributed doubtfully to the Byzantine age, wall paintings had not been discovered previously in ancient Palestine. The paintings, which are on plaster, have suffered from various causes, including the damp soil, which may explain the apparent absence of wall-paintings on

excavated sites. It is just possible to make out the subject of two of the paintings. One is apparently a religious scene and shows several, six or seven, human figures gazing towards a shining object in front of which stands a smaller figure, facing the others; and the second is a landscape or hunting scene, in which the only well-preserved figure is a bird, painted with a master's touch. The colours, light and dark red, brown in various shades, black, yellow and white are the same as appear in the painted pottery. The site, which is being excavated by P. Mallon, is somewhat obscure in its cultural and chronological relations. It appears to be of late neolithic or early copper age date.

Exhibition of Scientific Instruments and Apparatus

A PRELIMINARY announcement of the Physical Society's twenty-third Annual Exhibition of Scientific Instruments and Apparatus which is to be held at the Imperial College, South Kensington, on January 3-5 has already appeared in these columns (Dec. 10, p. 887). Particulars are given there of the times of opening and of the times and titles of the discourses. The catalogue of the exhibition, which is used by many as a reference book during the year, has now been published, and copies may be obtained from the Exhibition Secretary, at the office of the Society, 1, Lowther Gardens, Exhibition Road, London, S.W.7 (9d. post free). We are glad to notice that although the name of the Optical Society no longer appears on the catalogue, since it has amalgamated with the Physical Society of London, the optical instrument trade is as well represented as in former years. The Physical Society is making an important contribution to the scientific instrument trade by the inclusion of a section for apprentices and learners at the Annual Exhibition. The catalogue shows that the exhibits in the research and experimental section will be of great interest, and that the trade section, which forms the principal part of the exhibition, will include many important new developments. The value of the exhibition is enhanced by the excellent response of those taking part in it to the desire expressed by the organising committee, that the working parts of instruments or apparatus should be exposed to view. In some instances exhibitors have provided working models. We understand that the discourses to be delivered at the exhibition will be fully illustrated by experiments, lantern slides, and cinematograph films.

Floodlighting

THE floodlighting of many of London's famous buildings last year was a great popular success. It also gave engineers a unique opportunity of studying the problem critically. In a paper on the subject which appears in the *General Electric Co.'s (G.E.C.) Journal* for November, Mr. T. E. Ritchie begins a very thorough discussion of the subject. He shows the fallacy of thinking that floodlighting is objectionable because it is 'unnatural'. The same objection might be urged against the inside lighting or the warming of a building or even against the building

itself. In many cases, however, the way in which it is done is open to severe criticism. To illustrate this he shows photographs of Thames House, Millbank, floodlighted, first when special attention is paid to the roof and skyline and secondly when they are neglected. In the first case, the effect produced is beautiful but in the second case the floodlighting is very disappointing, the building appearing dwarfed and incomplete. The floodlighting in the first case was designed by Sir Frank Baines, the architect responsible for the building, and he supervised its execution. It is also pointed out what an important part the reflection factor of the lighted portion of the front of the building plays. In floodlighting the front of the Institution of Electrical Engineers, London, for example, the aggregate total load on the 26 floodlights used is 39 kilowatts. Owing to lack of time, the front had not been steam-cleaned prior to the installation and so the average reflecting factor was only 7 per cent. If it had been steam-cleaned, the average reflecting factor would have been increased about five times and so the saving, if the same total illumination were produced, would be about four-fifths of the present current bill.

Electric Cooking on the Thermal Storage System

SINCE coal can be produced at a uniform rate and stored ready for use as required, the plant necessary for its production has only to be capable of supplying the average demand. The same is true of oil and gas but not of electricity. Therefore the size of the necessary generating plant for electricity is fixed by the maximum and not by the average demand. As a rule the maximum output is about three times the average output and so most generating stations could treble their output provided the load was evenly distributed over the day and night. As capital charges usually represent an appreciable fraction of the selling price of electricity, any new demand which tends to level the load can be supplied economically at a reduced tariff. In thermal storage systems for heating buildings or for supplying hot water, use is made of this principle by supplying heat to the storage water at times of light load at a much reduced rate. In the case of electric 'cookers' using thermal storage, the problem is more difficult as the temperature required for cooking is much higher and the cost limits the use of too much thermal insulation. In an article on storage cookers in the *General Electric Co.'s Journal* for November, O. W. Humphreys and Dr. E. C. Walton describe different types of these devices used in America and various Continental countries as well as the 'magnet storage cooker'. Compared with the standard type of electric cooker, the latter has the following advantages. The cost of installation is very low as it is merely the cost of an extra lighting point in the house circuit. The cost of maintenance is also very low compared with the ordinary cooker, and no meter is required. When the electric supply is sufficiently cheap these cookers might well be used. Some are already in use in the Midlands in the homes of working-class people.

Research in Plant Industry in Australia

THE fifth annual report of the Australian Council for Scientific and Industrial Research shows that results of great economic value, far exceeding the total expenditure of the Council, have been achieved. Problems relating to the control of disease form one of the chief lines of investigation undertaken by the division of plant industry, and such outstanding success has been obtained in the control of bunchy top disease in bananas that it has led to the re-establishment of the crop on large areas. The heavy annual loss hitherto sustained from the development of bitter pit in exported apples should now be reduced to negligible proportions, since its relation to immaturity at picking time has been established. An additional activity of this division is the introduction from abroad of new varieties of plants likely to be of value, particularly in the drier districts. Following the success with which weed pests, such as St. John's wort, have been suppressed, the entomological division is extending the method of biological control to other noxious plants, and an appropriate insect for destroying the Noogoora burr having been recently discovered, on the completion of laboratory trials this fly will be liberated in the infested districts. The recently formed Division of Forest Products has carried out particularly valuable work on the seasoning of hard woods for the manufacture of cases, and has further devised a rapid and cheap method for treating wood to be used for butter boxes so as to avoid the development of taint, but although attention has been given mainly to problems of immediate importance, fundamental research has not been neglected.

Weeds of Grassland

IN spite of the increased attention paid to grassland farming in recent years, there is still a vast area of permanent grass of poor quality, and since the reduction of weeds is intimately associated with the best means for securing its improvement, the issue by the Ministry of Agriculture of "Weeds of Grassland" (prepared by H. C. Long, and published by H.M. Stationery Office, price 5s. net), should prove of great value. At the outset, emphasis is laid on the necessity for using clean seed when sowing land down to grass, as injurious weeds are readily introduced, and instances of the special dangers in the case of the rye-grasses and clovers are cited. The principles in eradicating weeds from grassland are those which make for general improvement in the herbage, and in many cases attention to drainage, manuring, grazing, etc., rather than direct methods of destruction (though spraying is considered), will lead to the eradication of undesirable species. A large number of the worst weeds that occur on grassland are dealt with individually, classification being made according to the natural orders to which they belong. A short botanical description, in which technical terms are so far as possible avoided, coupled with 92 illustrations (18 of which are coloured) from seeding to fruiting stages, renders identification a comparatively simple matter, and points of interest such as the association

of a weed with certain soil conditions, its possession of poisonous or other special properties, as well as the best methods for its eradication, are given in each case.

Salad Crops

THE growing of salad crops has become a highly specialised business in several parts of England and there seems no reason why the acreage devoted to this branch of horticulture should not be profitably extended. As an aid to growers, whether on a large or small scale, the Ministry of Agriculture has issued an illustrated bulletin (No. 55, H.M. Stationery Office, 1s. 6d. net), from which it is evident that with good management it is possible to have supplies for the market throughout the whole year. Lettuce is quite the most important crop that is included under the term salad, and the best methods for its cultivation in the field, in heated and unheated glass-houses or in frames, are described in detail. Some account is given of the varying methods adopted in different districts and the varieties found to be most satisfactory in each locality, while cultural methods in use in other countries such as America and France are also included. Watercress is another important crop grown for salad purposes. Although little difficulty is experienced in its cultivation, it is essential that the water in which it is grown should be of the highest quality as the industry has suffered considerable harm from cress grown in contaminated streams. Attention to local conditions and markets, and the choice of a suitable variety to meet these requirements, are also needed if the cress-growing is to prove a thoroughly profitable undertaking.

Forest Flora of Syria

AN expedition under the leadership of Dr. Alexander Eig, head of the Section of Systematic Botany and Ecology at the Hebrew University, Jerusalem, has been examining the forest and other flora of Syria (Science Service, Washington, D.C.). During the tour, the members of the expedition were able to collect valuable material for the herbarium as well as to complete plans for the Syrian Section of the new Botanical Garden at Mount Scopus. The party travelled twice throughout the length and three times across the width of Syria, and were able to fix in a preliminary fashion the line of demarcation between the Mediterranean zone and that of the Urano-Turanic region, the precise boundary between which was previously unknown. An important part of the expedition's work was a study of the forest species of Syria, and the investigations undertaken enabled the principal types of forest species, particularly in the Amanus and Cossus hill regions, to be determined. A study thus begun came to the knowledge of the French Governor of Jebel Druze. The expedition received great assistance from the French Government officials in the mandated territory north of the Sykes-Picot line, and the French Governor has asked Dr. Alexander Eig to advise on the subject of afforesting certain parts of the Jebel Druze region. The determination of the principal Syrian forest types will be, it is said, of considerable importance to the Botanical Garden on Mount Scopus.

Revision of Ordnance Plans

THE methods adopted in the field revision of the large-scale Ordnance Survey Plans, with some account of earlier methods, are described and explained in detail in a pamphlet by Capt. J. C. T. Willis ("An Outline of the History and Revision of the 25-inch Ordnance Survey Plans". H.M. Stationery Office. 2s. 6d.). The revision in the field is carried out by methods of prolongation and intersection but new detail must be 'hung' on to the original survey and not on to matter added at a previous revision. The use of specially selected points on the original survey has been abandoned and the equal reliability of all the original detail is accepted. The newest development adopted to counteract the liability of errors in redrawing the revised sheet entails the use of 'coated' paper at that stage. This paper permits all old detail to be expunged chemically, without affecting the surface of the paper beneath. Then it is found possible to avoid the redrawing of old detail, which involves a saving in accuracy as well as in time. A method of partial revision has had to be adopted in the centres of town and cities on the ground of economy. This neglects minor alterations in back premises while concentrating on the alignment and position of street fronts. The pamphlet contains a number of practical examples of revision, illustrated by charts, and discusses the kind of errors the surveyor may make.

Weather Maps showing Typical Distributions of Pressure

A PAMPHLET has been produced (Air Ministry: Meteorological Office. Examples of Weather Maps showing Typical Distributions of Pressure. (M.O. 237, second edition.) Pp. 8. (London: H.M. Stationery Office, 1932.) 3d. net.) to meet the needs of those schools where another publication prepared by the authority of the Meteorological Committee entitled "The Weather Map", which forms an introduction to modern meteorology, is used as a textbook for the teaching of elementary meteorology. The latter work appeared a little more than two years ago (see NATURE, 126, 755, Nov. 15; 1930). Being a comparatively expensive production (price 3s. net, compared with 3d. net in the case of the pamphlet under notice), it was regarded as unsuitable for distribution to individual pupils and accordingly six of the most important illustrative synoptic weather charts have here been selected from it so that pupils would be able with the pamphlet in front of them to follow the explanations of a teacher using "The Weather Map" as a textbook. The six figures selected are those numbered 9, 18, 21, 22, 23 and 24 in the textbook, and give typical examples of a depression, anticyclone, secondary depression, V-shaped depression, wedge and col. There is no explanatory matter beyond a paragraph describing the weather corresponding with the various letters that appear on the map (the Beaufort weather notation is used), the method of showing the speed and direction of the wind, the temperature, and—by means of isobars for 4 millibar steps—the distribution of pressure. The two publications, both

of which are to be obtained from H.M. Stationery Office, should, if used generally at schools, put young students on very familiar terms with the weather maps appearing in many of the leading newspapers, and at the same time give some idea of the methods of working of the official forecasters.

Atlantic Ice

THE work of the United States ice patrol on the Atlantic shipping routes during 1931 (International Ice Observation and Ice Patrol Service, 1931. Coast Guard Bulletin, No. 21) records a most unusual year. The normal number of icebergs coming south of lat. 48° N. during the year is 419; this is the mean of thirty-two year's records. During 1931 only 13 icebergs came so far south and ten of these were in May, which is the month of widest spread ice distribution on the Grand Banks. March showed two bergs and April one south of the 48th parallel. There is only one record of another year so free from ice—in 1924 only eleven bergs were recorded. These figures may be contrasted with more than a thousand in 1929, 1912, and 1909. The report contains the usual chart of the distribution of ice on the routes frequented by shipping and also the records of oceanographical observations. An interesting appendix gives an account of the ice observations made in the polar seas during the cruise of the *Graf Zeppelin* in July 1931 over the Barents and Kara Seas.

The North-East Passage

RUSSIAN newspapers have announced that an expedition on the ice-breaker *Sibirjakov*, under the leadership of Prof. Schmidt, has succeeded in navigating the whole length of the North-East Passage, from the White Sea to Vladivostok. The most dangerous section was found near the North Land, which the expedition rounded on the northern side, where it was necessary to blow up the ice in order to make any progress. The mouth of the Lena was reached in less than a month after leaving Archangelsk, but great difficulties were encountered between the mouth of Kolyma and the Bering Strait. Here the ice was three to four metres thick and all the blades of the ship's screw were broken one after another. After six days of strenuous work the ship's stern was raised above water by shifting the coal and the necessary repairs made, but when the expedition was only ninety kilometres from the Bering Strait, the screw was lost altogether, since the main axle broke, so that the remainder of the journey had to be made under sail.

Memorial to Dr. R. Stenhouse Williams

THE National Institute for Research in Dairying, University of Reading, has recently issued an appeal for funds to provide an appropriate memorial to the late Dr. R. Stenhouse Williams, first director of the Institute, who died on February 2, 1932. It has been decided to devote the fund chiefly to the further development of the Institute, to which Dr. Williams devoted all his energies. The signatories to the appeal, who represent dairy science in all its aspects,

consider that this application of the fund will form a lasting monument to Dr. Stenhouse Williams. A small permanent memorial will also be erected within the Institute. Further information can be obtained from Mr. S. R. Whitley, "Rookwood", Shinfield, Reading.

M. Santos Dumont

ON December 21, the State funeral of Santos Dumont, the Brazilian pioneer of aviation, took place in Rio Janeiro. His death occurred on July 23 at São Paulo, and owing to the disturbed state of the country he was first interred there. On December 18, after the body had lain in state in the crypt of the Cathedral of São Paulo for some time, it was removed to the capital, where on arrival it was met by an escort of military and naval aircraft which performed evolutions during the transit from the station to the Cathedral of Rio Janeiro. The public were afterwards admitted to pay their last respects to one who is proclaimed by his country as the father of aviation, and on December 21 the final rites took place at the St. John the Baptist cemetery.

Announcements

MR. H. T. TIZARD, Rector of the Imperial College of Science and Technology, has been appointed chairman of the Aeronautical Research Committee in succession to Sir Richard Glazebrook.

THE Government of Ecuador has awarded the decoration of Al Merito, in the degree of Gran Oficial, to Dr. George Sheppard, State geologist to the Republic of Ecuador, in recognition of his valuable work in a consulting capacity to various departments of the Government, and also in appreciation of his published contributions to geological science during the past few years.

THE annual report of the Rockefeller Foundation for 1931 details the activities of the Foundation, of its grants in aid in various domains of human knowledge, scientific and humanistic, with brief reviews of the chief researches carried out under its endowment. Much work has been done on yellow fever, including trials of preventive vaccination. Under malaria, the existence of two races of *Anopheles maculipennis*, the chief mosquito-carrier in southern Europe, is described, one with barred, the other with dappled eggs, the former predominating in the non-malarious districts. The disbursements of the Foundation during the year amounted to 17,477,225 dollars.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A public analyst for the Metropolitan Borough of Fulham—The Town Clerk, Town Hall, Fulham, S.W.6 (Jan. 4). A principal of the Newport Technical College and Institute—The Director of Education, Education Offices, Charles Street, Newport, Mon. (Jan. 14). A University professor of civil engineering at the Imperial College (City and Guilds College)—The Academic Registrar, University of London, S.W.7 (Feb. 17).

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.]

Glycogen in Cartilage

IN 1923 Robison¹ showed that when bones of rachitic rats were immersed in solutions of calcium hexose-monophosphate or glycerophosphate, a dense deposit of calcium was formed in the matrix of the hypertrophic cartilage at the site where calcium would have occurred *in vivo* if the rats had been fed on a normal diet. He showed that the deposition of soluble calcium salts as an insoluble phosphate of calcium was due to the activity of an enzyme, phosphatase, which he was able to separate from bone.

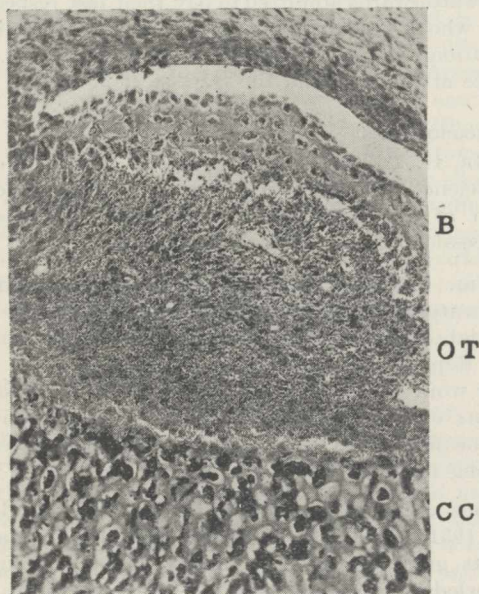


FIG. 1.—Untouched microphotograph of section through mandible and Meckel's cartilage in a human embryo of about 72 days. Stained with Best's carmine.

C.C.—senescent calcified cartilage of Meckel with 'hypertrophied' cells laden with glycogen.

O.T.—Osteogenic fibrous tissue in which osteoblasts are differentiating with discrete particles of glycogen.

B.—Lamella of membrane bone with osteoblasts serially arranged on the free surfaces.

Fell grew the isolated femora of six-day chick embryos *in vitro* and with Robison² proved that the enzyme is formed by or in the hypertrophic cells of the cartilage.

Phosphatases have been found not only in actively growing limb bones but also in other tissues of the body though these phosphatases are not all of the same type. They are normal constituents of the blood, occurring both in the corpuscles and in the plasma. Both corpuscles and plasma also contain hydrolysable phosphoric esters (Robison,³ Kay⁴). Kay published a method for estimating the activity of the phosphatase in the blood plasma. He measured the number of milligrams of inorganic phosphate liberated from excess of sodium glycerophosphate in 48 hours at 38°C. and pH 7.6 by 1 c.c. of plasma. In the normal adult the average value is 0.15 mgm. Numerous

papers dealing with the quantitative distribution of phosphatase have appeared. There is general agreement that in cases of generalised bone disease the phosphatase activity of the blood plasma is increased even to twenty times the normal, and that the increase is proportional to the severity of the disease. Robison and Kay have thus extended the fundamental problem of deposition of calcium and bone from an elusive inorganic reaction to a carefully balanced reaction involving inorganic radicles in combination with organic molecules as in the phosphoric esters, and controlled by an enzyme, phosphatase, which seems to be specific, within limits, in its action and subject to quantitative estimation.

Harden and Young⁵ and, later, Robison had emphasised the part played by phosphatase in the fermentation of yeast in relation to a deposit account of glycogen and a circulating account of hexose-phosphoric esters. Meyerhof⁶ and Embden⁷ later depicted the metabolism of muscle in terms of glycogen, hexose phosphoric esters and a muscle phosphatase as distinct from the earlier conception of the breaking down of glycogen to glucose and lactic acid. They showed that only about one-fifth of the lactic acid formed in the process of contraction of muscle is oxidised directly to carbon dioxide, the remainder being retransformed through hexose-phosphate to glucose and glycogen in the presence of oxygen.

In view of the known facts with regard to the distribution of glycogen in association with the hexose-phosphoric esters and phosphatase both in yeast and in the muscle cell, it immediately occurred to me that the hypertrophic cells of cartilage should be examined for glycogen in the hope that the chemical system in the ossification process would bear some relation to that already described for cells so widely different as the yeast cell and the muscle cell. Accordingly human embryos and the embryos of various laboratory animals were examined for glycogen. The tissues were fixed in Allen's modification of Bouin's fluid, sectioned in paraffin and stained with Best's carmine. Control sections were spat upon to digest any glycogen on the section previous to staining. It was found that cartilage cells in the neighbourhood of the epiphysis store glycogen in direct proportion to their age. This is true not only of the cartilage cells arranged in columns at the epiphysal line but also of cartilage cells in relation to primary and secondary centres of ossification. Thus the cartilage cell in an avascular area exhibits its vegetative characteristics in the manner of storing glycogen. The more senescent the cell the greater the storage of glycogen. The osteoblasts and highly vascularised bone contain no glycogen. It is suggested that the senescent or hypertrophic cartilage cells provide both the phosphatase enzyme and the glycogen; the latter on hydrolysis yields hexose-phosphoric esters which under the action of the phosphatase and the calcium of the circulating body fluids lead to the deposition of an insoluble phosphate of calcium in the matrix.

In view of the atypical features attributed to Meckel's cartilage, sections of the lower jaw in a human embryo of 10 weeks were examined (Fig. 1). At this stage Meckel's cartilage consists of nothing but senescent cells heavily charged with glycogen. At the proximal end of the cartilage is a mass of osteogenic fibrous tissue in which early differentiation of the osteoblasts can be seen. The glycogen is distributed in the form of discrete fine dots of about 2 μ in diameter. Adjoining this is seen the first

lamella of membrane bone with osteoblasts serially arranged along its free surfaces. Both the ground substance of the bone and the osteoblasts are devoid of glycogen.

Numerous examples are found in plant physiology and animal pathology of the manner in which new cells and tissues are able to live and multiply on the autolytic products of senescent and dying cells. This is a feature of new tissue in pathological inflammation no less than of the growing shoot in tubers such as the potato. It is suggested that the vegetative proliferating cartilage in the senescent stage provides at the site of future ossification both the store of glycogen for the production of the hexose moiety of the hexose-phosphoric ester and the active enzyme, the phosphatase of Robison. The circulating body fluids provide both the calcium and the phosphates which Kay has so frequently emphasised. The phosphatase leads to deposition of calcium salts in the matrix of the senescent cartilage. The osteoblast is a highly differentiated cell which appears with the irruption of those blood vessels that proceed to remove the virtually dead calcified cartilage by a process which has much in common with that seen in aseptic inflammation. The osteoblast is able to control the deposition and re-absorption of bone in this system, presenting many of the features of a reversible reaction. The osteoclast is a multicellular osteoblast which appears in response to an urgent demand for re-absorption of bone rather than deposition.

This preliminary note on the association of glycogen with phosphatase in the senescent cartilage cell for the purpose of bone formation may serve to focus attention on the manner in which biochemical conceptions are gradually destroying the hitherto satisfying but none the less unsatisfactory views of the mechanist in anatomy. It is interesting to note from the scant facts collated by Pryde⁸ that in the unincubated egg phosphatase is absent (Kay) and also the hexose-phosphoric esters (Kay, Plimmer and Scott). Both substrate and enzyme reach a maximum by the twelfth day in the chick embryo and then steadily decrease. Glycogen is practically absent in the unincubated egg, appears about the second day and rapidly increases in parallel with the phosphatase and substrate. After the twelfth day the glycogen deposit in the liver of the chick increases rapidly. Creighton⁹ in 1896 thought that "the cartilages which are destined to continue throughout life as cartilages have little or no glycogen in the foetal period, but those which later will ossify have plenty and it usually appears in the spots which afterwards become ossification centres." Marchand¹⁰ in 1885 said: "The increase in the size of the cartilage cells in the neighbourhood of the bone is due to the accumulation of glycogen or at least coincides with it." Needham¹¹ in his admirable compendium on "Chemical Embryology" says: "Nobody now accepts Creighton's views and the attribution of any special embryological importance to glycogen is superfluous. While it may be useful to know the histological distribution of glycogen in the embryo, at present little physico-chemical meaning can be attached to most of this work." It is suggested that the work of Robison, Kay and Fell does provide a physico-chemical meaning for the distribution of glycogen in areas of future bone formation. Moreover, examination of the developing tooth in the embryo displays a gradual transition from concrete accumulation of glycogen in the epithelium of the primitive dental

furrow, to discrete particles of glycogen in the dentine germ and absence of glycogen in the fully differentiated ameloblast of the enamel organ. The 'vegetative' characteristics of cartilage and the rôle of vitamin D in promoting calcification therein have been emphasised repeatedly by me¹². The association of glycogen, phosphatase, phosphoric esters and vitamin D in this 'vegetative' cartilage provides a new and fundamental approach to the processes involved in diseases of bone, joints and teeth.

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¹ Robison, *Biochem. J.*, **17**, 286; 1923.

² Fell and Robison, *Biochem. J.*, **23**, 767; 1929.

³ Robison, *Ergebn. Enzymforsch.*, **1**, 280; 1932.

⁴ Kay, H. D., *Phys. Rev.*, **12**, 384; 1932.

⁵ Harden and Young, *Proc. Chem. Soc.*, **21**, 189; 1905.

⁶ Meyerhof, *J. Gen. Physiol.*, **8**, 531; 1927.

⁷ Emden and co-workers, *Z. physiol. Chem.*, **179**, 149; 1928.

⁸ Pryde, "Recent Advances in Biochemistry", p. 238. London, 1931.

⁹ Creighton, "Microscopic Researches on the Formative Property of Glycogen". London, 1896.

¹⁰ Marchand, *Virch. Arch. path. Anat.*, **100**, 42; 1885.

¹¹ Needham, "Chemical Embryology", vol. 2, p. 1036, 1931.

¹² Harris, H. A., *Brit. J. Radiol.*, **4**, 561-588; and 622-640; 1931. *Amer. J. Med. Sci.*, **181**, 453-473; 1931. *Lancet*, 489-491, Sept. 8, 1928.

Vitamin C and Hexuronic Acid

IN connexion with experiments under the direction of Dr. L. J. Harris¹ on the rôle of the suprarenal gland in vitamin C metabolism, we have investigated the silver nitrate staining capacity of glands taken from normal and scorbutic animals. It will be recalled that long before the identity of vitamin C with hexuronic acid was postulated^{2,3}, Szent-Györgyi⁴ noticed the presence of a reducing substance (hexuronic acid) in the suprarenal cortex, which had the characteristic property of causing deep staining in the tissues when treated with dilute silver nitrate. It occurred to us that if the identity of vitamin C and hexuronic acid were genuine, suprarenals from scorbutic animals might react negatively, or less intensely in the staining test. In view of the unspecific character of the reagent and of the possible presence of other reducing substances, we were not sanguine that a clear-cut distinction from normal glands would be observed, but in actual fact the difference is unmistakable and dramatic. After staining for 15 minutes with 0.4 per cent silver nitrate solution, glands from normal guinea pigs were deeply blackened; glands from scorbutic guinea pigs were completely unaffected.

With the whole normal gland, staining was confined to the surface on account of failure of penetration by the reagent, but when the glands were cut the whole cross-section was blackened. No differentiation between cortex and medulla, similar to that observed by Szent-Györgyi in ox suprarenals,⁴ and confirmed by ourselves, was noticed, but a final decision on this point must await detailed histological examination, since the relative sizes of the two zones show considerable variation in different species.

The above evidence lends further colour to the view that hexuronic acid and vitamin C are identical, or at least that their rôles are closely interrelated. Since, however, it is well known that the suprarenals become injured not only through vitamin C deficiency but also through vitamin B deficiency and simple starvation, caution may be necessary in accepting absence of staining capacity as a specific sign of avitaminosis C. The possibility of lack of

staining substance in the suprarenal from secondary causes must be kept in mind.

In preliminary experiments on suprarenals obtained from rats fed for prolonged periods on diets completely deficient in vitamin C, we have invariably observed positive silver nitrate reactions, even when through the simultaneous absence of vitamin A or the vitamin B complex the animals had reached a state of extreme emaciation. This finding is in good agreement with the current view that the rat is capable of synthesising vitamin C.

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Dec. 7.

¹ Harris, Mills and Innes, *Lancet*, 2, 235; 1932; Harris and Ray, *Biochem. J.*; 1932 (in press).

² Svirbely and Szent-Györgyi, *NATURE*, 129, 576; 1932; *Biochem J.*, 26, 865; 1932.

³ King and Waugh, *Science*, 75, 357; 1932.

⁴ Szent-Györgyi, *Biochem. J.*, 22, 1387; 1928.

Calculation of the Reflectivities of Sulphide Ore Minerals

THE practical difficulties of the direct determination of the indices of refraction and absorption of the opaque ore minerals have resulted in little work in this direction being accomplished. The progress of ore microscopy, however, has established the measurement of the reflectivity for (nominally) vertically incident light, whether by visual photometry as developed by Berek¹ and Schneiderhöhn, or by a photoelectric ocular as developed by Orcel², as a routine process in the determination of these minerals. The figures obtained present evidence of certain regular relationships. Thus, amongst the simple sulphides, selenides and tellurides a general increase of reflectivity with increasing atomic number can be traced in such series as ZnS-CdS-HgS or PbS-PbSe-PbTe.

Amongst the more complex sulphantimonites and sulpharsenites, such as the series $xPbS.ySb_2S_3$ or the Binn valley minerals $xPbS.yAs_2S_3$, the relationships are less simple. To a first approximation, however, many of these minerals can be treated as transparent in small thicknesses, still relatively great compared with the wave-length of the light employed³. With this assumption an approximate refractive index n may be calculated from Fresnel's relationship

$$n = \frac{1 + \sqrt{R}}{1 - \sqrt{R}}$$

The value of n thus obtained is used to derive from the Lorenz-Lorentz equation

$$MR = \frac{M}{d} \frac{n^2 - 1}{n^2 + 2}$$

the molecular refractivity MR (usually, unfortunately, denoted by the same symbol R as is now universally adopted to denote the reflectivity). For anisotropic crystals for which R_α , R_β and R_γ are known, the value $\bar{n} = \sqrt[3]{n_\alpha n_\beta n_\gamma}$ is used⁴ in calculating MR . If this is done for the simple sulphides, selenides and tellurides, MR values are obtained which have the same additive relationships as the usual molecular refractivities calculated for transparent salts. Of forty-five complex opaque minerals chosen at random, the MR values calculated direct from the measured reflectivities (Schneiderhöhn-Ramdohr⁵, and my own

measurements with a photoelectric ocular), and those computed from the MR values of the constituent molecules showed a significant difference in only a single instance, that of klaprothite (klaprotholite), $3Cu_2S.2Bi_2S_3$; it may be suggested with some confidence that the value for d quoted in the literature and based on an early determination by Petersen should read, not 4.6, but 6.4, the value obtained by calculating backwards from the MR value. (I have not yet been able to examine a pure specimen of the natural mineral, but the crystalline mass obtained by the Sommerlad method⁶ from the fusion of the constituents gave a value for d of 6.3.) These calculations therefore appear to be of interest from several points of view.

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¹ *Z. Krist.*, 77, 1-22; 1931.

² *Bull. Soc. franc. Min.*, 53, 322; 1930.

³ *Ibid.*, p. 302.

⁴ *Z. Krist.*, 77, 108; 1931.

⁵ "Lehrbuch der Erzmikroskopie", Band 2, Berlin, 1931.

⁶ *Z. anorg. Chemie*, 15, 173; 1897.

Electric Charges on Rain Drops

DURING the last year we have maintained in continuous action an apparatus for recording the electric charge on individual drops of rain. A drop of rain in order to have access into the insulated receiver has first to pass through a fixed but adjustable cylindrical opening of average diameter 1.4 cm. and then through a second opening of diameter 2.4 cm. at the periphery of a rotating disc. Both openings are provided with trap arrangements so that a drop striking the sides is caught and led away. The period of rotation of the disc is so adjusted that with moderate intensity of rain a second drop may not enter into the receiver until the charge of the first has been recorded and the system earthed by an automatic device. A glass manometer of very fine bore is attached to the receiver and keeps a record of the size and number of drops.

For recording the charge given to the receiver by a drop of rain, a Wilson tilt electroscope is used very nearly at its maximum sensitiveness, and the movement of the gold leaf is photographed by allowing light from a point source (a 'Pathé-Baby' projector lamp) to pass through a minute slit and a short focus lens and fall transversely as a narrow beam of about half the breadth of the leaf over a fine pin-hole made at its lower end, which is twisted at right angles to its plane. The transmitted light through the hole gives a magnified image of its displacement on a quickly moving photographic paper. All necessary precautions were taken to avoid the influence of the field of the earth and any artificial field on the drops.

This method of recording is of particular interest in view of the fact that the Wilson tilt electroscope has not to our knowledge been used in the past as a recording instrument. Simultaneously with the above apparatus, a Simpson apparatus giving the charge of rain collected every two minutes was kept in action.

An analysis of the records shows that both positively and negatively charged drops are present in the rain received from any part of the cloud. When the rain received during any interval is positively

or negatively charged as a whole, there is an excess of positively or negatively charged drops. The following table gives the charge per drop based on the measurement of about two thousand drops. In making the tabulations all drops were neglected the charge of which was less than 0.06 e.s.u.

	Charge per drop (e.s.u.)					
	Positively charged drops.			Negatively charged drops.		
	Mean	Absolute max.	Mean max.	Mean	Absolute max.	Mean max.
Non-thunderstorm rain	0.64	1.95	1.23	0.67	2.41	1.24
Thunderstorm rain	0.69	2.44	1.82	0.73	3.74	2.26

A detailed analysis of the observations with discussion will be given in our forthcoming memoir on the subject.

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Diamagnetism of Thin Films of Bismuth

At Prof. W. Gerlach's suggestion I have recently investigated the behaviour of the magnetic susceptibility of bismuth when measured in the form of thin films. A modified form of the Faraday method was employed, the measuring system consisting of a flat cross with four equal arms about 15 mm. long and 5 mm. wide, the arms being set at about 90° to one another. This system was constructed of glass about 0.1 mm. thick. A fine glass wire through the centre of the cross and perpendicular to its plane carried a small galvanometer mirror; the system was suspended from a torsion head by means of a fine quartz fibre and was thus free to turn about the glass wire as axis. The cross hung in an inhomogeneous, but symmetrical, magnetic field formed by two 60° wedge-shaped pole pieces such that each pole piece occupied the space between two adjacent arms of the cross. The plane of the cross was horizontal and parallel to the lines of force, the centre of the cross and field system being coincident. The gap between the pole pieces was about 10 mm. In the magnetic field the cross would take up a very definite position of equilibrium and this point was made the zero point of the system when no field was acting. A film of bismuth was now deposited on one long arm of the cross (that is, about 30 mm. long) thus upsetting the equilibrium and causing the system to be deflected, which in turn was brought back to its initial zero position by means of the torsion head, the angle of deflection being determined by a telescope and scale in the usual way.

The films were produced by evaporation from an electric furnace such that they were about the same size as one long arm of the cross, that is, about 30 mm. x 5 mm., and of very uniform thickness. The deposition of the films and measurements were made in vacuum; it was impossible however to outgas the cross system. The procedure was first to deposit a very thin sensitising film, the magnetic properties of which were negligible, in order to have a more or less definite surface on which to deposit the thicker films. A film was now deposited and the deflection measured; over this was now deposited a very much thicker film and the deflection again measured, always from

the initial zero position in the same field. Of course an intermediate film between the thick and the thin one could be deposited and measured if desired. If θ , K and d refer respectively to deflection, volume susceptibility and thickness of a given film, since the field remains the same for two or more given measurements,

$$\theta \propto Kd$$

$$\text{or } \frac{K_2}{K_1} = \frac{\theta_2}{\theta_1} \cdot \frac{d_1}{d_1 + d_2}$$

Hence in order to compare the susceptibility of a thin and a thick film we must know the ratio of d_1 to d_2 . By means of a shutter in the apparatus the time of deposition of the films could be accurately controlled. Both films are deposited under the same conditions of temperature and pressure in the apparatus. In order to give absolute values the thickness of the final film ($d_1 + d_2$) was determined in the usual way by weighing. From the times of deposition the ratio d_1 to d_2 is known and d_1 and $d_1 + d_2$ are known absolutely. The susceptibility of the thin film is then known in terms of the thick one.

Lack of space prevents giving a detailed table of results but in some forty determinations ranging in film thickness from 0.2 μ to 15 μ no variation of the susceptibility could be found. Certainly the fluctuations between readings is rather large (some 12 per cent) but these readings are all grouped around a mean value which is quite constant. I believe we can draw the conclusion that, in the given range, the susceptibility of bismuth remains constant.

A considerable amount of work on the susceptibility of colloidal powder of bismuth and other metals (Sb, Ag, Au) has been done by Vaidyanathan,¹ Rao² and others. These authors find that with decreasing particle size the diamagnetic susceptibility decreases and have advanced the hypothesis that the susceptibility becomes a function of the particle size when this is less than 10 μ . While Mathur and Varma³ in a careful series of tests have shown that a large part of this decrease in bismuth is due to oxidation, Rao² still finds a change when the oxide is removed as completely as possible. If, however, diamagnetism actually depends on particle size, we should expect the experiment described here to show it, since we know that a thin film is composed of small crystallites the size of which decreases as the film thickness is decreased.

I would suggest that the hypothesis recently advanced by Seemann and Kussmann⁴ to explain the effect of cold work on the susceptibility of metals might also account for the effect observed in colloidal powder. The process of mechanical colloidalisation (that is, grinding) could be looked upon as cold working, which sets free ferromagnetic impurities in the metal giving rise to a decrease in diamagnetism. Melting the colloidal powder (as Rao has done) would again render the impurity inactive giving rise to an increase in diamagnetism as observed. It might be possible to make a direct check on this point by measuring the susceptibility of each powder at various field strengths, since as the particle size decreases the susceptibility should show more and more variation with the field.

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¹ Vaidyanathan, *Ind. J. Phys.*, 5, 559; 1930.
² Rao, *ibid.*, 6, 241; 1931.
³ Mathur and Varma, *ibid.*, 6, 181; 1931.
⁴ Seemann and Kussmann, *Naturwiss.*, 19, 309; 1931.

Velocities of Emission of α -Particles

THE relative velocities of the α -particles from thorium X, thoron, thorium A, thorium C, thorium C' and radium C' have been measured by the direct magnetic deflection method using a permanent magnet¹ giving a field of about 5,000 gauss. The deflections were measured with a microphotometer, and by carefully investigating possible sources of error such as loss of velocity by absorption at the source, non-uniformity of the magnetic field, and the effect of any movements of the photographic emulsion during development, it has been possible to obtain a considerable improvement in the accuracy of measurement of α -ray relative velocities.

The results for the relative velocities are shown below; the probable error is 1 in 20,000. The absolute velocities are deduced from the value 1.922×10^9 cm. sec.⁻¹ for radium C' ².

Relative Velocity	Absolute Velocity
Radium C' .. 1.00000	1.922×10^9 cm. sec. ⁻¹
Thorium X .. 0.86042	1.653 ₇
Thoron .. 0.90464	1.738 ₇
Thorium A .. 0.93935	1.805 ₄
Thorium C .. 0.88811	1.707 ₀
Thorium C' .. 1.06872	2.054 ₁

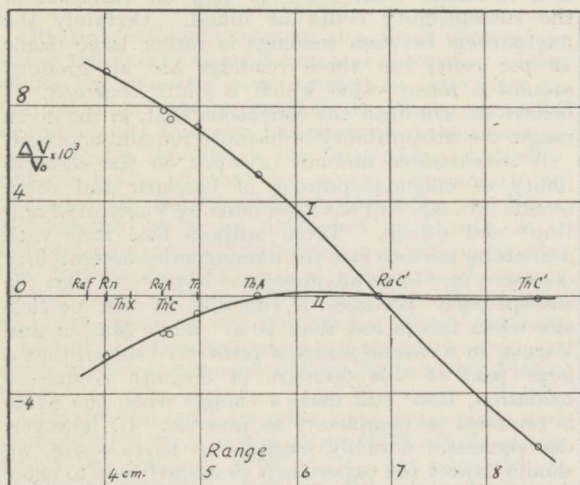


FIG. 1.—The relation between range and velocity of α -particles. Curve I, deviations from the Geiger relation $V^3 = kR$; Curve II, deviations from $V^{3.26} = kR$.

The complexity of thorium C discovered by Rosenblum produced a slight broadening of the line but no evidence of complexity was found in the other groups. The velocity for thorium C corresponds to the weighted mean of the two main components.

The relative velocities of the α -particles from radium A, radon, and radium C' are also being measured and the following preliminary results have been obtained:

	Velocity relative to Radium C'	Absolute Velocity
Radon	0.8455 ± 0.0003	1.625×10^9 cm. sec. ⁻¹
Radium A	0.8839 ± 0.0002	1.699

From the velocity ratios obtained in this work and the range measurements of Lewis and Wynn-Williams³ a new correction curve (Fig. 1, curve I) to the Geiger relation, $V^3 = kR$, has been calculated from the equation

$$\Delta V/V_0 = V/V_0 - (R/R_0)^{1/2}$$

used by Rutherford, Ward and Lewis⁴. V_0 and R_0 are the velocity and range of radium C'.

It is found that the equation $V^{3.26} = kR$ accurately

expresses the relation between velocity and range above a range of 5 cm. The deviations from this relation calculated similarly are shown by curve II.

From these curves the velocities relative to radium C' may be calculated with a maximum error of 0.0004, for other groups of α -particles the ranges of which have been measured by Lewis and Wynn-Williams.

	Velocity relative to Radium C'	Absolute Velocity
Actinon (short)	0.9179	1.764×10^9 cm. sec. ⁻¹
Actinon (long)	0.9420	1.811
Actinium A	0.9795	1.883
Actinium C (short)	0.9034	1.736
Actinium C (long)	0.9282	1.784
Actinium C'	0.9841	1.891
Polonium	0.8310	1.597

There are systematic differences between the results given above for thorium C (mean), thorium C' and radium A, and those obtained earlier by Rosenblum⁵ in the course of his experiments on the fine structure of α -ray spectra using the large electromagnet of the Paris Academy of Sciences. Recently, however, Rosenblum and Dupouy² have measured the velocities of seven groups after having made a fresh exploration of the field of the magnet. The results agree to well within the limit of error, 0.5 to 1 in 1,000, with those reported here.

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¹ Briggs, *J. Sci. Inst.*, 9, 5; 1932.
² Rosenblum and Dupouy, *C. R. Acad. Sci.*, 194, 1919; 1932. Briggs, *Proc. Roy. Soc.*, A 118, 549; 1928.
³ Lewis and Wynn-Williams, *Proc. Roy. Soc.*, A 136, 349; 1932.
⁴ Rutherford, Ward and Lewis, *Proc. Roy. Soc.*, A 131, 684; 1931.
⁵ Rosenblum, *C. R. Acad. Sci.*, 190, 1124; 1930.

Productivity of the Fisheries North and South of the Suez Canal

THE work of the great oceanographical expeditions, and the experience of the fisheries administrations in the different countries, have alike gone to show that living things are more abundant in temperate and polar seas, than in those of the tropics and subtropics.

It is a little surprising, therefore, that the fisheries of the Gulf of Suez should have the reputation of being more productive than those of the Mediterranean coast of Egypt; for, though I have shown elsewhere¹ that the Port Said end of the Suez Canal may be the hotter, this is only so for six months of the year, and even then must be regarded as a local effect, the main water masses of the northern Red Sea being always hotter and saltier than the eastern Mediterranean.

That the Gulf of Suez fishery is indeed more productive, is well shown by the evidence of the Egyptian fishery statistics concerning the trawl fishery, where the mean catch in kilograms per net per day's fishing at Alexandria and Suez for the last ten years, and at Port Said for the last nine are: Alexandria, 115; Port Said, 131; Suez, 232.

In the long line fishery, a motor ketch, working in the summer of 1930 from Alexandria, and in the summer of 1931 from Suez, gave a greater yield per basket of lines at Suez, compared with Alexandria. Nevertheless, as much of the Suez catch was made up of dogfish, sharks and rays, the catch at Alexandria was sixteen times as valuable. Similarly in the trawl fishery, though elasmobranchs form only a small

part of the catch at Suez, the Red Sea fish are not esteemed as much as those of the Mediterranean, and the Alexandria catch is more valuable.

Finally, and in addition to the evidence of the commercial catch, my own observations (based on the change in hydrogen ion concentration on storing water samples, *loc. cit.*) and those of Natterer² show that there is more organic matter in the water of the southern than in the northern part of the Suez Canal.

The explanation of this anomaly seems to me to be a tidal one. At Suez there is a considerable ebb and flood, which is absent at Port Said. This tidal scour must cause a thorough vertical and horizontal mixing of the water mass in the head of the Gulf of Suez and the southern end of the Suez Canal. It would replenish with basic food materials areas that might otherwise have become exhausted as a result of the synthetic activities of marine algae. On the other hand, and particularly so between February and August, when the Nile out-flow is dammed, the water of the Mediterranean coast of Egypt must be relatively stagnant, and, for such mixing as there is, will depend mainly upon the strength and direction of the wind in the coastal area. Under these conditions, one can quite easily see that in long periods of calm weather the basic food materials necessary for algal growth would be used up, and in the absence of further supplies being circulated, this growth would cease. It is, of course, upon this algal and other plant growth that the yield of the fishery ultimately depends.

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¹ "Some Hydrographic Data from the Suez Canal, 1928-1929", Fisheries Research Section, Bull. No. 1. Govt. Press, Cairo, 1930.

² "Berichte der Comm. für Erforschung der Östliche Mittelmeers." 1893.

Cystine and Wool Production

ATTENTION continues to be directed to the difficulty of accounting for the manner in which sheep on pastures secure the cystine necessary for wool growth. In a recent communication to NATURE,¹ Rimington and Bekker conclude that the amount of cystine consumed in the grass fails to account for the amount present in the fleece and formulate an alternative hypothesis that "The intestinal flora and fauna . . . are almost certainly able to synthesise cystine from inorganic sulphur and it is conceivable that the population of the sheep's intestine, by continual increase, is transforming sulphates into cystine, built into their own protoplasm, with a high grade of efficiency. As bacteria die, their cell protoplasm autolyses, again setting free the sulphur, now in the form of cystine, which is readily available to the sheep."

Although this hypothesis is attractive, the evidence against it is considerable. Various Continental and American workers have noted that the bacterial flora of the intestine readily decompose sulphur-containing bodies and even elementary sulphur to hydrogen sulphide, ethyl mercaptan and similar compounds which, on absorption, are very rapidly oxidised by the blood stream and excreted as urinary sulphates. The possibility of the transformation of inorganic sulphur into cystine by such means has not been demonstrated, however. Recently, we have also studied the activity of cellulose-splitting bacteria isolated from the contents of the sheep's rumen by continuous sub-culturing in a medium containing ammonium sulphate as a source of nitrogen

and sulphur. Although there was a pronounced decrease in sulphate sulphur and the formation of hydrogen sulphide, there was no evidence of the formation of cystine or any similar sulphur compound. Fraser and Roberts² have made the suggestion that "cystine is formed during keratinisation, and that cystine synthesis is a function of the wool follicle itself. The amount of cystine produced in a fleece would then depend upon the number and activity of the wool follicles, and not upon the cystine content of the food or the bacterial population of the intestines."

It is of the utmost importance, from the point of view of pastoral industry, that the whole problem should be brought into its proper perspective. The recent work of Evans³ has shown that cultivated pasture, under English conditions at any rate, contains about 0.1 per cent of cystine on the basis of dry matter (*not* 0.01 per cent as is accepted as the average figure by Rimington and Bekker). Considering the case cited by these investigators, and assuming that a fully-grown sheep is able to consume daily an amount of pasturage containing 4 lb. of dry matter, it follows that the necessary 0.78 lb. of cystine in a 12 lb. fleece would be secured from the pasturage during a grazing period of 195 days. Even on the assumption that only 50 per cent of the cystine in the grass is actually retained in the animal for purposes of wool-protein synthesis, it is clear that a sheep would consume per annum roughly all the cystine necessary for the growth of a 12 lb. fleece. If, however, the average wool production per head of the sheep population in Great Britain be taken at the much lower official estimate of 5-6 lb.,⁴ then the argument becomes even more convincing.

We are led to the belief, therefore, that under English conditions, there is no difficulty in accounting for wool production in sheep subsisting wholly on pasturage. The cystine content of the herbage, although apparently low, is adequate for this purpose. The previous interpretation of the figure obtained for the cystine content of grass as indicating the presence in the herbage of a cystine precursor becomes therefore superfluous.

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Dec. 8.

¹ Rimington and Bekker, NATURE, 129, 687; 1932.

² Fraser and Roberts, NATURE, 130, 473; 1932.

³ Evans, J. Agric. Sci., 21, 806; 1931.

⁴ Wool Survey of the Empire Marketing Board, 57; 1932.

Radiation and Enzyme Activity

A SYSTEMATIC study of metabolic radiation by a modified photographic method in this laboratory (to be published at a later date) has revealed the following facts: (1) Radiation is a general function of normal organic metabolism, being exhibited by blood, milk, eggs, brain, bone-marrow, lung, the pituitary (anterior and posterior lobe) and the parathyroid gland, urine, roe of plaice, yeast, Demerara sugar, honey, etc. (2) Radiation fades with the lowering and re-appears with the raising of temperature; it is inhibited at -5° to -10° , destroyed by heating at 98° - 100° for two hours, inhibited by carbon monoxide in the dark but regenerated in sunlight, and destroyed by hydrogen peroxide, potassium permanganate and potassium cyanide. (3) Pure cholesterol, vitamins (C and D), sucrose, hormones and alkaloids as such are void of radiation.

Comparing the occurrence of radiation and the influences controlling it with the distribution and characteristics of respiratory enzymes, we have no difficulty in recognising radiation as an inseparable part of normal enzymatic activity (oxidase, dehydrogenase).

This deduction links two hitherto unrelated lines of research on malignant growth, namely, (a) Warburg's work on abnormal glycolysis by restricted activity of respiratory enzymes, and (b) Gesenius's investigation on inhibited radiation in relation to disease.

Excluding parasitic inhibition (syphilis, tuberculosis) and passivity caused by suppressed intake of oxygen (pernicious anæmia), the depletion of respiratory enzymes in cancerous cases may be due to enzyme starvation, for which our diet and culinary methods are mainly responsible. To restore normal metabolism in all its phases we should require the introduction of a cellular system capable of regulating glycolysis, the vitamin and hormone equilibrium, to be non-toxic and able to function under partly anaerobic conditions. Yeast, especially commercial baker's yeast, in an enzyme-bearing medium (unrefined sugar, honey, etc.) which is respiratorily much more virile than any pure culture, should provide such an enzymatic association.

Local inductive and contact influences (rays, tar, etc.), affecting respiratory enzymes, become, if protracted, carcinogenic.

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Nov. 29.

Liesegang Rings

Dr. HEDGES is to be congratulated on his book on "Liesegang Rings", which gives for the first time a comprehensive survey of the subject together with a most extensive bibliography. It will be a valuable work. His description of my theory is adequate, except that he is incorrect in stating that it does not account completely for all the facts. The example quoted against it is a beautiful confirmation. The formation of zones of precipitated sodium chloride is due to the oppositely diffusing solutions of hydrochloric acid and sodium chloride being constrained by the capillary tube to pass near the deposited salt. This demonstrates the essential part played by the precipitate in removing the solute from the solution in its neighbourhood.

This experiment is not the first case of so-called rhythmic precipitation without chemical reaction. In 1921¹ I described beautiful bands of tiny gelatin particles suspended in water, which were formed by diffusing alcohol into dilute solutions of gelatin. Further, my adsorption theory explains the formation of banded structures by crystallisation.²

Dr. Hedges proposes an alternative theory that the phenomenon requires "(1) a critical condition, which has to be reached before crystallisation, precipitation, coagulation, condensation, or other change involved in the formation of the periodic structure takes place, and (2) mobilisation of the material which can occur during the delay caused by the first condition. In this way material is moved from the zone which eventually become the spaces to those which eventually become the rings." This attempt at generalisation is too indefinite as a working hypothesis. The majority of systems included would give no periodic structures.

It does not indicate the part played by the precipitate, or specify that it must be held in place. Even if the statement is made more definite by specifying supersaturation as the critical condition and diffusion as the means of mobilisation, only a very small proportion of the many systems that would conform to these conditions would produce good banded precipitates. The theory is incapable of explaining the facts in detail as my adsorption theory does.

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Nov. 21.

¹ *Biochem. J.*, 15, 561; 1921.

² *Biochem. J.*, 12, 360; 1918.

Carbon-Oxygen Linkage in the Metal Carbonyls

DADIEU and Kohlrusch¹ have shown that the $>C=O$ group in aldehydes, ketones and esters, is associated with a Raman displacement of 1,500–1,700 cm^{-1} ; Rasetti² found for carbon monoxide a shift of 2,155 cm^{-1} , in satisfactory agreement with the structure $\overset{-}{C}\equiv\overset{+}{O}$. Observation of the Raman effect in the metal carbonyls should therefore discriminate between a co-ordinated structure³, and any cyclic structure embodying $>C=O$ groupings.

Through the kindness of Prof. A. Fowler, I have been able to photograph the Raman spectrum of nickel carbonyl, and to find a strong line corresponding with a displacement of 2,038 cm^{-1} , together with a number of diffuse lines of displacements up to 450 cm^{-1} . Since the performance of this preliminary experiment, Dadiou and Schneider⁴ have examined the Raman spectrum in detail, and found shifts of 2,125 and 2,039 cm^{-1} , corresponding to the carbon-oxygen linkage, together with lines at 595, 456, 379 and 80 cm^{-1} which have been attributed to the fundamental frequencies of a tetrahedral molecule.

The Raman effect thus affords decisive evidence that the carbon monoxide is present in the molecules of the metal carbonyls as such, the difference between the value 2,155 cm^{-1} found for carbon monoxide itself, and the doublet 2,125 and 2,039 cm^{-1} found in the case of nickel carbonyl being attributable to the modification in the forces operative in the carbon-oxygen linkage brought about by the co-ordination of the carbon monoxide to the metal, and the consequent redistribution of polarities.

It is important to note that this evidence, as also that derived from measurement of the dipole moment⁵, is in full accord with the chemical properties of the carbonyls, in particular the replaceability of the carbon monoxide by amines (cf. the formation of the compound $Ni(CO)_2 \cdot C_{10}H_8N_2$ and analogous iron and cobalt compounds⁶). The convergence of evidence may therefore be taken as establishing beyond doubt a structure of the type indicated above.

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Dec. 5.

¹ Dadiou and Kohlrusch, *Ber.*, 63, 251; 1930.

² F. Rasetti, *NATURE*, 123, 205; 1929.

³ cf. Sidgwick, "Electronic Theory of Valency", p. 216.

⁴ Dadiou and Schneider, *Akad. Anzeiger der Akad. der Wiss.*, Wien, Oct. 15, 1931.

⁵ Sutton and Bentley, *NATURE*, 130, 314; 1932.

⁶ Hieber, Mühlbauer and Ehmman, *Ber.*, 65, 1090; 1932.

Research Items

Dried Head from New Guinea.—Mr. H. G. Beazley figures and describes in *Man* for December one of the rare dried heads of the Marind-anim (Tugeri) peoples of Dutch New Guinea. Two methods of preserving the head are known from the various districts of New Guinea. In addition to the 'preserved' head method, is that in which a reconstruction of clay overlies the cranium. In the specimen described here both methods are followed. While the original skin still covers the features, the posterior portion is entirely constructed of clay. The Tugeri to-day are an inland people; but they make periodical raids down river in their canoes on the peoples who inhabit scattered islands at the river mouth. It is possible that originally they were a coastal people, who were driven inland by later arrivals. Their social organisation would seem to require a steady stream of captives for the supply of these reconstructed heads, which are obtained from the captives brought back to the Tugeri villages. The prisoners' legs are broken to prevent their escape and their death takes place only at the feasts that are held on the return of the raiders. The object of the raids is to secure the souls of the victims, and immediately before they are killed they are made to cry out by ill-treatment. Whatever cry is uttered is accepted as the name of the spirit. The word is treasured and the influence of the spirit, of which it is the name, will guard and benefit the captor. An outstanding feature of this type of preserved head is the fibre 'wig', which is added owing to the fact that most of the coast peoples have short hair. Lengths of fibre are close woven at their base to form a close-fitting cap which is attached to the scalp.

Bari Initiation.—Fr. L. M. Spagnolo contributes notes on the initiation of young men and girls among the Bari tribe of the Sudan to *Africa* (vol. 5, No. 4). Initiation of the youths was, in the days before the Bari were affected by white civilisation, one of the links between the chief and his people. When his son had reached the age of entering the ranks of the warriors, the chief would present him with a bull and bid him summon all the youths of his age-class, who henceforth would form his bodyguard. They assembled on an appointed day, a bull was killed with the usual ceremonies, and much beer drunk. The young chief of the class then announced the name by which his class would be known, this usually expressing some attribute such as courage, strength and the like. The name was chanted in all tribal songs sung at marriages, funerals and on similar occasions, and was used as a battle cry. The class formed a society with bonds which only death could sever. The custom is now falling into disuse. The initiation of young girls fell into five stages, which entailed cicatrization at certain ages, beginning at about fifteen. In the fourth stage the initiates had the lower canines and incisors removed to mark the passage from girlhood to married status. No girl could marry unless she had undergone this stage of the ritual, and failure to comply caused infecundity. The neophytes lived in seclusion and the operation was carried out by a skilled operator with an iron instrument, sometimes reinforced by a stone. The period of seclusion was passed in singing, dancing, and in the preparation of a number of ceremonial objects. Certain taboos had to be

observed. At the close of the period—about three months—suitors presented gifts to the girls and to the members of their family. The last tattooing takes place about two years after the extraction of the teeth, that is, when the girls are something over twenty years of age. Age classes, five for each sex, determine the joint of the fat ox to which participants are entitled at ceremonial feasts.

Contraception and Fertility in Women.—"Contraception and Fertility in 2,000 Women" by Raymond Pearl (*Human Biology*, vol. 4, September, 1932), is a preliminary report on the first 2,000 cases collected in an investigation of the prevalence and effectiveness of the use of contraceptives. The data are collected by physicians attending women who are undergoing parturition in the obstetric clinics of 38 large hospitals in the United States. As Prof. Pearl points out, selection is an important factor in the inquiry and the data cannot be regarded as a sample of the general population because there were no women from rural areas and all the women had been delivered of a baby in hospital. No data were collected from Roman Catholic hospitals. The cases were almost entirely from the lower economic and social levels; 70 per cent were white women and 30 per cent negroes. The average number of pregnancies was 2.68 for white women and 2.89 for negroes. It would appear from this sample of women that the practice of contraception is far less prevalent than is commonly supposed, for only about 36 per cent of white women and 15 per cent of negroes had made some attempt to prevent conception. The different methods of contraception used were such that the white men alone assumed 48.7 per cent of the responsibility of family limitation, the white women alone 49.3 per cent and the couples conjointly 2 per cent. Among the negroes, family limitation was practised more by the women; the males alone assumed only 33.1 per cent of the total responsibility, the women 64 per cent and the couples together 2.9 per cent. A new method is described for calculating person-years of exposure to risk of pregnancy. No definite conclusions are attempted in this preliminary study. There is some reason to think, though it is not yet demonstrated, that women who practise contraception are innately more fertile than women who do not.

Distribution of Bugs of the family Peloridiidæ.—The remarkable hemipterous family Peloridiidæ has formed the subject of a number of speculative and controversial papers during the last decade. The interest which these insects arouse is due partly to their excessive rarity but more particularly to their extremely puzzling relationships. Indeed, it proved necessary to establish a special series within the suborder Homoptera for this one family with its three genera, each with only one species. Practically nothing was known of the habits of these bugs and it is only recently that Hacker has published (*Queensland Agri. J.*, vol. 37, 1932) some authentic observations on the ecology of *Hemiodæcus veitchi*, which proved to be a forest insect associated with the antarctic beeches of the genus *Nothofagus*. On the basis of this discovery, W. E. China (*Ann. Mag. Nat. Hist.*, vol. 10, October, 1932) has analysed the distribution of other members of the family. One of

them, *Peloriidum hammoniorum*, is known from the vicinity of the Straits of Magellan, where several species of *Nothofagus* occur; another, the New Zealand *Xenophyes cascus*, has been found in a locality where several species of *Nothofagus* are known to occur; the habitat of the Tasmanian *Hemiodæcus leai* remains unknown, but a species of *Nothofagus* grows there. The existence of a species of *Nothofagus* in the McPherson Range in Queensland, together with the occurrence there of a peloriid, suggests that the range in question can be regarded as a relic island of the ancient antarctic flora and fauna, comparable to the European Alps with their isolated arctic species of plants and animals.

Respiratory Organs of Isopod Crustacea.—Mr. Ernest E. Unwin has described the respiratory organs and their modifications found among various genera of terrestrial Isopoda forming the group Oniscoidea or wood-lice (*Papers and Proceedings, Roy. Soc. Tasmania, 1931, pp. 37-104*). These Crustacea inhabit very diverse situations, some requiring wet conditions while others live amid comparative dryness. In this connexion there are correlated modifications in the organs of respiration. In all cases the exopodites and endopodites of the first five pairs of abdominal appendages are respiratory in function. The endopodites are uniformly thick-walled, somewhat flattened sacs filled with blood. Their surfaces are coated with a film of water and the author concludes that they are capable of absorbing oxygen through the medium of this moisture layer. The exopodites, on the other hand, present greater structural diversity. In *Oniscus* and *Philoscia* there is a special thin extension of the outer border of the exopodites forming small lung chambers. In such cases the blood follows through radial passages in the thin-walled plate and the air bathes the surface of the special organ. In *Porcellio, Armadillidium* and other genera the outer wall of the exopodite is invaginated to form a branching system of very thin-walled air tubes. The blood within the cavity of the exopodite bathes the surfaces of the air tubes. The second method of respiration is comparable with the tracheal respiration of Insecta but the wood-lice are handicapped by the small size of the organs concerned and their inability to do without endopodites. These facts appear to have limited the range of wood-lice, since they have to seek situations favourable for both types of breathing.

Pedigree Strains of Herbage.—The results of the comprehensive trials with pedigree strains of herbage, carried out at the Welsh Plant Breeding Station, Aberystwyth, during the seasons 1926-1931, have been published from the Station as Bulletin No. 13, Series H. The evidence obtained shows how far we are at present from being in a position to lay down truly scientific rules for the maximum exploitation of grasses and clovers, but although much critical field experimentation is still needed before our knowledge can be translated into terms of practical grassland management, the information already obtained allows of certain important generalisations being made. For example, no two species or strains of grass react similarly to factors (such as grazing or nitrogenous manuring) which influence seasonal productivity, palatability or persistency, and as a means of securing the right type of herbage at the right season, a simplification of the botanical personnel of the swards in conjunction with a rotational system of grazing is suggested. As regards the live weight increase of

sheep fed on the different pastures, the outstanding result is the exceptionally high feeding value of wild white clover. An increase in live weight and carrying capacity of the sward was also obtained by the application of a nitrogenous manure, although this entailed a decrease in the percentage of clover present. Chemical analyses carried out to determine the effect of dressings of nitrogen on the composition of the individual grasses show that the nutritive value and palatability of a pasture can, to a considerable extent, be controlled by careful selection of the most suitable species, coupled with judicious management.

Virus Diseases of the Peach.—Three virus diseases of the peach in Michigan are described by D. Cation, in Circular Bulletin No. 146 of the Michigan State College, Agriculture Experiment Station (pp. 1-11, 1932). The diseases known as 'peach yellows' and 'little peach' are well known in peach-growing districts, but the trouble known as 'red suture' is of more recent occurrence. The foliage of infected plants becomes bronze in colour, giving the tree an unhealthy appearance, and the fruits bear a distinct red ridge along the suture. The malady is transmitted by grafting and is, in all probability, a virus disease. The bulletin under review deals with the symptoms and control of all three diseases.

Crystallisation of Pyroxenes.—An important contribution to the current discussion as to the course of crystallisation of pyroxenes from rock magmas is made by S. Tsuboi (*Jap. J. Geol. Geog., 10, 67-82; 1932*). Whereas Barth found that in the basaltic rocks of the Pacific, South Africa, India and Cape Verde the porphyritic pyroxenes are diopsidic, while those of the ground-mass are pigeonitic, Tsuboi finds that in the majority of Japanese andesitic and basaltic rocks both monoclinic and rhombic pyroxenes occur as phenocrysts. It is suggested that in the intratelluric stage crystallisation may begin with either type of pyroxene according as the composition of the original magma lies in the field of monoclinic or rhombic pyroxenes. Only a limited degree of miscibility prevails in this stage. In the effusive stage, however, there is no limit to the miscibility of the pyroxenes, and in the residual liquid that remains both components crystallise in a single pigeonite phase. This inference corresponds with the results obtained by Bowen in his experiments with artificial pyroxenes under pressure conditions like those of lava flows. The variation of the course of crystallisation with pressure changes as well as with changes of composition in the residual liquids makes it possible to understand more clearly some of the apparent discrepancies between fact and theory in the very complicated history of pyroxene crystallisation.

After-Shocks of the Hawke's Bay Earthquake of February 3, 1931.—A brief, but valuable, summary of the New Zealand earthquakes of 1931 is given by Dr. C. E. Adams and Dr. J. Henderson in Bulletin No. 84 of the Dominion Observatory, Wellington, N.Z. The outstanding feature of the year was the destructive Hawke's Bay earthquake of February 3, the epicentre of which lay on the coast-line of Hawke's Bay 5-15 miles north of Napier, and the focus at a depth of 10-15 miles. The frequency of the after-shocks, at first great, declined rapidly. During the rest of February 595 were recorded, but the number fell to 79 in March and 12 in December. Of the total number, 17 were of intensity 6 (Rossi-Forel scale)

or higher. A semi-destructive shock (intensity 8) occurred on February 13, with its epicentre close to the middle point of the chord joining the extreme points of the Bay. The positions of the epicentres of forty of the principal after-shocks of 1931 have been determined and are represented on the map accompanying the paper. It is remarkable how many of these epicentres lie along or close to the chord of the Bay and its continuations, that to the north passing close to Gisborne and therefore to the epicentre of the important after-shock of September 16, 1932 (NATURE, 130, 468; 1932).

Electrochemical Theory of Organic Reactions.—Two lectures by Prof. R. Robinson, published by the Institute of Chemistry, give a very convenient review of this subject, with a bibliography. Prof. Robinson dealt with the applications of the modern electronic theory of valency to organic reactions, taking up various aspects of the problem. The general or inductive effect due to the disturbance in electron arrangement owing to the presence of groups is considered in relation to the strengths of acids and bases. Reagents may be classified into anionoid, or electron donating, and cationoid, or electron accepting, which groups include reducing and oxidising

agents, respectively. Electromeric changes constitute a second type of electron displacement which appears in the simplest form in the course of the saturation of olefines or the additive reactions of carbonyl compounds. There is then a tendency for electrons in the double bond to break away from carbon and become attached to oxygen. Normally, such changes have a very restricted amplitude except in the course of reactions. All reactions of unsaturated substances are considered to be preceded by a degree of electromeric polarisation. A classification of conjugated electromeric systems into polyenoid $C=C-C=C$; hetero-enoid $O-C=C$; cationoid $C=C-C=O$; neutralised systems $O-C=O$; dicationoid and dicatio-enoid (quinonoid) $O=C-C=O$ and $O=C-C=C-C=O$; and dissociating systems, such as the carboxylic type, are discussed. Prof. Robinson then dealt with polar symbols for inductive, field and electromeric effects, with examples; anionoid reactivity of aromatic types; ordinary aromatic substitution, and cationoid reactivity of aromatic types. These lectures bring together a large amount of interesting material in a logical sequence and are a very useful contribution to modern chemical theory.

Astronomical Topics

Comet 1932 n (Dodwell-Forbes).—This comet, the magnitude of which is between 10 and 11, was found independently by Mr. G. F. Dodwell, the Government Astronomer at Adelaide, and by Mr. A. F. I. Forbes at Hermanus, Cape of Good Hope. It is Mr. Dodwell's first comet and Mr. Forbes's fourth. The following observations are from U.A.I. Circulars 409, 410, 411 and 413:

U.T. 1932	R.A. 1932-0	S.Decl. 1932-0	Place
Dec. 17 ^h 13 ^m 0 ^s .0 ^m	23 ^h 2 ^m 23 ^s	28° 43'	Adelaide
18 17 58.7	23 6 50.9	27 53 0	Johannesburg
19 0 17.4	23 7 45.0	27 41 33	Harvard

The time of the first observation was telegraphed as 1^h; but that was in daylight, and comparison with the other positions leaves little doubt that 13^h is correct. The Harvard observation was by Dr. Whipple and Mr. Cunningham; they have deduced the following elliptical orbit from their own observations on December 19 (beginning), 19 (end), and 21; the interval is so short that great precision cannot be expected:—

<i>T</i>	1932 Dec. 30.27 U.T.
ω	327° 18'
Ω	79 53
<i>i</i>	23 52
<i>q</i>	1.100
<i>e</i>	0.7470
Period	9.07 years

Ephemeris for 0^h U.T.

	R.A.	S.Decl.
Dec. 30	23 ^h 45 ^m 54 ^s	18° 34'
Jan. 4	0 3 25	14 20
„ 9	0 20 45	9 38
„ 14	0 38 34	4 52
„ 19	0 56 52	0 1

The comet is nearest to the earth about January 17: distance 0.9 of a unit.

The comet does not appear to be identical with any previously observed. If *T* is in 1932, it makes the tenth observed comet to pass perihelion in this year. This number was only exceeded once; there were

eleven perihelia in 1925, and ten in 1898; these are the only years with double figures. The number of discoveries in 1932 was thirteen, which is the greatest on record; but one of these comets passed perihelion in 1931, and two others were not sufficiently observed to enable their orbits to be computed.

Work of the Naval Observatory, Washington.—Vol. 13 of the publications of this Observatory contains interesting details of the observations of three total solar eclipses. That of January 1925 was observed from an airship, which was too unsteady for delicate photography; nevertheless, some interesting pictures are given of the spectrum of the chromosphere and corona; the former was traceable to $\lambda 8800$, the latter to $\lambda 7100$. The eclipse of 1926 was observed in Sumatra; there are two beautiful reproductions of coronal photographs taken with the 65-ft. camera. Pictures on a smaller scale, taken with a cinematograph, show a good deal of detail in the outer corona; the reality of the features shown is checked by comparing different images.

The 65-ft. camera was taken to Iloilo (Philippine Islands) for the 1929 eclipse; also an 11-ft. camera. Pictures with both of these are reproduced. The report contains a vivid account of the eclipse seen from an aeroplane.

The Sproul Observatory sent an expedition to Sumatra in 1929: an hour elapsed between totalities at the two stations. Comparison of coronal details on the Sumatra and Iloilo plates shows systematic outward motion. The mean velocity from ten coronal markings was 3.8 km./sec.; since there must be some foreshortening, the true speed is greater.

The volume closes with a discussion of errors of the moon's longitude from 1866 to 1929, based on the results of many observatories, and compared with Brown's tables. The observed-minus-tabular longitude was 0" in 1871, -3" in 1893, 0" in 1902, +8" (maximum) in 1922, +6" in 1928. The residuals after removing the great empirical term are also given.

The Modern Radio-Meteorograph

THE difficulties and uncertainties of securing measurements of upper-air temperature, pressure, etc., by means of the customary *ballon sonde* are already well known. Considerable value therefore is attached to methods which cause the recording meteorological instruments to operate a small radio transmitter carried with them by the ascending balloon and sending out some form of distinctive signal which can be received immediately on the ground and used to compile a record of the elements concerned.

What is believed to be the first kind of such radio-meteorograph was devised a few years ago by Prof. Moltchanoff, of Leningrad, records of temperature and pressure being obtained in several test ascents in January, 1930. Considerable modifications have since been made in the design. Humidity records have been included as well as those of temperature and pressure, while the method of radio control now

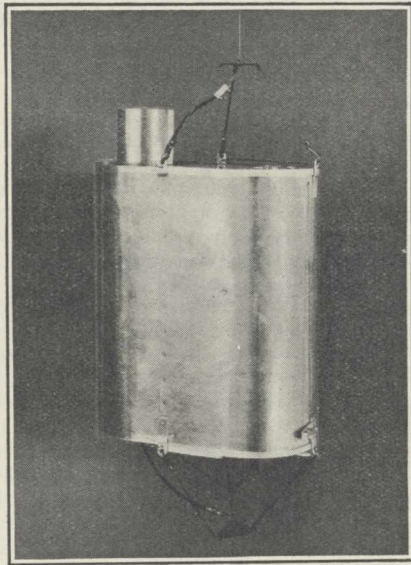


FIG. 1.

employed is such as to permit automatic recording by instruments of the rotating cylinder type such as are used for wireless picture reception.

The new pattern of Moltchanoff's radio-meteorograph is made by Askania-Werke of Berlin.

The apparatus consists essentially of a small short-wave radio transmitter (25-100 metres) located at the middle of a dipole antenna which trails below the balloon. The external appearance of the instrument is shown in Fig. 1. The disposition of the apparatus is shown in Fig. 2, which shows the wireless transmitter *T* and its small batteries *B* for filament heating and anode supply. The frequency of the transmitter is controlled by a quartz crystal in order to maintain constancy of frequency over the range of temperature encountered in practice. Special dry batteries have also been developed to withstand the lower temperatures, as difficulties were encountered with batteries of ordinary type. The batteries are additionally protected by thermal insulation in the course of their assembly into the transmitter.

The transmitter is of normal c.w. type and emits

its signals under the control of a contact which makes or breaks its anode circuit in accordance with the elements to be signalled. The arrangement of this control is shown schematically in Fig. 3. A contact-arm *A* is rotated continuously by a clockwork drive. The three pointers of the appropriate measuring elements are arranged one above the other so that they move on a uniform circle, the top of each pointer making a fleeting contact with the brush of *A* in the course of its rotation. The brush also makes

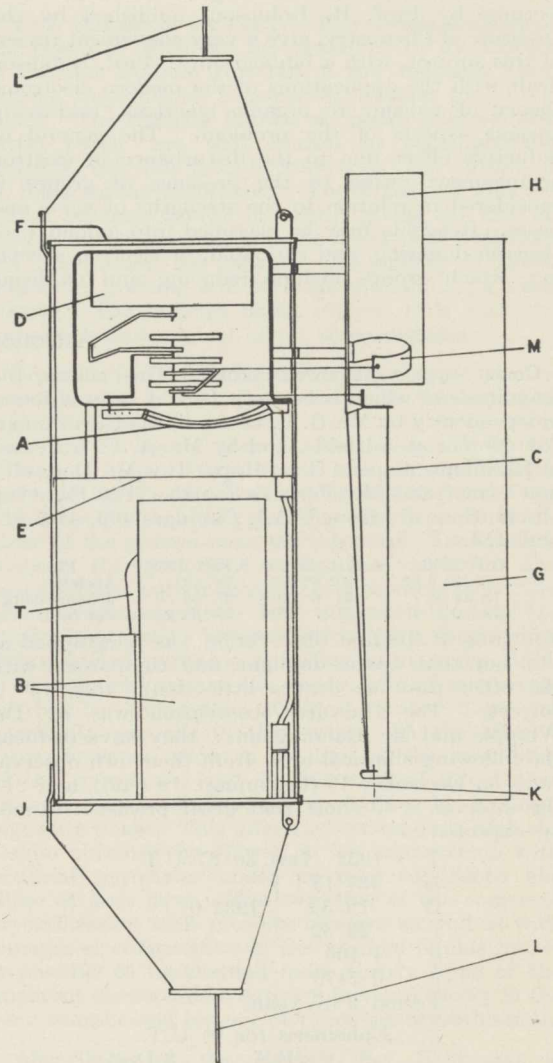


FIG. 2.

contact on the synchronising segment *S* and on the fixed contacts *C*₁ and *C*₂, which jointly mark its revolution into three parts, temperature, barometer and humidity respectively. The relatively long contact at *S* is for the purpose of emitting a longer signal in order to synchronise the recording cylinder at the receiver in a manner already well known in connexion with picture-receivers. The temporal interval between the end of the synchronising signal and the contact with the 'temperature' arm thus depends on the instantaneous position of the latter ;

similarly the interval between the signal from C_1 and that from the 'barometer' arm depends on the positions of this pointer, etc. The contact has necessarily to be extremely light, and takes the practical form of a small elastic silver strip. Apart from mere weight, an additional need for lightness is that the contact should not sensibly disturb the position of the instrument pointers. The contact now in use is stated to be satisfactory in this respect, while it is to be noted that a slight disturbance, resulting in a lengthening of the signal, is immaterial in practice since it is the *first* instant of contact that marks the position of the pointer. The rotating arm A revolves once in 33 seconds.

Moltchanoff's original radio-meteorograph was intended primarily for aural receptions on a radio-receiver of normal pattern. The signal impulses were then arranged so as to permit ready aural identification with human interpretation of their meaning. The newer instrument now described is

beginning of the signals from the fixed contacts C_1 and C_2 .

The meteorological instruments are indicated in Fig. 2. The three measuring elements are the barometric diaphragm A , the bi-metal thermometer M and the hygrometer hairs C . The thermometer and hygrometer are housed in the air channel G , while the former is protected from radiation by the highly polished cylinder H . The clockwork motor which drives the contact-arm is shown at D , holes for winding and control being provided in the cover F . These are all supported on the plate E in the upper part of the casing. The transmitter and its batteries

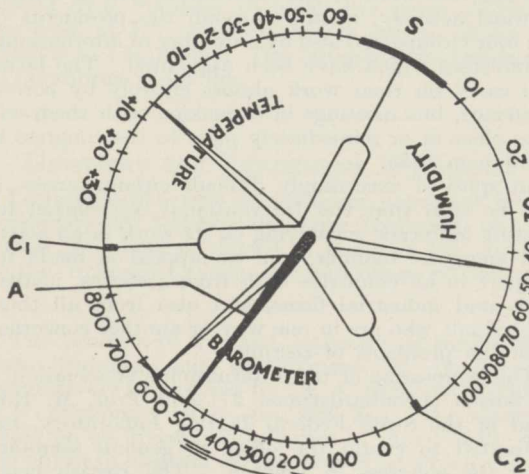


FIG. 3.

particularly designed for automatic recording, giving a record of the three elements which become normal Cartesian graphs by the addition of a scale of co-ordinates. Automatic recording is effected by an ordinary radio receiver followed by a picture-receiver of the rotating cylinder type. A suitable picture-receiver is that due to Prof. Dieckmann. This operates on principles, for example, of synchronising, etc., generally similar to those of the Fultograph receiver already well known in Great Britain, and need not be further described here. The type of record made by the Dieckmann receiver is shown in Fig. 4, which additionally shows the application of a scale of ordinate values covering the ranges measured by the instruments. A graduated graticule is available for application to the record for this purpose, a strip of it being added alongside the record of Fig. 4 to illustrate the assignment of scale values. The scale is applied by reference to the

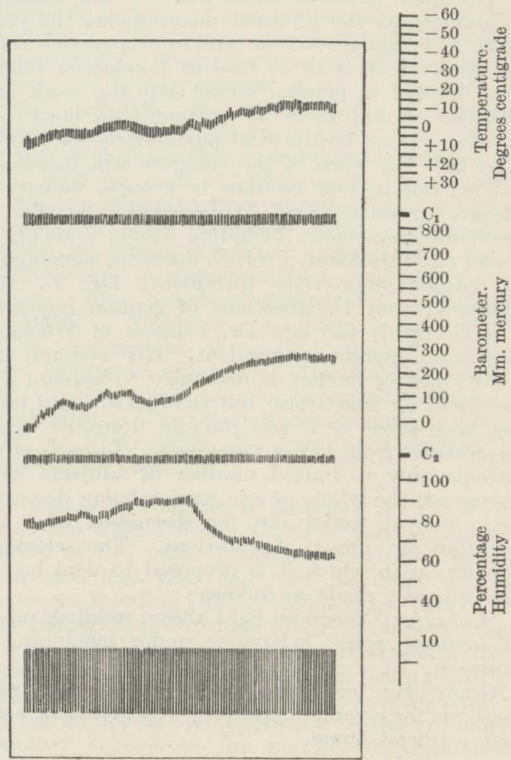


FIG. 4.

sit on an insulating sheet on the bottom-plate and can readily be withdrawn for adjustment or renewal. The plug K completes the circuit to the contact-arm and also to the leads L of the dipole antenna.

The various measuring instruments are calibrated by the makers before delivery. It is stated that the thermometer and barometer need not generally be recalibrated, but errors can readily be corrected should they develop. In the case of the hygrometer it is necessary to renew the hairs from time to time.

The complete instrument, as shown in Fig. 1, weighs only 2 kgm.; and recording ranges up to 100 km. have been achieved.

J. F. H.

International Association for Testing Materials

THE eighth meeting of the Permanent Committee of the International Association for Testing Materials was held on October 3-4 at Florence under the chairmanship of Dr. Walter Rosenhain, president of the Association. The Committee reviewed the

financial position of the International Association and decided to issue a letter, through the president, directing the attention of certain countries to their moral obligations to the Association. Some countries, notably Switzerland, have already contributed more

than their quota and it is hoped that the remaining countries will also make an adequate response to the financial appeal which the Committee has been obliged to make.

The completion and issue of the "Book of the Congress of Zurich in 1931" was reported, and the desirability of securing the further sale of this volume was emphasised. It is believed that the nature and value of this publication have not yet become fully known to many of those who might be interested in it, so that a much larger sale should be attained; this is highly desirable if the future work of the International Association is to go forward vigorously.

The main question dealt with by the Permanent Committee at the Florence meeting was the plan of work to be undertaken at, and in preparation for, the congress which is to be held in London in 1935. It was decided in general terms that the work of the congress should again be organised on lines similar to those which had proved particularly successful at Zurich. The work of the congress will therefore be carried out in four sections or groups, namely: A, Metals (president, Prof. C. Benedicks, Sweden); B, Inorganic Materials, including stone, cement, concrete, etc. (president, Prof. E. Suenson, Copenhagen); C, Organic Materials (president, Dr. F. Barta, Prague); and D, Questions of general importance. For Group D the late Dr. Burgess of Washington had been appointed president. His untimely death unfortunately renders it necessary to appoint a new president for this Group, but the appointment has not yet been made as it was thought desirable to await suggestions from various countries. In each of these Groups only a limited number of subjects will be discussed, the whole of one session being devoted, as was done at Zurich, to the discussion of a single question or group of questions. The selection of subjects with which it is proposed to deal has been provisionally made as follows:

Group A: Corrosion, light alloys, welding, progress of metallography, behaviour under machining and abrasion.

Group B: concrete and ferro-concrete, testing methods for ceramic materials, weathering of natural and artificial stone.

Group C: textiles (artificial silks), wood cellulose, india-rubber (cautchouc), preservation of timber.

Group D: progress in testing machines and measuring appliances, materials of construction in the laboratory and in service, methods and concepts of physics and chemistry in their application to problems of testing materials, sound and heat transmission of materials.

While it has been thought desirable to lay down in these general terms the subjects to be discussed at the congress in London, it is realised that in the intervening period developments may occur which may make an alteration of this programme desirable.

In view of the financial stringency which the International Association feels, in common with the industrial and technical world upon which it depends for support, it may not be possible to issue any intermediate publications such as those issued some eighteen months before the congress at Zurich. None the less, the work of the Association will be carried forward actively, mainly through the presidents of the four Groups and also by a number of international committees which have been appointed. The latter will carry on their work almost entirely by correspondence, but meetings in connexion with them will take place at or immediately prior to the congress in London in 1935.

In spite of exceedingly difficult circumstances, it will be seen that the International Association for Testing Materials is carrying on its work in an active and energetic manner, and an appeal is made for support in all countries both from societies, institutions and industrial firms, and also from all those individuals who are in one way or another concerned with the problems of testing.

The secretariat of the International Association is at Zurich (Leonhardstrasse 27) and Prof. M. Roš, head of the Swiss Federal Testing Laboratory, has consented to retain the office of general secretary until the congress in London. The British headquarters of the association are in the hands of Mr. G. C. Lloyd (honorary secretary and treasurer) at the offices of the Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

Air Waves from Experimental Explosions

THAT the audibility of explosions must be due in some way to conditions in the upper air at considerable heights above the ground has long been recognised. It is therefore appropriate that experimental explosions should be included in the programme of intensive meteorological research during the Polar Year. The first experiments to be organised in accordance with this programme by Prof. H. Hergesell, president of the International Commission for the Investigation of the Upper Air, took place on December 15. These explosions were at Russian Harbour in Novaya Zemlya and at Oldebroek in Holland. At each place there were to be four explosions, at 6.0, 6.6, 7.0 and 7.6 G.M.T. Four Kühl undographs were to be operated in the neighbourhood of the Russian Harbour explosions, three in Novaya Zemlya and one in Franz Josef Land. Several undographs were to be used in Germany and one, at Flushing, in Holland. For co-operation by Great Britain, the sound-ranging apparatus which is in regular use for recording at Birmingham, Bristol,

Cardiff and Nottingham the air waves caused by firing at Woolwich, was available, as well as similar apparatus at Foulness near the mouth of the Thames and at Hythe near Folkestone.

According to newspaper reports, the explosions at Oldebroek were not heard over any large area. The air waves were recorded at Potsdam and at Lindenberg. It is surmised that the photographic records from the other stations in Germany would be sent to a central point to be developed, so that some delay in the announcement of results is to be anticipated.

There was no reception of the air waves at Foulness, Hythe or Nottingham. Definite information is not yet available from Birmingham and Bristol. At the Cardiff station, Cefn Mably, Dr. J. Shaxby obtained a series of records showing disturbances, mostly minute, which were at first thought to indicate the reception of waves from the explosions at Oldebroek, but this interpretation is very doubtful.

Of the reports which have reached the Superintendent of Kew Observatory, in response to a

notice issued to the Press by the Air Ministry, one of the most valuable is from Miss Mabel Williams, who noticed at Cambridge that the window of her room vibrated vigorously at 6.21½, at 6.26½ and again at 7.26½. Sir John and Lady Smith, who were listening at Havering-atte-Bower in Essex, report that, between 19 and 22 minutes after 7, hundreds of birds in the trees surrounding their house suddenly made startled cries as if in danger. A considerable number of people in various parts of England have reported that they heard noises, which they attributed to the experimental explosions, but there was no area in which the sounds attracted general attention, and observers who listened with the intention of timing the series were not successful.

It is in accordance with previous experience that the infra-sonic waves, which carry most of the energy of an explosion, can be effective at great distances, at places where no sound can be perceived by ear. In the present case, the infra-sonic waves seem to have passed over Foulness to make the twigs quiver in the trees at Havering-atte-Bower and to shake the window at Cambridge. The distance from Oldebroek to Cambridge is 400 km.

University and Educational Intelligence

LONDON.—The title of reader in petrology in the University of London has been conferred on Dr. Alfred Brammall in respect of the post held by him at the Imperial College—Royal College of Science.

THE problem of the deaf, especially of their education, training and employment, is dealt with exhaustively in a report by Dr. A. Eichholz (London, H.M. Stationery Office, pp. 206, 3s.). The report is based on an investigation begun in April 1930, with the object of clearing up the facts upon which various representations have been made from time to time since 1924 (when the National Institute for the Deaf was founded) to Parliament and to the Ministry of Health and the Board of Education. Comprehensive statistics of the incidence of deafness in adult life are lacking, but indications that deafness of a disabling character exists in a marked degree among the general population are afforded by rejections for ear-diseases of applicants for service in the Army (5 per cent) and Royal Air Force (2 per cent). Among children, some gratifying decreases, attributable to arrangements by local education authorities for inspection and treatment, are reported. The statistics of deaf and dumb children also show a gradual decrease, attributable to improvement in the general health supervision of the population, from 4,173 in 1924 to 3,621 in 1930. The report suggests, *inter alia*, that arrangements for the detection of defects of hearing should be improved by the use of acoustic apparatus such as the audiometer now used in many American cities, that the Ministry of Health and Medical Research Council should institute a study of the age incidence, causes and treatment of ear defect, that provision for vocational courses for deaf people should be made in the north, west and midland districts of England and in South Wales, and that a secondary school for the deaf should be provided.

THE International Federation of University Women (Crosby Hall, Cheyne Walk, S.W.3) has published a full report of its sixth conference, held last August

at Edinburgh. Created, mainly on American and British initiative, in the year following the War as a means of promoting international understanding and friendship, this organisation has year by year extended its membership until it now comprises, in addition to those of the United States and the British Empire, associations of university women of every country of Europe (outside Russia), and Egypt, Palestine, Mexico and Brazil. The list of participants in the conference reaches the imposing total of 575 and although the American and British largely predominated, thirty countries in all were represented. Among the subjects dealt with were: international aspects of the development of science, co-ordination of university standards, the contribution of women to the newer knowledge of nutrition, epidemics of plant diseases and, in one of the sectional meetings, the careers open to women biologists. At this sectional meeting there was a consensus of opinion that it is far more difficult for women than for men to obtain work as biologists, that this is not due to their unsuitability for any of the kinds of work available (with the possible exception of certain kinds of tropical field work) and that there is consequently a waste of women biologists. Two members undertook to investigate this matter. Statistics of membership of the affiliated associations show that seventy per cent of the aggregate total are American university women. These constitute the financial backbone of the Federation. The German membership decreased heavily in 1932, while the Austrian increased by seventy-six per cent.

EDUCATION in Belgium is described by Dr. J. F. Abel, of the United States Office of Education, in a pamphlet of 145 pages prepared after investigation on the spot last year and now published by the Government Printing Office, Washington. One of the most striking facts to which Dr. Abel directs attention is the very heavy enrolment in the kindergartens—nearly a quarter of a million; this being nearly as large a proportion of the total number of children of kindergarten age as the proportion of the enrolment in primary schools to the number of children of primary school age. The secondary school curricula in Belgium have lately been remodelled so as to lessen school work and give more opportunity for recreation and physical development, the number of school hours being limited to 34 a week and teachers being warned that assigning tasks for home study is generally useless, and that it is habit rather than subject matter that the pupil is to acquire. Physical and biological sciences figure in the curricula of all divisions of secondary schools, but the time allotted is in general only two hours a week. Commenting on the problems arising out of bilingualism, Dr. Abel observes that the Belgians have proved that language unity is not necessary to, or perhaps advantageous for, national unity where appropriate arrangements are made in the schools. In the attempt to give effect to the principle of equal instruction for equal intelligence, very elaborate procedures have been prescribed for the guidance of the committees entrusted with the task of selecting children in primary schools for bursaries; the model school card enumerates forty-one characteristics to be estimated in the case of each pupil. An interesting account is given of the Colonial University, which selects annually twenty young men who contract to serve at least three years in the Congo after a four years' course.

Societies and Academies

LONDON

Physical Society, Dec. 16.—Allan Ferguson and J. T. Miller: A method for the determination of the specific heats of liquids, and a determination of the specific heats of aniline and benzene over the approximate range 20° to 50° C. The specific heats of aniline and benzene are determined by measuring the electrical power E^2/R necessary to hold the temperature of a calorimeter and its contents steady at various temperature-excesses.—E. V. Appleton and G. Builder: The ionosphere as a doubly refracting medium. In a previous communication the occurrence of wireless echo doublets was described and was provisionally attributed to the influence of the earth's magnetic field on the dispersive properties of the ionosphere. A more extended study of the subject, which has included an experimental determination of the polarisations of the doublet components, has confirmed this hypothesis. In south-east England, for ionospheric reflection at vertical incidence, the echo component of lesser delay is in general of right-handed, and the component of greater delay of left-handed, circular polarisation, but this temporal sequence should be reversed in the southern hemisphere and in certain special circumstances in the northern hemisphere.—M. Taylor: The Appleton-Hartree formula and dispersion curves for the propagation of electromagnetic waves through an ionised medium in the presence of an external magnetic field. (1) Curves for zero absorption. The curves are drawn to show the value of the squares of the indices of refraction and attenuation as functions of the electron density for a series of twelve frequencies, which are chosen to illustrate the various classes of curve and the boundary curves separating the classes and, in the case of frequencies of more than 1.321 megacycles per second, the various regions of short and ultra-short waves. The derivation and general properties of the Appleton-Hartree formula and the various possible modes of propagation are also discussed. The dispersion curves are classified according to the infinities they contain and a diagram is given to show how the classes of curve holding for any angle of inclination of the direction of propagation to the magnetic field H depends on the ratio of the longitudinal component of H to H itself.—L. F. Bates: A new apparatus for the measurement of the earth's magnetic field. A small cylinder of mumetal is wound with fine wire, the ends of which are connected to wires forming a torsional suspension. This cylinder is placed with its centre at the mid-point of a Helmholtz coil system with its axis adjusted to coincide with the direction of the component of the earth's field which is to be measured, the suspension being perpendicular to the component. The current through the coil system can be adjusted so that there is no deflection of the suspended cylinder when the current in the solenoid wound upon it is reversed, in which case the calculated field produced by the coils is equal to the required component.—E. G. Richardson and E. Tyler: The flow of liquid suspensions. Measurements of the velocity from point to point in a liquid rotating in the space between two concentric cylinders, of which the outer rotates while the inner is still, have been made by means of a hot-wire anemometer. In a suspension, the velocity gradients are abnormal but can be explained in

terms of a variable viscosity, which is a function of the velocity gradient.—Lewis Simons and E. H. Smart: A model to illustrate the motion of a diatomic rotator with two degrees of freedom. An arm 5 in. long is pivoted at one end and carries at the other end a small electric lamp which is thus capable of moving on the surface of a sphere about the pivot as centre. The two angular velocities $\dot{\Phi}$ and $\dot{\theta}$ can be independently controlled by two hand-regulated motors: Φ is the azimuthal and θ the co-latitudinal angular co-ordinate of the arm. If $\dot{\Phi}$ and $\dot{\theta}$ are commensurable, the resulting figure traced out by the lamp remains stationary in space. This path represents the motion of one of the atoms of the rotator, which has two degrees of freedom.

PARIS

Academy of Sciences, Nov. 7.—J. Costantin: The secret of Java. An account of the methods used to combat the sugar cane disease (Sereh) of Java, with special reference to the favourable effects of growing the young shoots at high altitudes.—Bertrand Gambier: Ruled algebraic surfaces and their singularities.—Potron: Certain conformal transformations in a Riemann space.—Vignaux: Riemann's method of summation.—Nikola Obrechhoff: The summation of the Fourier trigonometric series and conjugated series.—P. Papcovich: General expressions for the components of stresses, containing as arbitrary functions only harmonic functions.—J. Haag: The improvement of the isochronism of pendulums by the use of elastic stops. The method is not new, but has hitherto been based empirically on experiment. A theoretical study is given, defining the characteristics of the best arrangement.—R. Thiry and L. Sackmann: A special arrangement of the stream lines in front of an obstacle. Outline of an experimental method with a hydrodynamic tunnel, with some preliminary results.—P. Idrac: Ultra-sensitive recorders of variation of altitude and temperature for aeroplanes.—Kiveli-ovitch: Some particular cases of the problem of three bodies with impacts.—Th. V. Ionescu and C. Mihul: Ionised gases in the magnetic field: pressures below 0.001 mm. mercury. Continuation of experiments on the influence of pressure and of water vapour on the conductivity of ionised gases. Curves are given showing the conductivity as a function of the magnetic field.—G. Athanasiu: The sensibility in the spectrum of photo-cells with electrodes of copper covered with cuprous oxide. It is concluded that, in general, a copper electrode covered with a thin layer of cuprous oxide and dipped into neutral or alkaline electrolytes gives a negative E.M.F. on illumination. The effect commences at about 6500 Å., increases as the wavelength diminishes, reaches a maximum and diminishes again towards the extreme violet of the visible spectrum. The method of preparing the film affects the results.—E. Carvalho: The effect observed by Miller at Mount Wilson was the Esclançon effect. The author gives another interpretation of Miller's experiments. He regards them as confirming and generalising Michelson's law, that the earth's velocity introduces no difference of path between the two rays of the interferometer.—Yves Rocard: The theory of critical opalescence.—S. Y. Sze: The β -rays emitted by the active deposit of actinium.—Francis Perrin: The average life of activated atomic nuclei. Probable cases of the impossibility of the γ -emission.—G. I. Costeanu: The measurement of electromotive forces in liquid ammonia. Details of the experimental

method and data for two cases.—B. Bogitch: The use of diaphragms in the commercial electrolysis of metals. Advantages are claimed for the use of impermeable diaphragms. High purity of the anodes is less necessary; the cathodes can be as pure as desired and the volume of electrolyte in circulation is considerably reduced. There is one disadvantage: there is an increase in the electrical energy used—about twenty per cent in the apparatus described.—Mlle. Suzanne Veil: Rhythmic phenomena observed in the electrolytic precipitation of colouring matters.—Mme. Ramart-Lucas and M. Trivédi. Colour and chemical behaviour in the cinnamic series.—E. Darmois and R. Chalin: The cryometry of some electrolytes in the fused hydrate $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$.—E. Vellinger: The superficial properties of india-rubber.—A. Demolon and E. Bastisse: The influence of the anions on the flocculation of colloidal clay by potassium salts.—André Chrétien and Pierre Laurent: A method of physico-chemical analysis in organic solution by measuring the specific inductive power. Variations of the dielectric capacity can serve to detect acid and basic characters in the absence of water. Thus in benzene solution, mixtures of quinoline and phenol give indications of the formation of a combination of equal molecules.—Pierre Jolibois and Louis Cloutier: The basic salts of lead.—Firmin Govaert: The determination of the halogens in organic substances by the sodammonium method.—P. Carré and D. Libermann: The chlorides of the arylsulphurous acids and mixed aryl and alkyl sulphites. Thionyl chloride and aryl sulphite react according to the equation $\text{SO}(\text{OAr})_2 + \text{SOCl}_2 = 2\text{ArO}\cdot\text{SOCl}$. The chloride thus formed cannot be distilled without decomposition, but its existence is proved by its reactions, notably with formic acid and with alcohols. Mixed aryl alkyl sulphites are formed in the latter reaction.—Georges Lévy: Some derivatives of β -ethylnaphthalene.—Pierre Bedos and Adrien Ruyer: Some reactions of cyclohexadiene.—A. Demay: The existence of an antestephanian arc and on the continuity of the apparent thrusts towards the exterior of the arc from the Lyonnais to Corrèze.—Jean Goguel: The tectonic of the Luberon (Provence).—Jacques Fromaget: The structure of the indosinides.—A. Rivière: Contribution to the study of the Palaeozoic of the central Elbourz.—Jean Legrand: The utilisation of observations of height indicators on rivers for the purpose of research on climatic cycles.—J. Lacoste: An earthquake with a Mediterranean epicentre.—Jean Lugeon: The solar eclipse of August 31, 1932, and investigation by atmospheric.—St. Jonesco: The movements of the flowers of *Ipomœa purpurea*. The flowers of this species are continually in motion from the bud stage to the formation of the fruit.—P. Martens: Alternation of phases and sexuality in a conidian cycle in *Pholiota aurivella*.—F. Obaton: The presence of saccharose in the branches and leaves of *Euonymus europæus*.—Jean Chaze: The existence of a new active principle in *Bryonia dioica*.—Raoul Lecoq: The B vitamins and the utilisation of the lipides. The assimilation of lipides by the organism, like proteins and glucides, requires the presence in the ration of sufficient quantities of B vitamins.—J. Giaja and Ilija Dimitrijevič: The influence of the surrounding temperature on the effect of pyretic substances.—Marcel Florquin: The dissociation curve of oxyhæmerythrin in the cœlomic liquid of *Sipunculus*.—Charles Dubois: The specificity of the allergic reaction as a method of diagnosis of ovine melitococcia.

GENEVA

Society of Physics and Natural History, Nov. 17.—E. Friedheim: Two accessory respiratory ferments of animal origin. The tegumentary pigments of *Halla parthenopea* and of the sea urchin, *Sphaerechinus granularis*, possess the function of very considerably increasing the respiration of non-impregnated eggs of sea urchins and of non-nucleated red blood corpuscles. It is a case of catalysis due to the reversibility of the oxidation and reduction of the pigments. The Halla pigment can be titrated electrometrically.—P. Rossier: (1) Spectrophotographic photometry. The author gives a second approximation of the coefficients of experimental formulæ established before.—(2) The rôle of atmospheric humidity in astronomical photography. Certain coefficients of the formulæ studied in the preceding paper vary with the vapour pressure of atmospheric moisture.—(3) The refraction correction to be applied to differential astronomical observations. Micrometric observations of precision are vitiated by atmospheric refraction if the two stars observed are of different colours. The constants of spectral sensibility of the eyes now appear to be sufficiently well known to render it possible to calculate the effect. These systematic errors may be too large to be neglected.—J. Weigle: The orientation of non-polar molecules by a dipole. The author shows that a molecule with a permanent electric moment placed in a medium the molecules of which are non-polar but anisotropic, produces an orientation of these molecules. This orientation of the neighbouring medium should affect either the measurement of the permanent electric moment or the refractive index of the medium. By measuring the latter the author shows that interesting information on the form and structure of the molecules can be obtained.—Ch. H. Wakker and B. Susz: A rapid method of quantitative spectroscopic analysis. The method consists in carrying out a photometric measurement of a selected line of the spectrum emitted by the element to be determined. The measurement is made by direct observation with the spectroscope without making use of photography.—E. Briner and H. Biedermann: Ozone the only persistent allotropic form of oxygen produced in appreciable quantity by the silent electric discharge. The products resulting from the action of the silent discharge on oxygen, working with different forms of apparatus both at low and high frequency, were submitted to fractional distillation. No allotropic modification of oxygen other than ordinary ozone could be found.—R. Wavre: The polydromes of potentials.—H. Lagotala and Ch. Couchet: Note concerning the tectonic of the cupriferos region of the middle Congo. The authors have proved the mylonitised zones in the grits, limestones and at the contact of the grits and limestones. They have remarked the frequency of the sub-horizontal movements and the presence of laminations some of which are mineralised. In certain cases a single layer is separated for a considerable distance. The age of these separations appears to be earlier than the formation of the faults.—G. Tiercy: The hypothesis of continental drift: the chronological succession of the first upholders. The order given is as follows: 1668, Le R. P. Francois Placet: 1858, Antoine Snider Pelegrini: 1889, R. Mantovani: 1890, J. A. Boulanger.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 609-632, Oct. 15, 1932).—Thomas Wayland Vaughan: The fora-

miniferal genus *Orbitolina* in Guatemala and Venezuela.—Thomas Wayland Vaughan and W. Storrs Cole: Cretaceous orbitoidal Foraminifera from the Gulf States and Central America. A new type of orbitoid from the Upper Cretaceous of the Gulf coastal plain and another specimen, both from oil well cores, are described and illustrated.—Robert Balk: Structure and correlation of metamorphic rocks in south-eastern New York. The older view, due to Dana and Merrill, following Mather, regarded the metamorphic sediments of this area as equivalents of the fossiliferous Cambro-Ordovician sequence north-west of the Hudson Highlands. Later, Berkeley tentatively regarded the highly metamorphic series as Pre-Cambrian. Detailed field work over the area, of which a long abstract with map and diagrams is given, supports the older view.—Sterling Emerson: Chromosomes rings in *Enothera*, *Drosophila* and maize. It is suggested that the postulates of 'inverted section' and 'differential segments' are not in accord with published data and are unnecessary to account for the small amount of crossing-over observed.

Forthcoming Events

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, Jan. 2-9. At University College, Gower Street, W.C.1.

The Right Hon. the Earl of Athlone: Presidential Address on Jan. 4, at 3.

Joint Conference on "The Trend of Education". Speakers: H. Ramsbotham, Miss W. Mercier and J. E. Barton, on Jan. 2, at 5.

PHYSICAL SOCIETY, Jan. 3-5. Twenty-third annual exhibition of scientific instruments and apparatus at the Imperial College of Science and Technology, South Kensington, S.W.7, at 3-6 and 6-10.

Dr. Allan Ferguson: "Surface Tension and its Measurement", on Jan. 3, at 8.

R. A. Watson Watt: "Cathode Ray Oscillography", on Jan. 4, at 8.

F. Hope-Jones: "Time Measurement: Old and New", on Jan. 5, at 8.

SCIENCE MASTERS' ASSOCIATION, Jan. 3-6. Annual Meeting at the University of Bristol.

Prof. A. M. Tyndall (Presidential Address): "Gaseous Ions".

GEOGRAPHICAL ASSOCIATION, Jan. 4-6. Annual Conference at the London School of Economics and the Imperial Institute.

Dr. H. R. Mill (Presidential Address): "An Approach to Geography", on Jan. 4.

MATHEMATICAL ASSOCIATION, Jan. 5-6. Annual Meeting at the Institute of Education, Southampton Row, London, W.C.1.

Prof. G. N. Watson (Presidential Address): "The Marquis and the Land Agent: a Tale of the Eighteenth Century", on Jan. 5, at 3.45.

Discussion on "The Study of Statistics in a School Course", to be opened by F. Sandon, on Jan. 6, at 2.15.

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Society. Series A, Vol. 138, No. A836, December 1. Pp. 479-722. (London: Harrison and Sons, Ltd.) 12s.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 6: Observations on the Cytology of *Opalina ranarum* and *Nyctotherus cordiformis*. By Ruth Patten. Pp. 73-94+plates 6-7. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

The Journal of the Ipswich and District Natural History Society. Edited by Henry Ogle. Vol. 1, Part 3, November. Pp. 141-196. (Ipswich.)

Proceedings of the Linnean Society of London. Session 1931-32, Part 6. Pp. 167-220. (London: Linnean Society.) 2s.

No. 3296, VOL. 130]

The Salters' Institute of Industrial Chemistry. Pp. 28. (London: The Salters' Institute.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 432, December. Pp. 837-992+xii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 7: Some Noteworthy Plants found in or reported from Ireland. By Dr. R. Lloyd Praeger. Pp. 95-124. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1475 (T.3264): Arithmetical Solution of Problems in Steady Viscous Flow. By Dr. A. Thom. Pp. 6+3 plates. 6d. net. No. 1477 (T.3260): Slotted R.A.F. 34 Bristol Fighter—Forces on Slat in Flight. By A. Ormerod. Pp. 6+15 plates. 1s. net. No. 1490 (T.3270): Aerodynamic Characteristics of a Semi-Rigid Wing. By A. G. Pugsley. Pp. 11+4 plates. 9d. net. (London: H.M. Stationery Office.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1932. Edited by Prof. Alexander Meek. Pp. 42. (Cullercoats.) 5s.

University College of the South-West of England, Exeter. Proceedings of the College Field Club and Natural History Society, 1930-31. Pp. 23. (Exeter.)

OTHER COUNTRIES

University of Wisconsin Studies in Science. No. 5: Root Nodule Bacteria and Leguminous Plants. By Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy. Pp. xxii+343+47 plates. (Madison, Wis.) 3 dollars.

Proceedings of the United States National Museum. Vol. 81, Art. 12: Report on the Hexactinellid Sponges collected by the United States Fisheries Steamer *Albatross* in the Northwestern Pacific during the Summer of 1906. By Yaichiro Okada. (No. 2935.) Pp. 118+6 plates. Vol. 82, Art. 2: A New Paleocene Mammal from a Deep Well in Louisiana. By George Gaylord Simpson. (No. 2943.) Pp. 4. Vol. 82, Art. 3: The Chinese Lizards of the Genus *Gekko*. By Leonard Stejneger. (No. 2944.) Pp. 8. Vol. 82, Art. 4: Description of a Tick, *Dermacentor halli*, from the Texas Peccary, with a Key to the North American Species of *Dermacentor*. By Allen McIntosh. (No. 2945.) Pp. 6+1 plate. (Washington, D.C.: Government Printing Office.)

The Journal of the Astronomical Society of South Africa. Edited by Dr. H. Spencer Jones. Vol. 3, No. 2, November. Pp. 61-100. (Cape Town.) 2s.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 106: Ethnographical Survey of the Miskito and Sumu Indians of Honduras and Nicaragua. By Eduard Czemius. Pp. vii+191+10 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 6: Statistics of Public High Schools, 1929-30. By Emery M. Foster and Russell M. Kelley; with the co-operation of Carl A. Jessen. Pp. 95. (Washington, D.C.: Government Printing Office.) 10 cents.

Cornell University: Agricultural Experiment Station. Bulletin 539: An Economic Study of Agriculture in Northern Livingston County, New York. By Stanley Whitson Warren. Pp. 244. (Ithaca, N.Y.)

Bulletin of the American Museum of Natural History. Vol. 63, Article 6: The Vertebral Columns of Ricochetal Rodents. By Robert Torrens Hatt. Pp. 599-738+plates 11-20. (New York City.)

Collection des travaux chimiques de Tchecoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 11, Novembre. Pp. 473-520. (Prague: Regia Societas Scientiarum Bohemica.)

U.S. Department of the Interior: Office of Education. Pamphlet No. 32: Institutions of Higher Education in Sweden. By Alina M. Lindgren. Pp. v+45. 10 cents.

Smithsonian Miscellaneous Collections. Vol. 87, No. 13: The Functions of Radiation in the Physiology of Plants. 1: General Methods and Apparatus. By F. S. Brackett and Earl S. Johnston. (Publication 3179.) Pp. 10+1 plate. Vol. 87, No. 14: The Functions of Radiation in the Physiology of Plants. 2: Some Effects of near Infra-red Radiation on Plants. By Earl S. Johnston. (Publication 3180.) Pp. 15+4 plates. Vol. 87, No. 15: An Improved Water-Flow Pyrheliometer and the Standard Scale of Solar Radiation. (Roebing Fund.) By C. G. Abbot and L. B. Aldrich. (Publication 3182.) Pp. 8+1 plate. (Washington, D.C.: Smithsonian Institution.)

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